Part I

Concepts and scenarios

1

Climate policy and inter-linkages between adaptation and mitigation

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Summary

The objective of this chapter is to provide a better understanding of the inter-linkages, trade-offs and synergies between adaptation and mitigation, building on the work of the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. The chapter elaborates on three different perspectives for assessing the two domains and illustrates these with examples from the ADAM research: the analysis of mitigation and adaptation in the European energy system based on integrated assessment models; mitigation and adaptation opportunities and barriers in the context of urban planning to reflect on social learning and capacity building; and an analysis of present and future climate governance challenges in the EU as an example of institutional and policy analysis. In an explorative section, the chapter then provides a meta-analysis of European climate policies of the past ten years. The analysis shows that the inter-relationships between the two domains of adaptation and mitigation are complex and may involve different temporal, spatial and organisational scales. This leads us to conclude that: (i) mitigation efforts today may lead to climate vulnerabilities in the future if the life cycles specific to each sector are not adequately taken into account; (ii) development of response capacity in one domain does not lead to capacity in the other because adaptation and mitigation involve mostly different sectors, actors and institutions; (iii) climate impacts may lead to growing welfare inequalities, which can be balanced through co-ordinated policies at higher levels, but which need to overcome existing institutional barriers; and (iv) synergies between adaptation and mitigation are most easily found where mitigation efforts are reinforced by behavioural changes, which lead to

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an overall increase in resilience by implementing broad concepts of sustainability. Further consideration of these adaptation–mitigation linkages is a research priority. Policy innovation will be needed to capture synergistic benefits and avoid the introduction of new climate vulnerabilities or accelerated emissions of greenhouse gases.

1.1 Introduction

Climate change adaptation and mitigation strategies in the context of existing policies and policy development stand at the centre of this volume. A critical discussion of the concepts and perspectives used for assessing adaptation and mitigation is therefore essential to place the contributions of the following chapters into perspective. In particular, there is a need for a better understanding of the inter-relationships between adaptation and mitigation as policies in both domains become more developed. The objective of the chapter is therefore to provide some evidence of the inter-linkages, synergies and trade-offs between adaptation and mitigation. This will lead to more effective decision making in the European policy arena.

Linkages between mitigation and adaptation have been explored in the *IPCC Fourth Assessment report*, in particular in Chapter 18 of Working Group II 'Inter-relationships between adaptation and mitigation' (Klein *et al*., 2007) and chapter 3 of Working Group III 'Issues related to mitigation in the long-term context' (Fisher *et al*., 2007). One important limitation of these earlier works, however, is that the linkages have not been sufficiently explored in the context of the very distinct research approaches that are applied for assessing mitigation and adaptation policies. This chapter therefore analyses these linkages in the context of three main approaches: integrated assessment modelling, social learning and institutional and policy analysis. These three approaches are complementary and have been used equally throughout the ADAM project in order to provide a multi-faceted picture of European climate policy and its challenges and trade-offs.

Integrated assessment models frame mitigation and adaptation either from a top-down or bottom-up decision analytical perspective (see Chapters 3 van Vuuren *et al*., 4 Aaheim *et al*., 7 Eskeland *et al*., 8 Mechler *et al*. and 11 Knopf *et al*.) and provide information on the direct and indirect economic effects of climate policies, together with the technological settings needed to achieve them. However, there is increasing recognition of the value of the social-learning approach as complex problems generally involve many actors at different temporal and spatial scales (Tàbara and Pahl-Wostl, 2007). This complexity makes it difficult and often impossible to predict outcomes of actions and suggests that the decision-analytical framework should be embedded in a social-learning framework that can better take account of the complexity of nested decision situations (see Chapters 2 Russel *et al*. and 5 Hinkel *et al*.). In such cases, case studies can often help understand the different temporal, spatial, and institutional scales involved by focusing on how actors interact and learn and on the cross-cutting themes that transcend the analysed cases (see Chapter 9 Werners *et al*.). Finally, institutional and policy analysis can identify important barriers to, and opportunities for, climate policies by analysing the norms, institutions, policies and measures of climate governance (see Chapters 6 Berkhout *et al*., 10 Biermann *et al*., 12 Gupta *et al*. and 13 Linnerooth-Bayer *et al*., as well as the companion ADAM volume edited by Jordan *et al*., 2010).

For each of the three perspectives, we explore the inter-linkages and trade-offs between adaptation and mitigation by focusing on one representative case study from the ADAM research. These are:

(i) The analysis of mitigation and adaptation in the European energy system based on bottom-up technology integrated assessment models (IAMs). The chapter focuses on IAMs because serious attempts have only recently been made to integrate adaptation into mitigation frameworks, whilst most modelling frameworks still focus solely on mitigation (Fisher *et al*., 2007);
(ii) Mitigation and adaptation opportunities and barriers in the context of urban infrastructure. This examines the need for social learning and capacity building to achieve synergies and avoid technological lock-ins whilst dealing with the different perspectives of multiple stakeholders; and
(iii) An analysis of present and future climate governance challenges in the EU. This describes how climate policies emerged in the context of enabling and constraining factors in the EU and its Member States and how mitigation and adaptation could be better integrated.

The chapter is organised as follows. Section 1.2 first summarises the IPCC understanding of the inter-linkages between adaptation and mitigation and then briefly introduces the three perspectives: modelling, social learning and policy analysis. Section 1.3 then presents the three cases, illustrating these perspectives. Section 1.4 analyses the status of European mitigation and adaptation policy based on a meta-analysis of European and EU Member State climate policies to shed some light on the way the two domains influence each other at the policy level. Section 1.5 discusses and synthesises the findings focusing on the synergies and trade-offs between adaptation and mitigation at different scales and, finally, Section 1.6 draws some overarching conclusions.

1.2 Perspectives on the assessment of adaptation and mitigation

1.2.1 The IPCC perspective

Even the most ambitious mitigation policies will lead to some climate change that requires a certain level of adaptation (see also Chapter 3 van Vuuren *et al*., and van

Box 1.1. IPCC definitions of adaptation and mitigation

Working Group II of the *Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC, 2007a) defines adaptation as 'adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' whereas mitigation is defined as 'an anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhance greenhouse gas sinks'. The definitions of Working Group III (IPCC, 2007b) do not differ significantly from the ones cited above.

Vuuren *et al*., 2008). The impacts of a changing climate (i.e. higher temperatures and altered patterns and amounts of precipitation, extreme weather events and sea-level rise) will have negative effects on regions and sectors that are sensitive to climate alterations, and will be felt most by those who are most vulnerable and lack the means to protect themselves (IPCC, 2007a). Adaptation is therefore most likely to be implemented at scales where direct impacts will occur. This will help to bring immediate and long-term benefits to those who are affected, either by raising their resilience or by reducing their exposure to climate impacts (Adger, 2006).

Mitigation, on the other hand, requires co-ordinated action, predominantly at international and national levels, and is mainly applied to sectors with high greenhouse gas emissions. The benefits of these actions accrue at the global scale and only after considerable lag times. The exceptions are, however, the immediate welfare benefits of investing in mitigation technologies and measures, such as improved air quality or reduced fuel poverty. Hence, adaptation and mitigation have different problem structures and pose considerably different challenges to policies and management. The formal IPCC definitions of adaptation and mitigation are given in Box 1.1.

Nevertheless, there are important linkages between adaptation and mitigation, which have an impact on two key factors: the implementation of measures and the fostering of 'response capacity' (Tompkins and Adger, 2005).

In regards to implementation of adaptation and mitigation measures, the IPCC (Klein *et al*., 2007) distinguishes four relationships: (i) adaptation actions that have consequences for mitigation; for instance, higher temperatures may induce more air conditioning which in turn will increase energy demand and thus the need to mitigate emissions; (ii) mitigation actions that have consequences for adaptation; for example, increased use of biofuels will likely have effects on food supply and prices, particularly for poor countries, lowering their ability to adapt; (iii) decisions that include trade-offs or synergies between adaptation and mitigation, such as large-scale mitigation with effects on impacts and adaptation; and (iv) processes that have consequences for both adaptation and mitigation; for instance, afforestation initiatives can act as a carbon sink, protect against flash flooding, and provide income for local communities (hence increasing local adaptive capacity).

The achievement of adaptation and mitigation measures also requires sufficient capacity for measures to take hold. Tompkins and Adger, 2005 refer to this as 'response capacity', which includes both mitigative capacity as 'the ability to reduce anthropogenic greenhouse gases or enhance natural sinks' (Winkler *et al*., 2007) and adaptive capacity, as 'the ability or potential of a system to respond successfully to climate variability and change' (Sathaye *et al*., 2007). It is based on the observation that despite some differences in spatial scale and sectoral focus, both mitigative and adaptive capacities are driven by similar sets of factors. In particular, it is recognised that the response capacity is determinate upon a broad range of socio-technical, economic and institutional resources. These, in turn, can be influenced by socio-cultural dimensions, as well as by other important factors such as infrastructure, risk perception, and political will, which allow a given group (community, society, etc.) to respond adequately to a threat. Therefore, Klein *et al*. (2007) suggest that 'the influence of each determinant of capacity is highly location-specific and path-dependent'.

1.2.2 The integrated assessment modelling perspective

Integrated assessment models (IAMs) have become a common tool for assessing the costs and benefits of climate change policy over long time horizons. They traditionally focus on questions related to defining mitigation targets (e.g. stabilisation levels), assessing the costs and benefits of reaching different targets (e.g. social costs of carbon, costs of residual damages) and the type of measures needed to achieve certain targets.

Mitigation is represented differently in different types of IAMs. Process-oriented IAMs represent mitigation strategies on the basis of the emission reduction potential and costs of a wide range of specific mitigation measures. Examples of such models are MESSAGE (Riahi *et al*., 2007) and IMAGE (Bouwman *et al.*, 2006). Other models focus more on economic consistency and represent mitigation costs in terms of production functions. Examples include FUND (Tol, 2006) and DICE (Nordhaus, 2007).

Adaptation in IAMs is represented more crudely. Most IAMs that include a description of damages, in fact, implicitly assume optimal adaptation. In these IAMs adaptation is therefore not a policy variable like mitigation, but a direct function of the mitigation target. These models do not describe the impact of different adaptation strategies nor do they provide a description of the measures and costs needed to inform adaptation policies.

Only a few IAMs include adaptation as a policy variable, namely PAGE (Hope, 2006) and AD-DICE (de Bruin *et al*., 2009). These models use a much aggregated

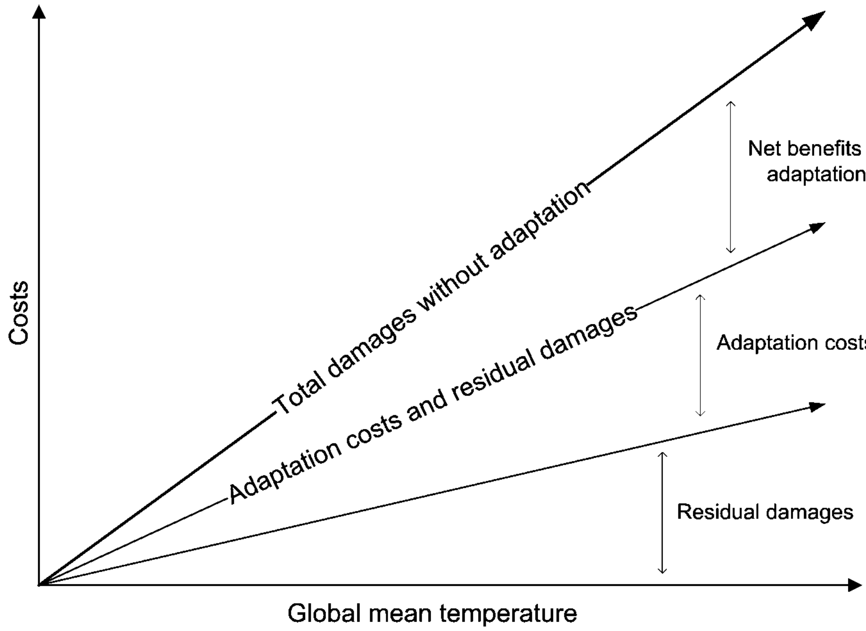

Figure 1.1. Schematic representation of adaptation (adopted from Stern (2006)). The total costs with adaptation are the sum of adaptation costs and residual damages. The net benefit of adaptation is the difference between these costs and what these costs would have been in the absence of adaptation.

approach to adaptation. Adaptation in PAGE affects the rate and level of temperature change at which an onset of impacts begins, and can reduce the severity of these impacts (Warren *et al.*, 2006). AD-DICE disaggregates the damage function of DICE into adaptation costs and residual damages (see Figure 1.1). The model selects the preferred combination of mitigation and adaptation in response to climate impacts. However, there is an important difference: mitigation reduces climate change damages only in the long run, while adaptation can also reduce damages in the short run.

Given this crude treatment of adaptation, IAMs continue to provide only limited insights into adaptation. They indicate how much to adapt, but not on how to adapt[1]. Based on the assumption that damage functions include some form of optimal adaptation, Patt *et al.* (2009) recently suggested that IAMs are likely to overestimate the amount of adaptation that will occur and therefore also overestimate the benefits obtained from adaptation. The authors also argue that global IAMs cannot identify the costs and benefits of adaptation measures accurately because to do so would require local or regional level detail. Adding a better

[1] Chapter 4 (Aaheim *et al.*) provides a discussion of opportunities and challenges of representing adaptation in IAMs.

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description of adaptation to IAMs would therefore improve the overall cost–benefit analysis of mitigation strategies, but would not help develop adaptation strategies. In order to do this, IAMs would need to include more data on the amount and distribution of adaptation costs.

1.2.3 The social learning perspective

IAMs formally represent action–outcome linkages that allow prediction of the outcome of chosen actions. However, the point of departure for the social-learning approach is that socio-ecological systems are too complex to be fully understood or formally represented in action–outcome linkages. The unpredictability of action – outcome linkages requires learning (i.e. act, observe outcome and learn, then act again), and the interdependence between the nested decision situations requires learning to be a social (institutional) process amongst different actors (Tàbara and Pahl-Wostl, 2007).

Approaches that model action–outcome linkages, such as those of IAMs described above may be appropriate when the problems are 'tame', i.e. when issues can be easily deconstructed into cause and effect, and there is a clear understanding of how to fix the problem. These approaches however, are not sufficient to deal with some of the highly uncertain and complex situations associated with adaptation and mitigation to climate change (e.g. see Funtowicz and Ravetz, 1991, Gallopín, 1999, Darwin *et al*., 2002). Many of these situations can be considered 'unbounded' (or 'wicked' as opposed to 'tame'; see Rittel and Weber, 1973). Chapman (2002) has described them as problems where there is no clear argument about what exactly the problem is; where there is uncertainty and ambiguity as to how improvements might be made; and where the problem has no limits in terms of the time and resources it could absorb.

Unbounded problems require a different approach to planning and implementing solutions that recognise (rather than ignore) disagreement and uncertainty between different groups affected. This requires a process of dialogue in which the actors involved can listen to and understand the perspectives of others (Senge, 1990). Figure 1.2 illustrates means of stakeholder involvement along axes of increasing impact potential and uncertainty. As the stakes are raised and the complexity and uncertainty of the information to be dealt with also increase, more stakeholders and institutions are brought in to participate in the social learning process. The role of the moderator of the process then becomes increasingly important as someone who can, from a neutral position (or accepted non-neutral position), encourage and support processes of dialogue and engagement (Snowden, 2005).

Moreover, by seeing adaptation and mitigation as processes of 'social learning', we are enquiring into the ways in which individual actors make sense of the situation in

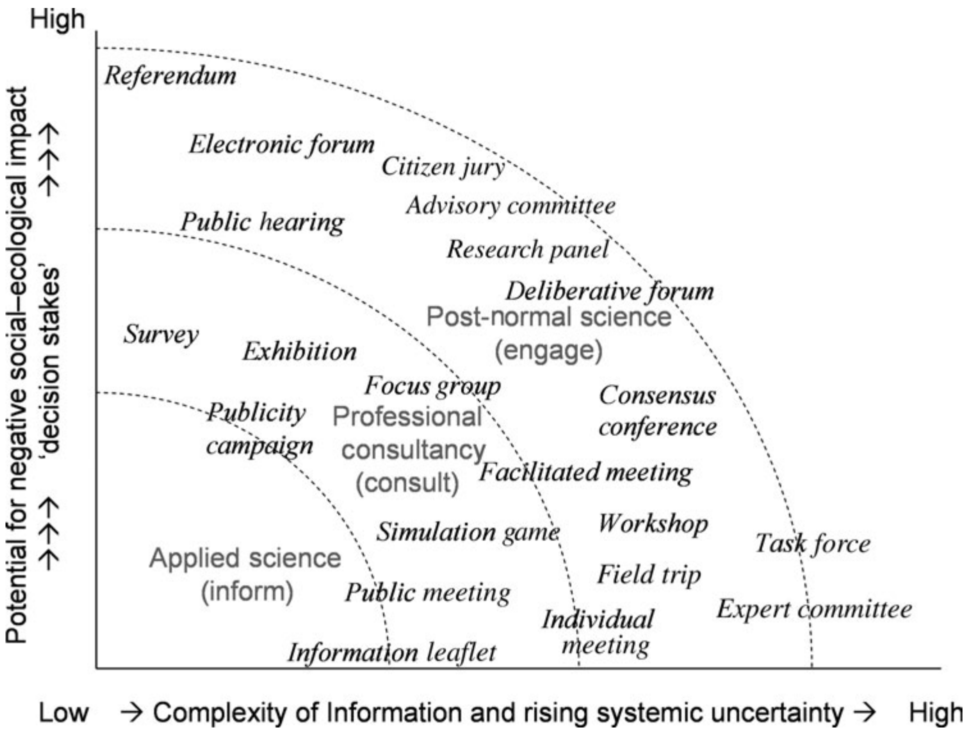

Figure 1.2. A typology of methods. After Forrester *et al*. (2008).

which they find themselves, and how they are supported or constrained in taking action. Therefore, for processes of social learning to be effective, opportunities for effective dialogue between the relevant groups must exist. This is not easy to achieve in practice and Cuppen *et al*. (2006) and Jochem *et al*. (2000) have identified a range of barriers to the process. These include power relationships, lack of knowledge and understanding, traditional routines and attitudes.

Finally, social learning is often about values and other 'higher-order' concepts such as norms, responsibilities, goals, and the framing of issues in terms of causes and effects (Kemp and Weehuiszen, 2005). When dealing with unbounded problems, the process of problem framing is therefore also important as this can pre-configure what are seen to be the available solutions (Rittel and Weber, 1973; see Hulme (2009) for an application of this thinking to climate change). The process of problem framing can thus become an exercise in power (Slovic, 2000).

1.2.4 The institutional and policy analysis perspective

The preceding section has noted the distinctive, 'wicked' features of the climate 'problem structure'. To the complexity of the problems themselves must also