

Title: D2.2 - Knowledge use, knowledge needs and policy integration in Member States.

Summary: This deliverable produces a comparative analysis of national adaptation strategies in a selected sample of EU Member States. It is split into 3 analytical parts. Part 1 explores the architecture of adaptation policy in different EU Member States through the lens of policy coordination, including knowledge sharing, and explores the tension between top-down and bottom-up approaches. Part 2 compares the climate policy integration rationale underpinning national adaptation strategies to examine conceptual differences between climate policy integration and climate adaptation policy integration. Part 3 examines the integration of adaptation concerns and associated knowledge use in three key policy sectors: agriculture, water management and health.

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List of acronyms

CAP: Common Agricultural Policy
CPI: Climate Policy Integration
EPI: Environmental Policy Integration
EU: European Union
IPCC: Intergovernmental Panel on Climate Change
NAS: National Adaptation Strategy/Strategies
UK: United Kingdom

Chapter 1: Introduction

This deliverable presents the work of Task 2.2 of the project on the national adaptation strategies (NAS) of a selection of European Union (EU) Member States. In keeping with the core Work Package 2 objective of evaluating the coherence of adaptation policy, the analysis in this document specifically focuses on coherence through the contexts of policy co-ordination, integration and knowledge use in selected Member State cases. Specifically, it contributes to the following work package 2 objectives: to assess the effectiveness and coherence of recent measures to support adaptation to climate change; to analyse the state of recent policy integration and knowledge use in climate adaptation of the European Commission and Member States. Adaptation policy in the EU is a maturing policy field with many front-running Member States (e.g. Finland) at the stage of revising strategies that were originally initiated in the early 2000s. At the same time other Member States such as Italy have finalized the technical aspects of the NAS and are awaiting government adoption. Others such as the Czech Republic are still formulating their adaptation strategies, largely in response to the publication of the EU's Adaptation Strategy in 2013. The EU's Adaptation Strategy was formally analyzed from a policy integration and knowledge use perspective in Deliverable 2.1. This deliverable builds upon this analysis by examining the national level or Member State tier of the EU.

This deliverable consists of four analytical aims : 1) to explore the architecture of Member State NAS and analyse the extent to which they facilitate a more coordinated thus integrated and evidence-based approach to adaptation policy making; 2) to examine different conceptualisations of climate integration as an output of Member State adaptation policies; and 3) to examine if and how climate change adaptation has been/ is being integrated into critical sectoral policies; and 4) to explore the role and use of knowledge in the adaptation policy processes, and identify potential barriers to use. In addressing these aims the deliverable will, among other things pay attention to the use of economic data and other research in policy development, the role of specific policy appraisal tools (such as impact assessment), and formal legal processes in facilitating (or retarding) policy integration and knowledge uptake.

This deliverable advances the state of the art in the following ways. First, it provides up-to-date, in-depth comparative accounts of a selected number of EU Member State NAS and related national policies to significantly update existing studies (Mickwitz et al., 2009; Swart et al., 2009) and policy-advice orientated overviews (EEA, 2013). While adaptation governance is a vast and increasing part of the literature on climate change (e.g. Adger et al., 2013; Berman et al., 2012; O'Neill and Handmer, 2012), studies and critiques of actual national adaptation strategies are still fairly limited, although the need for such studies and general overviews is rapidly increasing (e.g. Biesbroek et al., 2010; Jensen et al., 2014; Mullan et al., 2013; Salick and Ross, 2009; Termeer et al., 2012). The strength of this deliverable is in the comparative analysis, based on intimate knowledge of the national conditions using access to national sources of information.

Second, this deliverable examines the adaptation strategies from the conceptual perspectives of knowledge use, policy coordination and integration. While studies of adaptation strategies do exist, especially in the EU context (e.g. Biesbroek et al., 2010; 2013), there is a need to go deeper into these issues in adaptation *planning*. Policy coordination, integration and knowledge use are crucial to effective adaptation planning, as adaptation spans many sectors each with their own core interests, specific contexts and client groups. Moreover, the activities of one sector may spill over into another, impacting

upon adaptation planning (e.g. flood defence policy in the water sector may well have spill over effects on biodiversity in the conservation sector) (Urwin and Jordan, 2009). Adding to the complexity of this situation is the fact that adaptation policy is knowledge intensive and there are many uncertainties and interdependencies in different policy areas involved. Thus, if not properly accounted for, adaptation strategies can run into challenges of sector-based policy implementation in the form of policy incoherence and inconsistent and weak and/or fragmented knowledge use. Many reports with an explicit focus on policy coordination (e.g. OECD, 2013; EEA, 2013) have not analytically evaluated the challenges, but instead aimed at more direct instrumental policy support. Moreover, they have relied on data collected through the self-reporting of governments. This deliverable, aims for an academic – and at the same time policy and practice relevant – critique based on a wider range of data sources coupled to analysis informed by concepts and theories in the academic literature to examine among other things the effectiveness of the approaches taken.

Through providing the national-level policy context of climate (adaptation) policy integration and knowledge use this deliverable aims to support the work of other work packages in the project. Crucially, it looks for the use of economic knowledge in national-level adaptation planning, thus outlining important issues for Work Package 3 in terms of what economic knowledge is used and for what purpose. The deliverable also provides an overview of the national adaptation policy frameworks that can shape local implementation, therefore contributing important information to the case studies (Work Package 5, D5.4). Through the case studies it then feeds into Work Package 6, providing background knowledge on the policy context in which factors such as tipping points and adaptation pathways need to be considered. Finally, understanding the background policy context in conjunction with findings on the economic analysis (Work Package 3), the case studies (Work Packages 4 and 5), and adaptation pathways (Work Package 6), allows for policy lessons and advice to be drawn for Work Package 7.

Defining and evaluating policy coordination, policy integration and knowledge utilisation

It is important to clarify the meaning of policy coordination, climate policy integration and knowledge utilisation and their relationship. Climate change adaptation is seen as an important issue in the context of *policy coordination* as it is a crosscutting issue that spans the work of many economic, social and environmental policy areas. With such cross-cutting issues, there is a heightened risk of policy redundancy (where two parts of the state share responsibility for the same policy areas), incoherence (where policies addressing a similar issue have different and possibly conflicting objectives and requirements) and lacuna (where no organisation is responsible for a policy area) (Peters, 1998; Perri 6 et al. 2002). Policy coordination is therefore a broad strategy that can be followed by public administrations to minimise these risks. It is concerned with looking for synergies and trade-offs between policies, and avoiding conflicts. A more specific way of coordinating is the process of *policy integration*. Climate policy integration (CPI) is a spin off concept from environmental policy integration (EPI) (Adelle and Russel, 2013). Broadly speaking stronger interpretations of climate policy integration are concerned with the relative importance accorded to climate change priorities by public administrations vis á vis other sectoral goals. Weaker interpretations of climate policy integration tend to be more concerned with what coordination processes and procedures are in place to help decision makers think about climate impacts in their decisions-making and day-to-day work (Adelle and Russel, 2013).

When evaluating policy integration and policy coordination a policy analyst can focus on [or measure] three particular aspects: processes that facilitate coordination/integration; outputs in terms of whether policy documents have taken on board issues of integration; and outcomes in the sense of whether policy interventions have led to enhanced adaptive capacity and sustainable adaptation measures (see Jordan and Lenschow, 2008). Some authors have focused on policy integration as processes to encourage communication and learning among actors and across different policy sectors (e.g. Lenschow, 2002; Nilsson and Persson, 2003; Schout and Jordan, 2006; Jordan and Lenschow, 2008; Russel and Jordan, 2009). With this process focus, emphasis is placed on the development and performance of various communicative, procedural and organisational instruments. Studies employing this approach tend to be less concerned with policy outcomes (i.e. whether a policy is more or less sustainable), instead being more concerned with how these various instruments have succeeded in making sectoral policy makers give early consideration to environmental impacts (see: Jordan and Lenschow, 2008). For the purpose of this deliverable the focus is more on the process and outputs of policy coordination and integration for climate adaptation rather than outcomes. The reasons for this are twofold. First, focusing on the final policy outcome (i.e. whether a measure leads to a set of sustainable adaptation outcomes) would be difficult because of the counterfactual of whether or not a policy outcome would have occurred in the absence of a national adaptation policy (ibid). Second, national adaptation strategies have only emerged concretely over the last decade in the front running states and are still very much in their infancy in others. Therefore, their impact in terms of outcomes is likely to as yet be limited.

Finally, in evaluating policy coordination and integration, it is vital to examine the role played by knowledge and research in the wider policy making process. Knowledge and research on climate change adaptation are crucial to identifying spill-overs between different sectors and thus provide the essential information around which coordination and integration operate (Russel and Jordan, 2009; Jordan and Scout, 2006). The study of knowledge utilisation in decision-making is a mature academic field that has spurred a number of conceptual and theoretical advances (e.g. Weiss, 1979; Sabatier, 1998; Radaelli, 1995; Rich, 1997; Owens, 2012; Dunlop, 2014). The broad corpus of research has drawn on theoretical perspectives from public policy, science and technology studies and evaluation studies to better theorise the complex and recursive knowledge-decision dynamic. A number of studies have focused specifically on the issue of how we understand knowledge utilisation. As Rich (1997) notes, however, 'use' is not an "all-encompassing concept". Consequently, mapping the degree of knowledge utilisation ultimately depends on what types of knowledge are being investigated, what the analyst means by 'use' and whether they see knowledge utilisation as an 'outcome' or as 'processes' (ibid). Others have developed 'models' of knowledge use, e.g.: the *instrumental* model of knowledge use, whereby knowledge is used to affect policy outcomes (Weiss, 1979; Owens, 2005); the *conceptual or enlightenment* model of knowledge use, where a collective body of knowledge shapes a broader policy agenda (e.g. Weiss, 1979; Radaelli, 1995); the *strategic* model of knowledge use where knowledge is used tactically by different actors in contested areas of decision making (Weiss, 1979; Owens, 2005); and the *co-production* model whereby knowledge use and generation results form a two way processes of interaction between knowledge generators and users (Owens 2012). This body of research would suggest that the link between knowledge on climate impacts and adaptation responses on the one hand, and adaptation policy developments on the other are far from simple. This issue of knowledge use is covered more explicitly in Chapter 4 of this deliverable.

The Broad Methodological Approach

A comparative case study approach is applied in the the research for this deliverable. For the first two analytical sections of this deliverable on policy coordination (Chapter 2) and policy integration (Chapter 3) respectively, eight countries are studied and compared, namely: the United Kingdom (UK), Denmark, Finland, Italy, Portugal, the Netherlands, Germany and the Czech Republic. These cases were selected to obtain a broad and yet in-depth insight into different NAS processes. Cases were selected to represent different contexts, such as federal (Germany) and non-federal political systems (Portugal), reported leaders (e.g. Denmark, Finland, UK) and laggards (e.g. Italy, Czech Republic – see the MEDIATION project, Pfenninger et al 2010), and geographical spread across Northern, Southern and Eastern European countries. Moreover, this selection covers the majority of political jurisdictions in which the case studies in Work Package 5 are located. The third analytical part of the deliverable (Chapter 4) pursues a more in-depth exploration of integration of adaptation concerns and associated knowledge use in sectoral policy making, involving multiple sectors. Therefore, as a broader survey would have been unwieldy a smaller selection of countries was analysed, namely: the UK, Italy, Denmark, Finland and Germany. However, there is still variation among the countries in terms of the political and administrative culture, size, geographical location and where they are on the adaptation planning cycle.

Data was collected through a *combination of documentary analysis, and qualitative interviews*. Data was collected according to a common analytical framework – see Appendix A of this deliverable. In the first instance, the questions through the documentary analysis aimed to record the broader patterns. Once the documentary record had been established, gaps in the record/or unclear developments were filled through interviews where needed. Moreover, interviews provided data on issues, events and perceptions related to adaptation policy and planning not represented - or represented ambiguously - in policy documents. Where needed, interviews were conducted with officials in government as well as outside expert stakeholders (non-governmental organisations, experts, etc.) to get more critical insights. The methods for data collection were not strongly stipulated, as for some of the studied countries (i.e. Czech Republic, Germany and Portugal) the information is widely available in documents. In others (i.e. Denmark, United Kingdom, Finland, Netherlands and Italy) information is sparser so interviewees had to be undertaken to collect factual knowledge. The number of interviews for each of these countries ranged from three (e.g. the Netherlands) through to nine (e.g. Finland). For each country though, it was clearly indicated where data came from such as from specific documents or from interviewees. Thus data robustness is ensured through the quality and type of data collected rather than the specific method used. It is important to note that there might be processes occurring and policies in place that were not picked up by our methodological approach. That being said, the data was collected by highly experienced teams who are very familiar with adaptation policy in the studied EU Member States, thus reducing this risk.

The Deliverable Structure

This deliverable comprises three cumulative analytical parts. **Chapter 2** explores the macro-level architecture of adaptation policy in the UK (England), Denmark, Finland, Italy, Portugal, The Netherlands, Germany and the Czech Republic. It does so through the lens of policy coordination (a process through which to manage policy incoherence and conflict) and explores the tension between more hierarchal top-down and bottom-up approaches. It then explores the implications for knowledge use and the coordination of adaptation horizontally across policy sectors and actors (public-private), and vertically between governance levels. Having mapped out the national policy coordination architecture for

adaptation in Chapter 2, **Chapter 3** builds on this analysis through a comparison of the policy integration rationale underpinning the NAS of the UK, Denmark, Finland, Italy, Portugal, the Netherlands, Germany and the Czech Republic. The analysis for this chapter is focused mainly at the macro level of the NAS but also incorporates some meso level analysis of sectors targeted by the studied NAS. Specifically, it investigates climate policy integration (CPI) in national adaptation strategies to examine conceptual differences between CPI more generally and climate *adaptation policy integration* more specifically, adding to the empirical as well as to the conceptual understanding of policy integration. Finally, **Chapter 4** builds upon the broader analysis of policy integration in Chapter 3 by more specifically examining the integration of adaptation concerns and associated knowledge use in the sectoral policies of the UK, Italy, Denmark, Finland and Germany, in what can be seen as a more in-depth micro-/meso-level perspective on the adaptation strategies employed. This more in-depth analysis of sectors hones in on the degree to which climate policy integration objectives in the studied Member State NAS are actually implemented. The analysis in this chapter focuses on adaptation outcomes in terms of the integration and use of knowledge in three key policy sectors: agriculture, water management and health.

Chapter 2: Policy Coordination and the Architecture of National Adaptation Strategies

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2.1 Introduction

Climate change adaptation can be regarded as a ‘wicked issue’, i.e. one that needs to be addressed in many areas of human activity and is thus ultimately difficult to resolve (Rittel and Webber, 1973; Rayner and Okereke, 2007). Climate change adaptation is a major knowledge intensive cross-sector and multi-scale decision making problem that requires a radical shift in the way we organise our economy and society. It is also characterised by uncertainty and ambiguity associated with: i) precise climate impacts, ii) the costs and benefits of taking action, and iii) which policy measures will be effective in different sectors and policy scales (Russel et al., 2010; Adelle and Russel, 2013). Thus, designing and implementing effective adaptation policy is no simple matter and requires processes to coordinate cross-sectoral adaptive responses to climate impacts. Moreover it requires the capacity to produce and use knowledge so that actors have sufficient information around which to coordinate (Jordan and Schout, 2006). In the absence of more coordinated action there is a danger of: redundancy where two or more ministries share responsibility for adaptation policy in a conflictual rather than consensual manner potentially leading to weaker adaptation policies; lacuna where no organisation is responsible for adaptation; and incoherence when policies addressing similar issues have different, potentially conflicting, objectives and requirements when it comes to addressing adaptation (Peters, 1998; Perri 6 et al., 2002). In such situations non-adaptation and mal-adaptation can all too easily occur at the expense of adaptation that is more economic, socially and environmentally efficient. In an attempt to deal with these issues, most EU Member States have developed or are developing National Adaptation Strategies (NAS) to facilitate a more coordinated response alongside other, related national policy measures and more regional and local initiatives.

This deliverable chapter aims to examine the broader architecture of NAS and related policy in different EU Member States from the perspective of policy coordination, before looking more specifically at the issue how climate policy integration has been conceptualised within this coordination context in Chapter 3, and integrated into sectoral policies in Chapter 4. Specifically it examines national adaptation policies in the UK, Denmark, Finland, Italy, Portugal, The Netherlands, Germany and the Czech Republic. While national adaptation strategies have been the increased focus of recent research (Mimura et al., 2014), few of these studies have evaluated them in detail from the perspective of policy coordination, despite this being a central tenant for their existence. This chapter therefore draws on concepts from the coordination literature to help categorise the different components of the adaptation policies of the studied countries, and to comment on the effectiveness of the coordination process. The next section outlines the conceptual framing of the chapter drawing on wider coordination theory. Then adaptation policy for each country is outlined in its general context. Next the policy coordination architecture for adaptation is broken down for each of the studied Member States. Finally conclusions are drawn on the effectiveness of the strategies from the perspective of policy coordination.

2.2 Conceptual framing and methodological approach.

Policy Coordination

Coordination is not a new concept (Pollitt, 2003; Bogdanor, 2005) or unique to the issue of climate change adaptation; it has long been a 'holy grail' of most, if not all, public administrations (Peters, 1998). The perceived need for greater coordination is associated with so-called wicked problems which span many sectors, such as social exclusion, race relations and environment. Such cross-cutting problems are often argued to be thwarted by so-called sectorisation, a situation in which policy makers operate within sectoral silos at the expense of cross-government objectives (Richards and Smith, 2002; Hood, 2005 ; Degeling, 2005). Hence the push for more strategic approaches to climate adaptation policy coordination such as the development of a NAS to deal with cross-sectoral priorities.

An important point to make about the existing literature is in relation to the lack of clarity about the most appropriate means of pursuing policy coordination horizontally between sectors and vertically between governance levels (e.g. EU, National, regional and local). Debates are often framed around the use of more or less centralized instruments (Jordan and Schout, 2006; Russel and Jordan, 2009). Very simply put, centralized or top-down instruments seek to minimise the discretion of ministerial policy makers and sectoral or local actors when dealing with cross-cutting issues by helping to set targets and objectives to be met. While such instruments seek to reduce the opportunities for sectorisation or local discretion, they risk overloading the apex of government (Jordan and Schout, 2006) and may also circumscribe local autonomy. By contrast, less centralized or bottom-up instruments, such as broad strategies that raise awareness of an issue, aim to build coordination from the bottom up by providing guidance and recommendations rather than regulating actions. The advantage of a bottom up approach is that it allows greater local flexibility (e.g. to make use of departmental expertise). Conversely, the lack of strong central steering may allow ministries and their associated sectors to follow their own preferred styles to policy coordination - in effect, sectorisation. The existing literature tends to portray these two approaches – the more centralized or less centralised - either as rivals (e.g. Peters 1998, 299; Metcalfe 2000), or as mutually re-enforcing (e.g. Perri 6 et al., 2002; Page, 2005). In this chapter, we take the view that a set of concrete empirical cases - in this instance NAS case studies - are needed to examine how the two dimensions are shaped and interact in practice.

Another point that needs to be made about the existing literature for the purposes of this analysis relates to the instruments that can be used for coordinating policy. Peters (1997) provides one of the most exhaustive lists of more centralized top-down instruments. It includes: leadership by the Prime Minister and/or senior ministers to initiate and provide sustained political support for cross-cutting initiatives such as climate adaptation; the assignment of responsibility for coordinating adaptation initiatives to central ministries (e.g. the Prime Minister's/President's office, Cabinet Office, Finance Ministry) to compel ministries or local government to comply with cross-cutting goals; the allocation of cross-cutting climate adaptation responsibility to particular ministers to ensure they are embedded at a high political level; the creation of central agencies or integration units to support ministers and ministries in their climate adaptation policy; the use of the Cabinet and Cabinet Committees to set strategic cross-cutting goals and to mediate and/or resolve inter-ministry/sector conflicts around climate adaptation; and finally the establishment of inter-ministerial committees to set common objectives and share best practice on climate change.

The coordination literature is generally less precise when it comes to less centralised instruments that can be used to encourage bottom up engagement with climate change adaptation within sectors and at regional or local levels. Some parts of the literature identify the need to create an institutional culture that embraces

wider cross-governmental objectives (e.g. Peters, 1997; Perri 6 et al., 2002). Metcalfe (2000) usefully argues that successful coordination should be initiated from within ministries or indeed regional and/or local governments (i.e. not centrally imposed), more on which below. Therefore, he advocates the need to develop capacities to engage with cross-cutting issues like climate change. Drawing on Metcalfe, Jordan and Schout (2006) define coordination capacities as having the means to: help participants in the policy process exchange information through effective knowledge management (e.g. using instruments such as policy appraisal, cost-benefit analysis, etc.); identify areas where horizontal and vertical coordination (on adaptation) is required (as can be found in climate change risk assessments in many EU Member States); and arbitrate where conflicts (on adaptation) between participants are not resolved informally (e.g. through more centralized means such as Cabinet Committees). However, promoting activities such as information exchange arguably only works if bureaucrats have the right instruments (Perri 6 et al., 2002) to generate and exchange information on possible policy spillovers – i.e. suitable tools for knowledge management. Good examples of such an instrument in terms of climate change adaptation are risk assessment, cost-benefit analysis and stakeholder processes to bring in wider sector-specific knowledge perspectives (see Weiland et al., 2013).

While categorising the different coordination instruments in terms of being more or less centralised helps to clarify their different functions, it is important to note that in practice the distinction between the two is not always clear cut. For example, instruments such as cost-benefit analysis can be conducted centrally or in ministries, sectors, and regional and local governments, and political leadership can be crucial for initiating processes such as climate change risk assessments, or thwarting them to protect vested interests (Russel and Jordan, 2009).

Measuring Coordination: the Metcalfe Scale

Measuring the degree of coordination can allow for the diagnosis of the strengths and weaknesses in adaptation policy coordination processes in the countries studied (Metcalfe, 1994). Metcalfe (1994) has developed a coordination measurement scale based on intergovernmental relations (see Box 1). While the Metcalfe scale (*ibid*) does come from the less centralised school of thought on coordination, it offers flexibility through incorporating an eclectic meaning of coordination, i.e. one that includes horizontal, vertical, more or less centralised approaches or a combination of these (Schout et al., 2001). Furthermore, the scale ranges from very loose coordination for simple issues to highly integrated coordination for more complex matters. Metcalfe (1994) uses a Guttman scale, which, therefore, has the following properties: it is uni-dimensional, ordinal and cumulative. Its uni-dimensional aspect means that it can be considered as a “flight of steps in which qualitatively different components of coordination are added from the bottom-up” (*ibid*, 281). According to Metcalfe (2000, 830-831), the more complex coordination issues require the “activation of higher level capacities” where as if the lower levels function effectively “they filter out simpler and uncontroversial coordination problems.” Due to its ordinal property, it encompasses qualitatively progressing components of coordination capacity. Thus, the capacity for higher levels of coordination can be identified but not quantified, i.e. level four is not twice as high as level two (Metcalfe, 1994). The cumulative nature of the scale implies that the mechanisms for higher levels of coordination require the existence and reliability of the lower ones (*ibid*).

Once coordination weaknesses have been established, the scale can be used to identify appropriate remedies to redress them. For instance, Metcalfe argues that:

“Following the developmental logic of the policy coordination scale, a capacity-building programme would first strengthen the lower-level capacities for communication, consultation, etc...” (Metcalf, 2000, 831-832).

Therefore, the scale can potentially be used as a device by which to suggest strategies to build coordination capacity on climate adaptation.

Box 1. The Metcalfe Scale of Policy Coordination

Level 1: Independence: each department retains responsibility for its sectoral objectives, but accept some responsibility for cross-sectoral issues.

Level 2: Communication: departments inform one another of activities in their areas via accepted channels of communication.

Level 3: Consultation: departments consult one another in the process of formulating their own policies to avoid overlaps and inconsistencies.

Level 4: Avoiding divergence in policy: departments actively seek to ensure their policies converge.

Level 5: Seeking consensus: departments move beyond simply hiding differences and avoiding overlaps/spillovers to work together constructively through joint committees and teams.

Level 6: Conciliation: neutral (possibly central) bodies are brought in or are imposed upon conflicting departments to act as mediatory body. The onus, though, is still on the ministries to reach agreement between themselves.

Level 7: Arbitration: sometimes disagreement and conflict are too strong for voluntary approaches to overcome; therefore, a central or neutral actor is brought in.

Level 8: Setting common parameters: parameters are predefined which demarcate what ministries can and cannot do in their own policy making arenas.

Level 9: Joint strategy and priorities: the core executive (Cabinet/Prime Minister/Cabinet Committee) sets down, and through co-ordinated action, secures the main lines of policy at the early stage of the decision cycle.

Source: Adapted from: Russel and Jordan (2008)

So how can the scale be applied to coordination in terms of adaptation policy? Level 1 (Box 1), recognises that ministries, sectors or regional and local governments are largely responsible for their own policy objectives and that before any level of coordination can occur they must accept some responsibility for climate adaptation. Once responsibility has been accepted sectors need some form of knowledge provision and information exchange on issues like policy conflicts, sectoral spill-overs, the costs or benefits of different actions on different sectors etc. (2-3 on the scale). According to the logic of the scale, following a process of information exchange actors can start avoiding divergence in adaptation policy (level 4). From 5 on the scale, coordination becomes more positive where actors seek more consensus, right up to 8 and 9 on the scale where shared strategy and the setting of common parameters comes to the fore. Under the Metcalfe view of coordination as cumulative processes, the effective operation of a common strategy (8 on the scale) depends on how well bottom-up strategies such as knowledge management perform as they are the necessary first step towards coordination to highlight and feed information on potential policy spillovers and impacts into the higher level mechanisms (e.g. inter-ministerial Committees). One could assume that an ‘ideal’ NAS would correspond to 8 or 9 on the Metcalfe scale, but the actual role of a NAS

will depend on the legal, administrative and political context of a country. This has also been recognised by, for example the Least Developed Countries Expert Group (2012) in the United Nations Framework Convention on Climate Change guidance for 'National Adaptation Plans', which notes that the structure and form of the plans will vary from country to country. The EU guidance on NAS (EC, 2013) also avoids normative statements on what the NAS should be by stressing the process of adaptation planning rather than specific features of the strategy. Therefore the role of the NAS is an empirical question. By linking it to the Metcalfe scale it is possible to analyse its specific characteristics.

Data collection framework and methods

Drawing on insights from the above coordination literature, from literature on environmental policy integration (Schout and Jordan, 2008; Jacob and Volkery, 2008; EEA, 2005) and climate policy integration and mainstreaming (e.g. Adelle and Russel, 2012; European Commission, 2013) we have collected data around the following framework to analyse each Member State's adaptation strategy (see Table 1 below for more details):

- Knowledge management - e.g. if risk or vulnerability assessments are conducted, whether there are processes for stakeholder management, the existence of boundary organisations, etc; In line with the core aim of this deliverable, the use of economic analysis and policy appraisal (also known as impact assessment) in knowledge management is focused on in this part of the framework.
- Administrative coordination - e.g. the presence of leadership, inter-ministerial committees on adaptation, etc;
- Vertical coordination - whether there are specified links to EU adaptation policy and local initiatives;
- Resource allocation – the financial and non-financial resources (e.g. human, knowledge) made available for adaptation activities; and
- Autonomous adaptation – we also include the provision for a recognition of autonomous adaptation which is essentially a processes that occurs aside from a NAS and related national policy. In some instances autonomous adaptation may be more preferable (politically and pragmatically) to more coordinated action.

In deploying this framework we seek to categorise the studied NAS and related adaptation policies around core themes in the climate policy and mainstreaming literature, while also capturing elements of more or less centralised means of coordinating around climate change, and to link them to the Metcalfe scale (Box 1). This allows us to speak to the adaptation literature while also being able to conduct analysis which draws on useful insights from the coordination literature as outlined above. In addition, we collected information on the political and administrative structure of each of the studied Member States to see if patterns existed in terms of most similar and different cases, e.g. federal vs. non federal systems, new NAS verses more mature ones. Eight countries are studied and compared for the analysis in this chapter: the United Kingdom, Denmark, Finland, Italy, Portugal, the Netherlands, Germany and the Czech Republic. These cases represent a sample that can provide in-depth insight into different NAS processes but broad enough to capture different contexts, such as federal (Germany) and non-federal political systems (Portugal), leaders (Denmark, Finland, United Kingdom) and laggards (Italy, Czech Republic) and

geographical distribution in Europe (e.g. northern, southern and Eastern European countries). The data collection for the analysis in this chapter draws on a mixture of documentary analysis and interviews. The methods are outlined in more detail in chapter 1 and in Appendix 1 of this deliverable.

2.3 General Overview of National Approaches

The picture of adaptation policy in EU Member States is very mixed. Front running countries like Finland are revising their existing strategies following extensive review processes, while countries like Italy have only recently formulated an official strategy and awaiting its adoption, despite a number of ad hoc developments in a number of sectors and in the municipalities. Some countries like the UK have also moved beyond an adaptation strategy to focus efforts on a programme for implementation. This section provides a brief overview of adaptation policy history in the selected countries.

The United Kingdom (UK)

The UK has often been regarded as a leader in the area of climate policy. There has been a national adaptation strategy in the UK since 2008 as part of the 2008 Climate Change Act. As well as introducing some novel features (e.g. the Adaptation Sub-Committee of the Climate Change Committee), the NAS also consolidated existing adaptation activity (e.g. the UK Climate Impacts Programme of information provision to stakeholders, and adaptation priorities outlined in the UK 2005 Sustainable Development Strategy). Adaptation policy has now become more federalised with each region of the UK (England, Wales, Scotland and Northern Ireland) being responsible for developing separate approaches. This analysis focuses primarily on the National Adaptation Programme in England that came into effect in June 2013, which serves as a framework for adaptation in England over a five year period. It builds on the Climate Change Risk Assessment (HM Government, 2012) for the UK, which identified the main risks and opportunities related to climate change that would affect the UK. The UK government had to respond to the Climate Change Risk Assessment, as set out in the Climate Change Act 2008, with the production of the National Adaptation Programme. The National Adaptation Programme takes the highest order risks from the Climate Change Risk Assessment and brings Government into partnership with businesses, local government and other organisations, to develop objectives, policies and proposals to address the higher order risks.

Portugal

Since 2010 the Portuguese National Adaptation Strategy has laid out the case for adaptation in Portugal through a synthesis of the main observed changes in the climate over the 20th century, and a summary of the conclusions of climate scenarios and projections for Portugal (phase 1, 20010-2013). Currently, phase 2 (2014-2020) is being discussed and aims at creating the conditions to facilitate the initiation of concrete adaptation action across sectors and regional scales. Officially, the Portuguese NAS is at the stage called “Formulation” (i.e. responsible actors respond by formulating adaptation policies) and is thus still in its infancy.

Germany

In Germany, as elsewhere, mitigation was for a long time the primary focus of climate policy, with adaptation seen as a sign of resignation and acceptance of climate change (Swart et al., 2009). As Germany

has been a front-runner in climate mitigation, resistance to accepting climate change and, hence, to engaging with climate adaptation was particularly fierce. However in 2008 the Federal Government of Germany adopted the “German Strategy for Adaptation to Climate Change” (Deutsche Anpassungsstrategie, DAS). This strategy lays the foundation for a medium-term process to progressively identify the effects of global climate change, assess the risks, and develop and implement adaptation measures. To underpin this strategy with specific action, the strategy was followed by the “Adaptation Action Plan of the German Adaptation Strategy” (APA) which was adopted in 2011. The action plan commits to concrete steps in the further development and implementation of the Strategy. It follows an integrated approach which takes account of the interactions between sectoral and regional activities and strives to anchor consideration of the possible impacts of climate change in all relevant policies. Germany is in the decision stage of the adaptation policy process, i.e. policymakers have adopted an adaptation policy whereas implementation is still ongoing (and possibly a continuous process anyway).

Denmark

Denmark launched its first national climate adaptation strategy, *Strategy for adapting to climate changes in Denmark*, in 2008 (Danish Government, 2008) in which climate adaptation was put on the agenda at national and local level (Jensen et al., 2014). While implementing a number of measures in central government, the focus in the strategy is on presenting a range of options that local government can take in order to prepare for a changing future climate, and on assessing the risks of impacts for particular types of Danish landscapes and society. No specific obligations are attached and the strategy presents climate change as an opportunity for the future as well as introduces a range of threats and risks that have to be addressed. In late 2011 a centre-left coalition took office; part of their Agreement of Government was to focus on climate adaptation, including a stronger role for and actions of municipal planning and policy. In 2012, this was followed up through an action plan, *How We Manage Cloudbursts and Rains* (Danish Government, 2012). The Action Plan stresses flooding and other water related climate changes as the major challenges in Denmark, and thus requires each municipality to map its territory according to risk of flooding and to develop a local plan that includes actions to adapt to climate changes in a short and medium term perspective. Moreover, the Action Plan specifies national level actions to improve the framework for local level actions, and stresses this framework provision as vital for local actions due to adaptation as an area with uncertainty and in need of innovative policy approaches/measures. By end of 2013, all municipalities had developed or were finalising a local climate adaptation plan, as required, in the form of an amendment to the Municipal Plan or in the form of integrating climate adaptation directly in the Municipal Plan (Danish Government and Local Government Denmark, 2012). Municipalities that did not manage to meet the deadline made an agreement with the Ministry of Environment for its finalisation.

Italy

Italy is a relative latecomer to adaptation policy. Despite a number of disconnected adaptation initiatives in the regions and some sectors, Italy finalised the technical-scientific work in support of the development of the Italian NAS in May 2014 leading to the release of the NAS to the ministry, and currently is in the process of being adopted at the national governmental level (expected by the end of 2014). The Italian NAS has been coordinated by CMCC and built up on knowledge provided by an extensive scientific team of around 120 scientists. The Italian NAS has been particularly novel in terms of assimilating recommendations and other relevant information through an analysis of EU directives and regulations, and national legislation relevant to the impacts, vulnerability and adaptation to climate change. The NAS

process is being carried out by means of an active consultation of national, regional and local stakeholders relevant for the national sectors. Furthermore, both an on-line public review and ad hoc public consultations were organized in order to promote the involvement of citizens and stakeholders such as NGOs, municipalities, the private sector and trade unions. The general objective of the NAS is to provide a framework for adaptation at national level in Italy by identifying relevant sectors and inter-sectoral issues, and by proposing a set of short (by 2020) and long-term (beyond 2020) adaptation actions for these sectors. Top-down and bottom-up approaches have been combined. The top down process, aiming at preparing a scientifically-based NAS and shared at the institutional level was implemented through the establishment of a Technical Panel of Experts and an Institutional Committee, including Ministries, Civil Protection and representatives of regional and local authorities. The bottom-up approach has been implemented through an on-line survey on the perception of risks of climate change and the “adaptation concept” in the country, which was launched in October 2012.

Finland

Finland is an early adopter of adaptation policy. Finland’s first National Climate Strategy was adopted in 2001 in the form of a government report to the Parliament. In its response to the report, the parliament noted the need to prepare a programme for climate change adaptation. Preparation of the programme was initiated in 2003 with the national adaptation strategy being published in January 2005. While the adaptation strategy was a separate, nearly 300-page, document, key aspects of it were included in a section of the 2005 National Energy and Climate Strategy. The Finnish NAS was adopted in 2005. In line with the principle of mainstreaming, detailed measures and implementation of the NAS was given to the sectors. Implementation in most of the natural resource and built environment related sectors covered by the NAS has been outlined in action plans prepared by the Ministry of Environment (2008 and 2010), Ministry of Agriculture and Forestry (2011) as well as the Ministry of Transport and Communications (2009, 2013). Evaluations of the National Adaptation Strategy’s implementation were carried out in 2009 and in 2012-2013. A substantially revised National Adaptation Strategy is currently being finalised in response to policy developments at national and EU level as well as improved knowledge on impacts and vulnerabilities that has accumulated since the Strategy was first adopted. The revised Strategy is to be published in 2014 and to be adopted as a ‘Decision in Principle’ by the Government thus providing strategic guidance for all sectors of government.

Netherlands

There are different views on whether the Netherlands had developed a National Adaptation Strategy, or not. Swart et al. (2009), Biesbroek et al. (2010), Mees et al. (2012) and Termeer et al. (2012) refer to the policy plan ‘Maak Ruimte voor Klimaat!’ from the Ministry of Housing, Spatial Planning and the Environment (2007) as a National Adaptation Strategy. This policy plan closely linked climate change adaptation to spatial planning. Termeer et al. (2012) also refer to the Delta Commission, “which was commissioned to develop an integral perspective to make the Netherlands climate proof, particularly for water-related issues” (p. 45); though they also observe that the Delta Commission’s advice is not directly related to the National Adaptation Strategy. However, the Dutch National Audit Office (Algemene Rekenkamer) (AR, 2012) observes that what was proposed as a ‘National Adaptation Strategy’ in 2007, has never been translated into concrete measures with a timeline and/or assigned to bodies responsible for implementation; despite promises to do so by the national government to the national parliament in 2008. As a result of this fragmented and seemingly weak approach to adaptation, in 2013 the Dutch Ministry of Infrastructure and Environment has proposed a new adaptation strategy which takes the

recommendations from the European Adaptation Strategy from 2013 and from Audit office (AR, 2013) into account, and outlines the steps to be taken to develop a National Adaptation Strategy before 2017.

Czech Republic

Of all of the countries included in this analysis, the Czech Republic is the furthest behind in terms of adaptation policy. Despite the preparation of the NAS starting in 2009, the strategy proposal has only just been approved by the Ministry of the Environment. Currently, the inter-departmental comment procedure is under preparation in order to finalize the Strategy for final governmental approval. In February 2014, a new government was named and presented Policy Statement of the Government. The Policy Statement includes a commitment to prepare the NAS by mid-2016, together with specific adaptation measures oriented mainly towards water management (e.g. water retention in the landscape, restoration of watercourses, protection of groundwater). In the absence of a formal strategy, implementation of adaptation measures in the Czech Republic is in the main supported by the national subsidy program of the Ministry of Environment called "Support to restoration of natural landscape features", which aims to assist in implementation of adaptation measures to mitigate the impacts of climate change on water, forest and non-forest ecosystems.

2.4 The Architecture of National Adaptation Strategies and Programmes

Table 1 outlines some of the key features of our studied countries' NAS and adaptation policy. We have provided a systematic and broad review of each country's approach. It is important to note that we have recorded those measures observed. Where something has not been recorded as being present does not necessarily mean a measure does not exist. It means that it has not been observed in our extensive research process. It is also important to note that the table features countries with a longer history of adaptation planning (UK-England, Denmark, Finland, Germany, Portugal), while others are in the process of totally revamping their approach (the Netherlands), or implementing a new strategy (Italy), or in the case of the Czech Republic still devising a strategy. Data for the Czech Republic is therefore particularly thin with many gaps. The information contained in Table 1 is filled out in more detail below. With ongoing strategies concrete measures are recorded by an 'X' in the table, whereas future measures that are planned but not yet active are indicated by an 'F' (plan for the future policy) in the table. For Italy where the strategy is awaiting government finalisation we have included all intended measures in the NAS outline as concrete ('X'). In the case of the Czech Republic the NAS development process is still ongoing so here we have also used the 'F' symbol to indicate future plans. Where a measure is partially present we have used the '!' symbol. For each of the studied countries, Table 1 also indicates measures that are formally part of the NAS (AS – adaptation strategy) and measures that concern climate change adaptation but are not formally part of the NAS (OP – other policies and procedures).

Table 2.1 Key components of National Adaptation Strategies and Programmes, and other processes that support adaptation in selected EU Member States.

	UK (Eng)		Portugal		Germany		Denmark		NL		Finland		Italy		Czech Rep.	
	AS	OP	AS	OP	AS	OP	AS	OP	AS	OP	AS	OP	AS	OP	AS	OP
Knowledge management 1) policy appraisal/impact assessment that includes provisions on adaptation 2) cost-benefit analysis encouraged (economic analysis) 3) Vulnerability (V) or risk assessments(R) 4) provisions for stakeholder engagement 5) Independent advisory panels/boundary organisations 6) Adaptation portals 7) Strategies to deal with data uncertainties/gap 8) Measures and/or guideline (specify which) in place for evaluating adaptation		X				X					X		X			
	X				X		X		X	X	X		X			
	R	V	V		V		VR		VR	VR	VR		V			
	!	X	X	X	X		X	X		X	X		X			
	X(2)				X		X		X	X		X	X			
	X		X		X				F	F		X				
	X				X		X		!	!		X				
	!		X		X		X		F		X		X			
	X				X		X		F							
Administrative coordination 1) Strong and sustained political leadership 2) Inter-ministerial working groups. 3) Dedicated integration units 4) Sectoral strategies for adaptation 5) Action /implementation plans 6) Provisions for private sector engagement 7) Provisions for public sector engagement? 8) Provisions for household engagement							X			X	X				F	
	X		X		X		X		X	X	X		X			
			F							X					F	
	X		X	X		X	X		X	F	F	X			F	
	X															
	!		!				X		F	X	X		X			
	X		X				X		F	F	X		X			
									F	!			X			
Arrangements for vertical coordination 1) Link to the EU adaptation strategy/policy 2) support for local and regional-level adaptation	X		X						X	X	X		X			
	X				X		X		!	!	X		X			
Resources and Funding 1) Financial resources to assist cross-sectoral adaptation 2) Organisational resources (e.g. manpower, training, expertise)						X	X		!	!	X	X				
	X				X		!			!	X			!		
Autonomous adaptation 1) Autonomous adaptation actively considered and encouraged	X				X	X			!	!	X		X			

AS = Adaptation Strategy, OP = Other process/policy supportive of adaptation

X = present measure, ! = partial measure, f = intended future measure, R = risk assessment, V = vulnerability assessment

NB: Where the space is left blank, no measure has been observed

Knowledge Management

Policy appraisal – also known as regulatory impact assessment - is a widely used and arguably the most established tool for integrating all kinds of knowledge, but especially economic analysis, into policy making, (Turnpenny et al 2009). However, in our analysis it is only highlighted as a keystone tool in the adaptation strategy in one of the studied cases, Finland, in relation to its 2014 revision of its NAS. In other jurisdictions policy appraisal is also mentioned in relation to adaptation, but not necessarily as a formal part of the NAS. For example, mandatory policy appraisal in the UK (England) has supplementary guidance on adaptation, while adaptation is one area that policy appraisal in the Germany and Finland can cover. It is also useful to observe that there are a number of studies showing that policy appraisal has not necessarily had a strong track record of integrating environmental knowledge into policy making in many EU Member States including the UK (England) and Germany (e.g. Nilsson et al., 2008; Hertin et al., 2009; Turnpenny et al., 2008).

Despite the general link to formal policy appraisal procedures in many of the countries studied, **cost-benefit analysis** has been a formal part of many of the studied countries' NAS (UK-England, Netherlands, Germany, Italy). Cost benefit analysis is widely promoted as a key mechanism in which to integrate economic analysis into policy making (e.g. Hanley, 2001; Hockley, 2014). In Denmark the NAS and associated action plan mentions socio-economic analysis rather than a more narrowly focused CBA. While this situation is seemingly positive, there are critiques of the comprehensiveness and breadth of many of the economic studies. For example, in the Netherlands and in Finland these CBAs are only partial or indicative, in Italy they are not comprehensive in all key sectors and in the UK (England) there has been insufficient knowledge on full costs and benefits of adaptation in key sectors (ASC, 2010). As far as Italy is concerned, the economic analysis has mainly focused on cost estimation in some sectors, rather than a 'formal cost-benefit analysis'.

We find a mix of **vulnerability and risk assessments** in the studied countries to help set adaptation priorities, with three of the studied countries standing out as having only vulnerability assessments (Portugal, Italy and Germany). For Germany a proper vulnerability assessment for the whole country is still under preparation, though. Of those countries deploying both approaches, we observe that analysis in vulnerability and risk assessment efforts may be hampered by the need for more cost estimates in Finland, and in the Netherlands risk and vulnerability assessments have until recently only been partial in the NAS – in other words there is a critical gap in economic data and analysis. Some countries deploying a mixed approach also originally started out with vulnerability assessments, only incorporating risk assessments with later developments in their adaptation strategies. For example, in the original Finnish NAS, vulnerability assessment was prioritised, but risk assessment alongside vulnerability assessment will be encouraged in the revised 2014 strategy. Likewise, in Denmark the initial focus was on vulnerability assessments with risk assessment being more formally considered following the 2012 Action Plan. A mixed approach clearly has the advantage of identifying vulnerable groups, infrastructure, economic activity and environments alongside a better understanding of the probabilities of the different risks involved.

Stakeholder inclusion in the adaptation process is argued to an important factor in bringing in their expertise and context specific knowledge and to ease the implementation of adaptation policy. Crucially, we find stakeholder inclusion to be important in many of our studied countries either as a formal part of the NAS and/or the general policy making processes. In Denmark, for instance, it is institutionalised as part of the planning process, and in the Netherlands a broad array of actors from public bodies, social groups and charities are consulted as part of the Delta project with similar intentions for the revised NAS (note

though that for the original Dutch NAS stakeholder provision was weak). That being said, the evidence collected in this research suggests some of the stakeholder processes are far from comprehensive. For example, in the UK English National Adaptation Programme it is claimed that the measures were produced on the basis of extensive consultation, but there is little elaboration of on how this process was managed or indeed who the stakeholders were. In Germany the range of stakeholders consulted appears to be limited to mainly government. Other countries such as Portugal and Italy appear to have strong stakeholder inclusion processes incorporating a range of actors. For Italy stakeholder processes have occurred to date mainly during the development stage of the NAS. While in Portugal the stakeholder processes have occurred mainly at the implementation stage, meaning there were limited opportunities for stakeholders to input their expertise into the important area of the design or evaluation of adaptation measures.

Many of the studied countries have, or plan to have in the case of Portugal, some form of **boundary organisation** which sits on the interface of science and policy (Turnpenny et al., 2013) to manage the integration of knowledge into policy making and to provide expert scrutiny and evaluations of the implementation of adaptation efforts. In Finland governmental research institutes are expected to provide expert advice on adaptation for the NAS and there is also an independent climate change panel of experts which operates separately but alongside the NAS to advise government. Its main focus is on mitigation but adaptation is also included. Likewise the UK has a Climate Committee comprising experts from the scientific, business and charity sectors to advise and scrutinise UK government. Like Finland this committee focuses mainly on mitigation but does have a Sub-Committee on Adaptation. The UK (England) also has the Environment Agency Climate Ready Programme, which took over from the Climate Impact Programme, to provide data to government and the private sector. In the Netherlands, the Dutch National Audit Bureau and Environment Assessment Agency have both reported critically on adaptation in terms of the NAS and Delta programme. In Germany, the Environment Agency has created networks for knowledge creation and sharing, and in Italy a scientific panel that was responsible for drafting the NAS. Thus in many of the studied countries opportunities for scientific engagement with adaptation policy are extensive.

Interestingly, our research suggests that only a few of the studied countries have a clear link to **adaptation information portals** in their NAS. In Denmark, the UK, Germany and Finland the portals referred to are domestic. By contrast, in the Netherlands and Italy, there are yet no national portals but some recognition of EU ones such as Climate-Adapt (also see findings from the MEDIATION project, Pfenninger et al 2010). This is clearly an area which could be expanded with national portals to provide domestic actors (public, private and third sector) with useful information for their own adaptation efforts, and European portals to practice and expertise across nations. Moreover, when the portals are interactive, they provide a platform for knowledge sharing among public and private, local and state actors.

Uncertainties and data gaps are recognised in many the countries studied. In Italy, for example, a whole chapter has been given to this topic in its draft NAS, and in the revised Finnish NAS the importance of uncertainty and development methodologies to handle this is highlighted. The UK's (England) Climate Change Risk Assessment recognises gaps in the data but does not provide a clear indication of how to address these. Likewise, in the Netherlands partial recognition of uncertainty and evidence gaps is given in both the revised NAS and Delta programme, but with no clear strategy on how to deal with these issues. The situation in Finland shows the great differences between sectors. Thus, climate related uncertainty is handled better in those that are used to such weather driven variation (water, flood management,

agriculture, transport) than in those for which extreme weather events and adaptation have more recently become part of the agenda (forestry, energy and health). A more in-depth analysis of data gaps is contained in Chapter 4 of this deliverable.

Evaluation is a key part of many NAS approaches. In Finland self-reported evaluations by the sectors have been used positively to provide lessons from the 2005 NAS as the basis for the revised 2014 NAS. This demonstrates evidence of institutional learning. In the UK, the expert Climate Change Adaptation Sub-Committee has a mandate to evaluate the UK's progress and to provide advice to government on the basis of such evaluations. In other countries such as Italy and the Netherlands, evaluation has been mentioned but with few provisions for doing so being outlined. Crucially, though, there are few indicators used to assess progress on adaptation. The UK had a limited number of indicators but they appear to have become redundant since 2011. Germany and the Netherlands have intentions to develop indicators. Finland does have a process-orientated indicator on level of integration into sectoral policies and planning, but no formally adopted quantitative indicators of activities or outcomes.

Administrative Instruments

To some extent strong and sustained **leadership** on adaptation is shown by the fact that a country has a NAS and/or other supporting adaptation policy. Under these conditions countries such as the Czech Republic which are still developing their NAS could be classed as low leadership, and countries such as Finland that were front-runners in adopting a NAS and are in the process of revising the approach following evaluations can be considered to have strong and sustained leadership. However, the issue of leadership is more nuanced and can wax and wane over time. In the UK, for example, climate policy, including adaptation, had strong cross party support in the 2000s but this support has been somewhat side-lined in England by the economic recession and the growth agenda and by a more climate sceptic wing in the major coalition government partner since 2009. In a similar vein, while there is strong support for adaptation in the Finnish bureaucracy, political support has tended to fluctuate with a weaker mandate for adaptation since 2011. In the Czech Republic wider political and social scepticism towards climate change may well have been significant in slow burning engagement with adaptation policy. Weak political leadership is compounded by the fact that in the majority of the studied countries, adaptation policy is owned by the environment ministry (or in the Finnish case, the Ministry of Agriculture and Forestry) which tend to be low in administrative hierarchies (Jordan and Lenschow, 2008). Thus, without strong and continued support from more powerful government actors (e.g. the Prime Minister, Finance Ministers, etc), with responsibility for adaptation may struggle to get other parts of Government and society to either act, or to do so in a coordinated manner.

Inter-ministerial working groups are present in all of our studied countries. In Germany, Italy, Finland and Denmark these working groups are quite broad comprising representatives from central level as well as the municipalities, or in the German case from the Länder. Note that Germany also has horizontal working groups of ministries also operating at the Federal and Länder levels. In Italy and the Czech Republic the inter-ministerial working groups are currently only temporary bodies in charge of drawing up the adaptation strategies. Whether these will evolve into permanent committees once the NAS is fully implemented, as happened in other cases such as the UK, remains to be seen.

Integration units embedded within government to provide direct adaptation expertise and to facilitate coordination between ministries are far and few between in the studied countries. Denmark stands out as having a Climate Research Unit, but this unit has more of a research coordination function for the

environment ministry rather than working with all ministries to facilitate integration. Portugal plans to have an integration unit. The former and renewed NAS in the Netherlands does not have an integration unit, but the Delta project (focusing on flood risk management) does have an administrative centre.

Many of the studied countries have some sort of **sectoral strategy**. In countries such as the UK (England), Italy, Denmark, and Germany, their coverage is broad with a focus on many key sectors. In the Netherlands, the focus has been very narrow with a focus mainly around adaptation in the water sector. In taking sectoral strategies to the next stage of **implementation plans**, progress in the studied countries is rather limited. In the UK (England) for example, according to an interviewee, implementation strategies are more of a “summary of what is already taking place” rather than a concrete implementation roadmap. In Portugal important sectors have been identified, but no implementation plans have been put in place. In Finland implementation plans have only been produced for a limited number of sectors, and in the Netherlands sectoral adaptation policies are currently subject of governmental study, with the government’s intention to assess per sector whether strategies are needed, or only implementation actions.

In the majority of countries studied, the NAS was primarily aimed at the **public sector**. However, in many NAS there is also a provision for **private sector** engagement. Out of these, Denmark seems to have the strongest provision for private sector engagement with a scheme for the co-funding of innovative projects to encourage private sector involvement. In countries such as the UK (England), the private sector is encouraged but not compelled to engage with adaptation, and the Netherlands Delta project strongly encourages the private sector to become engaged. Only the proposed Italian strategy has any sort of provisions for engagement at the **household level**, but only in terms of suggestions not provisions.

Vertical coordination

Vertical coordination upwards to the EU-level is seen in the observed strategies. The EU’s adaptation Strategy is acknowledged in many of the countries studied suggesting fairly weak upwards vertical coordination. In Italy and the Czech Republic, though, NAS development has coincided with the development of the EU Adaptation Strategy. Thus EU adaptation guidelines (EC, 2013) have had a strong influence on their approaches. In other nations where national strategies preceded EU action in this area, acknowledgement to the EU Strategy has been made in revisions to the original NAS or in policy developments spinning out of the original NAS such as the English National Adaptation Programme in the UK.

Vertical coordination downwards to the regional and local level is also prominent in many of the studied countries, especially in Federal Germany at the Länder-level and in Denmark with its strong municipal focus. Indeed, in Denmark, the national government has established a task force, a so-called ‘travel team of experts’, that assists municipalities in developing local adaptation plans and capacity as a means to ensure vertical coordination. Local government is target in the UK (England) with the founding of a Local Government Advisory Panel, while in Italy Local Authorities are encouraged but not mandated to engage with adaptation. In Finland the local level is emphasised more in the new NAS following criticisms of the 2005 Strategy showing evidence of learning.

Resourcing

Financial resource provision to aid sectoral adaptation is not particularly strong in many of the countries studied. Denmark stands out with its public-private fund for innovative private sector adaptation projects, and the Netherlands for its Delta fund to provide financing to flood and water supply projects. Other countries such as Germany and Finland have focused funding on adaptation-related research projects to increase the knowledge base. Funding, though, is reported to be under pressure in Finland where there has only been limited dedicated funding for adaptation research and development projects since 2010, and in the UK (England) where efforts to reduce public finances have reduced the funding available to flood defence projects. In Italy and Portugal, funding tends to be targeted at programmes from the EU rather than domestically. The financial and organisational resources devoted to climate change and adaptation in the Czech Republic are quite limited, which might have affected the process of NAS development.

Organisational resources to help sectors adapt also appear fairly limited. The UK (England) has seen the core team responsible for adaptation in the Environment Ministry reduced in size, but this has been counteracted to some extent by an increase in the size of adaptation teams in other ministries. In Finland, there is only one person in the Ministry of Agriculture and Forestry (the policy lead devoted to work on the overall adaptation strategy process), but again there are staff with responsibility for adaptation in other ministries. In Italy some municipal actors have had training. In Germany there are awareness raising and networking workshops (funded by different ministries, but mainly Federal Environmental Agency) which seek to improve policy makers' knowledge and skills. And again, in Denmark, the national government provides assistance to municipal planners through the travel team as well as through developing concepts for risk mapping.

Autonomous Adaptation

Autonomous adaptation is only formally recognised in a few of our studied jurisdictions. By autonomous adaptation we refer to adaptation in the public, private and third sectors that is not the result of national initiatives like the NAS. In the UK (England) it is recognised as an important issue to be especially encouraged in the private sector. Finland has noted the need for private sector autonomous adaptation, with a recognition for the need to support vulnerable groups, but there is little direct support for concrete activities. In the Netherlands, autonomous adaptation is partly recognised as an issue in the Delta project and new NAS, and in Italy it is only mentioned in theoretical terms. It is also worth noting that in Italy substantial adaptation action has occurred autonomously despite the absence of a NAS. Likewise in Germany, the Länder had already worked on adaptation autonomously prior to the NAS. Moreover, autonomous adaptation in Germany is supported by on-going stakeholder engagement and the building up the knowledge base dialogues.

Integration with wider administrative processes

Another interesting thing to note from our analysis is how disconnected many of the adaptation strategies seem to be from other administrative processes. Indeed, apart from official policy appraisal mechanisms and consultation processes that might include adaptation impacts, the adaptation strategies and plans appear to operate in isolation from wider initiatives. In such cases there is a danger that adaptation may be seen as an add-on rather than an integrated part of the decision making process (Russel and Jordan 2009). Moreover, in some cases, adaptation strategies seem to run/to have run in parallel with sustainable development strategies (especially for example in Germany, in England, and in Finland). While this is not in itself a problem and can be an asset in support of adaptation, this situation does run a two-fold

coordination risk: first the risk of duplication of efforts where resources are being marshalled by parallel rather than integrated processes. Second, a lack of integration with sustainable development strategies means that adaptation may not necessarily be steered to support wider sustainability goals.

2.5 Discussion/Conclusions

Overall, there is no clear pattern in terms of how different political systems orientate their coordination efforts for climate change adaptation (see though Chapter 3 below). It is worth noting that both Germany and Italy have noticeably fewer administrative mechanisms – both are federal systems and therefore administrative coordination in central government may be less important than activities occurring in the federal units. Our data suggests that a lot of activity occurs at the level of the Länder in Germany (but less so in Italy), which may not be fully reflected in our above analysis. That being said the Danish strategy also has a very strong focus on local units, but still has a vast array of administrative mechanisms in Central Government. Crucially, in terms of processes, procedures and mechanisms established, most nations (with the exception of the Czech Republic, on which we only have partial data on the emerging strategy) have a good mix of measures aimed at coordination within the public sector, which is a necessary but insufficient condition of coordination (Russel and Jordan, 2009). This pattern is less prominent though with regard to targeting private actors, beyond inclusion in stakeholder processes, as the studied strategies are mainly geared towards public actors.

Alongside more traditional horizontal coordination, we found evidence of some but generally weak vertical coordination in most but not all cases. In the case of upward coordination, the newer NAS (e.g. Italy) strong coordination was observed with explicit reference made to the EU Adaptation Strategy (EC, 2013) – see BASE D2.1 for an evaluation of the EU strategy. Revisions to older NAS (e.g. Finland) and recent developments stemming from the NAS (UK-England) also made reference to the EU Strategy. How much influence the EU strategy actually has in shaping the actions of Member States is not, though, entirely clear from our data, apart from the case of Italy where EU guidelines (EC, 2013) were followed. We also see some vertical coordination towards more regional and local levels of decision making. While this aspect is strong in Federal Germany and in the Danish NAS with its strong municipal focus, there are weaker links in other jurisdictions even in, for example, the UK (England) and Italy where the importance of the local level is acknowledged. Moreover acknowledgement of autonomous adaptation, which is more likely to occur at local levels, is only weakly recognised if at all. Overall, vertical coordination for adaptation is one area that could be improved in many of the studied Member States.

Despite having a strong mix of measures to facilitate coordination, the overwhelmingly majority of the approaches in our studied Member States are oriented more towards less centralised bottom-up approaches coordinating sectoral policy making with more centralized measures performing weakly. Indeed, weak or fluctuating central political leadership was observed in many country cases with the exception of Finland and Denmark. In the Netherlands, although strong leadership was shown in the water sector specific Delta project, its actual NAS was heavily criticized by the Dutch National Audit Office for being not much more than a paper exercise with few initiatives actually appearing on the ground (AR, 2012). Indeed, leadership has been generally left to environment ministries, which have fewer means at their disposal to compel other ministries, the regions, local governments and associated sectors to act, meaning that adaptation can all too easily get sidelined by sectoral interests, and meta political concerns like austerity. Admittedly more hierarchical interventions may be more difficult to deploy in Federal

systems such as Germany where powers are distributed between different levels of government. To compound the issue of weak leadership, few NAS have strong mandates or funds for action, with adaptation more in the line of knowledge management and provision, awareness raising and persuasion. Indeed as will be shown in Chapter 3, there is a notable lack of legal provision for adaptation policy integration to compel action.

Overall, the observed NAS are particularly strong in terms of the provision of a more bottom-up, less centralised approach to adaptation. There is here, though, the issue of capacity (Jordan and Schout, 2006) to pursue coordination on adaptation from the bottom-up. In many instances we do find the presence of factors that should augment bottom-up capacity such as measures for knowledge provision and management, and the provision of resources. We do observe though that the implementation and the actual working of these measures can be a little 'hit and miss'. For instance, as we observe many nations have conducted cost-benefit analysis as part of their NAS, yet many of these studies are far from comprehensive and can be plagued by data gaps. Moreover, few nations employ tools like policy appraisal whose job it is to systematically integrate knowledge into policy making activities across sectors from exercises such as risk and vulnerability assessments. There is thus potentially an issue of much knowledge being produced, without a mechanism to ensure it is constantly applied in policy making.

If we turn to the Metcalfe scale (see box 1 and section 2.2 above) we can see how the inconsistent use of more bottom-up less centralized measures around capacity (e.g. knowledge management, training) can lead to break down at low coordination levels. Clearly the fact that the majority of the countries studied in this analysis have a cross-sectoral NAS or are developing one suggests that the different ministries of government and associated sectors have acknowledged some responsibility for adaptation (1 on the scale). However, when it comes to 2, 3 and 4 on the scale (communication, consultation and avoiding divergence respectively) successful knowledge management is crucial in terms of understanding policy spillovers, and shared risks, costs and benefits. Thus the inconsistent knowledge management processes we have observed in this analysis and paucity of processes such as policy appraisal to integrate knowledge into the coordination processes can all too easily lead to coordination break down. The problem is perhaps compounded in some countries by the absence of higher-level mechanisms in the form of political intervention from powerful central government actors (e.g. intervention and or sustained leadership from the Prime Minister's/ President's Office or Finance Ministry) to compel different ministries and actors to find common ground through among other things better knowledge management (levels 6 and 7 on the scale). Thus while there appear to be higher-level priorities (8 and 9 on the scale), the reality of reaching these adaptation aspirations can be hampered by lower level coordination bottlenecks. This suggests that the existence of a NAS cannot be taken as evidence for a Metcalfe level 7 to 9. In all countries it can be argued the ambition level is clearly much lower. This observation raises two important and related questions: is the scale appropriate for judging the level of coordination, and what is the actual level of coordination that is currently needed to ensure progress in adaptation and adaptive capacity?

To answer these questions one can start with a reflection on the current demand for adaptation. The IPCC has compiled evidence for Europe (IPCC WG 2, 2014, Table SPM.A1.) showing that the sectors and impacts for which there is confidence in the observations and evidence for attribution to climate change are still rather isolated in the sense that most of them fall clearly under particular sector responsibilities (such as health), or are difficult to address at all (such as earlier migrations of birds). This suggests that disagreements and conflicts over resources or actions should currently be rare and therefore there is little need for coordination in the sense of 6, 7, or 8 on the Metcalfe scale. On the other hand the long-term

outlook suggests significant risks and potential for adaptation that cross sectors (for example flood management requiring landscape level responses or health actions affecting city planning or water management) (IPCC WG 2, 2014, Box SPM.2 Table 1.), potentially creating cross sector tensions and conflicts and limiting opportunities for identifying useful policy synergies. This means in practice that it is rational to introduce coordinated discussions on long-term strategies and actions at an early stage of national decision cycles, even if the current need for coordinated action is modest. Thus in the current context of climate change, 9 on the Metcalfe scale could actually be seen as one of the tools that ensures the functioning 2-5 on the scale.

This can explain why the range of measures established for adaptation in the observed Member States is generally impressive, despite weaknesses in the NAS and power of the overall coordinating bodies. Insights from the coordination literature, in combination with the outlook on future needs of adaptation suggests, however, that the role and position of the NAS needs to be regularly revisited so that the mix of measures is suitably incentivising actors to follow a consistent approach from the top-down while always allowing for contextual flexibility from the bottom-up. At the moment, the approaches observed in this research seem light on more hierarchical means to positively pursue coordination beyond inter-ministerial committees. Moreover, it is important that the measures that do exist in NAS and related policies are implemented properly to ensure that sectoral actors have the capacity to coordinate in a sustainable manner. Failure to do so means that there are fewer opportunities for identifying policy conflicts and synergies which risks policy failure with the associated dangers and costs of non and mal-adaptation.

This chapter has established the broader focus of policy coordination in the studied NAS's and concludes that while a number of useful coordination processes have been established in many Member States, a lack of suitably orientated hierarchal approaches means that in the longer term opportunities for identifying conflicts and synergies and avoid mal-adaptation may be limited. The next chapter builds upon this analysis by providing a more focused analysis of the specific conceptual logics of the climate (adaptation) policy integration strategies which operate within the broader coordination architecture of the studied NAS.

Chapter 3. Climate policy integration in national adaptation strategies: a comparative analysis based on programme theories

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3.1 Introduction

Chapter 3 in this deliverable dwells further into issues of mainstreaming and coordinating climate adaptation policy in other policy areas through focussing on climate policy integration (CPI) in key national policies. It investigates the representation of climate policy integration in NAS across partner countries and comparing the policy integration rationales embedded in the NAS, allowing for examination of conceptual differences between CPI and *climate adaptation policy integration*. The overall objective is thus to assess the degree of CPI in different member-states based on the analytical framework developed in Deliverable 2.1 and to add to the conceptual understanding of climate policy integration. This analysis will assist Work Package 7 in determining a better match between evidence-based climate knowledge (social science as well as natural science), and also serve as context for the analysis of adaptation in different sectors carried out in the case studies of Work Package 5.

The EU Strategy on Adaptation to Climate Change (COM (2013) 216 final) aims to contribute to a climate resilient Europe by ensuring that adaptation is addressed in all relevant EU policies. The effectiveness of such an approach depends on the successful transfer of commitment to and objectives and knowledge of climate adaptation to a range of policy areas and institutions at relevant levels of policy making, also referred to as policy integration or mainstreaming. But the EU adaptation strategy is based on a weak conception of CPI. The strategy mostly applies soft and process-oriented policy instruments, providing information and promoting, but not requiring, that sector policies give prominence to climate adaptation objectives (Hilden et al. 2013). Therefore, the degree to which climate adaptation will be integrated in other policy areas depends on policy sectors picking up the ball as well as on Member States or even local government implementing the principle.

This chapter follows up on this by analysing NAS and the programme theories implicit in the strategies. However, in order to assess CPI at the national level, the analysis goes beyond the programme theory by additionally analysing output. Output may for example in the form of allocation of resources (funding, building of competencies, etc.), of policy initiatives that follow directly from the strategies, of the formulation of climate adaptation policies/plans/strategies in specified key sectors, as well as the impact of national adaptation strategies at lower governance levels (in particular the local level where adaptation has to be implemented), focusing on the position that the NAS grants local adaptation policy.

Objectives

In examination of CPI of the NAS, this chapter, firstly, **compares strategies, as expressing specific interpretations and conceptualisations of CPI and analyses the importance of national policy contexts**, including governance structure, following the analytical framework laid out in deliverable 2.1 (Hilden et al. 2013). It is also of interest whether, based on these comparisons, we can identify a difference in the way that climate policy integration is promoted with respect to climate adaptation and mitigation, respectively. The externality profiles differ for mitigation and adaptation which might lead to such differences.

In probing into the different styles of CPI (i.e. horizontal/vertical, process/outcome, required/autonomous) represented in the NAS, the analysis, secondly, **maps and compares which sectors are targeted, and how adaptation is promoted through specific policy actions**. This analysis includes incentives for CPI, including different policy instruments aimed at sectoral actors as well as coordination instruments aimed at governmental actors; the processes that are put in place to push policy actors to make adaptation policies and measures; on actions following the NAS. Moreover, the analysis examines how different types of NAS address adaptation and CPI at lower levels of policy making, in particular the local level. The assessment of adaptation strategies and sectoral strategies is based on the criteria of inclusion, consistency, weighting and reporting, as outlined in the analytical framework of deliverable 2.1 (Hilden et al. 2013), see below. The degree of CPI in the included NAS is further assessed, using the criteria of strong or weak CPI (Jordan and Lenschow, 2010).

3.2 Theoretical framework

Both environmental policy integration (EPI) and climate policy integration (CPI) run into challenges of sector-based policy implementation, although EU has tended to use harder policy instruments and outcome based measures for implementation of CPI related to mitigation policies than for EPI (Adelle and Russel, 2013; Lafferty and Howden, 2003).

However, whereas EPI and CPI as part of mitigation policy aim to address externalities and market failures, and CPI therefore involves explicit trade-offs and conflicts with other objectives held by actors in the implementation process, the integration of CPI in adaptation policy refers to a different distribution of costs and benefits. Impact and action scales are more closely, if not entirely, aligned. Thus climate adaptation can appeal to the self-interest of the actors in operating environments that are changed by climate changes which may imply fewer and/or different barriers to action. But even in the absence of direct conflict, agenda overload and vertical and horizontal coordination remain challenges for implementation of an effective integrated climate change adaptation policy (Burch, 2010; Measham et al., 2011). At the policy level, CPI in adaptation measures may need to deal with spill-overs, trade-offs, moral hazards and decision making under uncertainty, but less with externalities (Hilden et al. 2013). Inter-linkages between climate adaptation policy and other policy areas, including land use, energy and water, embed opportunities for enhancing adaptation and adaptive capacity. However, existing (international) policy institutions are often not 'designed to promote mainstreaming' (Kok & de Coninck, 2007:588), suggesting that CPI involves a change in or mainstreaming of perceptions of climate impacts and feasible policy actions across scales and policy areas, as well as innovative measures and resource allocation. In this context the strength of the mandate for policy integration embedded in EU and national adaptation strategies becomes important.

Regarding the divide between strong and weak CPI, Jordan and Lenschow stress that whereas weak integration implies that sectoral policy makers take environmental/climate considerations into account, strong integration means to place these considerations at the heart of the policy process in the sectors (Jordan and Lenschow, 2010). In other words, strong/weak CPI conceptualizes the degree to which adaptation is defined as a prioritized objective or as one objective among several.

To examine the CPI of the national NAS included, we conducted analysis of the NAS based on theories on policy integration and the framework of programme and followed the key concepts developed in Hilden et al. 2013, based on an extensive review of the EPI and CPI literature. This enables us to map the concepts of CPI in the national adaptation strategies. Specifically, we focus on the extent to which national adaptation strategies address the following criteria of integration in sectoral policies (Hilden et al, 2013. D2.1; Mickwitz and Kiivima, 2007; Mickwitz et al, 2009):

Criterion	Key questions
Inclusion	To what extent have adaptation objectives and/or direct as well as indirect adaptation needs been identified?
Consistency	Have the contradictions between the aims related to climate change adaptation and other policy goals been recognised and have there been efforts to minimize revealed contradictions? / Have synergies been identified and have there been efforts to promote them?
Weighting	Have the relative priorities of climate change adaptation compared to other policy aims been decided and are there procedures for determining the relative priorities?
Reporting	Are there clearly stated evaluation and reporting requirements for climate change adaptation (including deadlines) ex ante and have such evaluations and reporting happened ex post? Have indicators been defined, followed up and used?

Moreover, we examine the policy processes for development of NAS as cross-sectoral multi-level participation is also an indicator of CPI. A similar analysis may be applied to vertical CPI: how do NAS conceive of integration across government levels and do policy processes include actors from different levels of government. Finally, the actual instruments implemented for CPI are another important indicator as to whether CPI can be expected to materialize or whether it remains a principle in name only.

The degree of CPI in the included NAS is further assessed, using the criteria of strong or weak CPI, that is the degree to which adaptation is defined as a prioritized objective or as one objective among several (Jordan and Lenschow, 2010).

3.2.1 Methodology

Methodologically, the chapter follows the methodology of the deliverable and applies a comparative country approach that covers seven European countries and applies qualitative document analysis and interview data. All data was collected during 2013 and early 2014, and thus more recent developments in individual countries work with developing NAS is not included in the study. We examine how CPI in adaptation measures is conceptualised and implemented in the national adaptation strategies, focusing on select sectors. We include national adaptation strategies in different stages of development: NAS from five countries that have developed and published NAS, and NAS from two from countries where strategies

currently are drafted and which may therefore more explicitly draw on the adaptation strategy. The existence of a NAS does however not indicate whether the country represents a stronger national CPI mandate or has a softer approach. Moreover, we focus on the sectors related to the individual NAS. The country studies are selected to ensure variation in policy contexts, stage of development of NAS, and the degree of complexity in sectoral policies and therefore represent different difficulties of integrating adaptation goals.

The chapter is based on a multilevel case study where data is produced through policy document analysis and interviews with policy makers, and other stakeholders who are central to development of the NAS. Data has been provided by policy document analysis of NAS and sectoral adaptation strategies, and by semi-structured, face-to-face, and in some cases by telephone, qualitative interviews with key policy makers in the area of national climate policy (Bowen, 2009; Fereday and Muir-Cochrane, 2006; Kvale and Brinkmann, 2008), also providing data for the analysis of chapter 2 of this deliverable. Interview guides and coding analysis of the policy documents and interview material have followed a common guideline. Thus, all country studies have followed similar interview guides and responded to the same set of questions for initial analysis of national data, and the data are treated jointly.

3.3 Climate policy integration in national adaptation strategies

3.3.1 Introduction to the included country studies: political system and status of NAS

In the study, we analysed the NAS of seven European countries: the Czech Republic, Denmark, Finland, Germany, Italy, the Netherlands and United Kingdom. Two of the countries are in the process of developing NAS; the Czech Republic and Italy (in the case of Italy the technical work has been done and the strategy is now awaiting adoption). The *Czech* strategy has been underway since 2009 and mixes climate adaptation and mitigation. The strategy is expected to be completed by 2016. Also *Italy* is in the process of developing the NAS which is expected to be adopted during 2014. Following the Italian NAS, an adaptation Action Plan is expected. The Italian Ministry for the Environment, Land and Sea is responsible for ensuring environmental protection by issuing national legislation on adaptation, while Italy's 20 regions (that are already involved in the consultation process) are responsible for its implementation. The strategy is designed to provide a framework for adaptation rather than detailed actions.

Five of the included countries have developed NAS over the past decades. As early as 2001, *Finland* published a climate strategy which also addressed adaptation, though adaptation was treated fragmented in the climate strategy. In 2003 a decision was made to prepare a separate strategy for climate change adaptation, and based on a consultative process a NAS was developed and published in 2005. The NAS has been subject to evaluations in 2008 and 2013, and a revised strategy will be adopted by the Government in the summer of 2014¹. Finland's political system is mainly state centric, centred on consensus among social actors on major policies, which is a feature of the political system that has guided the course of development of the NAS. Moreover, the political system builds on largely self-governing municipalities. The

¹ The revised strategy was passed in Parliament in July 2014.

latter implies that the local level has a large role in implementing actual adaptation measures, especially those related to land-use planning and urban structure, where municipalities have a "planning monopoly".

Denmark published the NAS in 2008, and revised it and added a national action plan by 2012. The development and design of the Danish NAS equally reflects the national political system. Denmark's state-centric system implies that the state provides the overall policy framework while the implementation through decentralisation is delegated to the 98 municipalities. With land-use and urban planning and water management allocated to local government, the role of the municipalities in implementing the NAS is emphasised, marked in key elements of the NAS. As the Danish system moreover is largely consensus oriented, the NAS is developed and implemented through engagement of policy actors and other stakeholders, i.e. the main interests at national and local level.

In *Germany*, the NAS has been in existence since 2008, with a national action plan published by 2011. The NAS addresses adaptation in a medium-term perspective. The German political system is state-centric and federal, and the NAS is thus designed to provide the overall framework for the adaptation actions and policies developed by the *länder* (the states at sub-federal level). Moreover, the NAS reflects that German policy making is consensus based, whereby the NAS has been in consultation among stakeholders at national as well as *lander* level before it was passed by the Bundestag (federal parliament).

The *UK* published in 2008 the agenda setting Climate Change Act which set targets for climate mitigation and introduced mandatory adaptation policy issues in British policy making. Concurrent with the Climate Change Act, the first British NAS was published in 2008, based on a mixture of existing and new policy actions that addressed climate adaptation. The British political system, with 4 self-governing countries, delegates concrete adaptation to the countries. Since 2013, England has had - in the form of the National Adaptation Programme – a framework for adaptation policy, while Scotland and Wales recently have developed National Adaptation Programmes².

The Netherlands published the first NAS in 2007, while the process was halted in 2010 (AR, 2012). Two severe near-flooding events in the early 1990s and the low-lying territory of the majority of the Netherlands were an incentive to develop a separate Delta Programme focusing on flood risk management and making urban areas more 'climate proof' (launched in 2010). The Dutch government is currently developing a new NAS (to be ready by 2017), after critical review from the Dutch National Audit Bureau (AR, 2012) and the incentive from the EU Adaptation Strategy from 2013.

3.3.2 Mode of including (or not) CPI: Interpretation and conceptualisation of CPI in the NAS

In the five countries that have developed NAS, integration of climate adaptation issues is stated as part of the policy. All strategies start from assessing vulnerabilities/risks or they identify vulnerabilities and/or risks as the starting point in each sector in order to pinpoint sectors where adaptation issues are of particular relevance. The *German* strategy is based on assessment of vulnerabilities and risks, at national,

² Scotland passed its National Adaptation Programme in March 2014.

länder and regional level. In the *UK*, the 2013 National Adaptation Programme is based on addressing the highest risks, and the Danish 2012 Action Plan makes mapping of risks across the 98 municipalities mandatory. In contrast, the previous *Dutch* adaptation policy (from 2007) focused on spatial planning, and did not focus on risks associated with different water impacts, in particular those leading to flooding. Flood risks were considered in a parallel initiative by the Delta Commission that published an influential advice in 2008 (which was later translated into the Delta Programme). The new NAS is expected to address risks and vulnerabilities in several sectors, while it is at this moment not clear to which extent the new NAS and the Delta Programme will be integrated. Also the *Danish* NAS appoints a central role for risks and vulnerabilities, reflected in the mandatory first step of the local climate plans.

Integration of climate adaptation issues and coordination of adaptation policy actions concerns vertical as well as horizontal inclusion and interpretation of the objectives and actions of the NAS. **Horizontal** integration denotes how climate impacts are interpreted, i.e. which policy sectors are included as necessary/vital for adaptation within the perspectives of the NAS. The NAS of our country studies each target a range of **sectors** as relevant for adaptation policy, and recognize the cross-sectoral nature of adaptation policy issues. Table 3.1 summarises the sectors addressed or identified as relevant for managing present or future impacts of climate changes in the NAS of our country studies. The NAS thus specify where adaptation policy issues are or should be included, while the sectors that in actual terms develop sectoral adaptation plans reflect sector specific inclusion. In Table 3.1, these sectors are for each country marked with an asterix, *. Most NAS – the forthcoming *Czech* strategy is the exception – call for different degrees of integration of adaptation issue, mainly at a fundamental level of sectoral policies. This is most prominent in land use planning and water/transport infrastructure where the horizon of planning is long. In identification of relevant sectors for the national strategies, most NAS base the assessment on risk and/or vulnerability assessment.

The way that risk and/or vulnerability assessments is included in identifying key adaptation areas reflect how climate adaptation given priority and it thus also indicates how adaptation issues are weighted against other priority issues. The *British* NAS addresses adaptation within multiple sectors that on the basis of risk assessment are appointed as particularly vulnerable to climate impacts. Innovation and industrial development based on adaptation technologies are strongly emphasised in the NAS, which through integration of climate adaptation in industry and innovation policy eyes synergies with economic growth and increased exports, as well as cost savings for individual firms. Also policies to prevent flooding are by the 2013 Adaptation Programme stressed as areas where adaptation issues are integrated. In the *Danish* strategy, the sectors have become more targeted from the publication of the NAS in 2008 to the 2012 Action Plan, reflecting that the latter has a strong focus on water related issues. Moreover, following severe floods in the early 2010s, the costs of non-adaptation have driven sectoral adaptation policies forward. For the transport sector, coastal protection and in agriculture (with respect to the use of pesticides), sectoral adaptation strategies are developed and/or mandated. Equally, local government is mandated to develop adaptation plans, including integration of adaptation issues in local land use planning. This obligation is supported by a change of the Planning Act that makes local adaptation plans an option in the municipal plans. This would support sector integration at the local level, thus linking horizontal and vertical integration of policy adaptation. The *German* strategy is focussed on state and länder level where sectors are specified on the basis of assessment of risks and vulnerabilities, in a risk of climate impacts perspective as well as a socio-economic perspective. In *Finland*, sectoral ministries have

been involved in the development of the NAS since 2003 and the NAS in 2005 addressed relevant policy sectors and specified implementation actions for these. Within sectors such as environment, agriculture and forestry, transport and communication, sectoral Adaptation Action Plans have been developed for the practical implementation of the NAS within the sectors. The *Netherlands* forms the exception, as the fragmented NAS mainly addresses water issues from a perspective of well-known water-proofing policy issues. A more comprehensive NAS that also addresses other sectors is expected to be developed by the Ministry of Infrastructure and Environment and published by 2017.

For the NAS under development, the *Czech* NAS is not specifically targeting sectoral integration of adaptation issues, while the *Italian* NAS builds on a series of policies that have addressed adaptation as a concern for sustainable development, agriculture, water management, health and biodiversity.

Table 3.1 Horizontal integration of climate adaptation policy: Policy sectors included in the NAS
* required, expected to make or considering sectoral adaptation strategies

** have developed sectoral adaptation plans on own initiative

	Sustainable development	Water management	Urban development	Nature conservation/ environmental protection	Health	Energy	Transport and infrastructure	ICT	Water supply	Land Use/spatial Planning	Agriculture	Insurance /financial industry	Coastal protection	Biodiversity /ESS	Forestry	Fisheries	Cultural heritage	Tourism	Industry /trade / business	Local government	Building and construction	Game management/wild husbandry	Soil degradation
The Czech Rep.		X	X		X	X	X				X			X	X			X	X				
Italy		X	X		X	X	X		X		X		X	X	X	X	X	X					X
Denmark		X		X	X	X	X*		X	X*	X*	X	X*							X	X		
Finland	X	X	X	X	X	X	X*	X*		X	X*	X		X	X*	X		X	X	X	X*	X	
Germany	X	X	(X **)		X **	X	x **			X*	X	X	X	X	X	X		X	X		X		
The Netherlands		X	X	X*	X*	X*	X	X*	X	X													
United Kingdom	X 1*			X	X		X				X				X				X	X	X		

Some of the NAS, i.e. the *German* and the *Finnish*, have clear links to national sustainable development strategies, in which climate change issues have been recognized, though mainly from the point of view of mitigation. Also the *Italian* forthcoming NAS is based on sustainable development, in particular in the way that governmental actors involved in drafting the strategy interprets adaptation. Moreover, the draft strategy has dedicated a chapter to synergies and possible spill-over effects between climate mitigation and adaptation. In contrast, the *British* NAS has until the recent government took office been embedded in the coordination procedures in national environmental policy making, but adaptation policy at national level has now changed to a more stand-alone activity. This change is due to recent abolishment of linking

adaptation policy to strategies and procedures, such as the Environmental Cabinet Committee and the Committee of Green Ministers, at national level for sustainable development, where climate changes and adaptation figured as one of five priority areas of action. Whereas the UK now lacks a formal requirement to consider adaptation actions in a wider sustainability and/or environmental context, coordinated actions has to a limited extent been replaced by piecemeal policy actions, e.g. .Regulatory Impact Assessment, pushing integration of climate adaptation issues towards more informal and optional procedures. In *Denmark*, the link to sustainable development is also optional and often takes place at local level when mandatory Local Agenda 21 Plans include adaptation to climate changes.

The link to sustainable development suggests that social, environmental and economic perspectives are relevant for adaptation, and moreover that adaptation policies are *consistent* with other development policies, i.e. within a sustainability framework. Consistency with other policy issues and priority areas are addressed more ad hoc while consistency in the form of synergies at the same time potentially promotes adaptation issues.

In all of the countries included, except *Finland*, the NAS designate the **environmental ministries** as main actors, and adaptation is also seen as mainly an environmental policy issue. In Finland, the Ministry of Agriculture and Forestry, which also has responsibility for water management, was chosen as coordinator as climate change was seen to be particularly important for the use and management of natural resources. For all NAS, actions to promote CPI of adaptation issues are developed on the basis of previous experiences of integration of environmental policy integration (EPI) and, to a lesser extent, on experiences of integration of climate mitigation policy issues. For the countries, the NAS is thereby developed within policy environments with a history for EPI and policy institutions which have had a focus on EPI and developed procedures and instruments for promoting environmental issues across policy areas. In

Climate adaptation policy integration among sectors have been promoted during the development of the NAS. In the UK, integration of climate adaptation policy issues across sectoral divides and policy areas, i.e. horizontal CPI, is represented by **cross-sectoral collaborative forums and procedures** set up in the 1990 Environmental White Paper. The strength of the British NAS is however also marked by being led by a weak Ministry of Environment, while in Denmark the 2012 Action Plan was drafted on the basis of input from a working group with representatives for those ministries that responded to a general invitation to participate in the working group, and further develop with consultation of sector actors such as interest organisations, labour market parties and climate research. The former was embedded in procedures of cross sectoral working groups which are part of the organisational culture in the Danish state administration, in particular within areas administered by the Ministry of the Environment. In Germany, inter-ministerial working groups have provided the basis for developing the NAS and the NAS thus builds on established procedures for cross-sectoral collaboration. From early on, also the *Finnish* NAS has developed with consultation of a working group with representations from relevant ministries, which was extended and made permanent with the establishment of Coordination Group for Adaptation to Climate Change with the revision of the NAS in 2008. This implies a two-way learning process where sector specific adaptation issue and overall adaptation issues potentially are discussed. In *Italy*, the NAS is drafted as an evidence-based policy (based on mainly climate science) with procedures for inclusion of climate experts and a committee with representatives for sectoral ministries as well as different levels of policy making.

Most of the NAS, e.g. the *Finish*, the *British* and the *Danish*, have included evaluations of the strategy. Though these evaluations are presented less systematic, they may indicate that a reporting mechanism is emerging.

3.3.3 National – local level dynamics related to CPI

Parallel to environmental policy, climate change policy is a policy area that largely operates on the basis of multi-level policy making. For adaptation policy, this means that the EU level may push agendas while the local level are often designated as the level of implementation, due to close relations to land use planning, local priorities in water management, built environment, green infrastructures etc, and local knowledge of bio-physical as well as socio-economic context. This is especially the case for the *UK*, *for Denmark* and for *Italy*, while the *Netherlands* in the NAS mainly addresses adaptation at the national level, leaving issues like flood-proofing to the local level (Table 3.2).

The countries that favour a framework approach to adaptation policy have delegated wide action spaces to the local or regional levels. In *Denmark*, the municipalities were at first (in the 2008 NAS) urged to include adaptation among priority policy issues and were later with the 2012 Action Plan mandated to publish local adaptation plans, and are furthermore encouraged to establish networks for coordination of impacts, e.g. flooding, that cross administrative boundaries. Many local governments have established such networks and forums, or take advantage of networks already in existence for water management.

For *Italy*, the lack of coordinated action is stressed as a barrier for adaptation, indicating difficulties in providing an overall and robust climate impact and risk assessment as basis for local adaptation actions.

Table 3.2 Vertical integration of climate policy issues

	EU	National	Country/Länder	Regional	Local	Individual, firms or citizens
The Czech Rep.	Is prompted by and follows EU Adaptation strategy		n/a			
Italy	Follows EU Adaptation strategy	Framework	n/a	Participate in developing the NAS	Participate in developing the NAS Autonomous bottom up actions included in development of the NAS	Room for autonomous actions included in the NAS
Denmark		Framework Agenda-setting Provide guidance and climate knowledge (evidence based) and data	n/a	None	Mandatory for municipalities to make plans	Create shared ownership of adaptation agenda foster autonomous actions
Finland	Current revision of NAS respond to EU strategy	Framework Agenda setting	n/a	Regional state administration is part of the implementation	Encouraged to act, consulted in developing NAS, several local initiatives	General information through climate change portal
Germany		Specifies actions and sets priorities	Climate impact assessments conducted	Consulted in development of adaptation policy	Consulted in development of adaptation policy	Informed
The Netherlands		Agenda setting and develop guidelines	n/a	Integrate flooding protection		
United Kingdom		Framework for the 4 countries Prioritized risk assessment	England, Scotland and Wales have national strategies	None	Mandatory for local authorities to include adaptation policy issues in local plans	Individual firms

3.3.4 Initiatives and instruments embedded in NAS to achieve adaptation and climate policy integration

Many of the included NAS have a **stated objective of promoting CPI**. This applies for NAS in existence as well as under development, i.e. in *Italy*. Of the former, the *Finnish*, the *Danish* and the *UK* strategies state climate adaptation policy integration as a desirable and necessary instrument to promote adaptation across society and sectors. However, to examine whether the CPI as a principle is likely to shape actual actions, we also analyse whether the NAS include instruments to foster this, as well as examining whether the strategies allocate responsibility for development of actions plans and/or implementation to sectors and/or lower levels of policy making. In these strategies, CPI is more explicitly targeted. This is potentially reflected in the case studies of Work Package4.

Knowledge and data promotion, sharing and availability, as well as lack of adequate knowledge, has a central position. Thus, a key instrument is to ensure and provide knowledge and data. Attention is given to issues of knowledge in all NAS, including the *Italian* NAS under development. In the *German* adaptation strategy, information is targeted for most of the sectors, where dissemination of existing knowledge as well as instruments for knowledge sharing and education are included. The *Danish* Action Plan recognizes the lack of knowledge, data and capacity among local governments to be a barrier for developing the mandatory local adaptation plans, and establishes as state task force to assist local governments when needed.

Climate research is targeted in some of the NAS to counter uncertainties and fill in gaps in existing knowledge on localised climate impacts, climate change processes, effects of different policy instruments, behavioural changes, etc., and this is the case for both the *German* and the *Danish* Action Plans. The *German* strategy allocates extra funding while the *Danish* Action Plan established the Coordination Unit for Climate Research to foster synergies and ensure accessibility to climate adaptation knowledge. Also the *Finnish* NAS had from its initiation in 2003 a focus on providing access to and promote production of relevant knowledge; an objective of the cross sectoral Coordination Group for Adaptation was to steer national research towards filling in the knowledge gaps. **Networks** with key actors within the relevant sectors are favoured by most of the NAS, often building on structures of policy making that are part of the national policy making milieu. In *Germany* and *Denmark*, this implies early hearing procedures and consultations with the affected interests, including business, environmental and consumer organisations, local government, parties of the labour market and individual stakeholders. In addition, the *Danish* 2012 Action Plan establishes an interactive and online climate portal with informal networks for sharing of knowledge and best practice among local governments. Also, the Action Plan promotes research networks and networks among innovative businesses, local authorities and climate research to promote integration of climate adaptation in measures and for example the urban built environment and transport and water infrastructures. In the *UK*, networks with business and industry are specified as an instrument that promotes adaptation policy through making adaptation a joint benefit, and through establishment of business partnerships around adaptation technologies. Moreover, the 2013 National Action Plan moreover mandates that local authorities are obligated to collaborate on adapting to climate changes that cross administrative boundaries.

3.3.5 Economic assessment to as decision support for CPI and adaptive measures

Economic assessment of action and non-action represents a policy instrument that at an abstract level relates impacts and adaptive actions to specified areas. The assessments integrate adaptation policy issues in monetary representations of policy areas and thus a particular form of integration of climate adaptation policy issues. On the basis of socio-economic projections and analysis, mainly CBA, (and on climate projections) the German Action Plan prioritizes areas as specifically vulnerable to climate change impacts and identifies thematic and regional hot-spots for action. The UK Action Programme and the Danish Action Plan, the Finnish NAS as well as the forthcoming Italian NAS stress the benefits of using economic assessment of non-/adaptation actions. It is however notable that economic assessment is not mandatory for sectoral and lower level policy institutions. Furthermore, in the NAS that address the use of economic assessment, CBA is one among several suggested.

3.3.6 Legal provisions for promoting CPI in the NAS

Overall, **changes of laws or new legislation** are not dominant. Significantly, the agenda setting British NAS was not reflected in subsequent passing of legal instruments. Legal provisions to promote and support the NAS as feasible policy instruments are however included a few places, especially with respect to spatial planning and water management. In Germany, new legislation within spatial planning and water management has followed the NAS, and in Denmark, the Planning Act has been amended to allow for Local Adaptation Plans. Moreover, the annual budget agreement between Local Government Denmark and the government has been legally mandated. In Finland legislation on flood protection refers to climate change and a Climate Act is under preparation which will also include provisions on planning of adaptation.

3.4 Conclusions: the strength of the CPI mandate and successful adaptation policies

Among our country studies, the *UK, Germany, Finland* and *Denmark* have more mature NAS that are based on vulnerabilities and risks, and on appointing tasks across different types of governmental and social actors. Though sharing a perspective on risk assessment as fundamental, the level of policy making where the climate change risks are assessed and prioritized varies. This is reflected in the extent to which sectors are included and the policy actions that the NAS expect from the sectors.

As also reflected in the analysis of coordination in chapter 2, cross-sectoral and multi-sector policy integration is included as principle in all of the NAS. **Consistency, weighting and reporting** not specifically or directly addressed. The studies indicate that there is inclusion and some consideration of consistency, but primarily from the point of view of synergies while conflicts are rarely identified. In this sense, most NAS do not represent a very strong mandate to back up adaptation and give adaptation actions momentum across sectors and scales. Since CPI is not explicitly prioritized above other policy objectives, the CPI concept applied is towards the weaker end of the spectrum, following by the Jordan and Lenschow (2010) definition. But when we examine instruments and decisions making processes there are some degrees or differences among strategies, and hence we can hypothesize that in the end policy instruments

and coordination of decision and planning processes are as important as the specific definitions for bringing about CPI.

Vertically the included countries represent in different ways a diffusion of adaptation policy across two or more policy levels, from local government to the EU level. The national strategies have generally recognized the role and importance of the local level and encourage local adaptation, but policy instruments for achieving this are generally soft. Only *Denmark* has included an explicit obligation to develop plans at the local level. The German instruments aimed at promoting adaptation in spatial planning and the task force in the Danish 2012 Action Plan are exceptions to this.

The sectors included reflect that integration of climate adaptation issues and coordination of adaptation policy actions **horizontally** concerns crossing compartmentalised public policy areas and involves the cross-over of policy objectives, perceptions and priorities, leading to sector specific interpretations of adaptation options and pathways. Integration of adaptation issues is however a two-way process and in many cases, the sectors qualified the NAS through sectoral knowledge and perspectives, and through inclusion of sector specific interests in development of strategic actions. As some of the country studies indicate, the responsibility for formulating and developing the NAS is mainly allocated to Environmental Ministries (except for in *Finland*), and supported by cross-sectoral working groups. In countries where procedures for such cross-sectoral forums are established, e.g. in connection with sustainable development policies, the cross-sector integration seemed to work with a faster pace than where such procedures were ad hoc or novel.

While all the examined strategies recognize adaptation as a cross-sectoral policy issue, few of them include strong policy instruments to ensure the integration of climate adaptation issues throughout the sectoral policies. Instead the strategies can be seen mainly as information based instruments that raise awareness and encourage coordination across sectors. Thus, targeted research and access to information and data are promoted strategically to not only foster action but also maintain a shared understanding of climate impacts and the challenges they imply. In the countries that among policy instruments included socio-economic analysis as decision support tools, cost-effectiveness, cost-benefit and other socio-economic modelling justified actions. However, the NAS did not consider critical situations where important actions were not included in the socio-economic assessment, or the time scale for actions.

CPI in the UK, in Italy and Denmark also concerns engagement and coordination of actions that are not (mainly) governmental; i.e. at different levels of policy making and within relevant sectors, adaptation policy concerns and issues are also directed to non-governmental actors. This aspect goes beyond the CPI theory that focuses on governmental actors and institutions, while it indicates a vital role for private actors within sectors, as way to integrate policy concerns deeply, and overcome the tensions of wicked issues and make a broader commitment to adaptation measures.

Having examined the climate policy integration logic of the studied NAS in this chapter, the next chapter (Chapter 4) builds upon this analysis through providing a more in-depth micro analysis of policy integration and knowledge use in selected policy sectors.

Chapter 4: Adaptation Knowledge Use in Sectoral Policies

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4.1 Introduction

In recent years climate change adaptation has been increasingly included in political and scientific agendas. Numerous efforts (e.g. IPCC, United Nations, European Environmental Agency reports, and research programmes; CAPITAL-ADAPT; CIRCLE-2; CLIMSAVE; ClimateCost; KLIMZUG; KLIWAS; Knowledge for Climate; MEDIATION; PEER) have delivered important scientific and technical information in support of decisions concerning climate change adaptation and are expected to do so in the future (e.g. Horizon 2020). Additionally, there is clearly a growing demand for knowledge on impacts and adaptation by policy actors and the public at large.

In Europe attention placed on climate change adaptation has increased mainly after the release of the Green (COM(2007)354) and the White paper (COM (2009)147) on adaptation. As described in the previous chapters of this report, however, there is variation among European countries with regard to the stage of the adaptation policy cycle at which the different countries are currently and the progress that they have made in recent years. In an attempt to ensure climate-resilience throughout Europe, in April 2013 the European Commission published the EU Strategy on Adaptation to Climate Change (EC, 2013). Among other, the Strategy underlines the importance of having better informed decision-making (Objective 2) and improving mainstreaming of adaptation in sectoral policies (Objective 3).

Effective knowledge management is important to facilitate the integration of climate adaptation goals into sectoral policy making as it provides actors with information on impacts and spillovers into other sectors around which they can coordinate their activities (See Chapter 2). Scientific evidence provides the knowledge base for sound policy decisions but this is only one of the many factors that influence the decision-making process.

The influence of knowledge on policy decisions has been a topic of research both with reference to climate change adaptation decisions in particular, as well as in the wider context of policy making. Different opinions have been reflected in the literature with some scholars referring to the widely held assumption that "scientific knowledge can improve policymaking, guidelines and other decision-support tools" (e.g., Clar et al., 2013, p. 11), while others discussing the 'little effect' that knowledge has on decisions (e.g., Weiss, 1979; Owens, 2005).

The production of scientific and technical information on its own, however, does not ensure that this information gets always translated in policies or decisions. Knowledge use might be constrained either consciously or unconsciously due to a wide range of factors, including context specific problems, policy conflicts, time constraints, decision-maker characteristics such as personal interests, limited capacity or

skills to process scientific knowledge, organizational structure, mismatches between the type of knowledge that is produced and needed, uncertainties etc. (e.g. Simon, 1947; Juntti et al., 2009; Owens, 2012; Turnpenny et al., 2013; Hilden et al., 2014). Hence it is due to such factors, that in reality knowledge use and its influence on policy decisions often, if not always, deviate from the rational norms and expectations described in traditional conceptual models.

The objective of this chapter is to explore the extent to which adaptation has been integrated in key existing or forthcoming policies and policy instruments related to the sectors of agriculture, water management and health, in five European countries: Denmark, Finland, Germany³, Italy and UK. We investigate particularly the role of knowledge production, communication and use in adaptation integration, and identify knowledge gaps and other barriers that might constrain this process. The selection of the countries aimed at providing a wide representation of systems both with regard to political and environmental characteristics within Europe. The selection of the sectors was based initially on existing evidence from the literature in which their importance with regard to adaptation action was highlighted, and was also confirmed by discussions with experts from all five countries.

After this introduction and a brief presentation of the methodological and analytical framework (4.2) the rest of the chapter is organised as follows: First it explores if and to what extent adaptation has been integrated into policies in the aforementioned sectors (4.3.1). It continues with an overview of the knowledge relevant for adaptation that has been produced recently in each country (4.3.2). It explores the origins of knowledge demand (4.3.3), and the means of knowledge communication (4.3.4), learning (4.3.5), and use (4.3.6) and it finishes with a presentation of the barriers (4.3.7) and main knowledge gaps identified for each sector and country (4.3.8). Taking into account the presented results, the section closes with a synthesis of the areas and tasks on which future efforts should focus (4.4), and the conclusions (4.5).

4.2. Methodological and analytical framework

A common framework was developed to guide the data collection process (See Annex). This ensured that the same information was collected for all countries and sectors and thus allowed comparison. Guidelines relevant to this chapter were grouped in four parts: i. the level of adaptation integration in sectoral policies; ii. knowledge production; iii. knowledge communication; and iv. knowledge use.

Data collection initiated through document analysis. A team of scientific experts from each of the selected countries collected and analysed relevant policy documents to gather as much relevant information as possible. Different teams were needed for each country due to a language constrain as in almost all cases, policy documents were available in national languages only. Document analysis was supported by semi-structured interviews with policy makers and/or scientific experts working in each of the three selected sectors (agriculture, water management and health). The process of the selection of interviewees was driven by the potential of the interviewees to provide us with insightful information due to their role in the

³Data for Germany is available only for the water management and health sector

policy decision-making process or their scientific background, and in some cases by their availability and willingness to participate in this process.

The combined methods allowed us to focus the interviews on the topics that were not explicitly described in the analysed policy documents and/ or needed clarification. Also the approach allowed new information to emerge, particularly in relation to the knowledge gaps and barriers. Information on adaptation integration and knowledge production was analysed on a country-basis, while the rest of the information was analysed in a comparative mode.

4.3 Results and discussion

4.3.1 Status of climate change adaptation in sectoral policies across five EU countries

Adaptation policy process has initiated in all five selected countries. With the exception of Italy, which has finalized the technical aspects of the NAS and is awaiting government adoption, the remaining four countries have already adopted their NAS (Table 4.1). Denmark, Germany and UK have progressed further in the adaptation policy process and have already adopted a National Adaptation Plan. In Finland there is no comprehensive National Adaptation Plan, instead sectors have developed their own focused plans (e.g. "Action Plan for the Adaptation to Climate Change of the Ministry of Agriculture and Forestry 2011-2015. Security of supply, sustainable competitiveness and risk management"). Also, in Italy, adaptation action has already been undertaken in various sectors and governance levels.

Table 4.1: Overview of the NAS and National Adaptation Plans adopted across the five countries.

	Denmark	Finland	Germany	Italy	UK
National Adaptation Strategy	2008	2005	2008	In progress	2008
National Adaptation Plan	2012	In progress ⁴	2011	n/a	2013

(Source: Climate-ADAPT, Country profiles)

Integration of adaptation to sectoral policies can address synergies and conflicts between policy objectives, at a sectoral and cross-sectoral level. Thus, it may contribute to the enhancement of the adaptive capacity of different socio-ecological systems (Hilden et al., 2013). This section describes if and how climate adaptation has been integrated in the sectoral policies relevant to agriculture, water management and human health across the five EU countries, taking into consideration four criteria; inclusion, consistency, weighting and reporting (A detailed discussion on these criteria is provided by Hilden et al. (2013)). Information presented in the following paragraphs suggests that adaptation is better integrated in the water management sector, compared to the other two sectors and that integration is primarily achieved through the inclusion of adaptation into the relevant policies and policy instruments. Assessment of the consistency of policy objectives also exists in certain cases, but often in the form of potential synergies, whereas conflicts or contradictions, let alone, prioritization, are not typically considered.

⁴ The NAS of 2005 included also actions. With the revision of the NAS in 2014 sectors are expected to have their own plans

Denmark

In the absence of a dedicated sectoral strategy for the inclusion of climate change adaptation in the agricultural sector as well as of explicit consideration of climate change adaptation in the cross-compliance and in other rules determining eligibility for agricultural support under Pillar 1, climate change adaptation initiatives in the Danish agricultural sector originate primarily from the sector itself, i.e. individual landowners, farmer organisations and agricultural extension advisors.

Adaptation has started being considered in the more recent or revised policy instruments. The draft Rural District Programme 2014-2020 (not yet adopted), which is one of the main policy instruments in the agricultural sector, considers adaptation among its measures and objectives. Specifically, it is stated that all activities supported under the program are supposed to contribute, among other, to climate change adaptation and the minimization of costs related to it (Ministeriet for Fødevarer, Landbrug og Fiskeri, 2013). Nevertheless, climate change adaptation still receives very little mention in the description of specific measures and activities, and climate related sections focus mainly on mitigation measures. An exceptional case is that of the support provided for the restoration of the production potential when impacted by extreme climate events, and the prevention of loss under the objective 2A; "Improving competitiveness and maintaining a viable agriculture".

Adaptation to climate change is also extensively included in the recent Commission on Nature and Agriculture, namely in the recommendations on the establishment of the national nature network, the national fund for nature and the management of watercourses, and the specific initiatives to facilitate climate change adaptation in agricultural landscapes and in technology development. These recommendations are yet to be implemented, but they are already expected to set the agenda for the Danish agricultural policy.

The draft Rural District Programme proposal has been subjected to an environmental appraisal which explored the potential consistencies with other relevant policy objectives (NaturErhvervsstyrelsen, 2013). At the end of this process, no contradictions were pointed out. The development of targeted measures within the program may serve to ensure synergies between climate change adaptation and the nature protection goals addressed by the programme (e.g. measures established to prevent agricultural losses due climate change may, as a side effect, positively impact on biodiversity and other nature policy objectives). As far as the report of the Commission on Nature and Agriculture is concerned, this underlines synergistic effects along general lines. Nevertheless, an explicit consideration of the consistency between climate adaptation and other objectives is lacking from both instruments.

Having a multifunctional role that extends beyond the production of food, farmland is often used for purposes associated with the scope of other sectors. For example, agricultural land may serve as water retention area during flooding and extreme precipitation, or used for nature protection and nature restoration schemes. Programmes in which farmers can be compensated for using their farmland in such ways are already being explored, however the relevant activities or measures will be integrated in policies of other sectors.

The EU water framework directive constitutes the overarching policy framework for water management and the River Basin Management Plans are the main implementation mechanisms for this directive. The first round of River Basin Management Plans (2009-2015), the adoption of which was delayed due to

controversies with agriculture over the measures presented in them, did not include adaptation. However, this is expected to feature more prominently in the next round of plans, which are currently entering a public hearing phase. Even if adaptation gets explicitly addressed, under the current legal framework, the hierarchy of the planning laws ensures that should conflicts among policies emerge, river basin management objectives are to be given more weight than others, including adaptation⁵.

In the case of wastewater planning and drinking water management policies, climate change adaptation is already specifically addressed. Local waste water plans are expected to include adaptation, and urban and municipal plans increasingly include water retention through green infrastructures, transport infrastructure and recreational areas, as well as securing urban built environment against flooding (Hellesen et al., 2010; Jensen, et al, 2014; Zandersen et al., 2014). Also laws regulating water companies have been revised to allow for investment in climate change adaptation projects⁶.

Finally, with regard to the sector of health no overarching strategy or policy exists to integrate climate change adaptation, but this is included in regulations or policies where relevant and vice versa. For example the Danish Health and Medicines Authority, an agency under the Ministry of Health which contributed to the Danish NAS (2008)⁷, states that health objectives are linked to climate change adaptation in other sectors (e.g. climate change may affect the quality of indoor climate and the urban renewal policy includes subsidies for establishment of climate shields). Furthermore, issues such as the risk of increased rates of skin cancer and pollen allergies are handled by the municipalities, which are responsible for preventive health care through specific actions (e.g. formulate sun protection policies, inform citizens).

Finland

In Finland practical adaptation measures are implemented at different levels, with the local level being particularly important for specific measures such as those related to land use planning. Integration of adaptation into the wider climate change framework in the agricultural sector is taking shape at the policy level, primarily within the context of the national implementation of the Common Agricultural Policy (CAP). The Rural Development Programme for 2007-2013 directly supports adaptation through several actions and adaptation has been explicitly included as a 'new challenge' of the Rural Development Regulation since 2010 (Article 16a). The Rural Development Programme (2007-2013)⁸, the instrument for the implementation of the Rural Development Strategy, considers adaptation needs, and its measures enable project funding for *"Innovative operations relating to climate change mitigation and adaptation operations so as to contribute to the reduction in GHG emissions and adaptation of agriculture to climate change"*. In the latest draft⁹ of the Rural Development Programme (2014-2020), climate change is recognised as a

⁵<http://www.klimatilpasning.dk/sektorer/vand/faq.aspx>

⁶Even if these are not directly related to water infrastructure, urban green spaces often serve both recreational and water retention purposes

⁷http://en.klimatilpasning.dk/media/5322/klimatilpasningsstrategi_uk_web.pdf

⁸ Manner-Suomen maaseudun kehittämisohjelma 2007-2013 CCI 2007 FI 06 RPO 001.

http://www.maaseutu.fi/attachments/6BQPluj8V/Manner-Suomen_maaseudun_kehittamisohjelma_2007-2013_090114.pdf
[29.5. 2014]

⁹Rural Development Programme 2014-2020 (Draft 15.4.2014) http://www.maaseutu.fi/attachments/ohjelmakausi_2014-2020/WCzWJXipB/Luonnos4_Manner-Suomen_maaseudun_kehittamisohjelmaksi_2014-2020_15.4.2014.pdf
[29.5. 2014]

cross-cutting theme. Adaptation needs are acknowledged and multiple synergies across adaptation and other policy objectives are identified. Specifically, adaptation is referred to under the programme's fifth strategic priority; *"Promoting efficient use of resources as well as low carbon and climate-friendly economy in agriculture, food production and forestry"*. Also other priorities are consistent with adaptation objectives (e.g. priority 4 *"Restoration, conservation and improvement of agricultural and forestry-related ecosystems"*). Adaptation is also considered in the evaluation requirements, though most of the focus has remained on mitigation.

But for few exceptions¹⁰, regulatory and economic instruments related to Finland's national agricultural subsidies do not explicitly include climate change considerations, and some of them are consistent (to different extents) with adaptation objectives. Other National Strategies (e.g. on plant protection, alien species¹¹, food production) identify climate change impacts and related adaptation challenges. Yet in most cases, adaptation is mentioned as an aspect to be considered rather than as an integral part at an operational level¹².

Partially due to EU level policy development (e.g. the Floods Directive) and partly due to national level developments, adaptation aspects are relatively well included in key policies of the water management sector. The National Strategy for Water Management (2011-2020), which sets the framework for water management in Finland, considers adaptation to changing water and climatic conditions as one of its four strategic objectives. It entails management of health and security risks resulting from floods and droughts, it restricts new buildings and development in flood risk areas, it prepares for flood and drought risks in the regulation of watercourses, and it ensures the safety of dams and other built structures under varying conditions. Adaptation needs are not only recognised and included, but also have been seemingly prioritised in the strategic document. Proposed revisions to the Water Services Act (119/2001, revision ongoing), which aimed originally to ensure sufficient water services for household as well as appropriate sewerage for protection of health and the environment, include adaptation objectives and needs in explicit terms; to improve water services under special circumstances and clarify management of storm waters in urban areas.

The Flood Risk Management Act (620/2010) is another key policy for implementing adaptation. Direct adaptation needs (including those relating to long term climate change) are included in the Act and its aims are consistent with adaptation. Aspects of weighting are not applicable as the Act is fully supportive of adaptation. Other relevant policy instruments (e.g. Dam Safety Act (494/2011), the Water Act (587/ 2011) and the Act on support for water supply (686/ 2004)) may not explicitly address climate change, but their aims are consistent with adaptation, and others (e.g. Act on Water and marine Resources Management (1299/2004), the Government Decree on Water Resources Management Regions (1303/2004), the Government Decree on Water Resources Management (1040/2006)) provide a general legal background for planning according to EU Directives.

¹⁰ Law on state compensations for yield losses due to extreme weather events or flooding (Act 1214/2000); Law on organisation of agricultural markets (Act 999/1012 implementing EC regulation 1234/2007)

¹¹ The national strategy on alien species makes explicit reference to climate change as possibly affecting the risk.

¹²Source: Sorvali, J. (2013) Ilmastomuutokseen sopeutumisen kansalliset ohjaukset (national policy instruments for adaptation to climate change, in Finnish).

http://www.mmm.fi/attachments/ymparisto/sopeutuminen/6MoPuwJC3/Sopeutumisen_ohjaukset_selvityksen_loppuraportti.PDF [29.5. 2014]

In the health sector of Finland, awareness of climate change adaptation is present in policy discussions. Impact trends have been identified and adaptation has been partially integrated into sectoral policies at a strategic level. In their current state, key regulatory instruments (e.g. Health Care Act (1326/2010), Health Protection Act (763/1994)) make no reference to climate change adaptation, yet they are considered to be the backbone of the health sector for adaptation as they create the preconditions for people's health also in changing conditions, by providing and maintaining sufficient healthcare infrastructures.

In the handbook for environmental health care staff and cooperation partners on 'Exceptional situations related to environmental health' (2010) climate change impacts are considered as a cross-cutting issue and specific attention is paid to it in chapters covering extreme heat and cold weather, and prolonged disruptions in electricity distribution. Adaptation needs are thus included in it and adaptation objectives are in synergy with others. Aspects of reporting are not relevant as this is a guide for action. No systematic reporting on health incidents related to climate change or extreme weather events have been set up.

Germany

In Germany, official sector policies have yet to be developed in the areas of water management and health. However, some coordination measures and actions can be identified already within each sector.

Climate adaptation has been the focus of repeated discussions among the members of the Working group of the Federal government and the German federal states (Länder) on water¹³. This working group brings together the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety¹⁴ which is responsible for water management issues on federal level, and the responsible ministries from the 16 German Länder. Discussion on the first draft of the strategy paper on climate change and the impacts on water management and water industry started in 2007¹⁵. In 2009, a sample chapter on how climate change can be integrated in the river basin management plans was approved and published (LAWA, 2009), while the approval of the full strategy paper (LAWA, 2010), which includes the state of the art and recommendations for further actions, came a year later. The main chapters of the strategy are on the climate change impacts on water quality and quantity for groundwater, coastal waters, rivers and lakes; vulnerabilities and possible actions and strategic fields of action. Four of the six strategic fields concern the growth of knowledge and knowledge sharing, namely the basic evaluation of the climate change impacts based on existing databases and the establishment of a climate monitoring, modelling of climate impacts and estimation of vulnerabilities.

The German Federal Ministry for the Environment, the Federal Health Ministry (Bundesministerium für Gesundheit) and the Federal Ministry for Nutrition, Agriculture and Consumer Protection (Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz) have produced an 'Action Plan for Environment and Health' ("Aktionsprogramm Umwelt und Gesundheit"). This Action Plan aims at the reduction of climate change threats to public health through information, monitoring and early warning systems. The Action Plan is also intended to promote cooperation between all responsible bodies and at all

¹³ Bund/Länder-Arbeitsgemeinschaft Wasser

¹⁴ Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit, BMUB

¹⁵ [LAWA \(2007\): 1.Entwurf eines LAWA-Strategiepapiers "Klimawandel - Auswirkungen auf die Wasserwirtschaft" gem. Beschluss Nr. 2 zu TOP 6.2 a zur 133. LAWA-VV in Trier.](#)

levels of administration (DAS, 2008). Also since 2007, the Federal Ministry for Nutrition, Agriculture and Consumer Protection has been coordinating the 'Action Plan against Allergies' ("Aktionsplans gegen Allergien"), including information on the latest scientific developments provided by national research institutes.

In response to a request from the Federal Health Ministry and the Federal Environment Ministry, the Federal Environment Agency (UBA) in collaboration with national research institutes developed a General Framework of Recommended Actions on climate change and health for authorities and other actors in Germany.¹⁶ This process began with a background document concerning climate change and health (Eis et al., 2010). It was then followed by a technical meeting in 2011 at the Federal Health Ministry, where it was decided to develop an outlook with necessary precautionary measures, concrete recommendations on preventive measures (existing and new), and recommendations jointly agreed with all actors for action oriented to the common goal of 'preventive health protection of the population'. Upon its completion, the produced report was reviewed by researchers, experts and administrative actors (*inter alia* from the Kommission Umweltmedizin the Federal Health Ministry, the Federal Environment Ministry, the Federal Office for Radiation Protection (BfS)) and resulted, in 2013, in the working document "Handlungsempfehlungen" (Guido Mücke et al., 2013) for further discussion and development. Currently, however, there is no specific 'climate change adaptation' plan or policy in place to reduce any increased level of health risk.

Italy

Similarly to other EU countries, in Italy there is a not national policy for integrating climate change adaptation in the agricultural sector, and relevant instruments are primarily linked to the national implementation of the Common Agricultural Policy. In the absence of a formal strategy, the ministry of agriculture has developed a set of guidelines for climate change; "*Challenges and opportunities of rural development for mitigation and adaptation to climate change*". This White Paper includes general recommendations and specific adaptation actions for the agriculture sector. It focuses in particular on technology development; adoption of technologies; government programme and insurance services; financial management of farms adaptation (Medri et al., 2013). Although at first this document was seen as a knowledge tool, it also serves as the background for agricultural policies in Italy, with regard to climate change.

The Rural Development Programmes (2007-2013) considered adaptation needs and provided financial support for adaptation action in the regions of Italy. Actions were primarily related to water management and forestry measures (Medri et al., 2013). These, however, may also produce other benefits that improve the competitiveness of farms. For instance, improved irrigation equipment is an adaptation tool in that it optimises water use, but also helps farmers become more competitive by reducing the cost of water consumption. The role of adaptation is expected to be more prominent in the next CAP period (2014-2020). Italian farmers are expected to apply on their farms environmental measures to promote

¹⁶ „Klimawandel und Gesundheit - Allgemeiner Rahmen zu Handlungsempfehlungen für Behörden und weitere Akteure in Deutschland“ Mücke, Hans-Guido (Umweltbundesamt) and Niemann, Hildegard (Robert Koch-Institut) http://www.umweltbundesamt.de/sites/default/files/medien/382/dokumente/05_praesentation_stakeholderdialog_oeffentliche_gesundheit_und_medizinische_versorgung_mueck.pdf.

sustainability and combat climate change, and more efforts will be placed on promoting climate change adaptation, as part of the priorities for Italy's rural development (EC, 2014). Furthermore "fostering knowledge transfer and innovation" is seen as a cross-cutting priority in Italy (EC, 2014).

Funds to alleviate the impacts of extreme weather events were also provided via the National Plan for irrigation in support to the agricultural sector (2007-2010) (Medri et al., 2013). Also, since 2010, Italy has progressed to the implementation of economic and structural tools for preventive adaptation actions, supporting the costs of insurance premiums related to climate change risks on agriculture (e.g. crop production, animal diseases of livestock, diseases and pest infestations of plants) (Medri et al., 2013).

Other adaptation options linked to the agricultural management fall within the current national policy of environmental protection, prevention of natural disasters, sustainable management of natural resources and the protection of health. Such synergies are expected to continue further as environmental protection and sustainability are addressed in the reformed CAP. Furthermore, in attempts to ensure the sustainable production of typical Italian products, there is a strong support for biological and low input agriculture, and a rather strong opposition to genetically modified crops. In spite of not being explicitly related to adaptation, consistency exists with the adaptation objectives.

Despite the consistency and potential synergies which are currently identified, the lack of specific prioritisation procedures allow room for conflicts. The forthcoming new and revised policies; namely the reformed CAP, the new Rural Development Programmes 2014-2020 and the forthcoming Italian NAS, are expected to support a stronger integration of adaptation at all levels of the Italian agricultural sector.

Concerning the water management sector, the Resource Management Plan for the Water District of the Central Apennines (PGDAC)¹⁷ identifies climate change as a strong pressure for the area (Report of the General PGDAC, p.52). Similarly, the Flood Risk Management Plan (PGRAAC)¹⁸ takes into account climate change and scenarios for flood risk management. Contradictions between the aims related to climate change adaptation and other policy goals have not been recognised in this plan, which is probably because by the time it was not deemed a clear conflict. Regarding the hydraulic risk, however, conflicts in the context of analysis of urban development have been recognised for certain cases (e.g. Rome). Also, certain synergies have emerged for example, achieving compliance to standards and objectives established for the natural protected areas.

The public consultation procedure of the Resource Management Plan for the Water District of the Central Apennines and the Flood Risk Management Plan under Directive 2000/60/EC has been implemented. Priorities with respect to the other political purposes have not been identified, but care is taken with reference to the objectives in the field of agriculture. Also evaluation and reporting requirements are identified with regard to the preventive phase, but no ex post procedures have been implemented. A coordinated approach between the regions of the District for the development of water stress indicators (based on the recommendations of the Blueprint of the European Commission for the Protection of water resources) is ongoing.

¹⁷The Management Plan of the Water District and Central Apennines (PGDAC) was adopted by resolution 1 of 24 February 2010

¹⁸The Legislative Decree no. 49/2010, governing the activities of assessment and management of risks, establishes the preparation and implementation of management plans for flood risk (by 22 June 2015) (art. 7 of the Decree)

In the health sector, the need for adaptation to climate change mainly originates from the response to emergency situations that call for the protection of public health from heat waves and the infectious diseases transmitted by climate-sensitive vectors. Currently there are guidelines only related to the health effects of heat waves published by the Ministry of Health (Directorate General for Health Prevention - National Center for Disease Control and Prevention, 2006; 2013), while the different interventions/measures are implemented through regional circulars. At present, many Italian regions are characterized by a delay in the adoption and application of these circulars; Emilia Romagna is a virtuous case compared with other regions. Regarding water-borne diseases, notification systems of contamination cases or associated diseases are not currently available. The lack of information systems on the injuries and deaths from floods and/or landslides has been also highlighted.

In the drinking water sector a longer delay is registered and currently there is no form of integration of the climate change adaptation in the sector. New approaches for assessing and managing risk in the water supply chain for human consumption in the Water Safety Plan¹⁹ and the inclusion of climate change in the existing emergency plans of Water Service operators could be a step towards the integration of adaptation to sectoral policies.

A similar level of awareness and knowledge of climate change adaptation is not always present in each sector in Italy. As a consequence, this situation may promote potential conflicts between sectors (e.g. the need to introduce insulation systems of buildings to improve climate change adaptation versus the need to ensure the quality of the indoor air). In the drinking water sector, conflicts between the sector and other sectoral policies are also present. With regard to the use and management of inland waters, for example, the potable purpose²⁰ is in conflict with the purposes in agriculture. Some synergies have been identified, for instance, between the health sector and the framework of the National Biodiversity Strategy²¹. Climate-sensitive pathogenic vectors (e.g. mosquitoes, ticks) are identified and included, among other indicators, in the strategy. In the management of drinking water, synergies with the objectives of other sectors have not been identified. Yet, the purpose of potable water always prevails over the agricultural purposes. Regarding the drinking water sector, criteria for emergency responses are identified on a case by case basis by an institution called the Optimal Technical Area²², but they are not based on the knowledge of adaptation to climate change. Also, although specific reporting activities on climate change adaptation are not registered, some information on the management of water resources are integrated into the reporting of the Optimal Technical Area and the Regions.

¹⁹The Water Safety Plan aims to reduce the contamination of withdrawn water, to mitigate or remove the presence of risk factors through properly designed, performed, monitored microbiological and chemical water treatments, and ultimately, to prevent re-contamination during water storage and distribution to the point of delivery (Ottaviani et al. 2009)

²⁰It should be noted that in Italy the 80% of the potable water comes from the deep aquifers and only the rest from surface water so that this conflict has a marginal role.

²¹ <http://www.minambiente.it/pagina/strategia-nazionale-la-biodiversita>

²² The Optimal Territorial Area (ATO) is established by the Law n.36/94 and by the regional laws, implementing the Law 36/94, which establish the geographical limits of ATO. The ATO is mainly aimed at reorganization, on a local basis, of Integrated Water Services including water supply, uses, reuse, collection and treatment of urban waste water.

UK

The agriculture sector does not appear to have any specific adaptation policies, rather adaptation is associated with other policy areas that impact on agriculture (e.g. water management, the environment, drainage and soil management). Domestic UK agricultural policy is heavily influenced by EU policy, specifically the CAP, which provides support to farmers who follow good agricultural practices, and/or offer non-market benefits as well as those prepared to enter into active environmental stewardship. The previous CAP (2007-2013) primarily supported adaptation through Pillar 2 funding, for agriculture and forestry businesses, environmental land management and wider rural development. The majority of these funds are spent on environmental land management and agri-environment schemes such as Environmental Stewardship, increasing the resilience of habitats, species and ecosystems. After the negotiations over the next CAP period (2014-2020), a new direct payments system for farmers will replace the current Single Payment Scheme in 2015 and the new Rural Development Programme for England will also come into effect. In total it is expected that England will get £15 billion from the next CAP of which £3.5 billion is to be spent on 'environmental improvements' including rural development schemes.

As mentioned for other countries, resilience in agriculture is also built through sectoral policies beyond the sector, mainly the effective water management. The Climate Change Risk Assessment (2012) highlighted a number of risks to the agriculture sector the main ones being related to either the risk of flooding to agricultural land or increases in water demands for the irrigation of crops. The main focus for the Agricultural sector in England's National Adaptation Program (2013)²³ in terms of adaptation is 'effective water management'.

Furthermore, as seen for other countries, there are a number of points of entry where policies that impact on agriculture are to some extent addressing aspects of climate change adaptation. However, in such cases much of the emphasis is on the role of agriculture in environmental protection rather than on agricultural production per se. The implication here is that climate change adaptation has not been specifically focused on agricultural production but has rather been 'levered' into agriculture through an environmental focus.

Adaptation has been fairly integrated in water sector policies and many lessons can be learned (Dessai and Darch, 2014; Arnell, 2011; Arnell and Delaney, 2006). Since the late 1990s the water sector has not only been producing plans taking into account uncertainties of long-term planning, but also implementing measures to overcome any supply-demand deficit. One of the first relevant instruments was the Water Industry Act of (1991). According to this, Ofwat²⁴ is required to report to the Secretary of State the actions that have been undertaken to ensure that the water and sewerage sector are prepared for long-term challenges²⁵. In turn, water companies have to assess the future balance between water supply and demand considering the risks and the ways to secure the needs of the population and the environment, and produce a Water Resources Management Plan (WRMP). Also the Water Act (2003) imposed, among other, a legal requirement on water companies not only to make the WRMPs publicly available but also to state how they would meet their duties in case of a drought and adapt their practices accordingly by preparing a "Drought Plan" every 3.5 years. Several White Water Papers (e.g. Water for life, 2011) have

²³<https://www.gov.uk/government/publications/adapting-to-climate-change-national-adaptation-programme>

²⁴ <http://www.ofwat.gov.uk/>

²⁵ <http://www.legislation.gov.uk/ukpga/1991/56/contents>

been developed to set the goals and strategies to manage water resources in a changing climate. Also the Water Bill 2013-2014, which is now in the legislative process, aims, among other, to amend the primary duty of the Water Services Regulation Authority to secure resilience of water supplies and lead to cheaper and more efficient management of water resources in the longer term²⁶.

Requirements for reporting climate change adaptation actions have been developed in the water sector along with the policies implemented. A clear example is the first round of UK Adaptation Reporting Power, in which Ofwat, the environmental Agency and water companies, were appointed to state their current and future situation regarding climate change threats, opportunities and adaptation measures. This first round was statutory for the water sector, but the second round is voluntary (DEFRA, 2013).

Despite the several efforts to mainstream adaptation into water policies, it needs to be mentioned that there is a difference between policy and practice. Adaptation has not been incorporated to the same extent at a decision level because of issues such as uncertainty, financial considerations, opposing objectives (Dessai and Darch, 2014).

In UK's health sector, adaptation and the long-term thinking required for this have only recently started attracting attention. Historically, the sector has mainly been focused on reacting to emergencies and dealing with its 'front-line' issues on mitigation rather than adaptation. As part of the Health and Social Care Act (2012), the National Health Service published the '*Arrangements for Health Emergency Preparedness, Resilience and Response from April 2013*' (Department of Health, 2012), which set out how the health sector was going to deliver safe and consistent Emergency Preparedness, Resilience and Response (EPRR) in England. To this end local Health Resilience Partnerships are being established to deliver national EPRR strategy in the context of local risks. The aim of these is to bring together the health sector organisations and jointly work and plan for emergency preparedness and response by all relevant health bodies (Department of Health, 2012). Much of the focus will be on building preparedness and resilience to extreme events, such as flooding and heat waves. This will be a joint venture to plan and maintain healthcare facilities that are resilient to flooding and extreme temperatures (NAP, 2013)²⁷.

4.3.2 Knowledge production

Denmark

A considerable science-based effort has been undertaken to assess the future effects of climate change on the Danish agricultural sector and research to support adaptation has been increased. Extensive modelling on climate change and its effects on agriculture, research on the selection of crops, the use of fertilizers and pesticides, and the production of risk and vulnerability maps are some of the main activities undertaken in recent years. The government and research institutions, along with agricultural organisations, the Knowledge Centre for Agriculture, owned by the Danish Agriculture and Food Organisation (the largest trade / interest organization in farming) have been key actors in defining

²⁶<http://www.publications.parliament.uk/pa/bills/cbill/2013-2014/0082/14082.pdf> p.62

²⁷ <https://www.gov.uk/government/publications/adapting-to-climate-change-national-adaptation-programme>

knowledge needs and producing relevant knowledge. Despite the governmental funding for specific research programs or sub-programs to develop knowledge, the Researcher Network on Climate Adaptation recently concluded that more focus should be devoted to developing knowledge on climate adaptation strategies in agriculture.²⁸

As part of the Action Plan in the water management sector, local scale maps of flooding prone areas have been produced for the main part of the 98 municipalities. In the context of this exercise, high risk areas have been identified for each municipality and this information has been considered in the municipal climate plans. Furthermore, the Coordination Unit for Climate Adaptation Research has also funded social science research projects to study policy actor and citizen perceptions of flooding (Hellesen et al., 2010) and the barriers for adaptation at the local government level (Jensen, et al, 2014).

Knowledge relevant to the health sector has been produced mainly after the 2011 flooding in Copenhagen. Studies have focused primarily on the health effects of climate change, particularly on the infections developed due to flooding events. Knowledge relevant to this sector is generated within research institutes, namely the "Statens Serum Institut" which focuses on infectious diseases. This knowledge is distributed to the general public, and relevant national and local authorities. Finally, the Advisory Scientific Committee on the Environment and Health to the Danish Health and Medicine Authority in 2010 mapped the knowledge gaps pertaining to health and climate change.

Finland

Knowledge on climate change impacts and adaptation options is constantly accumulating in the Finnish agriculture sector. Recently produced knowledge has been primarily linked to development of new technologies and cultivation methods, and the climate change impacts, risks and vulnerabilities of the agriculture sector Ministry of Agriculture and Forestry (2013).

More and better information is available on floods and flood risk protection, rather than on droughts, as the latter have generally not been an issue in Finland. For some specific areas, for instance areas with intensive agriculture and low percentage of lakes, information on droughts and ways to develop water efficient practices in agriculture (and relevant industries) is a topic that can gain future prominence. Such knowledge can support domestic adaptation needs but also solutions that have export potential, for example through technology development.

Adaptation knowledge is primarily generated by research institutes and universities through publicly funded research programmes. In agriculture private actors also have a role, mainly due to the commercial interest, especially in plant experimentation with new cultivars. There are also extension services that have a fair capacity to provide information on new and emerging topics such as climate change, although the primary role of such services is the diffusion of directly applicable research results to the actors on the ground.

Weather and climate are clearly and very directly important for the water sector. As mentioned before, general adaptation knowledge has accumulated mainly with respect to floods and flood management. Multiple research projects have been undertaken to improve the understanding of climate change impacts

²⁸ klimatilpasning.au.dk

for water management, the development of guidelines for water utilities, management plans and warning systems. Among other foci, these have included assessments of flood risks in watercourses and coastal areas; research on the role of land use planning in minimising flood risks; projections of sea level rise; urban flooding caused by heavy rains and urban runoff.

The Finnish water sector has a tradition of close collaboration between research institutes and public administration actors at national and regional levels. The relevant information is generated partly by state planning (water management in general), partly by municipalities (land use planning, general planning for local water management) and partly by utilities. The distribution of roles is, for the most parts, fairly clear. Utilities are responsible for relevant operational level knowledge, whereas state and municipal authorities are responsible for basic information that also affect citizens directly. Research and development activities carried out by research institutes are directly linked to demands of ministries through sectoral steering arrangements, while other research needs are identified by the research community and are funded through research grants (both national and European). Preparation of the guide for managing urban runoff is an example of collaboration among actors at various levels of administration and co-production of knowledge.

In some parts of the health sector (e.g. water supply and related healthcare) adaptation knowledge is available but other areas are still lacking basic knowledge regarding climate change impacts on health and relevant adaptation needs. Research outputs as well as monitoring information of infectious diseases and chronic illnesses are considered key sources of knowledge in the health sector. The Finnish Food Safety Authority is concerned with questions related to animal health and vector borne diseases. Research institutes (e.g. National Institute for Health and Welfare, Finnish Meteorological Institute, University of Helsinki, Finnish Forest Research Institute) have a key role in knowledge generation, through their involvement in national and European research projects, for instance, on vulnerability of the elderly to climate change (especially heat waves) and vector-borne infections (FP7 EDENext^{29,30})

Germany

Identification of adaptation objectives and knowledge needs primarily takes place through projects, usually funded at federal level and implemented at local or regional level. For example, project clusters for regional networking and research on climate adaptation have been funded by the Federal Ministry of Education and Research (BMBF)³¹ while the Federal Institute for Research on Building, Urban Affairs and Spatial Development³² has funded metropolitan³³ and regional³⁴ pilot projects.

Major projects were developed for water management and climate impacts and adaptation. The research program KLIWAS: Impacts of climate change on waterways and navigation - Searching for options of adaptation (Auswirkungen des Klimawandels auf Wasserstraßen und Schifffahrt-Entwicklung von Anpassungsoptionen) is financed and supported by the German Federal ministry for transport and digital

²⁹ <http://www.edenext.eu/>

³⁰ See Ministry of Agriculture and Forestry (2013) Evaluation of the National Strategy for Adaptation to Climate Change, Annex 1

³¹ See <http://www.klimazwei.de> and <http://www.klimzug.de>

³² The BBSR is under the portfolio of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

³³ In the experimental programme for construction of living and city spaces (ExWoSt) the strand "Urban strategies for climate change: local strategies and opportunities" ([StadtKlimaExWoSt](#)) focuses on the development of adaptation strategies in cities and municipalities.

³⁴ In the KlimaMoro programme, regional climate adaptation strategies are developed through the adaptation of land-use planning strategies in eight model regions.

technologies (former German ministry on transport, building and urban development, BMVBS). The research program financed the research of the four subordinated research institutes of the ministry: the Federal Institute of Hydrology (BfG), the Federal Maritime and Hydrographic Agency (BSH), the Deutscher Wetterdienst - DWD (National Meteorological Service), and the Federal Waterways Engineering and Research Institute (BAW), while universities and other research institutions cooperate under partnership agreements. Within this program 30 projects were implemented related to the five research tasks; climate projections and regionalization; hydrology of coastal waters; ecology of coastal areas; hydrology of inland waters; ecology of inland waters.³⁵ Other projects have also been financed by the German Federal Environmental Agency such as WASKlim, which was on climate adaptation strategies for water management.³⁶

The large research program of the German ministry on education and research, KLIMZUG, also contained several projects with focus on water issues. Some examples include projects focusing on coastal areas and modeled climate impacts on the Baltic Sea, or the city of Hamburg and the region around, exploring issues on flood protection in urban areas. Another project undertook research on water aspects in relation to land use and agriculture. Finally dynaklim focuses on water availability and use in the Ruhr region, in the Western part of Germany.³⁷

In 2005, Zebisch et al. remarked that the German health system was “barely adapted to climate change” to the extent that in the absence of further measures, Germany would have a considerable level of vulnerability to the heat effects of climate change. In 2008, the German National Adaptation Strategy considered that climate-related health problems were not as widely known as they should be. However, recent surveys suggest an increasing level of knowledge regarding the impacts of climate change on this sector. At the local level, health impacts were the third most cited climate change risk (Chrischilles, 2012) and as an area where action was crucially necessary (Kiresiewa et al., 2013). Key risks and areas for action mentioned, included heat waves, especially for the elderly people, as well as allergies and the need to ensure an agreeable microclimate (Kiresiewa et al., 2013). Interestingly, flooding and heavy rains were not mentioned in connection to the area of health, despite the impacts that these might have for human health and sanitation.

Monitoring and control of certain plant and animal species are undertaken at the federal and local level. Also information on infectious diseases³⁸ that may increase through climate change is maintained in a database. The the Federal Ministry for Nutrition, Agriculture and Consumer Protection ‘Action Plan against Allergies’ led to the creation of an internet portal³⁹ for Consumer Protection and Food Security (Bundesamt für Verbraucherschutz und Lebensmittelsicherheit, BVL). The portal remained on-line until the end of 2012, providing information about allergies that may be provoked as a result of climate change, although climate change is not explicitly mentioned. The Bundeszentrale für gesundheitliche Aufklärung (BZgA) and the Stiftung für Qualität und Wirtschaftlichkeit im Gesundheitswesen also have internet portals with information on diseases and risks.⁴⁰ Climate change impacts on vectors, however, is still not a specific area of research or knowledge creation. Non-state actors and patient representative groups such as the

³⁵<http://www.kliwas.de>

³⁶<http://www.wasklim.de/index.htm>

³⁷<http://klimzug.de/index.php>

³⁸<http://www3.rki.de/SurvStat/>

³⁹www.aktionsplan-allergien.de

⁴⁰ See for example <http://www.impfen-info.de>, <http://www.gesund-aktiv-aelter-werden.de> and <http://gesundheitsinformationen.weisse-liste.de>

'Sozialverband VdK, der Deutsche Allergie-und Asthmabund' have an important role to play in diffusing knowledge to the public. However, in comparison to other sectors, non-state actors are less active in health-related climate adaptation activities.

Italy

Adaptation knowledge relevant to the Italian agricultural sector has increased in recent years, including information for determining vulnerability, adaptive capacity and adaptation measures. Recently, the Ministry of Agriculture financed a national project on climate change, agriculture and adaptation, called 'AgroScenari', which involved major research institutes in the country. The project aimed "to answer to the imperative need to search the interrelationships among climate change and agricultural systems, evaluate possible productive / economic losses resulting from climate change and then appropriate strategies of adaptation"⁴¹. A Strength-Weaknesses-Opportunities-Threats analysis was undertaken as part of this project and contributed to the generation of a number of suggestions for the implementation of the new Rural Development Programme in Italy. This particular part of the project illustrates a successful example of knowledge co-production between scientists and policy actors.

'AgroScenari' was the follow-up project of an earlier national project on climate change and agriculture called 'Climagri'; Climate change and agriculture project. Climagri constitutes the first national effort to enhance the understanding of climate change impacts on the Italian agricultural sector, and to produce recommendations for adaptation actions and to support their implementation (Medri et al., 2013).

Other relevant national and international projects include the Climesco, which explored the agronomic actions for the maintenance or possibly increase of the sustainability of the cropping systems in Southern Italy; the Soilsink, which aimed at providing advice to agricultural technicians and planners in support of farmland management decisions; and the Icarus, which investigated the issue of efficient water use in agriculture and aimed at identifying innovative adaptation strategies, practices and tools (Medri et al., 2013). Smaller projects have been undertaken by individual institutes. INEA (Istituto Nazionale di Economia Agraria), for example, has been involved in a project on risk management, creating insurance mechanisms to support farms in case of extreme events (e.g. late freezes, heavy rainfall, etc.). Also, 'Blup', a Life project on the development of the adaptation plan for the city of Bologna, considers, among other, the preservation of peri-urban agricultural areas. Similar activities have been also taken place in other parts of Italy (e.g. the First Italian Regional Adaptation Strategy in Italy for the Lombardy Region⁴²).

So far, these activities have produced important information but only in relation to the areas where the projects were implemented. Therefore, despite the significant progress, efforts are still needed on generating knowledge relevant for adaptation in the agricultural sector.

With reference to the water management sector, a climate change risk assessment on the District of the Central Apennine has been performed⁴³. Scenarios, with different hydrological characterization that affect water supply and distribution of the resource have been simulated, and the results show that a

⁴¹ <http://www.agroscenari.it/>

⁴² <http://www.alpconv.org/en/organization/groups/WGWater/workshopplanalp/Documents/ballarindenti2.pdf>

⁴³ AUTORITÀ DI BACINO DEL FIUME TEVERE "PIANO DI GESTIONE DEL DISTRETTO DELL'APPENNINO CENTRALE -DOCUMENTO DI SUPPORTO N.2 ALLA PARTE II - Il Rischio climatico (<http://www.abtevere.it/node/511>).

pronounced loss of water resource potential is present. The vulnerability of the water system that was demonstrated in the analysis, and thus of the water availability, highlighted the need to control the water system if aiming for vulnerability reduction. As far as flooding protection is concerned, only local cases are reported.

The State or regions are the main responsible for generating adaptation knowledge. Collaboration between scientists and policy makers occurs especially in the field of research, such as, for example, in the case of The Institute for Environmental Protection and Research (ISPRA). Nevertheless, currently there are no signs of co-production of adaptation knowledge except in a purely preliminary stage.

In the health sector, the level of adaptation knowledge has increased in recent years mainly thanks to the efforts of the Ministry of Health, and the involvement of a growing number of cities and public research community. Collaborations have led to the development of action plans to deal with the consequences of heat waves, in particular with regard to strengthening security services. In the drinking water sector a structural approach aiming at improving climate adaptation knowledge is not present. Instead sporadic initiatives at local/territorial level are undertaken. Examples include the new Memorandum of Understanding signed in 2014 by the Hera Group⁴⁴ with the Fire Department of the Emilia Romagna region; a five-year agreement that *"provides several joint activities to share methods of intervention and emergency management in case of accidents arising from, for example, failure or loss on the gas distribution network or water, fire, or flood"*; international conferences such as the one organised by the Smat company of Turin (manager of the integrated water services in the Turin area) in 2013 focusing on the fate of water resources in Italy and in Europe⁴⁵ "Water Future, the future of water services"; international initiatives such as the involvement of the IREN⁴⁶ company in the "United CDP 100 - Climate Change Report 2012"⁴⁷, as part of the Carbon Disclosure Project which aimed to increase the awareness of investors, companies and institutions on the possible strategies to counter climate change effects.

The level and the type of adaptation knowledge in these sectors is characterized by lack of homogeneity. In the health sector, for example, adaptation knowledge is performed through reporting activities on the excess of mortality associated with hot temperatures and the preparation of reports on human/veterinary cases related to infectious diseases transmitted by vectors. It is not possible to speak of an effective knowledge on climate change adaptation in the drinking water sector. Useful valuations and elements can be taken from technical documents, in particular the ISTISAN 05/4⁴⁸ report on the safety of water supply systems of the National Institute of Health, in support of the development of guidelines on climate adaptation.

⁴⁴http://www.gruppohera.it/gruppo/com_media/comunicati_stampa/-hera_spa/pagina445.html

The Hera Group Bologna (Italy) is a multi-utility in the management of services related to the environment, the use of energy sources and the water cycle. Hera currently operates in the provinces of Bologna, Ferrara, Forlì-Cesena, Imola-Faenza, Modena, Ravenna, Rimini and Pesaro-Urbino and in a few neighbourhoods in the municipalities of Florence

⁴⁵"Evoluzione tecnologica del settore delle acque reflue in Italia a seguito dei cambiamenti climatici" Prof. Renato GAVASCI, Tor Vergata University ROME - contribution to the International Conference on Water Future, the future of water services 7-8 November 2013 in Turin.

⁴⁶Iren, multi-utility, operates in the sectors of thermal energy for district heating, gas and management of integrated water services, environmental services (waste collection and waste disposal) and services for Public Administrations http://www.gruppouren.it/chi_siamo.asp

⁴⁷<https://www.cdp.net/CDPResults/CDP-Italy-100-Climate-Change-Report-2012.pdf>

⁴⁸National Institute of Health ISS - Sicurezza dei sistemi acquedottistici. By Massimo Ottaviani, Renato Drusiani, Luca Lucentini, Emanuele Ferretti e Lucia Bonadonna 2005, ix, 100 p. Reports ISTISAN 05/4

United Kingdom

Over the last years the UK has produced a number of reports that have highlighted climate risks to a number of sectors. These 'evidence-based' reports represent current knowledge about climate change risks and how these may impact on the UK.

With regard to the agricultural sector, the UK Climate Projections 2009 (UKCP09) "reflects scientists' best understanding of how the climate system operates, how it might change in the future". This report includes 5th generation climate probabilistic projections in the United Kingdom and allows a measure of the uncertainty in future climate projections to be included.⁴⁹ The UKCP09 Medium emissions scenario for the 2020s (2010-2039) and the Low, Medium and High emissions scenarios for the 2050s (2040-2069) and the 2080s (2070-2099), and a range of climate projections representing lower, central and upper estimates within each emissions scenario were considered for the production of the Climate Change Risk Assessment, which was published in 2012. Among other, the assessment includes a chapter focused on agriculture sector. This pointed out that, "Many of the challenges facing the UK agriculture sector can be linked to socio-economic, environmental and technological trends and issues-with climate change being an exacerbating factor, rather than necessarily the driving force of change" (Climate Change Risk Assessment Summary Agriculture, p.1).

A year later, the Committee on Climate Change, an independent, statutory body established under the Climate Change Act 2008, published the Adaptation Sub-Committee progress report (ASC, 2013). The overall purpose of the committee is to advise the UK Government and Devolved Administrations on emissions targets and report to Parliament on the progress made in reducing greenhouse gas emissions and preparing for climate change. In its latest report 'Managing the land in a changing climate' (2013), the chapter on agriculture reviews some of the key ecosystem services provided by the land. Specifically, the report addresses the use of land to continue to deliver important goods and services in the face of a changing climate, e.g. supplying food and timber, providing habitat for wildlife, storing carbon in the soil, and coping with sea level rise on the coast. Also it explores the extent to which decisions about the land are helping the country to prepare for climate change. Other reports relevant to the agricultural sector include the Economics of Climate Resilience (DEFRA, 2013), which includes a chapter on Agriculture and Forestry, and the House of Lords European Union Committee report: Adapting to Climate Change – EU agriculture and Forestry (2010).

Similarly for the water management sector, there is a vast amount of information available to support the implementation of relevant policies. For instance: UKCP09 (2009), the Case for Change (2011), The Water White paper (Water for life, 2011), the Natural Environment White paper (The Natural Choice: securing the value of nature, 2011), the Climate Change Risk Assessment (2012), Adapting to Current and future water availability (2013), the National Adaptation Plan (2013). In addition, the Environmental Agency and the Ofwat have produced guidelines to support adaptation on the ground. Co-production of adaptation knowledge does happen in the water sector, mainly in an attempt to clarify scientific knowledge and make it usable to reform existing policies.

The UK health sector, like other sectors has had its knowledge about climate change improved over the last

⁴⁹ <http://ukclimateprojections.metoffice.gov.uk>

years. The publication of the latest climate projections, UKCP09, which been used to outline the sector's key risks in documents such as the Climate Change Risk Assessment and National Adaptation Plan. Other relevant adaptation documents include '*The Heatwave Plan for England, 2013*'; '*The Cold Weather Plan for England, 2013*' and the '*Health Impacts of Climate Change in the UK, 2012*'. Also the Special Report on Extreme Events and Disasters (2013) draws relevant 'case studies' from across the globe and presents lessons learnt towards risk reduction.

4.3.3 Demand for knowledge

Knowledge on climate change impacts and adaptation options is constantly accumulating, and so is the demand for knowledge to support policy decisions. Knowledge needs, however, differ between actors in the same and across different sectors, which are also changing in response to the changing circumstances. The implementation of European and national legislation and action to confront the climate change impacts asks for knowledge to support planning and monitoring. Hence it is not surprising that in most countries adaptation knowledge is demanded primarily by the Government's spheres e.g. central and regional government/administration, Ministries, actors from within the sectors, policy makers and planners. Particularly in reference to the water management sector demand for knowledge is also initiated by water companies, while extension consultants and farmers, who are increasingly confronted with the anomalous weather also push for knowledge production in the agriculture sector. Scientists themselves often try to anticipate knowledge demands, that is to predict the requests from the relevant ministries, based on knowledge gaps and existing or new legislation. Thus scientists are often the first actors to initiate the production of specific information. Finally the general public is also seen to have an impact on knowledge demand as a result of the increasing awareness about climate change.

4.3.4 Knowledge communication

Knowledge communication is a critical task when aiming to improve knowledge use in policy making. It can take place both through vertical and horizontal processes, and may involve a wide range of actor networks. Communication may act as a main barrier for knowledge integration when the flow of information is not consistent and well developed, and communication takes place primarily through sporadic initiatives.

References from the agriculture sector highlighted the importance of sector organisations in communicating information. Representatives from the National Farmers Union and the Agricultural, Horticultural Development Board, for example, have a key role in communicating adaptation and other information to farmers in England. In attempts to improve the resilience of local farming businesses, but also to promote knowledge sharing between farmers, smaller and more localized organisations lead a variety of actions including training courses, demonstration sites, cases studies, briefing notes, advice, farm resilience plans. Also specialist sector organisations (e.g. the UK Potato Council) have a knowledge transfer remit that covers the impacts of environmental changes on specific aspects of the agricultural production. The role of extension organisations for sharing information to farmers was also highlighted by other countries (e.g. Finland, Italy, Denmark). The focus of extension consultant advice, however, is often on

agricultural subsidies and support schemes, opportunities and achievements of the rural development programmes rather than purely on climate adaptation.

Organisations play an important role for communicating information also in the health sector. The Climate Ready, for example, is a dedicated organisation situated within the UK Environment Agency, which has included 'Health and Wellbeing' among its areas of focus and serves as a source information and advice for other organisations which want to better understand how to adapt to a changing climate. Also, Natural Hazards Partnership, was set up to provide "...information, research and analysis on natural hazards for the development of more effective policies, communications and services for civil contingencies, governments and the responder community across the UK"⁵⁰. It is made up of 12 'full technical members' and 5 government partners. Similarly the Public Health England and the National Health Service Sustainable Development Unit have responsibilities for communicating information within the sector, under the co-ordination of the Department of Health, which has the lead responsibility for communicating understanding about climate change and adaptation with reference to health and well-being in England. Likewise, in Denmark, the Ministry of Health is the responsible actor of distributing relevant knowledge to municipalities, the regions and private citizens to enhance preparation for climate change.

Academic and research institutes, and consultancies play also an important role not only in generating and aggregating knowledge, but also in its 'translation' and communication to support the implementation of policies, and decision-making. For example, in the UK there is a network of research institutes including the Agricultural and Horticultural Development Board; the Country Land and Business Association; The National Non-Food Crops Centre; The Farm energy Centre and Rothamsted Research Centre all of whom contribute to communicating knowledge to farmers. Also in Italy, scientists involved in the national project AgroScenari used the research outputs of the project to identify strengths, weaknesses, opportunities and threats for the agricultural sector as a result of climate change and produced a number of suggestions for the implementation of the new rural development program.

Another way through which information is communicated is the national-level strategic documents. The UK National Adaptation Programme (2013), for instance, outlines the current risks and responsibilities. Practitioners within a sector can access these and gain some understanding of how climate change is likely to impact on aspects of the sector. Likewise, in the water management sector of Italy, adaptation knowledge is communicated through documents in the procedure of public consultation in accordance with the Directive 2000/60/EC.

Some countries have established national web portals to transfer knowledge. In Denmark, "www.klimatilpasning.dk" makes the data such as future developments of precipitation and levels of ground and sea water at local scale publicly available. Knowledge is communicated to local government and citizens, respectively, with a focus on how flooding risks will affect specific areas and groups, and potential actions that may reduce flooding hazards for citizens and for local governments. Task force for climate adaptation is responsible for maintaining a high level of information. Task force for climate adaptation includes a mobile team, which assists, supervises and stimulates learning on climate adaptation planning in municipalities (Action Plan 2012) when local governments take initiative to consult it and request its presence. In Finland the climate guide-portal (<http://ilmasto-opas.fi/en/>) provides information on adaptation, impacts and climate variables and also tools for examining possible future change.

⁵⁰ <http://www.metoffice.gov.uk/nhp/about-us>

Finally, knowledge communication takes place also through formal or informal networks. In Italy, for example, a well-organized network of heat waves surveillance, coordinated by the Ministry of Health, is distributed at the level of municipalities and carries out the activities of collecting and communicating meteorological data. On the other hand, peer networks is identified as one of the ways to communicate information in the agricultural sector in Finland.

4.3.5 Learning

Learning is defined as "the process of gaining knowledge and or expertise" (Knowles et al., 2005 cited by Nutley et al., 2007, p.156). Learning in policy may involve different constellations of actors at different points and in dynamic ways (Lee and van de Meene, 2012). Among other definitions that exist in the literature, here we use the following three: 'empirical'; an explicit form of learning based on quantitative or qualitative research study; 'theoretical'; when derived in intuitive and informal ways based on the use of different theoretical frameworks for thinking about a problem and sometimes informed by research, or 'experiential' when referring to learning-craft or tacit knowledge built up over a number of years of practice experience (adapted from the definitions of 'ways on knowing' (Nutley et al. 2007, cited by Shaw 2013)). Distinction between the types of learning is difficult and often unclear, both because learning occurs through processes that are not always conscious and because it is often difficult to separate out which elements most impact on learning.

Learning through 'pure' scientific information alone is usually absent within the circles of policy actors. Instead a mixture of experiential learning through the promotion of educational and training activities and, when possible, through supporting activities, and of empirical learning, as a sort of 'learning simply by doing', was described by most countries and with reference to most sectors. Participation in conferences and workshops, 'learning from others' (e.g. assimilation and translation of technical sources information by consultants or other 3rd parties (i.e. academics)), communities of practice (Cox, 2005); regular national and regional meetings between actors where common issues are explored, public engagement and stakeholder involvement, and self (sector)-feeding learning (i.e. learning based on the knowledge produced by the sector itself) are some of the reported examples of learning modes. Also, the use of several information sources are reported to support the learning process of policy actors per sector and country. (see Table 4.2 for an overview)

Table 4.2: Sources of information used by policy actors per sector and country

Sources of information /Sectors	Agriculture	Water management	Human health
Research programmes	FI, IT	FI, IT, UK	FI, IT, UK
Risk/ vulnerability assessments	FI	FI, UK	UK
Cost/ benefit assessments		FI, UK	IT, UK
Participatory approaches	FI, IT	FI, IT, UK	IT, UK
Expert judgment	FI, IT	FI, IT, UK	UK
Web portals	FI	FI, UK	FI, UK
Other	FI (monitoring)UK (CP09)		IT (Centre for Infectious Disease Control)

4.3.6 Knowledge use

Knowledge use is very much context specific and no general conclusions can be drawn with confidence. Policy actors tend to use knowledge primarily in an instrumental way (Table 4.3) due to the practical relevance of adaptation knowledge. Knowledge is used in a more conceptual way when it involves future projections and research outcomes that focus on longer time perspectives. In most cases, however, more than one types of knowledge use might be relevant. An example of instrumental and imposed use of adaptation knowledge is the use of the UKCP09 as a key source of climate information in UK's health sector. Adaptation decision-making requires the use of the most up-to-date climate projections that give legitimacy and so can 'justify' decision-making. Simultaneously, this report is to some extent imposed on organisations and sectors by government, as the projections included in it represent the most legitimate government-backed source of climate information. Finally, non-use of climate information would be where alternative sources of information, such as socio-economic or experiential knowledge are used to inform decisions.

Table 4.3 : Overview of the types of adaptation knowledge use employed by policy actors in the three sectors across the case countries

Sectors/ Knowledge use*	Agriculture	Water management	Human Health
Instrumental	FI	FI	FI, IT, UK
Conceptual	FI	FI	FI
Symbolic	FI	FI, IT	FI
Imposed	IT	FI ⁵¹	UK
Non use	UK		IT, UK

*For definitions of the types of knowledge use see Dunlop (2014)

4.3.7 Barriers to adaptation integration

Despite the growing research on climate change adaptation, the current understanding of the factors that act as barriers to its implementation is not adequate in the academic literature (Biesbroek et al., 2013). Identifying such constraints and finding ways to overcome them is of utmost importance for the successful integration of adaptation. Analysis showed that across the five countries and the three sectors under study adaptation integration is limited by a wide range of factors. These vary from lack of knowledge on certain topics and the ineffective communication of knowledge, to the limited skills or capacity to process and use scientific information and the lack of funding. Table 4.4 presents for the barriers identified for each country and sector. Barriers that do not appear in the table do not necessarily mean that are irrelevant to the countries and sectors under study, but instead they may not have been revealed through the document analysis and interviews.

⁵¹ At least with regard to certain issues such as flooding

Table 4.4: Overview of the barriers identified for each sector per country⁵²

Sectors / Countries	Agriculture	Water management	Human Health
Finland	No specific barriers were identified ⁵³	<ul style="list-style-type: none"> • Abstract knowledge that is not directly applicable • Climate projections and impact studies are often not sufficiently downscaled for local level measures 	n/a
Germany	n/a	<ul style="list-style-type: none"> • Communication 	n/a
Italy	<ul style="list-style-type: none"> • Lack of a reliable, central weather and climate information provider • Old fashion reasoning in the agriculture scientific (Limited sensitivity/awareness about the issue of climate change adaptation) • Short-term reasoning of policy actors • Uncertainties in the estimation of potential adaptation and mitigation effects • Absence of regulation mechanisms or incentives for farmers • Limited information and education at the local farm level • Interference with other regulations • Lack of targeted policies • Financial constraints 	<ul style="list-style-type: none"> • Knowledge complexity 	<ul style="list-style-type: none"> • Lack of awareness on the risk of climate change for health in other sectors • Absence of mandatory reporting requirement • Absence of institutional mechanisms to support climate change adaptation integration • Lack of funding • Inadequate communication among sectors • Fragmentation of the drinking water sector at both central and local level • Knowledge complexity • Limited skills
United Kingdom	<ul style="list-style-type: none"> • Resources/ austerity • Limited skills • Uncertainty in projections • Climate change skepticism amongst farmers • Other priorities 	<ul style="list-style-type: none"> • Inadequate communication • Lack of tailored research • Lack of funding • Other priorities 	<ul style="list-style-type: none"> • Lack of funding • Definition of cc/cca • Other priorities

⁵² Data on barriers was not available for Denmark

⁵³ Partly lack of recognition and lack of integration into wider policies and their implementation

4.3.8 Knowledge gaps

Evaluation of the knowledge base is a critical task, relevant to all sectors and countries. It provides an overview of the information that is available at a certain point in time, and hence that can be readily used for the development and implementation of adaptation policies. Also, and perhaps more importantly, this process allows for the early identification of knowledge gaps and highlights the areas on which research should focus. As part of its implementation, the European Climate Adaptation Strategy (EC, 2013) states that "the Commission will continue working with Member States and stakeholders in refining knowledge gaps and identifying relevant tools and methodologies to address them". The strategy also identifies four areas as key knowledge gaps including information on damage and adaptation costs and benefits; regional and local-level analysis and risk assessments; frameworks, models and tools to support decision-making and to assess how effective the various adaptation measures are; means of monitoring and evaluating past adaptation efforts (EC, 2013). The main knowledge gaps identified in this study are presented below (Table 4.5).

- **Estimation of uncertainties**

Uncertainty is one of the main challenge that both policy actors and scientists face. It is identified as a barrier relevant to the whole process of policy development and implementation (Clar et al., 2013). Uncertainties in future climatic and non-climatic changes influence our understanding of the way that certain sectors and regions will be impacted and thus the type of adaptation action, if any, that will be needed. Also uncertainties impose an additional challenge when trying to define what 'better knowledge' means, and in some cases they comprise the use or usefulness of knowledge. For example actors from the agricultural sector in the UK see potential in 'seasonal-decadal' climate information to support decision-making. Yet at present they consider that this information is too uncertain to use it for providing advice or informing planning. Similar examples, mainly associated with climate projections, were also mentioned with reference to the sectors of water management and health. The emphasis that is placed on having better estimation of uncertainties is undoubtedly justifiable. Nevertheless, it is suggested that relevant statements should be expressed with caution as they can wrongly diminish the value of knowledge, impede decision-making (Hanger et al., 2013) or even result in inaction (e.g. Forskernetværk, 2014).

- **Cost/ benefit assessments**

Information about the 'economics' of climate change is still lacking for many countries, and thus reference is made to it as a main knowledge gap. This was the case not only for countries which have been characterised as laggards but also for those that have been the frontrunners in the field of adaptation. Finland, for example, referred to the need for knowledge to support the shifting of responsibilities for compensating yield damages from the state to a system based on private insurance. Denmark highlighted that the economy of climate change and its influence on the agro-environmental regulation needs to be further investigated, while Italy underlined that cost/benefit assessments can support adaptation decisions. The lack of, and hence need for, detailed data on the costs and benefits of adaptation action and the climate risks was also mentioned with reference to the Finnish water management sector. Especially municipalities, which are responsible for land use planning, have an interest in getting a better

understanding of relationships and trade-offs between long term water risk management, adaptation measures and climate change. **Climate change impacts**

Despite the increasing knowledge on climate change, countries still call for more and better information on climate change impacts. In the UK, the agricultural sector calls for additional information on the direct and indirect effects of climate change on agricultural productivity. For instance the potential climate change effects on agricultural pests and diseases, water availability for new and existing crops, especially in areas affected by sea level rise and coastal flooding, and the effects of heat waves and droughts on animal health and welfare. In Denmark, the same sector requests more knowledge on the climate change effect on agriculture. The Danish research network on climate change adaptation recently concluded that there is a bias in focus toward extreme events at the expense of knowledge generation on long-term and gradual changes (Forskernetværk, 2014). There is a general need, therefore, for knowledge on gradual developments and longer term needs. The opposite was highlighted in the UK where representatives of the agricultural sector underlined that farm businesses struggle from year to year to survive and thus more information is needed in support of their short-term decisions. The water management sector in Italy discussed the absence of simulation of impact scenarios considering varying assumptions about climate change, and the same sector in Germany underlined the importance of improved climate scenarios. Italy also mentioned the need to identify a set of criteria/indicators to correlate weather events linked to climate change impacts and the performance of the system for drinking water, as a way to measure of the level of climate change impact on it. Finally, the Danish health sector, raised the importance of improved climate change effect models for reducing uncertainty.

- **Risk/vulnerability assessments**

Promoting the knowledge not only on the impacts but also the vulnerability to climate change is one of the priorities for the Italian health sector. This will need to be undertaken on a cross-sectoral basis in an attempt for other sectors that are not directly dealing with health, to become aware of their own role in the prevention of health risks associated with climate change. The need for a better understanding of climate change risks was also concluded for the agriculture in the UK (e.g. risks linked to pests, diseases, waterlogging of agricultural land) (ASC, 2013). Also the Finnish agricultural sector refer to that fact that knowledge is missing with regard to risk management, including management of market risks and risks from climate change to the overall operational environment. With reference to water management, the same country mentioned the lack of information for the practical applications of risk management approaches (especially the combination of risks and probabilities of extreme events that in the face of uncertainties may lead to significant mal-adaptation in investments)

- **Others**

The agricultural sector in Italy requests more knowledge in order to promote synergies and minimise conflicts between mitigation and adaptation actions. To achieve this, the conduct of integrated assessments is suggested. The same sector in the UK makes reference to the need to increase the ability of rural communities to adapt to the effects of climate change on their lives and livelihoods.

The water management sector in UK states that while the demand for adaptation knowledge has centered on climate scenarios and probabilistic approaches to scenario analysis, it would be desirable that to have

downscaled data, as well as information specifically tailored for the water industry. Science has tried to produce more detailed information, but this gap still persists. The health sector in Denmark calls for monitoring of the spread of disease causing agents, particularly mapping of TBE virus in ticks and for the longer monitoring of the occurrence of specific types of mosquitoes and their capacity to carry and transfer diseases. Indeed, the 2012 action plan states that the Ministry of Health will monitor developments in infectious diseases and the occurrences of new microorganisms, and will distribute such information and advice for how to address health issues to municipalities and others responsible for adaptation, and to the general population. Having an overview of the monitoring of vectors undertaken in different projects, was also mentioned by the health sector in Germany. The health sector in the UK highlighted the concerns about ‘interventions’, namely about what practically works ‘on the ground’ in terms of adaptations that can positively affect peoples’ health and wellbeing, and highlights the potential disjuncture between national level strategic plans and policies and local interventions. Finally, the water management sector of Germany mentioned the need for better communication on flood protection measures and improved flood and low water level warning systems.

Table 4.5: Overview of the knowledge gaps per sector of each country

Knowledge gaps	Agriculture	Water management	Human Health
Uncertainty estimates	DK, FI, IT, UK	FI	DK, FI, UK
Cost/ benefit assessments	DK, FI, IT	FI	FI
Climate change impacts	DK, UK	IT, DE	DK, IT
Risk/ vulnerability assessments	FI, UK	FI	FI, IT
Integrated assessments	IT		
Adaptive capacity	FI, UK	FI	FI
Data downscaling	FI	FI, UK	
Monitoring			DK, DE
Interventions			UK
Warning systems		DE	

4.4 Synthesis

In recent years, adaptation knowledge base has been significantly improved in Europe and world-wide. IPCC reports, a growing number of international and national research projects focusing on adaptation, and an increasing number of countries undertaking risk and vulnerabilities assessments have produced a significant amount of relevant information to support the development of adaptation strategies and action. In Europe research on adaptation will continue largely through the Horizon 2020 research and

innovation programme in which climate change adaptation will be addressed through the theme on societal challenges (EC, 2013).

Policy document analysis and interviews indicated that research supporting adaptation policy decisions in the sectors of agriculture, water management and health is increasing across the five countries included in this study. However, adaptation is not yet well and strongly integrated in the policies of all three sectors. Table 4.6 summarises the main drivers which were identified to underpin adaptation integration. These are often seen to be linked to the top down pressure imposed for the implementation of European and national legislation or the urgency to confront with extreme weather events, and, at least for some sectors, to a lesser extent to knowledge reflection.

Table 4.6: Summary of the main drivers underpinning the integration of climate adaptation in sectoral policies

Sectors	Drivers
Agriculture	EU Adaptation Strategy 2013 (DK, IT) Common Agricultural Policy (2014-2020) (DK, FI, IT) National Adaptation Strategy (DK, FI) Market (IT) Recent extreme weather events (IT) Farmers (DK, IT)
Water Management	EU Directives (e.g. Water Framework Directive, Floods Directive) (FI, DK, UK) National level developments (FI) Political agenda (UK) Water management/ Higher level agencies (IT, UK)
Health	Extreme weather events (FI) Emergency preparedness (DK, IT) Mechanisms for monitoring and reporting (DK) Climate projections (UK) Risk assessment (UK)

Water management seems to be the sector in which adaptation is better integrated. Adaptation in the agricultural sector takes place largely within the context of the implementation of the Common Agricultural Policy and in some countries is largely dependent on autonomous initiatives resulting from the decision-making of individual farmers. Agro-ecosystems in Europe and other parts of the world are sensitive to climate changes (e.g. Olesen and Bindi, 2002; Maracchi et al., 2005; Schaap et al., 2011), and thus it is important to understand both the ways that climate change will affect them as well as ways to adapt to it. Observed climate change impacts on European agriculture, however, are not expected to be the same across all regions. For some countries, namely in northern Europe, climate change is expected both to offer advantages and to cause adverse impacts.

Even after the observed impacts of climate change on human health (e.g. the high death rates during the heat wave of 2003 in Europe), there is still a misconception that climate change is only an **environmental problem**. This can be problematic particularly for the integration of adaptation in the health sector, where health issues related to climate change are considered in some countries to be in the realm of preventive healthcare. In the UK for example, while at a strategic level the importance of climate change is increasingly recognised and evidence, tools and policies are being implemented, at the level of the health care practitioner its importance is seen lower compared to other more pressing and immediate health issues. This may limit the capacity of the sector to respond adequately to climate change impacts on health but also to ensure the operational delivery of the healthcare system (SDU, 2014). On the other hand, countries in the Mediterranean region, such as Italy, have been severely affected by extreme weather events. In response to such emergency situations, the health sector has increased the level of awareness and adaptation knowledge which has led to the adoption of preventive measures in the face of new health risks.

Findings emerged from document analysis and interviews emphasized that if adaptation knowledge is to support adaptation integration, there is a need to ensure that it is **relevant, applicable** and **usable**. The identification of significant **knowledge gaps** and their communication through policy documents is the first step for increasing the production of relevant information. Despite the considerable efforts undertaken in recent years and the large amount of information that has been produced, there are still certain areas that have not been fully explored and understood. We identified **uncertainty estimates, cost/benefit assessments, climate change impacts** and **risk/vulnerabilities assessments** as the main areas on which research efforts should focus (See table 4.5). These areas are to a large extent in agreement with knowledge gaps identified in the Strategy (EC, 2013).

Policy recommendations is one of the research outputs that projects often aim to produce. It is not a rare case, however, for such recommendations to provide information that cannot be directly used to support decision making (Mastrandrea et al., 2010). The UKCP09, for example, constitutes such a case. While being considered as a very informative report, of high value and importance by scientists, it is considered by some decision makers to be problematic in terms of its implementation (Tang and Dessai, 2012). For example with reference to the agricultural sector, it was mentioned that UKCP09 are very technical and the representatives of agriculture often lack the technical capacity to use them to use for providing advice to farmers.

Despite the relatively well-established national strategic frameworks are already in place in many countries, the demand for specific knowledge that is **applicable on the local level** remains constant and high. Applicable information is of utmost importance to support the implementation of policies and when knowledge fails to meet this criterion, there is a danger that policy actors consider it as irrelevant.

The **usability** of scientific knowledge is largely dependent on the **format** and the **language** in which information is presented. Scientists collaborating with the Italian Ministry of agriculture described that scientific results presented as policy briefs or as a summary of potential strengths-weaknesses-opportunities-threats (SWOT analysis)⁵⁴, tend to be more easily well-received by policy actors. Other studies have highlighted that visualisations aids such as maps and graphs are also favoured by policy actors

⁵⁴ The proposal (COM (2011) 627 final) includes the conduct of a situation (SWOT) analysis as a requirement for the rural area programme and mandates that this analysis considers also CCA (article 9)

(Mitter et al., 2014). Also, attention should be paid at ensuring the avoidance of scientific jargon and the use of 'decoded' information.

Interaction between scientists, policy actors and other stakeholders can reduce discrepancies with regard to the actual knowledge needs and the mismatches with the produced knowledge. Interaction is needed to develop an environment of mutual **trust**. Policy makers need to appreciate and acknowledge the importance of evidence-based decision-making and the limitations or even the potential threats of decisions when being solely opinion-based. Promoting **training** and other activities to increase awareness of policy actors is an important step for facilitating communication at the science-policy interface.

Establishing a continuous collaboration between scientists, policy actors and other stakeholders in framing research, producing knowledge and decision-making may also contribute to overcoming the aforementioned challenges. Several examples of such collaborations are mentioned in this report (see section 4.3). Indeed the importance of combining different types of knowledge, for instance scientific, bureaucratic and practical knowledge, has been already emphasised in the literature (e.g. Edelenbos et al., 2011) particularly for creating comprehensive and applicable knowledge. Also the involvement of policy actors in the research process creates a feeling of 'ownership of' and 'trust in' the research results.

Generation of evidence to support policy decisions is a time consuming process and thus the demand for knowledge needs to be proactive process rather than a response to extreme events or other emergencies. This is often linked to the fact that policy makers often have a short-term viewpoint. Long-term objectives, however, are increasingly embedded in EU policies and ask for adequate and timely preparation. Hierarchical instruments such as a strong **vertical coordination at a European and national level** may enhance and accelerate the process of adaptation integration. Some countries mentioned that the initial inputs to facilitate the integration process should be provided by the central government in order to stimulate an overview and a structural approach to the topic. Related to this is also the need for the establishment of central, reliable providers of scientific data/ information. In Italy, setting up a new national weather service has been constrained, among other reasons, by the frequent changes in the political scene.

What still needs to be emphasised with regard to the communication of scientific knowledge is the importance to reach also the **general public audience**. In certain countries (e.g. Germany Denmark **e-learning platform and portals** have been launched to support this aim. Raising attention to adaptation particularly among the general public might require the involvement of social scientists, even artists, musicians.

Interdisciplinary teams are also needed to overcome the challenge of the inherent complexity of climate change and to investigate this phenomenon holistically. For instance, technological innovation alone can provide effective solutions up to a certain extent. Hence climate change adaptation actions should not focus only on this.

Cross-sectoral assessments are needed to holistically assess synergies and conflicts, which is a fundamental step for a stronger integration of adaptation. For example, most health impacts from climate change result indirectly from impacts in other sectors (e.g. water, agriculture, building sector) so they are difficult to identify and predict if climate change impacts on it are assessed when looking at a single sector.

Such a perspective might lead to spillovers or ignore important issues such as the social implication of a decision.

Finally, it is important to highlight that the high price at which scientific and technical knowledge to support adaptation is often 'sold' may restrict its distribution and limit its potential influence on policy decisions. Interviewees related to the agricultural sector of Italy mentioned the importance of making scientific information freely available on the web. The issue of the cost of scientific data and that of the access to it has been also highlighted in other projects (see Pfenninger et al., 2010). During the current period of **austerity** in Europe, in addition to ensuring that enough **financial resources** are available to support new research, investing on the free access of knowledge is expected to become critical.

4.5 Conclusions

Results of this study and others (e.g. Pfenninger et al., 2010) show that integration of adaptation in sectoral policies and relevant policy instruments (mainly new or revised) has started. Although for most sectors and countries integration is at an early stage, meeting mainly the criteria of inclusion and consistency, there is evidence to suggest that this process will continue and improve in the future. Examples in the literature show that when adaptation is treated only on a sectoral basis may lead to mal-adaptation (see Fazey et al., 2010; Rounsevell and Reay, 2009; Jones et al., 2012). Such examples emphasise the need for stronger integration of adaptation in policies. Synergies and trade-offs between policy goals need to be explicitly assessed both within or across sectors. Indeed some countries have already initiated such processes. Establishing robust and transparent mechanisms for prioritization is important for minimising conflicts and so are the reporting requirements for monitoring the progress of integration.

Variations in the level of integration across sectors and countries seem to relate the progress that has been made in the adaptation policy process in general, as well as to other factors such as the magnitude and type of climate change effects, the general political context, the level of awareness, the sense of urgency, the available resources and funding etc. Further, analysis will be undertaken to explore in depth if and to what extent such relationships exist, and investigate what (if anything) has an impact on adaptation integration to sectoral policies when it comes to knowledge use.

This report suggests that if the integration of adaptation in sectoral policies is to be improved, attention should also be placed on overcoming the relevant barriers (Table 4.4) and filling knowledge gaps (Table 4.5). Changes in surrounding conditions and the new knowledge that becomes available will determine future needs. Thus it is important that these needs are continuously assessed for different contexts. In addition to challenges linked to knowledge production, communication and use, adaptation is expected to be challenged by the austerity period that most European countries are going through. The heavy attention that is placed on the economic crisis and the wide range of implications that it has for people's daily lives (e.g. high unemployment rates) may reduce the relative importance placed on adaptation, limiting the financial and other resources in support of its stronger integration. This stresses the need to find cost-effective approaches that have multiple benefits. The knowledge production should also focus on increasing adaptive capacity, as the uncertainty with respect to the actual development is significant.

Chapter 5: Deliverable Conclusions

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This deliverable has looked at knowledge use and policy integration in the NAS and wider adaptation policy in different EU Member States from three interlinked and cumulative perspectives: policy coordination, climate policy integration and knowledge use in policy sectors. Through this combined and cumulative analysis the following of conclusions emerge.

The triggers for developing adaptation strategies are diverse: It is often thought that policy developments to address complex scientific issues like climate change adaptation stem from the weight of scientific evidence and international scientific processes like the IPCC. While these reports are important, the evidence from this deliverable suggests that for many of the leading countries the primary trigger for developing adaptation strategies was in response to natural events like floods and heat waves, and national political cultures and pressures such as large cities lobbying for specific national adaptation policies. Likewise, for those countries that are only just implementing or developing their strategies the primary push for action comes from European Union pressure, albeit in relation to the EU's response to the urgency of message presented by the latest climate science (e.g. IPCC, 2014). Also, when adaptation was framed in terms of synergies with other prioritized policy issues such as urban development, innovation and employment, this would push adaptation forward on national policy agendas and trickle attention to adaptation policy issues down to lower levels of policy making and across to other sectors.

National adaptation strategies are very diverse, but the process of developing them has put adaptation on the political agenda: NAS have gained support and are seen as worthwhile instruments, but their nature and the processes leading to them have differed. The EU (and UNFCCC) guidance is right in underlining the process rather than the formal contents of the strategy to allow Member States to develop context specific measures. For example in Italy Steps 1-4 of the EU Guidance (EC, 2013) were followed to develop a NAS. As a result differences are observed in terms of how strategies relate to the policy context. For instance in Finland, Denmark and to some extent the UK, a framework approach has been taken, where a lot of action has been devolved to more local and regional levels. Other strategies have a strong focus on addressing knowledge gaps (e.g. Finland and Germany). Others are more based on awareness raising (e.g. Portugal, Italy) to create a foundation for cross sector cooperation. For example, one of the strong elements of the Italian NAS is that it involved stakeholders from different governance levels and sectors. This ongoing dialogue contributed both to knowledge production and to awareness raising. Crucially, the work stream for this deliverable sought to map the legal provisions for adaptation. Very limited use of legal instruments was found in the strategies studied, with perhaps the exception of the Danish change of the Planning Act and of rules for funding for local government. More on the implications of this are discussed below.

The importance of coordination is likely to increase with progress in climate change: While few conflicts have been encountered that would call for arbitration or strict demarcation of what individual ministries can and cannot do in the field of adaptation, it is important that the NAS creates a dialogue and common general sense of direction as this is likely to become more important with progress in climate change. This means that we are currently in most countries seeing a "soft" form of CPI both with respect to horizontal coordination across societal sectors and vertical coordination from central to regional and local

government. However, to address longer terms climate change impacts, more hierarchical means of adaptation may be required with strong central leadership from bodies such as the Prime Minister's/President's Office or the Finance Ministry to add pressure to sectoral or regional/local actors, in order to ensure that adaptation actions are taken in all relevant areas and not just where resources and capacity are strong. Such leadership could be backed up by stronger legal provision which is only weakly featured in a minority of the European Union Member States studied. This is an especially important line of argument given the failure of many past initiatives to achieve better coordination and integration through softer means (Hood, 2005; Bogdanor, 2005; Steurer, 2007). As Page (2005) argues, coordination is highly resource intensive activity with obvious opportunity costs. He questions the need to devote significant resources to coordination, especially when the payoffs may be relatively low. Indeed policy making occurs in crowded policy spaces (Jordan and Halpin, 2006; Dery, 1999) with many issues competing for a limited set of resources. The evidence in this deliverable suggests (see chapter 4) seeing the benefits of adaptation may be a problem for actors who are dealing with multiple issues. Even if they do see the benefits policy makers may consider other issues as more pressing or urgent. The example of the health sector in some countries illustrates the differences between the way climate change adaptation is prioritised as an urgent issue at the national level compared to the 'street level'. This is not to say that more coordinated and integrated approaches to adaptation should not be followed, but that more needs to be done to identify and make the co-benefits of adaptive action visible to policy makers. For example, agricultural policies promoting efficiency in water use can reduce environmental impacts of agriculture, and make it more resilient to extreme events, as well as offer cost savings to farmers. Similarly, flood protection policies can advance the conservation of biodiversity. Policy makers who see the links between policy areas can address multiple policy aims alongside adaptation and also recognise the need for coordination. Other studies show that for some local government institutions such dynamics also work as a barrier (Burch, 2010; Jensen, et al, 2014)

The economic costs and benefits of adaptation is identified as a knowledge gap: In order to sell co-benefits to policy makers who are under increased pressure to reduce public spending, a better understanding of the costs and benefits of adaptation and the cost effectiveness of such measures is required. Examining the use of such economic data in adaptation planning is one of the core issues of the work programme associated with this deliverable. Results show that cost-benefit analysis is often done at the sectoral and national level. However, our data shows that such analyses have often been partial with many data gaps. Conducting such analysis can be difficult at the national level, and many data gaps exist. Adaptation policies might be better incentivised if efforts are made to show the economic benefits of adaptation - even in the light of data gaps and uncertainty -, especially the case in the current fiscal environment of budgetary deficits and pressures to rein-in public spending.

There have been extensive efforts to improve the knowledge base for adaptation in all sectors: A major emphasis has been on actual or anticipated impacts of climate change in the studied sectors, but the barriers to adaptation suggest that this knowledge production has not fully succeeded in framing adaptation as something to be easily integrated in the sector policies. Important knowledge gaps remain that need to be addressed through future research efforts (Section 4.3.8), and in Work Packages 5 and 6. However, as shown in this deliverable (section 4.3.7), barriers limiting the integration of knowledge extend beyond the existing knowledge base, and relate to a wide range of factors including, among others, how policy actors weigh-up and prioritise evidence, the skills required by policy makers to process the complexity of scientific and technical information, the competition for funding, the interference of climate change adaptation with other policy goals, inadequate communication, etc. This set of barriers shows that

the conception of the relationship between knowledge production and use as linear process deviates from what happens in reality. There is a need to consider further what knowledge should be produced and how to share this during adaptation policy development (e.g. the actual type of knowledge, the scale that it refers to, the way that is presented) in order to advance integration into the policy process and how boundaries, such as organisations, and processes, such as policy appraisal and ex post/ex ante evaluations, can be designed and used to better integrate adaptation knowledge into sectoral policy making. Moreover, more understanding is needed about the more general context in which knowledge is communicated, co-produced as adapted to specific geographical and policy contexts, and use takes place in practice.

Future progress in adaptation requires greater engagement of the private sector, regional and local government and citizens and policy instruments to promote such engagement: Overall this deliverable has shown that there are procedures in place to steer cross-sector working on adaptation but these are mainly focused on public sector. There is though a need for more than just establishing strategies that promote knowledge management and policy integration in the private and civil society. How they are implemented and how they are adopted by the private sector, regions, local government and civil society is crucial. It is all too easy to establish strategies but much more difficult to follow them through to ensure that they meaningfully target the actors and the actions that they aim to. In this respect, it is notable that solid understanding of the latter increases the chance for successful implementation of adaptation planning. While such analysis is beyond the scope of this deliverable, thought needs to be put into to how different approaches interact and incentivise actors to make integrated decisions in the short and long term as different approaches can lead to varied adaptation pathways (or even mal-adaptation) from economic, social and environmental perspectives. For instance, a purely economic focus in a NAS may promote the prioritisation of short term budget balancing against longer term social and environmental needs. It is therefore important to have a mix of measures which provide different long and short term incentives. It would make sense to link climate adaptation policy and strategies to the integration of sustainable development, especially as the significance of both these perspectives is expected to increase in the future. Sustainable development represents a policy area which is widely accepted as beneficial and which for decades has been recognized as cross-sectoral and cross-policy level, and thus there is experience with coordination, policy integration and knowledge management. Such procedures and practices provide a solid platform for climate adaptation policy development and action, and thus the strong potential to promote and embed national adaptation goals between sectors and governance levels.

Policy conflicts and synergies have been hard to detect, but may become more salient as adaptation strategies become more fully embedded: A specific aim of the work stream for D2.2, and indeed Work Package 2 as a whole, was to identify conflicts and synergies between adaptation policy and sectoral policy objectives. As with D2.1 on the EU Adaptation Strategy, finding data on conflicts and synergies at the national level in the work for this deliverable has been harder than anticipated for perhaps two reasons. First, many of the strategies studied are still being embedded, even in the more mature NAS e.g. in Finland and the UK. Thus opportunities for understanding where the conflicts and synergies lie are limited. There is potential for exploring this issue further in D7.2 where the impact of the EU Strategies in strategic sectors will be explored. Moreover, effective adaptation strategies need to be tailored towards local contexts and thus opportunities for identifying conflicts and synergies will be enhanced through examining the implementation of adaptation policies. Indeed, the real test of policy integration lies in the actual implementation: to what extent will integration of climate adaptation inform decisions on what types of activities are eligible for support? Thus the case studies may reveal more precise data on some of the conflicts and synergies through D5.4. While this work package has not provided clear insights on policy

conflicts and synergies, it does offer a clear critique of the capacity of the studied Member State NAS to handle and address such issues, the key points on which are highlighted in these conclusions.

Through providing a detailed analysis of NAS in key European Union Member States, this analysis provides important background context for BASE Work Packages 3, 5, 6 and 7: Crucially, for Work Package 3, this analysis demonstrates that the use of economic knowledge in national adaptation planning is still relatively limited due to political deficiencies, but also due to significant data gaps on the economic costs and benefits. For Work Package 5, the combined analysis shows that while many Member States have an array of different mechanisms in place as part of their national adaptation planning, their impact at the local and sector level may be limited especially in the longer term. This means that at the policy level in which the case studies operate, the capacity for NAS to steer adaptation actions is somewhat limited, with NAS serving instead to put adaptation more broadly on the political agenda and providing an overall framework for how to address the vast number of challenges. For Work Package 6, the analysis would suggest that currently the studied NAS are not sufficiently geared up for dealing with critical issues such as storylines, tipping points and adaptation pathways. Knowledge management processes are still developing and need to be more strongly backed up by hierarchical means (e.g. through legal mandates and high-level political leadership. For Work Package 7, the analysis in this deliverable has uncovered both positive and negative aspects of the NAS studied. It will be possible to draw lessons on what works, and to make recommendations for improvements to enhance policy coherence for adaptation in Member States especially in terms of knowledge management, and the identification and handling of synergies and conflicts.

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Appendix 1 – Common Data Collection Framework

This appendix introduces the common framework used to collect data by BASE partners across Member States. The common framework was devised to ensure that all partners consistently collected the same type and level of data so that comparisons between Member States could more easily and robustly be made. The methods for data collection were not stipulated as for some of the studied countries the information is widely available in documents. In others information is more sparse so interviewees had to be undertaken (see section 1 of d2.2 for more details). All BASE partners were asked to clearly indicate where specific data came from such as from specific documents or from interviewees. Thus data robustness is ensured through the quality and type of data collected rather than the specific method used. The framework is split into two core parts. Part 1 is for data collection on the first two pieces of analysis in D2.2 on policy coordination and integration respectively (Chapters 2 and 3). Part 2 is for data collection on the third piece of analysis in D2.2. (Chapter 4) on integration and knowledge use in the sectors.

BASE Deliverable 2.2 - Common Data Collection Framework

Part 1. Guide for analysis of policy documents and interviews for analysis 1 & 2 (Chapters 2 and 3) in D2.2

The following questions should be included in the data collection which all examines the position and strength of climate adaptation policy coordination and integration in the NAS, building on the Deliverable 2.1 framework analysing CPI included at the end of this note and frameworks for policy integration/coordination. Please note that the bullets for each question indicate the meaning of the question; during the interviews and the analysis these guide how the question is answered:

1. Public administration/political culture (1-3 paragraphs)

E.g. type of system (presidential vs parliamentary, federal vs unitary etc), conflictual or consensual tradition, centralised or decentralised system, most powerful actors, etc. Does there exist institutionalised structures/processes/procedure of learning and feed-back in the policy-making system in general (e.g. across sectors or across policy levels)', e.g. a systematic policy evaluation programme, institutionalised participatory processes and consultation, horizontal and vertical governance coordination units).

*Assign a governance mode (state, society, stakeholder interactions) from Pierre and Peters – below. If the country has a more federal structure and there are differences between tiers of government please differentiate between the tiers. **Please base this assessment on the political science literature where possible.***

Pierre and Peters (2005) Governance modes

2. History of climate adaptation policy, including catalysts such as extreme weather and the effects of a change in government (1-3 paragraphs)

3. What are the motivations, drivers behind the development of the NAS and/or other adaptation measures? (1-3 paragraphs)

4. Is there a NAS? How long has it been in existence? At what stage in the implementation process is the NAS? If there is no NAS, why? (1-3 paragraphs)

5 Are there other national measures/strategies that operate independently of a NAS? For example is there a sustainable development/ environmental planning/ better regulation strategy that has measures that can support climate change adaptation. For example, the UK has a system of policy appraisal as part of its better regulation strategy which can be used to support adaptation planning. What are their origins (2-5 paragraphs p – specific details can be provided in question 9).

6. If relevant how does the NAS generally relate to other national adaptation measures mentioned in question 5? (3-5 paragraphs)

7. What is the rationale for the NAS and/or other adaptation measures? How is adaptation understood? Please distinguish between the NAS and other national adaptation measures.

- Which impacts are addressed (all or a selection – name these)?
- Which barriers for action are addressed ?
- Does the NAS and/or adaptation measures take a CPI perspective?
- What is the stated aim for inclusion of CPI in the NAS?
 - Does it address the distribution of costs/benefits related to (non)adaptation?
 - Does it address the motivations of private actors in engaging with climate adaptation?
 - Does it address externalities (as with mitigation policy integration)?
 - Does it address market failures (as with mitigation policy integration)?

Interpretation of CPI

- Is integration of climate change adaptation into other policies addressed as a normative (assigning specific value to climate adaptation) or a rational concept (emphasizing effectiveness and efficiency)?
- Is CPI included as a weak mandate (climate change adaptation is one among several objectives to be addressed in a balanced approach) or as a strong mandate (CPI adaptation should be prioritized above other policy objectives)?
- Evaluation criteria
 - Is consistency between adaptation objectives and climate objectives considered? How is this included? Which policy issues are presented as promoting/impeding adaptation within climate policy/sectoral policies. Is a weighting among conflicting or multiple objectives considered?
- How closely is adaptation CPI linked to mitigation CPI?

Governance of CPI

- Administrative: Is CPI approached as a process (i.e. coordination processes) or as an output (policy output: strategies, actions and regulatory instruments put in place)?
- Political: Does the NAS and or other adaptation measures approach policy integration as a political task, i.e. as a matter of bridging conflicts? If so:
 - Which policy actors are included
 - Does the NAS prioritise some interests over others – e.g. protecting economic infrastructure over housing from flooding
- Cognitive: Does the NAS approach CPI as a matter of learning?
 - If so, how is learning promoted/ensured?
 - Which forms of action/initiatives are anticipated to promote adaptation?

8. What types of adaptation activities are included or supported in the NAS and/or other adaptation measures (e.g. social, environmental, technical, economic, knowledge generation) and what approaches are favoured (e.g. soft - changing behaviour-, grey – Technological-, green -ecosystem services)? Are these activities targeted at specific sectors and/or levels of governance (which ones?) or are they generally cross sector? Are certain actors targeted (which ones?)

- What stage of intervention in sectoral policies does the NAS target?
 - Agenda setting: aim to influence sectoral policy objectives
 - Policy formulation: target the allocation of resources

- Policy adoption/formulation: seek to influence interaction of sectoral actors by changing the administrative system
- Evaluation: monitor and evaluate the impacts of policy instruments
- Which sectors pick up and respond to CPI aims of NAS?

9. Please answer as many questions on the NAS or other national adaptation measures in the table as you can. Questions based on policy integration and coordination literature. Note that we only need the additional information in columns 4 & 5 if you answer 'yes' in columns 2 or 3.

	Part of the NAS	Other measures to support adaptation policy other than the NAS (indicate whether introduced before or after the NAS where relevant)	Description of measure and if possible why/how it was adopted.	How has the measure been operationalised. If poorly what accounts for this?
<i>Tools/processes for knowledge management</i> <ul style="list-style-type: none"> - <i>Is there a system of policy appraisal/impact assessment that includes provisions on adaptation</i> - <i>Is cost benefit analysis encouraged as part of the policy appraisal?</i> - <i>Do such assessments focus on vulnerability assessments or risk assessments?</i> - <i>Are there provisions for stakeholder engagement?</i> - <i>Are there independent advisory panels/boundary organisations?</i> - <i>Are climate adaptation portals used? Which ones?</i> 				

<ul style="list-style-type: none"> - <i>Is there a strategy to deal with data uncertainties/gaps?</i> - <i>Does targeted institutional support exist or is suggested in NAS, e.g. task forces or expert supervision aimed at assisting sectorial/local governance</i> 				
<p>Policy instruments present to promote adaptation planning both among public and private actors:</p> <ul style="list-style-type: none"> - Hard: rules, monitoring and sanctioning, including a legal provision mandating adaptation planning - Soft: information and process-based (participation), - In between: economic incentives such as subsidies targeting private actors <p>Funding for public actors, i.e:</p> <ul style="list-style-type: none"> - Are there dedicated funds to assist sectoral and/or cross sector adaptation (p2)? - Are there dedicated funds to finance of adaptation innovations trails? E.g. experiments for managing floods through afforestation, experimental architecture to deal with flooding/higher summer temperatures etc. - Are there allocated organisational resources 				

to assist development /implementation of adaptation strategies? At NAS and/or sectorial level? E.g. manpower and training				
<i>Administrative instruments/ processes for crosscutting coordination to ensure adaptation CPI</i> <ul style="list-style-type: none"> - <i>Is there strong and sustained political leadership? Where is this leadership (e.g. Prime Minister, Ministerial, senior civil service).</i> - <i>Are there inter-ministerial working groups? Are such groups permanent or temporary? Is the group committee populated by ministers of civil servants</i> - <i>Are there dedicated integration units/centres of expertise within the administration to aid adaptation planning?</i> - <i>Are there dedicated sectoral strategies for adaptation ?Are there procedures or mechanisms to resolve conflicts?</i> - <i>Are there action/implementation plans? Do they cover all sectors or specific ones? Do they take a longer or shorter term view of adaptation planning? ST =</i> 				

<p>upcoming, MT = to 2020, LT = 2050</p> <ul style="list-style-type: none"> - Are all sectors targeted or specific ones (please name)? ?? - Are there provisions for private sector engagement? - Are there provisions for public sector engagement? - Are there provisions for household engagement? - 				
<p>Arrangements for vertical coordination (p2)</p> <ul style="list-style-type: none"> - Is there any link to the EU adaptation strategy/policy in the NAS document and procedures? - Does the NAS encourage/support/require local and regional- level adaptation? (p2)Are climate adaptation objectives included in sector policy output and/or at local or regional levels? Are other outputs included? 				
<p>Reporting and Evaluation processes</p> <ul style="list-style-type: none"> - Are there measures and/or guideline (specify which) in place for evaluating the NAS and adaptation planning? - Are there performance indicators? - Does the NAS specify criteria for integration as 				

an outcome?				
Other measures <ul style="list-style-type: none"> - Are there other measures that do not fit into the above categories? 				
Recognition of and support for autonomous adaptation <ul style="list-style-type: none"> - Is autonomous adaptation actively considered and encouraged? In which sectors? - Do sectors (which?) not particularly pay attention to adaptation because they trust that autonomous adaptation will occur when needed? 				

Part 2. Guide for analysis of policy documents and interviews for analysis 3 (Chapter 4) in D2.2

Investigating the integration of climate change adaptation in support of the implementation of sectoral policies based on a knowledge perspective.

This analysis aims to map and compare the integration of climate change adaptation in sectoral policies related to agriculture, water management and health across a set of EU Member countries using a knowledge perspective. We will explore several aspects of knowledge generation with reference to each of the three aforementioned sectors (who are the producers of knowledge? what is the content and the scope of knowledge generation? etc.), the ways that the generated knowledge is communicated, as well as the extent to which the generated knowledge supports adaptation implementation in sectoral policies. We will explore potential (mis-) matches between the supply of and demand for knowledge, and identify gaps/issues that need to be addressed in order to produce appropriate knowledge, to improve its communication and to facilitate its use.

Part I. Adaptation policy context

Q. 2 from paper 1

With reference to the sectors of agriculture, water management and health, please answer as many questions as you can. When questions refer to policy actors please consider policy actors involved in the implementation of sectoral policies (the street level bureaucrats). This should also be kept in mind when selecting potential interviewees (Experts with good knowledge on this topic are also recommended)

interviewees). Also, 'adaptation knowledge' refers to information that may support the implementation of policies on the sectoral level.

01. a. Please describe the extent to which adaptation has been integrated in sectoral policies (see Table 1 for criteria and relevant questions)

2. Table 1 Criteria and questions for examining integration of climate adaptation.

Criterion	Key questions
Inclusion	To what extent have adaptation objectives and/or direct as well as indirect adaptation needs been identified?
Consistency	Have the contradictions between the aims related to climate change adaptation and other policy goals been recognised and have there been efforts to minimise revealed contradictions? / Have synergies been identified and have there been efforts to promote them?
Weighting	Have the relative priorities of climate change adaptation compared to other policy aims been decided and are there procedures for determining the relative priorities?
Reporting	Are there clearly stated evaluation and reporting requirements for climate change adaptation (including deadlines) ex ante and have such evaluations and reporting happened ex post? Have indicators been defined, followed up and used?

(Source: Hilden et al., 2013)

b. If adaptation has not been integrated in sectoral policies, please explain why this process has been constrained. Are there plans to do so in the near future? In any other case, please describe the main drivers for integrating adaptation into sectoral policies (e.g. Adaptation integration into sectoral policies has resulted from the development of the National Adaptation Strategy; EU Adaptation Strategy). How has this been achieved/ reflected in policies? What are the rationales?

Part II. Knowledge generation

02. Please describe if/ how/ to what extent the amount of adaptation knowledge produced to support the implementation of sectoral policies has been increased in the last five years.

[What type of adaptation knowledge is currently available (e.g. information that is useful in determining vulnerability, hazards or generally adaptive capacity; specific instrumental knowledge on grey or green adaptation measures, etc.)? Where does the demand for adaptation knowledge come from (e.g. from within the sector, it is imposed centrally by the administration, etc.)? Why? Who is considered to be mainly responsible for generating adaptation knowledge (i.e. is the state expected to fund it through procurement, the private actors in the sector, independent researchers through grants, ... ?)? Is there collaboration between scientists and policy actors in order to exchange information on the type of information the latter need? Is there is co-production of adaptation knowledge; researchers- policy actors-other stakeholders?- Please provide as much explanation/evidence as you can]

03. Please describe the type of adaptation knowledge that is still lacking. What types of evidence should researchers be generating to support the implementation of sectoral policies? Who identifies knowledge

gaps and how? What kind of adaptation knowledge do policy actors tend to use, or tend to ask for, or to see as lacking knowledge?

Part III. Knowledge communication

04. How, when, why (e.g. is it policy actors who initiate this process?) and by whom (e.g. is there a group of experts that communicates adaptation knowledge and supports policy makers when making decisions related to climate change adaptation?) is adaptation knowledge communicated in the sector?

Part IV. Knowledge use

05. Please describe the ways of learning of the policy actors in the sector

- Empirical learning- the most explicit form of knowing, which is often based on quantitative or qualitative research study
 - Theoretical learning-it uses different theoretical frameworks for thinking about a problem, sometimes informed by research, but often derived in intuitive and informal ways
 - Experiential learning-craft or tacit knowledge built up over a number of years of practice experience
- [How are the different types of learning used by policy actors? What are the advantages/disadvantages?]

06. Please describe the type of adaptation knowledge use employed by policy actors in your sector:

- Instrumental; direct form of use, decision-makers operating in instrumental mode use knowledge to inform decision-making and improve policy action – building and terminating policy programmes on the basis of what the evidence says.
- Conceptual; 'to enlighten'- use in this mode is indirect and temporally contingent, where ideas come of age over time.
- Symbolic; evidence is used to deliver pre-existing preferences. Selective use, or cherry picking, of evidence is common here, but it can also simply be used to strengthen a policy stance that has most support.
- Imposed; knowledge use is a requirement imposed from a higher level governance
- Non-use

07. Please describe the importance of the role of adaptation knowledge on... and give examples/evidence

- formulating political interests
- setting priorities
- promoting policy commitment
- planning intervention towards accomplishing priorities

- implementing adaptation action

08. Please describe the processes for integrating knowledge into decision making in your sector

[How likely is it that adaptation knowledge is/ will be taken into account by policy actors in the sector? What is the process followed? (evidence based, i.e. the best available evidence from research at the heart of policy development and implementation; opinion based, i.e. relies heavily on either the selective use of evidence (e.g. on single studies irrespective of quality) or on the untested views of individuals or groups, often inspired by ideological standpoints, prejudices, or speculative conjecture. What are the motivations behind knowledge use? Are cross-sectoral synergies and trade-offs (please refer to trade-offs only if you haven't answer Q. 1b) considered? How are they dealt with? How are adaptation/climate change uncertainties communicated and addressed in sectoral policies? To what extent the decision-making is aligned to the scientific knowledge (used or reported)?]

09. Please describe the sources generating/ providing adaptation knowledge that are used by policy actors in your sector

- evidence from research programmes, data, articles
- results from risk or vulnerability assessments
- cost/benefit assessments
- participatory approaches / stakeholder engagement
- expert judgment
- web portals
- Other (please give examples)
-

If more than one of the aforementioned sources are used, please put them in order of importance, and explain why you have decided (or not) to use them. Please also indicate if any of the aforementioned sources is not relevant/ applicable.

10. Please describe the factors that you would identify as barriers and facilitators of adaptation knowledge use (with reference to the implementation of sectoral policies).

11. Please refer to any examples of "good practices" of adaptation knowledge generation, communication or use (with reference to the implementation of sectoral policies) .

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Please answer the following questions if time allows it.

- Please indicate the stage of your country in the adaptation policy process/ cycle.

Adaptation policy process has not started yet

- The need for adaptation has been recognised but work has not started yet
- National Adaptation Strategy (NAS) is being developed
- NAS has been already developed
- A National Adaptation Plan has been developed
- Monitoring and evaluation

-Please describe the extent to which the need to consider climate change adaptation in sectoral policies has been recognised by politicians, civil servants, key stakeholders related to the sector and society.

- Please describe if/ how/ the extent to which the relevance of adaptation knowledge that is produced to support policy implementation in your sector has been increased. Please justify your answer.

- Please describe the extent to which confidence in adaptation knowledge that is produced to support policy implementation in your sector has been increased. Why?

- Please describe if information is one of the main policy instruments (= the 'tools of government', the mechanisms and techniques used to implement or give effect to public policies) used to integrate adaptation into sectoral policies. Which other main policy instruments are used to achieve this goal? (e.g. regulation, voluntary action, government expenditure and market-based instruments. Why are these instruments used?)

- Please describe the type of support/ improvements would be needed to enhance the use adaptation knowledge in your sector