Climate change
vulnerability and adaptation indicators

ETC/ACC Technical Paper 2008/9
December 2008

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Executive summary

The purpose of this Technical Paper is to rehearse some fundamental concepts surrounding the development and delineation of adaptation indicators. It builds upon the outputs of an *Expert meeting on climate change vulnerability and adaptation indicators* (Budapest, September 2008) and on the contents of a Background Paper that was prepared for the meeting.

A major contemporary issue for policy and decision-makers is to understand and address the projected impacts of climate change and the related vulnerability of environmental, social, and economic systems. There is also a growing demand from stakeholders to share information on good practice in adapting to climate change impacts and to measure progress and effectiveness of resource commitments. Clarity over the primary purpose of such monitoring activity is crucial to guide the development of appropriate indicators. The nature and focus of indicators will depend on the desired purpose of the evaluation. Given the range of potential evaluation needs, it is unlikely that a single indicator or set of indicators would be universally applicable.

Adaptive management is a process for addressing the uncertainties implicit in planning for multi-decadal climate change. It is a theoretical approach, based both on scientific and practical experience, that serves to increase resilience and reduce vulnerability to climate change impacts. The approach has been developed to accommodate the policy challenges posed by adaptation and translates the established principles into a high-level policy context. Adaptation policies must ultimately aim to move human, economic and ecological systems along a path from climate vulnerable to climate resilient. Successful adaptation means that many adverse impacts are avoided and measures to accommodate change put in place. Because of its diverse nature, monitoring and evaluation of adaptation is challenging. A particular challenge relates to the importance of 'mainstreaming' adaptation. Adaptation indicators should, therefore, be precise, robust, transparent and objective; they should also be simple, clear and easy to understand.

Some key principles have been identified as the basis for a conceptual framework for the development of adaptation indicators. The framework focuses on planned adaptation to climate change impacts and makes linkages between:

- Building adaptive capacity, where indicators are needed to *monitor the progress* in implementing adaptation measures (so-called *process-based* indicators).
- Delivering adaptation actions, where indictors are needed to *measure the effectiveness* of adaptation policies and activities in general (so-called *outcome-based* indicators).

It is expected that a combination of process-based and outcome-based indicators will be needed in order to monitor progress in adaptation across Europe.

It is proposed that the conceptual framework should be developed further through testing on European biodiversity and in a European region and its utility then discussed in more detail at a second expert meeting in 2009.

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1 Introduction

1.1 The need for adaptation indicators

There is unequivocal evidence that climate change is happening and its impacts are already observable at many places on Earth, including in Europe. These impacts are expected to become more severe as changes in climate intensify in the near future. A major challenge for policy and decision-makers at different scales of governance is to understand how, where and in what form the projected impacts of climate change will occur. This task is complicated by a number of factors, not least being that the relationship between changes in climatic variables (e.g. changes in precipitation), impacts (e.g. increased flooding) and system response (e.g. adaptive capacity) is far from clear. A further complication is that vulnerability is dynamic and related both directly and indirectly to a range of environmental, social, economic and political factors. Vulnerability may be assessed to raise awareness of particularly threatened regions or communities, or to develop and implement strategies to reduce risk.

Despite stringent mitigations measures aimed at stabilizing global greenhouse gas concentrations, the impacts of climate change are likely to be large. There is therefore a need for all countries, developed and developing, to adapt to climate change. Adaptation offers opportunities to build resilience to climate change. Adaptation indicators are desirable for:

- Targeting, justifying and monitoring adaptation funding and programmes.
- Evaluating adaptation policy interventions.
- Informing future adaptation policy development.
- Comparing adaptation achievements across regions or countries.
- Communicating adaptation to the general public.
- Informing political climate change negotiations in the international arena.

There is also a growing demand from stakeholders to share information on good practice in adaptation to climate change and also to measure progress and effectiveness of resource commitments (e.g. monitoring and assessment of long-term investments in infrastructure to accommodate the growing risks of weather extremes). A further role for indicators is, therefore, as a communications tool to raise awareness in the policy community and among practitioners (whilst reaching out to the general public). For this reason, indicators should be as transparent as possible.

In order to rehearse some the fundamental concepts surrounding the development and delineation of adaptation indicators, the EEA convened an *Expert meeting on climate change vulnerability and adaptation indicators* in Budapest, Hungary on 3 – 4 September 2008. Prior to the meeting, the European Topic Centre on Air and Climate Change (ETC/ACC) prepared a Background Paper to initiate discussion on evaluation methods and indicators for climate change adaptation[1].

1.2 Defining adaptation

A crucial starting point in the consideration of adaptation indicators is the need to clarify the concept of "adaptation". Adaptation means slightly different things to different organisations[2] and OECD (2006)[3] has drawn together definitions of key terms used by the IPCC, UNFCCC Secretariat, UNDP and UKCIP; these include *adjustment*, *practical steps*, *process* and *outcome*. *Process* is an open-ended term lacking time or subject references. Adaptation as an *outcome* is likely to have more tangible results than adaptation as a *process*. These seemingly small differences create different levels of expectation from different stakeholders. For example, community-based adaptation practitioners might use a more technical interpretation than adaptation policymakers, who might use a broader definition

[1] Background Paper for expert meeting on climate change vulnerability and adaptation indicators, 3 - 4 September 2008, Regional Environmental Centre for Central and Eastern Europe, 2000 Szentendre, Hungary, Budapest

[2] E.g., Tompkins, E.L., Boyd, E., Nicholson-Cole, S.A., Weatherhead, K., Arnell, N.W. & Adger, W.N. (2005) Linking Adaptation Research and Practice, A report submitted to Defra as part of the Climate Change Impacts and Adaptation: Cross Regional Research Programme (GA01077)

[3] Levina, E. & Tirpak, D. (2006) Adaptation to Climate Change: Key Terms, COM/ENV/EPOC/IEA/SLT(2006)1 (Paris; OECD)

and emphasize the institutional/policy aspects. These varied interpretations have implications for monitoring and evaluating outcomes and developing adaptation indicators.

Definitions of adaptation

"Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation" (IPCC 4AR, 2007)

"Practical steps to protect countries and communities from the likely disruption and damage that will result from effects of climate change. For example**,** flood walls should be built and in numerous cases it is probably advisable to move human settlements out of flood plains and other low-lying areas…" (UNFCCC)

"…a process by which strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented" (UNDP, 2005)

"The process or outcome of a process that leads to a reduction in harm or risk of harm, or realization of benefits associated with climate variability and climate change" (UKCIP, 2003)

1.3 Reasons for developing adaptation indicators

The nature and focus of indicators developed to monitor adaptation will depend strongly on the desired purpose of the evaluation. At least five roles can be envisaged in the European policy context:

- Member State governments wishing to evaluate the success of national adaptation policies and inform future policy development.
- European institutions and agencies wishing to evaluate the standard of adaptation across the EU and within Member States to justify funding and programme decisions.
- European funding bodies wishing to evaluate the impact of adaptation supported across the EU and within Member States to account for funding and inform programme planning.
- International community wishing to develop a comparative measure of the adaptation status of the EU and its Member States in the context of international climate change negotiations.
- International funding bodies (to which EU Member States provide substantial resources) wishing to evaluate the impact of adaptation supported across especially non-Annex I (developing) countries to account for funding and inform programme planning.

While there may be overlap between these roles, there are also clear distinctions. A national government evaluating the success of adaptation policies will need to use indicators that are logically tied to stated policy goals and that chart progress towards policy targets (although this role is largely hypothetical at present as most countries are some way from defining this kind of adaptation policy monitoring framework). Adaptation indicators required by European institutions and agencies may serve two distinct purposes. Firstly, in planning and reviewing funding and programme activities, there may be a need to track adaptation across different regions of the EU, or between Member States, to ensure that activities and investments are directed towards the greatest need and/or where they will make the greatest difference; adaptation indicators in this case should be transferable from one region or country to another. Secondly, there may be a need to monitor the efficacy of activities and investments in adaptation interventions in a given region or Member State by measuring the impact over a given period; in this case, adaptation indicators should be scalable from community to national level, or from project to programme level. In the international political arena, indicators that provide some comparative measure of a country's "adaptation status" might prove instrumental in strengthening the case for particular international climate targets.

Given the range of potential evaluation needs, it is unlikely that a single indicator or set of indicators for adaptation at national or EU level would be universally applicable. Additionally, since climate change adaptation is still a relatively new policy area, there is little in the way of good practice, particularly at national level, to draw on. Finally, a further key complication in developing indicators

relates to the difficulty in separating progress in adaptation from progress achieved by broader sectoral policies. Since good adaptation is primarily delivered by "mainstreaming" climate resilience (or similar concepts) across sectors and policy areas (i.e. making changes to a policy area because of climate change), there will be problems of attribution. Indicators may, therefore, require sector-specific dimensions.

1.4 Purpose and structure of this Technical Paper

The purpose of this Technical Paper is to rehearse some fundamental concepts surrounding the development and delineation of adaptation indicators; it builds on available literature, the professional judgement of the authors and the key outputs of the Expert Meeting. The latter were captured in a set of minutes; these not only informed this paper but were also developed as background information for EEA's *2nd EIONET workshop on climate impacts, vulnerability and adaptation* (Copenhagen, Denmark on 9 – 10 October 2008)[4]. It is hoped that the paper will assist the EEA and ETC/ACC in defining the next steps for work in this field. The focus is on adaptation indicators, rather than vulnerability indicators, although it shows how the two may be connected so that the latter can be explored in a related way in due course.

The paper has four main chapters. Subsequent to this introduction, the theoretical basis of climate impacts, vulnerability and adaptation is given in Chapter 2. The jump into adaptation indicators is made in Chapter 3, giving different concepts and key components. Finally, the key findings, conclusions and next steps are enumerated in Chapter 5.

[4] Minutes from expert meeting on climate change vulnerability and adaptation indicators, 3 - 4 September 2008, Regional Environmental Centre for Central and Eastern Europe, 2000 Szentendre, Hungary, Budapest.

2 Fundamental concepts in adaptation

2.1 Climate impacts, vulnerability and risk

Climate impacts, vulnerability and risk are distinct but related concepts (Figure 2.1). Impacts may be beneficial or harmful, with most observations and projections showing a range of effects on the environment, economy and society. The vulnerability of a system is defined as the degree to which it is susceptible to and unable to cope with the adverse effects of climate change, including climate variability and extremes. It is a function of the character, magnitude and rate of change and variables to which the system is exposed, its sensitivity, and its adaptive capacity. Sensitivity relates to the degree to which a system could be affected, either adversely or beneficially, by climate-related stimuli. Adaptive capacity is the ability of a system to adjust to climate change, to moderate potential damage, to take advantage of opportunities, or to cope with consequences. The concept of risk is often confused with vulnerability. Risk relates to a characteristic of a system or a decision where the probability that certain states or outcomes have occurred or may occur is precisely known. Risk assessments combine the probability of an event occurring, with the impact or consequence associated with that event.

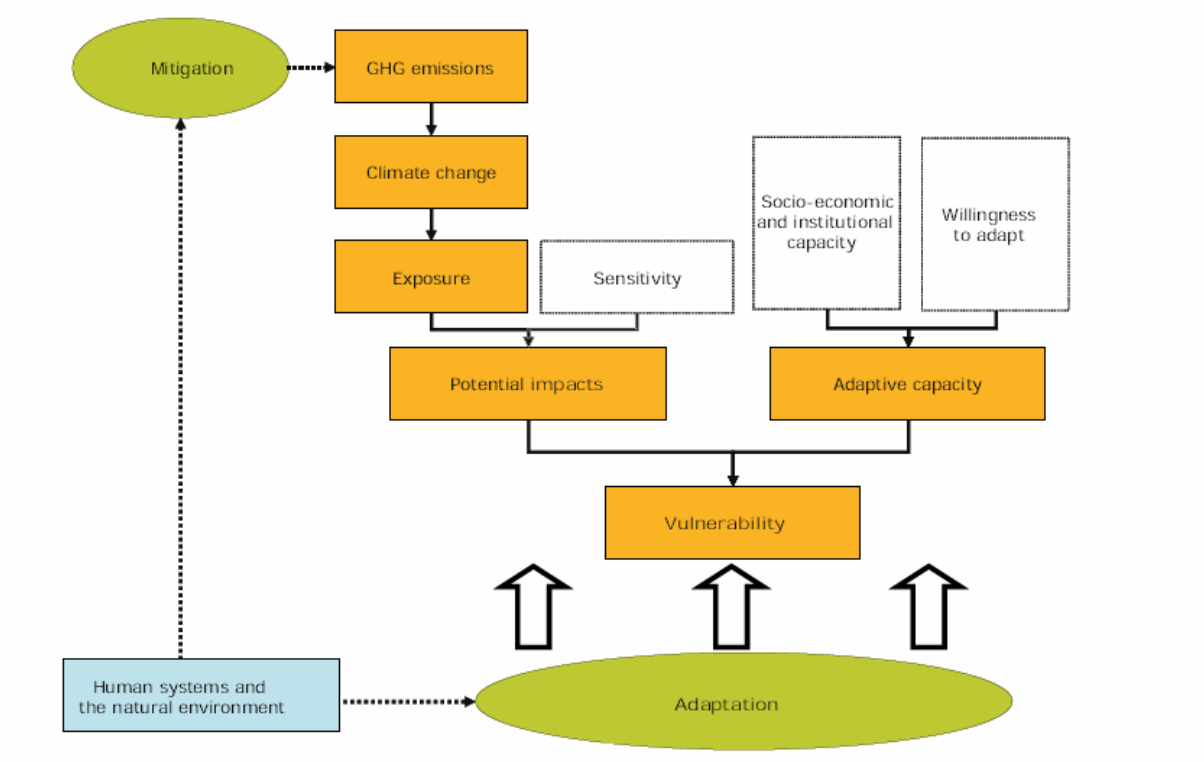

Figure 2.1: Conceptual diagram for climate impacts, vulnerability and adaptation[5]

2.2 Vulnerability indicators

The concept of vulnerability appears frequently in both scientific reports and policy documents. It has important communicative value: it captures notions of possible loss, damage and impact; of threat, risk and stress; of uncertainty and insecurity; of a lack of power and control; and of a number of other factors that contribute to a feeling or state of being vulnerable. The word “vulnerability” is also in

[5] European Environment Agency. 2008. Impacts of Europe’s changing climate: 2008 indicator based assessment (Ch.6. Adaptation to climate change; figure from Isoard, Grothmann and Zebisch (2008)).

widespread common use and, as a result, most people have an intuitive understanding of what the term means.

At the macro-scale, relatively coarse estimates of vulnerability have been generated by combining some measure of exposure (e.g. change average temperature) and some measure of adaptive capacity under a scenario-based approach (e.g., Yohe *et al,* 2006[6]). While this approach has proved useful as a broad-brush tool to identify consequences of different degrees of mitigation response at a global level, it may not prove to be detailed enough to give a realistic measure of vulnerability at higher resolutions to inform European adaptation policy.

Vulnerability is highly dependent on context and scale. The methods and frameworks for assessing vulnerability must also address the determinants of adaptive capacity in order to examine the potential responses of a system to climate variability and change. In some quantitative approaches, the indicators used are related to adaptive capacity, such as national economic capacity, human resources, and environmental capacities. Other studies include indicators that can provide information related to the conditions, processes and structures that promote or constrain adaptive capacity.

Indicators of vulnerability promise to provide a credible and transparent means by which decision-makers can identify priority needs and so justify certain types of action. However, given the range of potential evaluation needs, it is unlikely that a single indicator or set of indicators for vulnerability at national or EU level would be universally applicable. Additionally, because this work is in its infancy, there is little in the way of good practice: we are not at the stage of having widely accepted and useable vulnerability indicators.

2.3 Building adaptive capacity

Determinants of adaptive capacity have been widely debated in the literature and include the following:

- The range of available technological options for adaptation.
- The availability of resources and their distribution across the population.
- The structure of critical institutions, the derivative allocation of decision-making authority, and the decision criteria that would be employed.
- The stock of human capital, including education and personal security.
- The stock of social capital, including the definition of property rights.
- The system's access to risk-spreading processes (e.g. insurance).
- The ability of decision-makers to manage information, the processes by which they determine which information is credible and the credibility of the decision-makers themselves.
- The public's perceived attribution of the source of stress and the significance of exposure to its local manifestations.

2.4 Adaptive management

Adaptive management is a process for addressing the uncertainties implicit in planning for multi-decadal climate change. It is a theoretical approach based both on scientific and practical experience and provides a pro-active pathway to successful adaptation that should serve to increase resilience and reduce vulnerability to climate change impacts. Adaptive management is applicable across all spatial scales (EU, national, regional, local) and allows consideration of other agents of change at the same time as mainstreaming adaptation into policy.

[6] Yohe, G., E. Malone, A. Brenkert, M. Schlesinger, H. Meij, X. Xing, and D. Lee. 2006. "A Synthetic Assessment of the Global Distribution of Vulnerability to Climate Change from the IPCC Perspective that Reflects Exposure and Adaptive Capacity." Palisades, New York: CIESIN (Center for International Earth Science Information Network), Columbia University. http://ciesin.columbia.edu/data/climate/

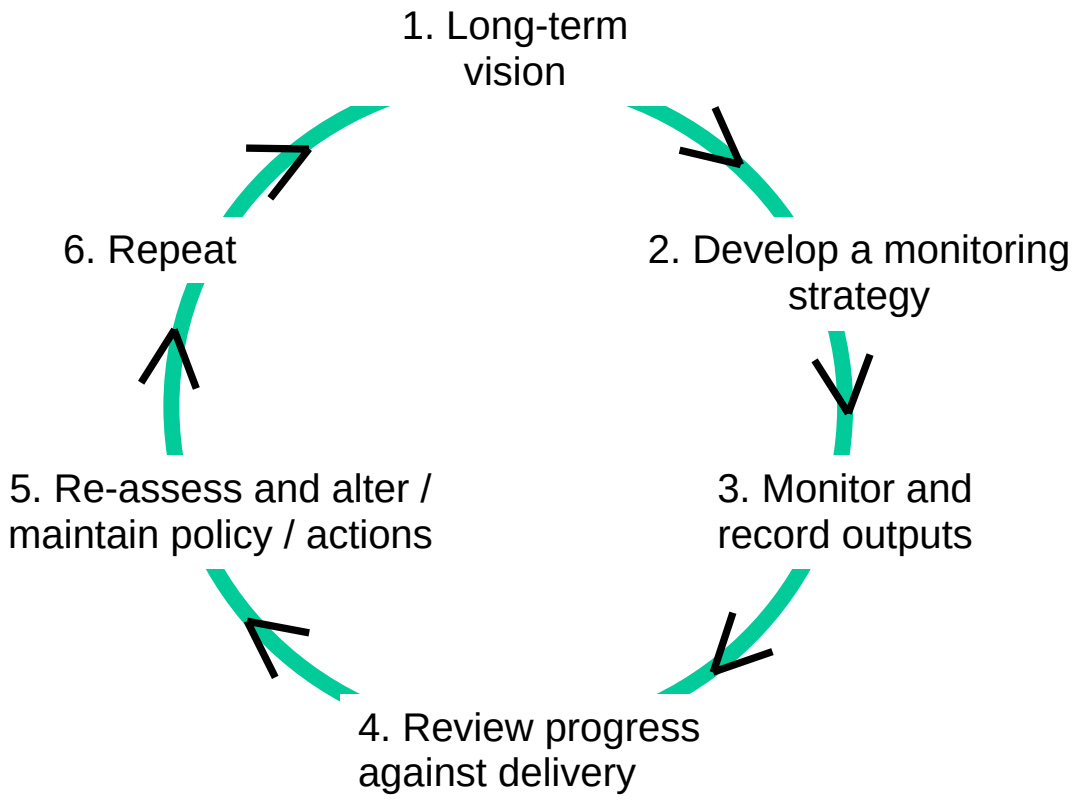

Figure 2.2: Principles of adaptive management

The six core principles, illustrated in Figure 2.2 and described below, are based on a continuous review cycle:

1. Assign a long-term **vision** underpinned by scenarios (and their uncertainties) and the projection of impacts at the current time.
2. Develop a monitoring **strategy** to evaluate the impact of actions, and continually review and re-assess the long-term vision (recognising that the vision may not be correct or achievable). This is likely to include both policies and actions at a range of levels (including sector-specific).
3. Undertake the first element of **monitoring** and record the outputs.
4. **Review** progress and the direction of travel against delivery of actions.
5. **Re-assess** policy and actions in light of new evidence, scenarios and projections. Maintain or adjust these as appropriate and accept that this may change the trajectory of the long-term vision.
6. **Repeat** the process on an agreed timescale that fits into existing cycles.

2.5 Policy framework for adaptation

A theoretical approach[7] designed specifically to accommodate the challenges posed by adaptation is illustrated in Figure 2.3, below. The method developed is circular and iterative, and translates the principles established for adaptive management into a high-level policy context. It allows for input from individual sectors to occur concurrently and somewhat independently, and requires engagement with a range of stakeholders at various stages in its application. It is crucial that the process is initiated and driven by a central champion setting the adaptation policy vision. It is then envisaged that individual sectors would take a proactive role in driving the process forward. Under this model, adaptation

[7] Horrocks, L., Mayhew, J., Hunt, A., Downing, T., Butterfield, R. & Watkiss, P. (2005) Objective Setting for Climate Change Adaptation Policy, AEA Technology Environment with Stockholm Environment Institute and Metroeconomica for Defra (unpublished)

indicators are developed as part of the responsibility of the sector leads. These indicators are directly related to specific sectoral targets identified in the policy development process. It should also be noted that the development of objectives, targets and indicators precedes the selection and implementation of adaptation options.

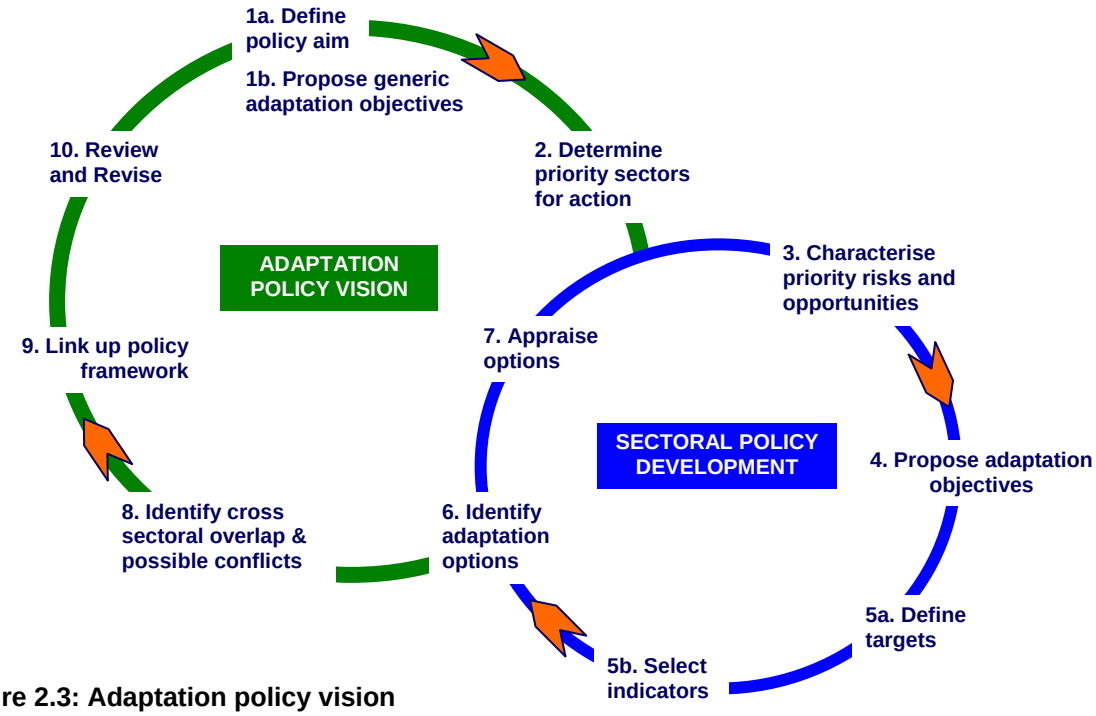

Figure 2.3: Adaptation policy vision

3 Developing adaptation indicators

3.1 From vulnerability to resilience

Adaptation policies must ultimately aim to move human, economic and ecological systems along the path from climate vulnerability towards climate resilience (Figure 3.1). Good adaptation policies will do so in an effective, efficient, equitable, flexible and sustainable manner. Resilience is the antithesis of vulnerability. It describes the amount of disturbance a system can absorb while still remaining in the same state or maintaining function: the degree to which a system is capable of reorganisation and renewal, the degree to which a system can build and increase its adaptive capacity. Understanding vulnerability and resilience is fundamental to the development of sustainable adaptation strategies. Firstly, the value(s) of the system must be determined (what services does it provide; what are its intrinsic values; what components are necessary to retain value and limit change?). Then, the risk to the values of the system can be assessed (impacts, vulnerabilities and probability of occurrence). This can be used to determine the cost of impacts to the system. Finally, adaptation responses can be developed based on the goal of increasing the system's resilience in order to maintain and enhance value.

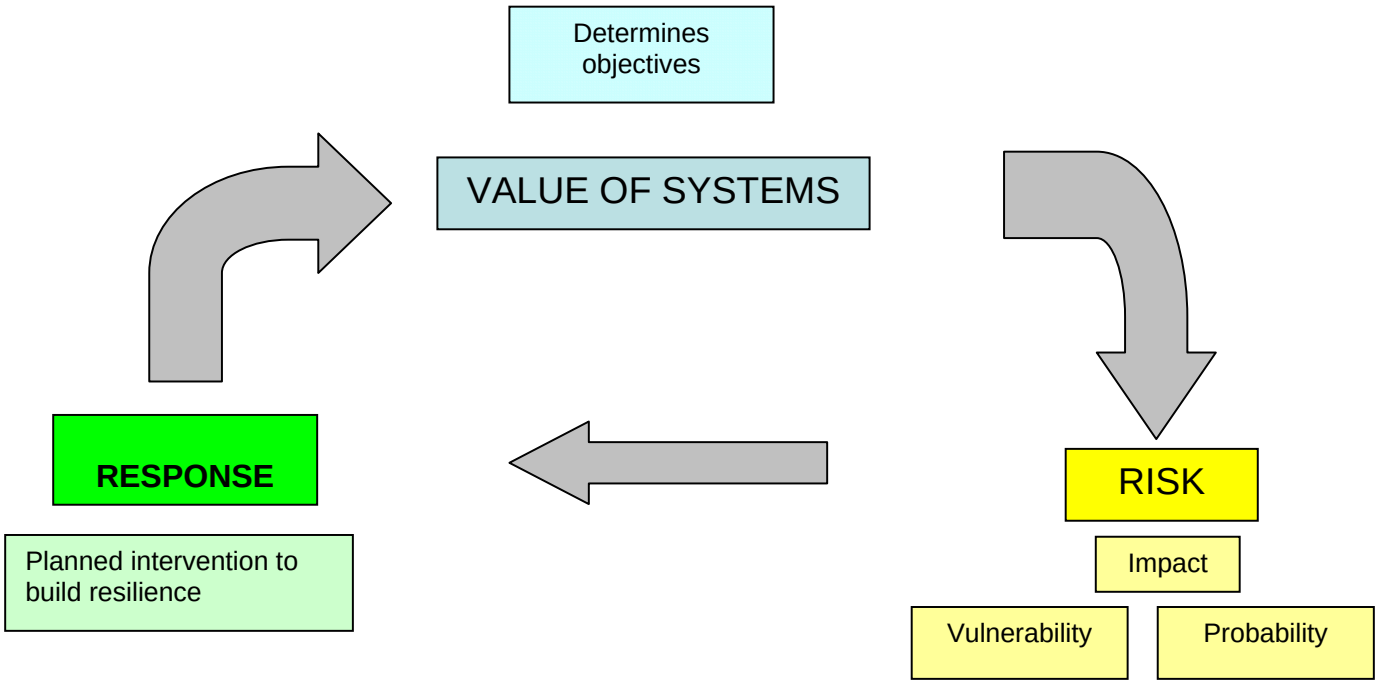

Figure 3.1: From vulnerability to resilience.

Source: Caroline Cowan, Natural England; unpublished 'work in progress' (2008).

For some purposes (e.g. comparative assessment of national adaptation status), it would be useful to monitor progress along a spectrum from climate-vulnerable to climate-resilient (e.g. changes in sensitivity to potential hazards and changes in adaptive capacity reducing vulnerability and increasing resilience).

3.2 Challenges in developing adaptation indicators

The particular issues surrounding the development of indicators for measuring effectiveness in adaptation have been discussed in a number of publications[8]. The nature of adaptation makes it particularly challenging for monitoring and evaluation using standard approaches (e.g. *via* individual, quantitative, outcome-based indicators) because of a range of factors:

- The long timescales associated with climate change, the difficulties with distinguishing the "noise" of natural climate variability from anthropogenic climate change, and the indirect impacts of climate-driven socio-economic change.

- The moving baseline presented by climate change (i.e. evaluation against a backdrop of a changing norm).

- The need for effective adaptation to safeguard against potential discontinuities and surprises resulting from climate variability, and the inherent uncertainty associated with climate projections.

- The mix of hazards and opportunities (e.g. taking advantage of opportunities such as longer growing seasons may increase exposure to hazards such as mid-season drought).

- The multi-sectoral nature of adaptation and the involvement of a large number of responsible organisations and delivery partners at different scales (e.g. each may have different requirements for indicators and their own appropriate monitoring and evaluation systems and information networks).

- The inherent challenges of defining a long-term vision of the outcome of adaptation, since it constitutes the process of making adjustments to everything else (infrastructure, livelihoods, institutions, etc).

- The absence of agreed definitions of acceptable performance in adaptation, or even agreement over what constitutes success, coupled with the wide range of potential adaptation activities and a need for multi-stakeholder agreement on levels of acceptable risk.

An additional challenge relates to the importance of "mainstreaming" adaptation. Specific adaptation interventions (e.g. at project level) may be measured in the context of the sector and local community at which they are targeted. However, at the national or European level, adaptation and its monitoring and evaluation requires strong coordination across sectors, policies, strategies and plans. Progress in addressing climate change requires adaptation to move from an environmental challenge to one that also includes economic and social policy.

Successful adaptation should mean that many adverse impacts are avoided. However, as the impacts to be avoided are not expected to occur until some time in the future, the absence of events or progress in advance of the event is difficult to measure. Good adaptation is likely to involve a range of incremental activities (adaptive management) across related sectors; these may be difficult to distinguish from other sectoral activities and, to report effectively on progress, may need a new approach to be determined and agreed.

The decision context is critical: whether present-day or future vulnerability is the target, the relevance to specific stakeholders and their planning frameworks, and the use in various decision analyses (from narratives and policy exercises to cost-benefit analysis). The need for precision, robustness, transparency, and objectivity are common concerns. Scale issues require consideration, including the resolution of the indicator (e.g., the water resource zone or government planning districts), time period for events and trends, and aggregation to the national level (e.g., loss of information about 'hotspots').

Indicators for vulnerability and adaptation should be precise, robust, transparent and objective. They should also be simple, clear and easy to understand. Some indicators already in use are indirectly

[8] See, for example, Horrocks, L., Mayhew, J., Hunt, A., Downing, T., Butterfield, R. & Watkiss, P. (2005) Objective Setting for Climate Change Adaptation Policy, AEA Technology Environment with Stockholm Environment Institute and Metroeconomica for Defra (unpublished)

related to adaptation, so any new indicators should avoid duplication of these. Instead, monitoring should include assessments of the extent to which wider sectoral policies and actions are contributing to adaptation.

3.3 Process- and outcome-based indicators

There are a number of approaches that could be used to develop adaptation indicators. In general, it is important that indicators are relevant and measurable at different spatial and temporal scales. If adaptation were seen as a decision process, rather than a specific action or series of outcomes, then approaches (including monitoring frameworks) are needed to inform and justify decisions, and to assist decision-makers and stakeholders who have an interest in the outcomes of their decisions to progress strategically and proactively through the adaptation process. If adaptation were seen as an outcome (e.g. climate change resilient sectoral policies), then monitoring and indicators would logically need to focus on the long-term effectiveness of policy decisions in the face of the changed climate.

The tables below illustrates important distinctions between *monitoring progress* in implementing adaptation measures in particular (so-called *process-based* indicators), and *measuring the effectiveness* of adaptation policies and activities in general (so-called *outcome-based* indicators).. Process-based indicators seek to measure an agreed course of action and chart progress towards the desired outcome. There is no guarantee, however, that successful progress and achievement of the measure will also mean that effective adaptation is taking place (if the measure is well researched and part of a wider well-designed adaptation strategy, there is more likelihood of it delivering effective adaptation). The task of measuring the effectiveness of an adaptation policy or programme is more challenging. The development of appropriate indicators should (logically and ideally) follow agreement of long-term goals and definition of medium and short-term objectives and targets.

Indicators	
Process-based	A *process-based* approach seeks to define the key stages in a process that would lead to the best choice of end point, without specifying that point at the outset. This is an 'upstream' approach in the sense that it seeks to provide enhanced capacity to manage a range of outcomes. Indicators are needed to inform and justify decisions, and to assist decision-makers and others to progress strategically and proactively through the adaptation process.
Outcome-based	An *outcome-based* approach seeks to define an explicit outcome, or end point, of the adaptation action (e.g. increased drainage capacity to cope with more intense winter precipitation events). This might also be referred to as 'downstream' in the sense that the focus is on the residual effects of risks as experienced. Indicators should focus on the long-term effectiveness of adaptation policy decisions in the face of the changed climate.

Process-based indicators	***Outcome-based indicators***
<u>Advantages</u> Allow stakeholders/sectoral experts to choose the most appropriate adaptation action to meet an outcome. Flexible approach – can adjust to new information as it becomes available.	<u>Advantages</u> Most other government policy objectives/targets are outcome-based. May be possible to link adaptation objectives with objectives in other policy areas.

Process-based indicators	***Outcome-based indicators***
	Likely to be sector-specific.
<u>Disadvantages</u> Defining a process does not guarantee successful adaptation. A different approach from most other government targets, so more limited experience. May be difficult to integrate adaptation targets with objectives in other policy areas (because they are different in nature). Not necessarily sector-specific.	<u>Disadvantages</u> Defining an outcome does not guarantee successful adaptation. Risk of being overly prescriptive of adaptation options (specifying sub-optimal options). May be inflexible and make it difficult to introduce new information (though great scope for flexibility in implementing specific actions to achieve outcome).

It is expected that a combination of process-based and outcome-based indicators will be needed in order to monitor progress in adaptation across Europe. Given that adaptation policy is still at a relatively early stage of development, it is likely that process-based indicators will be the focus initially. However, a gradual shift towards outcome-based indicators is probably desirable, once policy goals and programme targets can be more clearly defined.

The outcome-based approach is compatible with most other policy areas and provides a clear but long-term goal on which to focus. However, there is a danger that the initial choice of endpoint based on incomplete information at the outset could constrain effective adaptation so that what results is not a cost-effective or feasible outcome.

3.4 Attribution

A further complication in developing indicators relates to the difficulty in separating progress in adaptation from progress achieved by broader sectoral policies. Good adaptation is primarily delivered through "mainstreaming" and usually involves a range of incremental activities in related sectors: if 'successful' adaptation also means 'cost-effective' adaptation, then the best options are likely "to go with the grain" of sectoral policy development. This means that adaptation progress within a given sector may be difficult to attribute to adaptation policies or programmes as distinct from any wider sectoral advances.

The issue of attribution in developing sound indicators is crucial, and depends on the purposes for which monitoring is being carried out. If indicators are needed in order to show that a particular policy, project or investment has been worthwhile, then it will be essential to find ways to attribute measured successes to those individual actions. By contrast, if the only purpose for developing an indicator (or set of indicators) is to measure the status of the system and to observe trends, then attribution of any movement in those indicators to particular actions or agents is less important.

The uncertainties and long timescales associated with climate change impacts do not permit adaptation measures and strategies to be effectively evaluated in the short-term[9]. Consequently, p*rocess-based* indicators may be more appropriate for monitoring and evaluating adaptation. The *process-based* approach also allows the introduction of new information and activities to shape the course of adaptation at later stages following incremental review (adaptive management).

Attributing positive or negative trends in indicators to proactive adaptation (as opposed to other 'reactive' determinants) is difficult. Other determinants include:

- Changes in the climatic situation (whether or not climate event occurs).
- Changes in the socio-economic situation.

[9] See for example "Linking adaptation research and practice" report (Tyndall Centre, 2005) for Project F in Defra's Climate Change Impacts and Adaptation Cross-regional Research Programme.

- Sectoral policy developments not associated with climate change.

Whether attribution matters depends upon the reason for the evaluation:

- To prove that a policy intervention has worked.
- To demonstrate that adaptation funding has been effective.
- To compare the status of one Member State to another.

3.5 Key principles for defining adaptation indicators

The following set of key principles has been identified as important in the development of a framework for adaptation indicators. Indicators should:

- Sit in the spectrum between vulnerability and resilience.
- Fit within the concept of adaptive management.
- Focus on monitoring progress rather than measuring effectiveness.
- Be sectorally distinct.
- Include checklist-type indicators.
- Include process-based and outcome-based indicators.
- Include narrative reporting alongside quantitative indicators (to provide context and explanation).
- Be used to avoid mal-adaptation.
- Be simple and transparent for communication purposes.
- Be dependant upon the purpose of the evaluation.
- Not duplicate pre-existing indicators.

3.6 Relationship between different categories of indicators

There are a number of categories of indicators that relate to adaptation which could help in its monitoring; these include measures of awareness, knowledge and engagement, measures of changing exposure, measures of changing vulnerability or adaptive capacity, and measures of changes in actual impacts. Each of these categories could serve a different monitoring purpose, and it is instructive to first reflect upon how different categories relate to fundamental elements in the concept of adaptation to climate change.

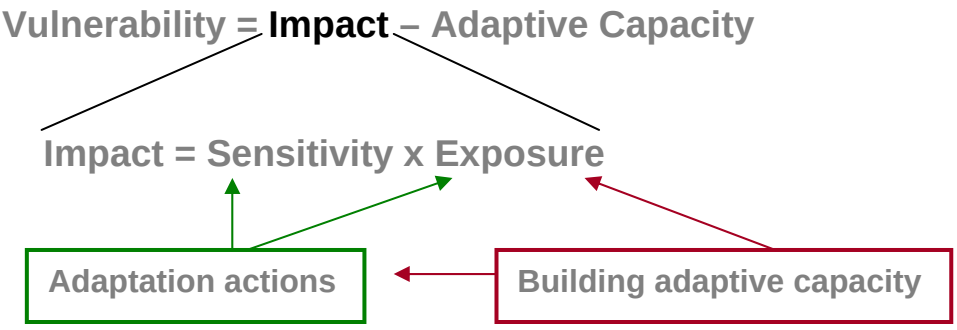

Figure 3.2: Conceptual relationship between adaptation, impacts, adaptive capacity and vulnerability

Figure 3.2 illustrates the conceptual relationship between adaptation and vulnerability. Adaptation actions (essentially reactive) seek to address the felt impacts of climate hazards through adjustments to sensitivity and/or exposure, while building adaptive capacity (essentially proactive) can provide additional headroom to reduce vulnerability. Thus, depending upon the decision context determining the reason for monitoring effort, separate sets of indicators to measure adaptation actions and building adaptive capacity are warranted. Furthermore, any overall measure of climate vulnerability should in

some way provide a proxy for (or be strongly related to) the sum of the measures for adaptation action and building adaptive capacity.

The complicating factor here, however, is that felt impacts depend not only on the extent and effectiveness of adaptation measures, but also on the actual weather events that occur. So indicators of climate impacts are rarely useful or direct measures of adaptation actions, and indicators of vulnerability are also strongly dependent upon the actual or projected weather and climate.

Nevertheless, it is envisaged that policy-makers and fund managers may find indicators of adaptation action, adaptive capacity, vulnerability and even climate impacts useful in different contexts, depending upon the individual purpose of their monitoring activity.

3.7 The key components of adaptation indicators

There are many different approaches to describe adaptation, but what they all have in common is that, ultimately, actions are locally specific and the result of a process that considers local climatic, environmental, socio-economic and cultural factors. Adaptation can be autonomous or planned, and can be carried out in response to or in anticipation of changes in climatic conditions. There are also huge differences across Europe in institutional adaptive capacity and the readiness of organisations and individuals to adapt.

In working towards the identification of adaptation indicators, it is first necessary to develop a conceptual framework for adaptation and understand the theoretical building blocks that will make up such a framework (Figure 3.3). There are two key components here. The first relates planned and autonomous adaptation to process and outcome-based indicators, and splits planned adaptation into building adaptive capacity and delivering adaptation actions. This provides a means for assessing the cost effectiveness of measures, the time scale for measures, the irreversibility of outcomes, and mal-adaptation.

		Process	Outcome
Planned	**Building adaptive capacity**	**X** e.g. UK LA NI 188 **	
	Delivering adaptation actions	**X** e.g. Heat alert	**X** e.g. Heat alert related benefits *#
Autonomous	**Autonomous (good)**		**X** e.g. Crop patterns #
	Autonomous (mal-adaptation)		**X** e.g. desalination

* Impact or adaptation; # Issue of attribution
** See details in contribution, Annex 1

After Watkiss, 2008

Figure 3.3: Typology for development of adaptation indicators

The second component (Figure 3.4) defines levels in building adaptive capacity that could support the delivery of adaptation actions through, for example, target setting and assignation of funding.

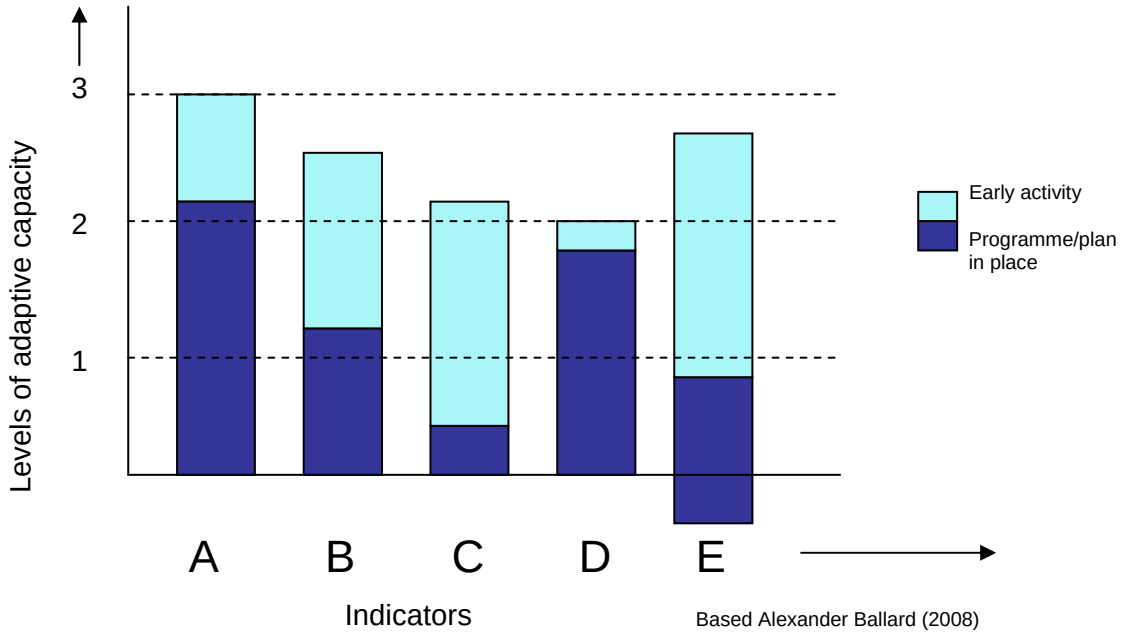

Figure 3.4: Levels and indicators for building adaptive capacity

The level of adaptive capacity would be determined by, for example[10]:

- Availability of climate change scenarios.
- Availability of vulnerability assessments.
- Availability of disaster plans.
- Identification of crosscutting issues (e.g. links to other sectors).
- Level of stakeholder engagement.
- Availability of local adaptation guidance.

A key strength of this approach is that it can be related to indicators that link the development of adaptive capacity with EU and Member State policy:

- Indicators may be generic at EU level.
- Indicators can also be used at sector-specific levels.
- Indicators can compare performance between sectors within Member States (and therefore can be used to assign adaptation funding at Member State level).
- Indicators can also be used to make comparisons between Member States (and feed into existing EEA score card reporting).

3.8 Framework for developing adaptation indicators

The concepts and issues discussed in preceding sections of this paper provide the conceptual basis for a framework for the development of adaptation indicators. The framework focuses on planned adaptation to climate change impacts and makes linkages between building adaptive capacity and delivering adaptation actions in terms of process and outcome. This is seen as being a necessary part of a logical theoretical and practical basis for defining adaptation indicators. The two-tier conceptual framework advocated here should provide the EEA with a robust tool to monitor progress in adaptation to climate change at all levels in Europe.

[10] See also CCCIAR (2008) Wise Adaptation to Climate Change. Committee on Climate Change Impacts and Adaptation Research

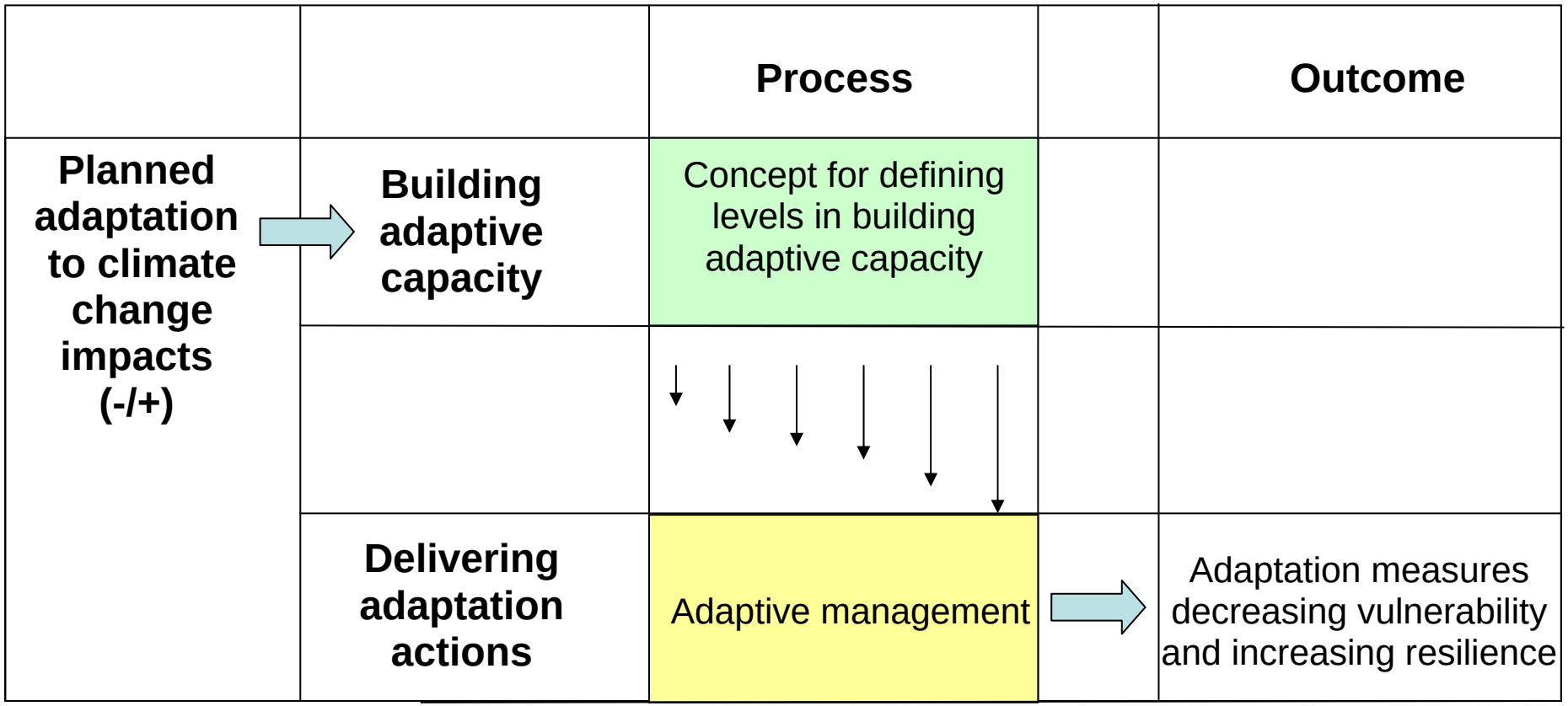

Figure 3.5: Conceptual adaptation framework (Watkiss and Harley, 2008)

Building adaptive capacity: criteria and process indicators

The conceptual framework for adaptation builds on the concept of response levels in defining adaptive capacity (Alexander Ballard, 2008[11]). Response levels should be tailored according to specific policy needs (i.e. local institutions to the EU level) and considered alongside other approaches (e.g. ATEAM[12]) when developing indicators of adaptive capacity.

When considering the development of such indicators, it is important to distinguish between indicators of adaptive capacity *per se* and those that measure progress in building adaptive capacity. There are two clearly defined pathways to monitoring the quality of implementation by sectors and institutions. Related information must be captured, ideally through the Climate Change Impacts and Adaptation Clearinghouse Mechanism, and assessed by the EC and EEA:

1. **Top down:** monitoring of activities that are closely related to the availability of national adaptation strategies/action plans (these are advanced in some Member States and do not exist in others). A suitable process-based indicator of adaptive capacity might be: Is a national adaptation framework in place and what spatial scale does it cover?

2. **Bottom up:** monitoring of activities that bring together local knowledge and experience. Despite considerable variation in the availability of national guidance, local experiences could be informing local action where no such framework exists. A suitable process-based indicator of adaptive capacity might be: Are local level experiences informing actions within and across sectors?

Delivering adaptation actions: adaptive management and outcome indicators

Adaptive management is a cyclical approach to adaptation that accommodates the uncertainties in planning for climate change over long time horizons. It is aimed at multi-decadal planning, is applicable across all spatial scales and, through a process on continual evaluation and review, should be effective in progressively increasing resilience and reducing vulnerability to climate change impacts. Outcome-based indicators should be established to monitor progress through the adaptive management cycle, in accord with the specific objectives set at each stage in the process (see Figure 2.2). These should provide data from which to:

- **Record** the results of monitoring the effectiveness of policies and actions and the impacts of these actions.
- **Evaluate** policies and actions, both in terms of short-term objectives and targets, and in delivering the long-term vision.
- **Review** progress and the direction of travel against the delivery of policies and actions.
- **Re-assess** policies, actions and the long-term vision in light of new evidence, scenarios and projections.

Robust indicators will be fundamental to effective monitoring and should be revised as the process enters successive cycles.

[11] Alexander Ballard Ltd and Hampshire County Council (2008) Adaptation Capacity Benchmarking: A Handbook and Toolkit. Project carried out for Hampshire County Council on behalf of the ESPACE (European Spatial Planning: Adapting to Climate Events) extension project September 2007 to May 2008

[12] ATEAM (Advanced Terrestrial Ecosystem Analysis and Modelling) www.pik-potsdam.de/ateam/

4 Summary and next steps

4.1 Summary

A major contemporary issue for policy and decision-makers is to understand and address the projected impacts of climate change and the related vulnerability of environmental, social, and economic systems. Disentangling the complexity of reducing vulnerability in relation to its underlying causes is a challenge that requires the development of robust adaptation policy and associated measures. Within this context, adaptation indicators are desirable for: targeting, justifying and monitoring adaptation funding and programmes; evaluating adaptation policy interventions; informing future adaptation policy development; comparing adaptation achievements across regions or countries; communicating adaptation to the general public; and informing political climate change negotiations in the international arena.

The purposes of this Technical Paper are to explore the theoretical and practical basis for defining adaptation indicators and then establish a conceptual framework for their development. The framework focuses on planned adaptation to climate change impacts and makes linkages between building adaptive capacity and delivering adaptation actions. The framework advocated here provides a robust tool to monitor progress in adaptation to climate change at all levels in Europe.

There is an important distinction between *process-based* indicators (i.e. for *monitoring progress* in implementing adaptation measures, and *outcome-based* indicators (i.e*. measuring the effectiveness* of adaptation policies and activities in general).

While the development of adaptation indicators faces a number of complex challenges, these can be reduced through a clear focus on the specific goals of individual monitoring activities. In order to make real progress in monitoring adaptation, policy-makers will need to set clear objectives for both their adaptation policies and their evaluation efforts. Initial practical solutions can be formulated by capitalising on links and overlaps with existing monitoring frameworks in climate-sensitive sectors.

The benefits of developing indicators to monitor adaptation are considerable:

1. They provide a framework with potential to develop links across sectors and at all levels through which to monitor and evaluate policy goals and outcomes.
2. They provide a means to communicate with wider stakeholders.
3. They are an essential step towards mainstreaming adaptation through links with related indicators (e.g. sustainable development).

4.2 Next Steps

The framework will be developed further in 2009 by testing the current ideas on European biodiversity and in a European region. A second Expert Meeting will then follow, at which the utility of the framework will be discussed in more detail. There is a range of related issues, some of which might be explored at the meeting; these include:

- The specific purposes of monitoring and evaluation (as this influences the kinds of indicators that will be needed).
- The major stakeholders in monitoring adaptation (including the role of the EEA).
- The spatial resolution and geographical coverage of indicators, and the levels at which these should be focused (EU, Member State, sectors, local stakeholders/institutions).
- The need for new indicators and links with existing indicators (including sustainable development and environmental indicators that may interface with adaptation).
- The relationship with the EC Climate Change Impacts and Adaptation Clearinghouse Mechanism.
- The need for links with vulnerability indicators (including measures of adaptive capacity).

The resulting Technical Paper might then address how adaptation indicators link to vulnerability and economic indicators, how indicators help in defining and avoiding mal-adaptation, and how monitoring and evaluation can be used to encourage good practice in adaptation.

Annexes

Annex 1: Existing datasets and information sources relevant to adaptation indicators

Annex 2: Examples of adaptation measures

Annex 3: Example of a process-based indicator for monitoring English local government progress in adaptation

Annex 4: Reporting on adaptation

Annex 1: Existing datasets and information sources relevant to adaptation indicators

The reference list below captures a cross section of approaches to indicator sets and provides an initial insight into which indicators might be useful from the perspective of adaptation (it is important to note that this is not a complete overview). In particular the most relevant and useful is the list of about 40 impact indicators of the 2008 EEA/JRC/WHO report on climate change impacts (to be published Sep 2008). This report also contains a chapter on economic and sectoral impacts that can form the basis for further discussions.

- Core Set of Indicators (CSI)[13]
- Energy and Environment (EN)[14]
- Transport and Environment (TERM)[15]
- Agriculture and Environment (IRENA)[16] indicators
- DG AGRI reports 'Adaptation to Climate Change in the Agricultural Sector' and 'Impacts of climate change on European forests and options for adaptation'[17]
- Greenhouse gas emission trends and projections in Europe - indicators (annual report)[18]
- Impacts of Europe's changing climate (2008 edition) - indicators[19], update to be published end Sep. 2008 (joint EEA/JRC/WHO report)
- SEBI2010 indicators (report due in 2009)[20]
- Freshwater and marine indicators (WISE)[21]
- EMMA project (Adriatic coastal area, eutrophication and anoxic events)[22]
- Eurostat structural and sustainable development indicators[23] (note that Eurostat has finalized an extensive study on streamlining of indicators with a full overview of all the sets mentioned and the possible overlaps with next steps to be discussed with EEA and JRC in autumn)
- DG REGIO note on climate change in view of the preparation of the White paper on regional cohesion[24]
- OECD Economic Aspects of Adaptation to Climate Change: Costs, Benefits and Policy Instruments[25]
- IGES/World Bank Expert Consultation on Adaptation Metrics (Tokyo, April 2008)[26]

[13] http://themes.eea.europa.eu/IMS/CSI
[14] http://www.eea.europa.eu/themes/energy/indicators
[15] http://www.eea.europa.eu/themes/transport/indicators
[16] IRENA (Indicator Reporting on the Integration of Environmental Concerns into Agriculture Policy) indicators and EEA indicator fact sheets:
http://www.eea.europa.eu/projects/irena
http://www.eea.europa.eu/projects/irena/products
http://reports.eea.europa.eu/eea_report_2005_6/en
[17] http://ec.europa.eu/agriculture/analysis/external/climate/index_en.htm
http://www.efi.int/portal/news___events/press_releases/?id=133
[18] http://reports.eea.europa.eu/eea_report_2007_5/en
[19] http://reports.eea.europa.eu/climate_report_2_2004/en
[20] http://www.eea.europa.eu/highlights/Ann1148473248/sebi.pdf
[21] http://water.europa.eu/
[22] http://emma.bo.ismar.cnr.it/index.php
[23] Structural indicators:
http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1133,47800773,1133_47802558&_dad=portal&_schema=PORTAL
Sustainable development indicators:
http://epp.eurostat.ec.europa.eu/portal/page?_pageid=1998,66119021,1998_66391726&_dad=portal&_schema=PORTAL
[24] http://ec.europa.eu/regional_policy/conferences/4thcohesionforum/consultation_en.cfm
[25] http://www.oecd.org/document/2/0,3343,en_2649_34361_40691458_1_1_1_1,00.html
[26] http://www.iges.or.jp/en/cp/activity20.html

Annex 2: Examples of adaptation measures

The list below is not complete, but is an indicative overview that was presented for discussion at the Expert Meeting; it can also be cross-referenced with the other data and information.

A - FROM IMPACTS INDICATORS TO ADAPTATION

Sector: water / Issue: flooding

Impacts	**Adaptation/Measures**	**Indicators (?)**	**Scorecards (?)**
Increasing flood damage	Improving forecasting and information Models of climate change impacts on flooding		
	European/national-level legislation and agreements River and river basin management schemes uniting upstream and downstream users.		
	Allowance for higher flows/higher flood risk in flood defence structures Natural retention of flood water		
	Technical flood protection		
	Restriction of settlement/building development in risk areas Standards for building development		
	Insure or compensate for damages		

Sector: water / Issue: drought & water scarcity; public water supply

Impacts	**Adaptation/Measures**	**Indicators (?)**	**Scorecards (?)**
Increasing drought stress in in Southern and Eastern Europe, due to further declines in rainfall	Improving forecasting, monitoring, information		
Water shortage	European/national-level legislation and agreements River and river basin management schemes uniting upstream and downstream users.		
	Increase water availability Landscape planning measures to improve water balance		
	Demand management Increasing efficiency of water use Economic incentives Restriction of water uses		
	Supply management Technical measures to increase supply - dams & reservoirs - water transfers/transport		
	Improving insurance schemes against drought damage		

Sector: Water / Issue: agriculture and water

Impacts	Adaptation/Measures	Indicators (?)	Scorecards (?)
Changing growing conditions for agriculture crops	Improving forecasting, monitoring, information		
	European/national-level legislation and agreements River and river basin management schemes uniting upstream and downstream users.		
	Increase water availability		
	Demand management Efficiency improvement in irrigation management Economic incentives Restriction of water uses		
	Supply management Technical measures to increase supply - dams & reservoirs - water transfers/transport		
	Improving insurance schemes against drought damage		

Sector: forestry

Impacts	Adaptation/Measures	Indicators (?)	Scorecards (?)
More frequent & more extent forest fires	Improvement of early warning and reacting systems		
Shift of forest vegetation zones	New silvicultural strategies Additional afforestation		
Loss in bio-diversity/ migration of species	Linking rare biotopes Introduction of gene banks		
Faster growth	More intensive harvesting		

Sector: winter tourism

Impacts	Adaptation/Measures	Indicators (?)	Scorecards (?)
Decreasing winter tourism due to worse snow conditions	Artificial snowmaking Going higher Facing north Glacier skiing		

	For example: Operational Practices Financial and marketing tools Winter revenue diversification		

B – INTEGRATING ADAPTATION ISSUES AND SECTORS WITH LANDSCAPE TYPES

		Landscape types					
		River basins	**Coastal zones**	**Mountains**	**Urban**	**The Mediterranean**	**The Semi-Arctic**
Sectors and Issues	**Water**						
	Agriculture						
	Biodiversity and ecosystems goods and services						
	Energy						
	Forestry						
	Tourism						
	Built environment & spatial planning						
	Health						
	Economics						

Annex 3: Example of a process-based indicator for monitoring English local government progress in adaptation

NI188: Planning to Adapt to Climate Change

NI188 is one of 198 indicators for monitoring the whole remit of local authority responsibility in England under a new local government performance framework introduced in 2008.

NI188 is designed to measure progress in preparedness in assessing and addressing the risks and opportunities of a changing climate. The aim of this indicator is to embed the management of climate risks and opportunities across the all levels of services, plans and estates. It is a process indicator that gauges progress of a local authority to:

- Assess the risks and opportunities comprehensively across the area.
- Take action in any identified priority areas.
- Develop an adaptation strategy and action plan setting out the risk assessment, where the priority areas are (where necessary, in consultation and exhibiting leadership of local partners), what action is being taken to address these, and how risks will be continually assessed and monitored in the future.
- Implement, assess and monitor the actions on an ongoing basis.

The following definition is taken from *National Indicators for Local Authorities and Local Authority Partnerships: Handbook of Definitions, Annex 4: Local Economy and Environmental Sustainability*, published by the UK Department for Communities and Local Government, 2008.

NI 188: Planning to Adapt to Climate Change			
Is data provided by the LA or a local partner?	**Y**	**Is this an existing indicator?**	**N**
Rationale	To ensure local authority preparedness to manage risks to service delivery, the public, local communities, local infrastructure, businesses and the natural environment from a changing climate, and to make the most of new opportunities. The indicator measures progress on assessing and managing climate risks and opportunities, and incorporating appropriate action into local authority and partners' strategic planning. The impacts might include increases in flooding, temperature, drought and extreme weather events. These could create risks and opportunities such as: impacts to transport infrastructure from melting roads or buckling rails, increases in tourism, increased damage to buildings from storms, impacts on local ecosystems and biodiversity, scope to grow new crops, changing patterns of disease, impacts on planning and the local economy and public health. Examples of the processes, tools and evidence that could be used to reach the various levels have been included. However, this list is not exhaustive and any appropriate methodology can be used.		
Definition	Local authorities should report the level of preparedness they have reached against the 5 levels of performance, graded 0 to 4. The higher the number, the better the performance. The criteria for achievement of each of the levels are detailed below. Level 0: **Baseline:** The Authority has begun the process of assessing the potential threats and opportunities across its estate and services (for example, flood and coastal resilience plans, emergency planning, community risk registers/strategies etc) and has identified and agreed the next		

	steps to build on that assessment in a systematic and coordinated way. Examples of evidence: • The Authority has identified a lead official to identify and provide advice to service/department heads on potential impacts of future climate change on its functions • The Authority has undertaken an audit of existing relevant risk registers and action plans in place (eg community risk register) • The Authority has established a process for actions it needs to take to meet higher levels

NI 188: Planning to Adapt to Climate Change *(continued)*	
Definition *(continued)*	Level 1: **Public commitment and prioritised risk-based assessment:** The Authority has made a public commitment to identify and manage climate related risk. It has undertaken a local risk-based assessment of significant vulnerabilities and opportunities to weather and climate, both now and in the future. It can demonstrate a sound understanding of those not yet addressed in existing strategies and actions (e.g. in land use planning documents, service delivery plans, flood and coastal resilience plans, emergency planning, community risk registers/strategies etc). It has communicated these potential vulnerabilities and opportunities to department/service heads and other local partners and has set out the next steps in addressing them. Examples of evidence: • The authority and partners have made a public commitment to manage climate risks e.g. signed up to the Nottingham Declaration or an equivalent • A Local Climate Impacts Profile or equivalent process is ongoing • Initial assessment produced using the UKCIP scenarios • Department/service heads facing significant vulnerabilities and opportunities have an understanding of the issues, with evidence of actions already in place to address these • Evidence of working in partnership and pooling of resources and expertise across sectors, areas and council tiers where applicable Level 2: **Comprehensive risk-based assessment and prioritised action in some areas:** The Authority has undertaken a comprehensive risk based assessment of vulnerabilities to weather and climate, both now and in the future, and has identified priority risks for its services. It has identified the most effective adaptive responses and has started incorporating these in council strategies, plans, partnerships and operations (such as planning, flood management, economic development, social care, services for children, transport etc). It has begun implementing appropriate adaptive responses in some priority areas. In its role as a community leader the council has started working with its LSP encouraging identification of major weather and climate vulnerabilities and opportunities that affect the delivery of the LSP's objectives. Examples of evidence: • Comprehensive risk assessment produced (for example using the UKCIP method) • Nottingham Declaration accreditation • Council Members and department and service heads have a detailed understanding of weather and climate risk in all vulnerable areas identified in risk assessment and actions taken in priority areas. • Documents like Local Development Frameworks include climate change adaptation • Local adaptation partnership established • LSP partners are aware of actions being taken by the council, feel engaged in the process and confirm they have started to identify weather and climate risk that affect the delivery of their own objectives.
Definition *(continued)*	Level 3: **Comprehensive action plan and prioritised action in all priority areas:** The Authority has embedded climate impacts and risks across council decision making. It has developed a comprehensive adaptation action plan to deliver the necessary steps to achieve the existing objectives set out in council strategies, plans, investment decisions and partnership arrangements in light of projected climate change and is implementing appropriate adaptive responses in all priority areas. This includes leadership and support for LSPs in taking a risk based approach to managing major weather and climate vulnerabilities/opportunities across the wider local authority area. Examples of evidence

	• Action plan developed and published • Nottingham Declaration accreditation at a higher level • Detailed understanding of risk and action taken to embed relevant adaptation response in council strategies, plans, partnerships and operations by all department/service heads where weather and climate risks have been identified. • Initial cost analysis undertaken and potential sources of funding identified for major vulnerabilities • LSPs feel fully engaged and action plan includes commitment from authority and LSP • Pooling of skills, knowledge and resource across LSP • Consulted with authorities responsible for climate change management and others who can provide advice on good practice e.g. Environment Agency, Natural England, Defra. Level 4: **Implementation, monitoring and continuous review:** The Authority and LSP are implementing the comprehensive adaptation action plan across the local authority area, and there is a robust process for regular and continual monitoring and review to ensure progress with each measure and updating of objectives. The Authority and LSP are taking appropriate adaptive responses. Examples of evidence: • Clear and robust continuous monitoring and review system in place • Outputs from the review and monitoring process are ploughed back into the action plan and other relevant council and LSP strategies

NI 188: Planning to Adapt to Climate Change *(continued)*			
Formula	N/A		
Worked example	LA rates performance against the 5 levels of performance	**Good performance**	Year on year improvement
Collection interval	Annual (Apr – Mar)	**Data Source**	Local authority assessment against the criteria

Annex 4: Reporting on adaptation

Alongside the development of new quantitative or qualitative indicators to monitor adaptation, a crucial element is narrative reportage describing progress and activities. This is a key component of any framework for adaptation indicators. This section discusses the potential mechanisms for reporting on adaptation, both in terms of individual indicators and narrative description.

As the process of adaptation to climate change increasingly moves into the policy cycles of the EU and Member State governments, there will be an increasing need for a repository of information on adaptation activities that can be used for sharing information among countries and exchanging knowledge and good practices. This need stems from the fact that, while adaptation is taking place across many countries, some countries are more advanced in their thinking and implementation of policies and activities than others. Furthermore, a problem in the dialogue between Member States is the absence of well-agreed structures surrounding adaptation and adaptation policy. Organising this repository on an EU level is especially useful if it contains up-to-date and state-of-the-art information, and is easily accessible and understandable. This in turn requires a standardised and harmonised reporting framework, including a European-wide agreement on definitions and key adaptation indicators.

Links with existing schemes

In order to limit the administrative burden and to avoid duplication of work, a key challenge is to establish links between the reporting scheme for climate change adaptation and other reporting obligations and frameworks, and by making use of existing or currently developed tools. Many such tools and principles are currently being developed under the “Shared Environmental Information System (SEIS)” of the EU. Existing EU reporting requirements that are relevant in the field of climate change adaptation fall under:

- Flood Risk Directive: Flood risk assessment (reporting required by 2011), flood hazard and risk maps (reporting required by 2013) and Flood risk management plan (reporting required by 2015).
- Water Framework Directive (reporting on River Basin Management Plan data by 2010) and WISE (Water Information System in Europe).
- Habitats and Birds Directives: reporting required every six years on progress in establishing and conserving Natura 2000 sites.
- EEA/EIONET information exchange: Water quantity and use (although still in testing phase, reporting date to the EEA still to be decided).
- UNFCCC convention: Reporting required in different fields with respect to climate change adaptation, e.g. progress towards the development and adoption of adaptation strategy (every 4-5 years through National Communications, next is due in 2010). The Nairobi 5 year work program on impacts, vulnerability and adaptation is meant to assist countries in their national activities. It does not have a reporting framework, apart from the UNFCCC web site that allows any organisation and/or country to upload relevant information, to enhance global information sharing.
- RAMSAR convention: Information on the impacts of drought and other natural disasters on the ecological character of sites as part of the (continues reporting required).
- CLRTAP convention with links to climate change: Reporting obligation for Data and accompanying report on phenology (note that monitoring and reporting are optional).

Outline of a potential reporting scheme for adaptation

A European reporting scheme for climate change adaptation could, for example, contain the following key elements (this list has been proposed by the EPA Network of Environmental Protection Agencies, as an input to the Commission consultation process for developing the White Paper on Adaptation):

1. Reporting on existing national adaptation plans and/or strategies, or those in preparation. This should include providing information on when such plans were developed or are expected to be developed, as well as their objectives.
2. Reporting on the institutional and legal framework for adaptation activities. This should include providing information on which national ministries and agencies have been given the mandate to undertake climate change adaptation activities. It should also include providing information on any national laws and/or regulatory measures that facilitate climate change adaptation activities.
3. Reporting on key climatic vulnerabilities. This might be based, for example, on risk assessments by region and sector.
4. Reporting on national (and European) research programmes and databases.
5. Reporting on policies and measures that are undertaken as adaptation activities (both implemented and proposed; see e.g. IVM/EPA project on adaptation frameworks and the PEER project). The information on policies and measures should include, where possible and relevant:

    a. *Objectives of the measure*. For example, is the main objective of the measure to proactively *reduce the risks of, and sensitivity to,* any climatic change, or to *mitigate damages* following an extreme climatic event, or to *capitalise or benefit* from a changing climate? Or is the main objective to *raise national public awareness* on climate change and climate change adaptation?
    b. *Aims and targeted sectors* of the measure. Which sector or issue domain is the policy measure addressing?
    c) *Type of (policy) instrument/method of implementation*. How will a measure (e.g. a tax regulation) be implemented?
    d) Key stakeholders involved.
    e) *Elements of adaptation strategies and plans* that are covered by the policies and measures.
    f) Possible links to existing (European and national) *regulations/policies.*
    g) *Implementation scale of the instrument*: Is the measure implemented nationally, regionally or locally?
    h) *Duration and target dates and deadlines*. Implementation date of the measure and its duration.
    i) *Budgetary and financial implications* of the measure.

6. Reporting on joint activities with other Member States and developing countries, including joint implementation of measures, research activities or agreements. Again, link this with other reporting activities, to avoid duplication.