MACIS

Minimisation of and Adaptation to Climate change Impacts on biodiverSity

Policy options to prevent/minimise negative impacts on biodiversity

Specific targeted research project (STREP)

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MACIS

Minimisation of and adaptation to climate impacts on biodiversity

WP4 Policy options to prevent/minimise negative impacts on biodiversity

Deliverable 4.2:

POLICY OPTIONS FOR BIODIVERSITY UNDER CLIMATE CHANGE

October, 2008

D 4.2	Report on coherent policy options for preventing or minimising negative impacts of adaptation and mitigation actions (across the range of sectors) on biodiversity (MACIS DoW p 23)

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POLICY OPTIONS FOR BIODIVERSITY UNDER CLIMATE CHANGE

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ABBREVIATIONS

BD or Bd	Biodiversity
BRANCH	Biodiversity Requires Adaptation in NW Europe under Climate Change ☸
BU	Bottom-up
CBD	Convention on Biological Diversity
CC	Climate change
CEC	Commission of the European Communities
Defra	Department for environment, food and rural affairs (UK)
Del.	Deliverable (a report prepared for the MACIS programme)
EC	European Commission
EEA	European Environment Agency
EIA	Environmental Impact Assessment (of individual projects)
ESPACE	European Spatial Planning - Adapting to Climate Events ☸
EU	European Union
Ghg	Greenhouse gases
ICZM	Integrated coastal zone management
IPCC	Intergovernmental Panel on Climate Change
MACIS	Minimisation of and adaptation to climate impacts on biodiversity ☸
MS	Member State
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
R & D	Research and development
SEA	Strategic Environmental Assessment (of plans, programmes, policies)
SWOT	Strengths, Weaknesses, Opportunities and Threats analysis
TD	Top-down
UKCIP	UK Climate Impacts Programme
UHI	Urban Heat Island
UNFCCC	United Nations Framework Convention on Climate Change
VROM (Netherlands)	Ministry of Housing, Spatial Planning and the Environment
WFD	Water Framework Directive

☸ EC-funded research programmes

1 Introduction

The impacts of climate change on biodiversity have been reviewed under MACIS WP1. MACIS WP 2 has examined the impacts of climate change mitigation measures on biodiversity, as well as impacts of adaptation measures. The array of policy in place to address climate change in connection with biodiversity has been presented and explored in MACIS Del. 4.1 *Minimisation of and adaptation to climate impacts on biodiversity* (Piper and Wilson, 2008).

Building on the findings of MACIS Del 4.1, this report is concerned with policy-making[1]: policy options and associated policy instruments which may apply in a wider set of non-climate policy areas (agriculture, transport, tourism, etc.) and which might be introduced to increase the resilience of biodiversity to climate change impacts (together with other impacts). Cross-sectoral policy instruments are also identified.

As defined in IPCC (2007a), the term *adaptation* covers actions which facilitate living with gradual climate change or which improve resilience to extremes of weather. Mitigation is used here to cover those measures and approaches which reduce the rate of emissions of greenhouse gases (ghg) to the atmosphere, or which either ensure retention of sequestered carbon or improve rates of sequestration.

> **Adaptation:** Initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g. anticipatory and reactive, private and public, and autonomous and planned.
>
> **Mitigation:** Technological change and substitution that reduce resource inputs and emissions per unit of output.
>
> **Sequestration:** Carbon storage in terrestrial or marine reservoirs.
>
> (source: Glossary for IPCC Fourth Assessment report, 2007a)

Conservation biologists, supported by ecology modellers, have identified a range of implementation measures appropriate for protecting biodiversity and increasing resilience not only to climate change but also to the combination of climate change with other pressures. These measures include, for example:

- Protection of natural adaptation potential as well as the existing habitats and species
- Landscape-level protection/enhancement
- Improving opportunities for movement by species e.g. linking biotopes
- Establishing protection areas aimed at preserving naturally occurring processes in ecosystems, as well as species
- Revising nature conservation concepts where necessary (e.g. "favourable status")
- Reviewing boundaries to protected areas to either extend them or make them more flexible, whilst ensuring that areas which have had biodiversity value are not immediately de-scheduled if that value appears to have declined.

[1] Policy making is taken to be: 'the process by which governments translate their political vision into programmes and actions to deliver 'outcomes' - desired changes in the real world. (*Modernising Government*, Cabinet Office, 1999).

- Taking related actions, e.g. skills development and technical adaptation capacity
- Promoting and ensuring the integration of climate change and biodiversity into the decision-making process for the range of development issues and
- Including adaptation management as an integral part of all fields of policy and action.

It has been recognised in MACIS Del. 4.1 (Piper and Wilson, 2008) and elsewhere (e.g. Piper et al. 2006) that action on policy – as well as implementation – must be taken at all levels of government, from international level (e.g. the Convention on Biodiversity) to local government level. The mainly non-government or "bottom-up" approach is discussed below in section 3.

It is the aim of this deliverable to explore and analyse a set of high-level policy options for the EC and Member States, to identify those which are of interest in the case of promoting the resilience of biodiversity to climate change, by minimising and adapting to climate change and via other related actions.

2 Policy fields

Four types of policy field are relevant here are:

- Biodiversity policy (protection and enhancement), as enforced via the Birds Directive, the Habitats Directive and the Water Framework Directive, as well as relevant EC Communications and international Conventions on biodiversity

- Climate change policy covering mitigation, carbon sequestration and adaptation. This includes:

  Mitigation

  - support for the generation of renewable energy
  - fiscal policy to reduce consumption of fossil fuels
  - policy and financial support for more efficient use of energy
  - use of market-based instruments, e.g. creating a market for carbon trading.

  Carbon capture/sequestration

  - Communication on carbon capture and storage
  - Agri-environment policy for protection of woodlands, soils and bogs, for example, may contribute to capture/sequestration, though this is not their principal purpose

  Adaptation

  - EC Adaptation Green Paper **-** {SEC(2007) 849}
  - EC Adaptation White Paper in course of preparation

- Policy for economic sectors which have indirect consequences for biodiversity or climate change (e.g. transport or energy sectors)

- Policy of a more general nature which has relevance for biodiversity and or climate change (e.g. the Sixth Environmental Action Programme, sustainable development policy, competition policy, integration policy)

There is increasing recognition (IPCC 2007b) that all of these policy fields need to take into account the interaction of climate change, biodiversity and economic activity if biodiversity is to be safeguarded for the future. In the following sections we attempt to identify appropriate policy instruments[2] within each policy field. First, the potential interactions between policy and implementation measures with biodiversity and climate change – investigated in depth under MACIS WP2 – are briefly outlined, in order to emphasize the need for careful evaluation of any policy initiatives.

3 Policy interactions and biodiversity

3.1 Interacting mitigation and adaptation policies

Deliverable 2.2 from MACIS WP 2 (Berry et al, 2008) has shown that adaptation measures may have subsidiary adverse effects for mitigation efforts, whilst mitigation measures may detract from adaptation. Moreover, both types of measure may have indirect deleterious impacts upon biodiversity, as well as beneficial impacts. Examples are given in the following tables for selected sectors: Table 1 gives examples of impacts of adaptation policies for both mitigation and for biodiversity, whilst Table 2 gives examples of mitigation policies for both adaptation and biodiversity. This underlines the importance of thorough impact assessment and the search for means and actions to minimise impacts of climate change, together with those of other pressures, upon biodiversity.

The indirect or secondary impacts upon biodiversity (which may be significant) are indicated here because once they have been identified and assessed – e.g. as part of an EIA or SEA process - measures may be taken both to minimise adverse impacts and to enhance beneficial ones. MACIS Del. 4.1 discusses further the role and development of impact assessment practice needed[3]. The set of policies listed in Tables 1 and 2 is not comprehensive – see MACIS Del. 2.2 for more detailed information.

3.2 Interacting top down and bottom up approaches

The role of policy-making in securing adaptation to climate change may itself also be questioned. This has been done by Urwin and Jordan (2008) who have examined alternative top-down and bottom-up approaches to climate policy integration. "Top-down" (TD) is taken to be an approach in which aims and objectives are set explicitly by government policy, whereas "bottom-up" (BU) approaches recognises the importance of other actors in shaping policy implementation. This element of the work by Urwin and Jordan was based on interviews with stakeholders in each of three sectors: water, nature conservation and agriculture. The interviews explored with stakeholders how far different sub-elements of policies supported or undermine potential adaptive responses, and showed in case studies that important constraints upon adaptive planning may result from apparently unrelated policies.

Urwin and Jordan identify both synergistic and antagonistic interplays between the three closely inter-related sectors from the TD perspective and antagonistic interplays from the BU perspective. Urwin and Jordan highlight the significant gap between "street level" activity and the formal, written content of policies, but

[2] "instruments" is used here to refer to specific types of action within a category of policy options.
[3] See MACIS project website: www.macis-project.net/publications

nevertheless recognise the need for "some kind of adaptation framework […] to provide a supportive context", and at the same time ensuring that *non*climate policies do not undermine any high-level frameworks. Acknowledging that this is typically done by proofing new policies, for example via Impact Assessment[4], these researchers emphasize the need for Impact Assessment to be the responsibility of an integrating department of government, rather than a simply "environment" department.

Urwin and Jordan also note that proofing works best when it encompasses not only central but also local levels (as seen from attempts at rural proofing rural policy by the UK Countryside Agency (Countryside Agency, 2003). A localised policy proofing process, they argue, could help minimise the most antagonistic policy interplays.

In their conclusions Urwin and Jordan state that they found "surprisingly few existing policies [which] explicitly encourage climate change adaptation across the three sectors, although some do (indirectly) support or undermine adaptative responses" (current authors' underlining). Lindblom's term "muddling through" is used to describe the process of working through the catalogue of different problems.

Urwin and Jordan also note that amongst their interviewees, perceived "*policy*" is only the second most important constraint on adaptive decision-making: "*financial resources*" was said by interviewees to come first, and "*information*" third.

In the light of this research it is apparent that the interplay of policies across major sectors and within the field of climate change response means there is a need for both

- vertical integration of policy-making (i.e. from EU to local level), and
- horizontal integration of policies, i.e. across sectors

as well as the integration of top-down measures with bottom-up community engagement.

[4] Urwin and Johnson refer to this as Regulatory Impact Assessment

Table 1 Selected examples of interactions between adaptation measures and emissions reduction (mitigation measures) by sector, and how they affect biodiversity (green = broadly beneficial; red = broadly adverse)

ADAPTATION measures	**Possible beneficial impact for mitigation efforts**	**Possible beneficial impacts for biodiversity**	**Possible adverse impact for mitigation efforts**	**Possible adverse impacts for biodiversity**
Built environment				
Re-settlement away from flood risk			Need for new construction increasing emissions and resource use initially	Loss of existing habitats to new urban areas; fragmentation
Urban intensification	Reduction in need to travel, therefore in emissions	Reduces future impacts on existing green-field sites	Greater use of air-con resulting from higher temperatures, exacerbated by urban heat island	Loss of gardens, parks and greenspace habitats
Forestry				
Fire suppression			Build-up of flammable material	Greater loss in eventual fire
Expand plantation forestry	C sequestration at fast rates in early years		Carbon losses during land clearance	
Transport				
Re-alignment of new roads away from threatened coasts			Need for new construction increasing emissions and resource use initially	Fragmentation and loss of habitats

NB: this table is not comprehensive and aims to give one or two relevant examples of interactions within each of the sectors shown

Table 2 Selected examples of interactions between mitigation policies/measures and adaptation policies/measures by sector, and how they affect biodiversity (green = broadly beneficial, red = broadly adverse)

MITIGATION measures	Possible beneficial impact for adaptation efforts	Possible beneficial impacts for biodiversity	Possible adverse impact for adaptation efforts	Possible adverse impacts for biodiversity
Energy generation				
Switch to renewables		Improved air quality	Construction and infrastructure materials requirement	Windfarms: Impacts on site habitats and birds. Geothermal: risks of chemical pollution of waterways
Carbon storage[5]	Use of new technologies (CLR and CLC may produce H_2 useable as fuel.)		Increases (may double) water use	Impacts on wetlands, rivers
Built environment				
Urban intensification	Reduction in need to travel, therefore in emissions	Reduces future impacts on existing green-field sites		
Green roofs/walls	Reduced cooling/heating demand	New habitat provision		
Transport				
Switch to biofuels				Use of marginal, previously uncultivated land and loss of habitats
Agriculture				
Low till	Reduced pesticide demand	Less disturbance of soils		
Peatland conservation (as carbons tore)	Reduces flood risk and erosion	Retain valued habitat		

[5] DG Env *News Alert* April 2008 Carbon capture and storage. CLR - chemical looping reforming and CLC - chemical looping combustion

4 Potential range of policy options and instruments

4.1 Introduction

The development of national policy on climate change and biodiversity (European Union Member States and others) was explored for MACIS Del. 4.1 (Piper and Wilson, 2008) identifying for example the need for climate change-integrated conservation strategies to further develop policy to assist with climate change adaptation for biodiversity (see also Hannah et al. 2002). The following set of policy options has been established as a framework in connection with preparation of the EC's Climate Change Adaptation White Paper (to be published late 2008). This array of options is also consistent with the Sixth Environmental Action Programme, which refers to horizontal integration measures as including EIA, SEA and ICZM, and vertical measures (i.e. within sectors). It will be noted that there may be some overlap between types, i.e. some actions could fall into more than one of these categories:

- Regulation
- Market based instruments
- Insurance
- Soft options (governance, guidance, communications) - also known as "suasive measures".
- Research and Development

In the following sections these options – and the instruments that fall within each option - are explored, for the specific case of biodiversity resilience to climate change. This review is based on: policy and literature review, the second MACIS stakeholder consultation event which took place on July 3 in Brussels, and attendance at other research meetings of experts and stakeholders (e.g. ESPACE meeting, the Hague).

At the second MACIS stakeholder consultation these options were discussed, together with possible approaches to improve biodiversity protection/adaptation. It was agreed that not all of these option types might be applicable within a given policy field (such as biodiversity policy or sectoral policy). A framework for policy instruments for biodiversity has been developed. The policy options and policy instruments are outlined and discussed in greater detail in section 5, but first the policy options framework is presented.

4.2 The policy framework: options and instruments

The analysis in section 3 above shows that policy measures affecting biodiversity in circumstances of a changing climate include those which are:

- directed specifically to protect/safeguard/enhance biodiversity,
- implemented with the purpose of mitigating climate change via ghg emissions reduction or maintaining/enhancing carbon storage, or
- intended to assist in adaptation to climate change, and also
- measures introduced for reasons not related to climate change or biodiversity.

The following framework matrix presents the policy fields – as discussed in section 2 above – and the array of policy options identified. It indicates which policy instruments might be applicable under these options to address the need to promote the resilience of biodiversity in the face of climate change. The policy fields are colour-coded (see overleaf). It is hoped that, by presenting the options

and instruments in this format, it will be possible to see which are "cross-cutting" or cross-sectoral.

Colour coding:

Biodiversity policy	green row
Climate change policy	yellow rows
Sectoral policies	blue rows

The broad aims of the five policy options are as follows:

Regulation	Command and control – enforceable policy, widely applicable.
MBIs and financial instruments	Introducing measures and policies which preserve and extend choice, but directing choice towards "desired" ends, working with the grain of the market. Includes fiscal and financial measures.
Insurance	Reducing risks associated with actions which are (in this case) "biodiversity friendly"
Soft options	Providing guidance, supporting governance, raising awareness and skills
R & D	Identifying methods and data which will improve effectiveness of future approaches.

Table 3 is presented as the outline version of the framework used to analyse the different approaches to policy, and leading to the completed Table 4 below (see section 5.6).

It is worth noting that the 2007 survey of European public opinion published as Standard Eurobarometer 67 (EC, 2007) indicates that 88% of the public see the need for EU action on "global warming" to be "very urgent" or "fairly urgent".

Table 3 Outline of policy options framework

	Policy Options to safeguard biodiversity				
	Regulation	**MBIs and financial instruments**	**Insurance**	**Soft options**	**R&D**
Biodiversity policy					
Halting loss and enhancing resilience	Command and control	Preserve and extend choice	Reduce risk associated with biodiversity-friendly actions	Provide guidance, governance, raise awareness	Identify effective approaches for the future
Climate change policy					
Mitigation					
Carbon capture and storage (CCS)					
Adaptation					
Sectoral policies					
Agriculture					
Construction/Built environment					
Energy generation					
Transport					
Water (resources, treatment, wastewater)					

5 Discussion of policy options

Each of the five broad policy options are discussed in this section, with an indication of how they are or may, in future, be used, and a preliminary, broad-brush evaluation of the strengths, weaknesses and opportunities of the option.

5.1 Regulation

Regulation includes EU legislation, standards and detailed regulations which can either set out a framework within which Member States have to detail their own legislation (such as the Water Framework Directive, WFD) or measures which are more detailed in their application (such as the earlier water quality legislation). Regulation can also be either vertical in coverage (sector-specific) or horizontal (cross-cutting measures applying to many sectors, such as the SEA and EIA Directives). We consider that there are four principal conclusions from the overall MACIS study with respect to regulations:

1. Existing "vertical" regulation, in the Birds and Habitats Directives, and in the creation of the Natura 2000 network, should be retained. The advantages of regulation here are that it provides a minimum standard of protection of critical assets, thereby conforming to wider EU principles such as meeting the precautionary principle. Implementation of these Directives provides an essential minimum area for the species protected, and also for the ecosystem functions provided by the habitats. Member States are familiar with the Directives and the Natura 2000 network, and there are good reporting systems already in place. Moreover, as shown by MACIS WP 2.3 (modelling), pressures on these existing spaces are likely to be exacerbated, with climate change impacting on other resources such as water and farmland.

2. The Natura 2000 network should be extended to accommodate the possibility of better dispersal of species, and to reduce the risks of habitat fragmentation, under conditions of climate change. Again, this meets the precautionary principle. This conclusion is supported by the results of the climate space modelling and was supported at the MACIS stakeholder meetings (such as by the EEA, IUCN and Birdlife International). Such an extension can be accommodated under the Articles of the existing Directives (especially Articles 3 (3), 5 and 10 of the Habitats Directive). The designation of further (lower level) sites for greenspace, to reduce pressure on high value sites affected by human populations and climate change, in line with the requirements of the Habitats Regulations is one way in which the Natura 2000 network may be given greater protection. An example of this is the designation of Sites of accessible natural greenspace (SANGs) within the Thames Basin Heaths[6].

3. Existing horizontal legislation such as the SEA and EIA directives should be retained and implemented: they satisfy the principle of integration, not just of environmental, social and economic concerns into decision-making within other sectors, but these procedures also offer opportunities for integrating adaptation and mitigation measures to achieve synthesis and avoid conflict. They also satisfy the principle of preventive and anticipatory action.

[6] For further information see:
www.surreyheath.gov.uk/planning/PlanningPolicyandConservation/ThamesBasinSPA.htm

4. The SEA and EIA Directives should be revised at the time of their next review explicitly to require (e.g. under Art. 5 and Annex IV of the EIA Directive (85/337/EEC) and Annex II of the SEA Directive (2001/42/EC)) the assessment of the plan, programme or project on the climate, and of climate change on the PPP, and to ensure mitigation and adaptation and their interactions are considered. For example, a new clause might highlight the cumulative interaction of climate change and project impacts. The evidence from MACIS WP2.2 is that decisions in all sectors and at all levels need to move towards win-win outcomes, and this will assist in achieving that aim.

The strengths of the regulation approach are that it is reliable and enforceable by penalty as well as providing the opportunity for close targeting of both adaptation ad mitigation measures, tailored to the needs of each MS. However, regulation is slow to devise, it entails a need for monitoring and enforcement which add to costs (though these may, initially at least, be met via penalties).

5.2 Market-based instruments (MBIs)

5.2.1 MBI development

There is wide interest and research into the development and implementation of MBIs in connection with nature conservation in several countries (USA, Australia, Germany, UK and elsewhere). MBIs are designed to act by either raising or cutting the price of an action or resource, by affecting the availability (quantity) of a desired "good" or by removing market friction and so facilitating transactions. The European Commission published its Green Paper on market-based instruments for environment and energy-related purposes (COM (207) 140) in 2007, asking whether the scope for using these instruments should be studied in greater detail. Respondents to the consultation were broadly supportive of taking this approach further, but warned that a number of issues may arise. Some of these issues are indicated in section 4.1.9 below. Annex 1 reviews the range of MBIs as they may apply to biodiversity protection and enhancement generally and presents a scheme for MBI design.

Advantages of MBI over regulatory mechanisms are listed in the Green Paper as including greater transparency (pricing signals) and flexibility in meeting objectives giving lower compliance costs, also providing incentives for innovation and, in specific circumstances, increasing employment. MBI at EU-wide level would "overcome adverse competitiveness effects" and strengthen the EU's position with respect to other trading partners

MBIs may be designed to modulate climate change adaptation activity affecting biodiversity. An MBI may offer a market where none previously existed, e.g. the creation of the market for biodiversity offsets. Enforcement via regulation may be necessary where this policy option is used. MBIs are seen as a means to improve the cost-effectiveness of funding and incentive programmes. This section briefly describes some MBI approaches which may be relevant in increasing the resilience of biodiversity (and ecosystem services) to climate change impacts.

5.2.2 MBIs, biodiversity and climate change

The set of MBIs outlined in Annex 1, and discussed with respect to safeguarding biodiversity, are as follows – the relevant section of Annex 1 is indicated:

Cap and trade	A.1.1
Habitat banking	A.1.2

Conservation tenders	A.1.3
Revolving funds	A.1.4
Market friction approaches	A.1.5
Fiscal incentives	A.1.6
Working within the current market	A.1.7

MBIs are being developed, within and beyond the EU, which are principally intended to control, limit or offset the impacts of development upon biodiversity by providing financial resources to safeguard habitats and species, or by promoting desirable actions (or decreasing undesirable actions) by fiscal means. Climate change impacts are additional, cumulative, impacts which may be affecting either a resource (water, sites) or an activity (e.g. increasing leisure activity).

Research and assessment of MBIs as a means of influencing behaviour are needed to ensure that such approaches, in particular circumstances, are cost effective and likely to achieve the desired results. Annex 1 (section A.1.2) presents a six-step process for MBI design proposed to the Australian government. The following figure (Figure 1) shows this process modified to take climate change impacts into account – see amendments in blue. The essential technique here is assessment (in steps 1 – 3) to include an evaluation of climate change impacts and their effects upon biodiversity cumulatively with other changes and impacts, in the MBI design process[7].

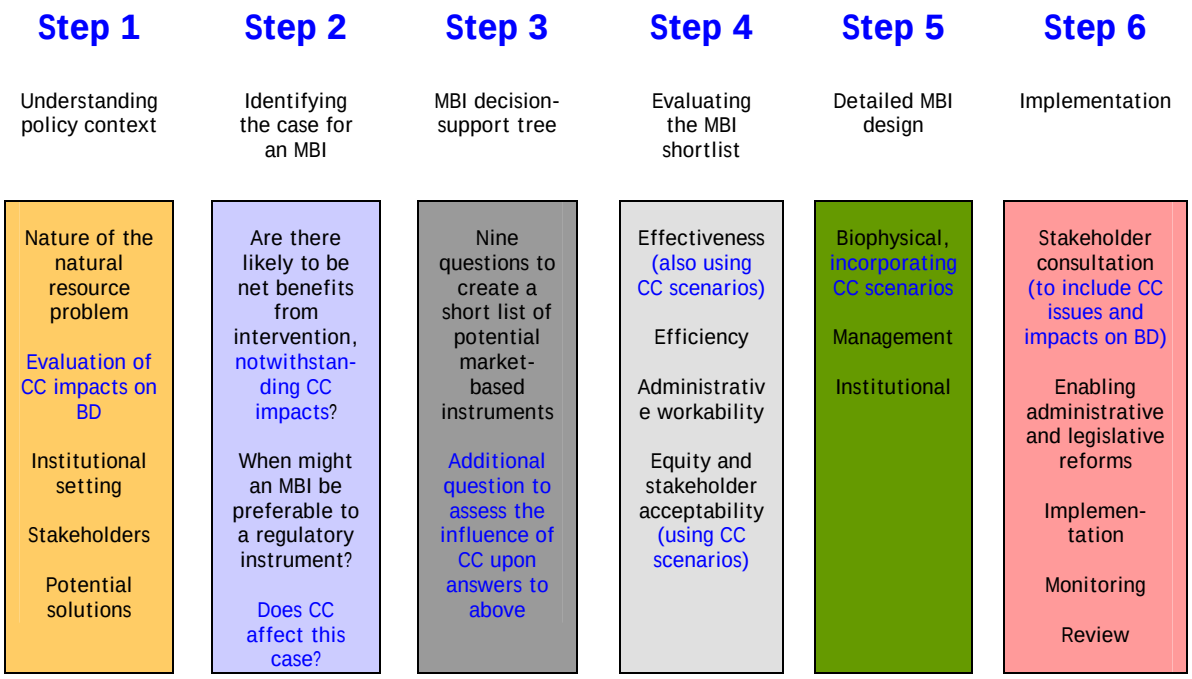
Amongst the array of MBIs available, perhaps the one most frequently discussed so far in connection with safeguarding and improving the CC-resilience of biodiversity is habitat banking (the subject of research currently being commissioned by the EC[8]). Others also have potential, for example:

- the market friction approach, and easing the development and implementation of desirable innovation, such as via special subsidy of new energy generation technology which is accompanied by biodiversity provision.
- Providing incentives or *removing* disincentives or perverse incentives (e.g. removing incentives for activities such as hedgerow removal or for installation of drains/mole drains on land which has or could develop biodiversity value)
- Ensuring that where carbon offset funds are developed, a proportion of this available funding is used to establish new land/wetlands for biodiversity
- Fiscal/price disincentives (imposing taxes on the sale of land with value for biodiversity development)
- Promoting the setting up of "revolving funds" so that properties with high nature conservation value, under different climate scenarios, may be acquired, improved for biodiversity and then sold to bodies with an interest in conserving them
- Payment of subsidies – intended to alter costs/benefits ratio of desired actions; the EU agri-environment payments are an example here.

[7] . This assessment could be underpinned by the use of climate change scenarios to ensure the likely extent of climate changes would be taken into account and therefore, impacts upon biodiversity.

[8] DG Environment: ENV.G.1/ETU/2008/0043 The use of market-based instruments for biodiversity protection – the case of habitat banking

Figure 1: Steps in MBI design for biodiversity under climate change



Source: modified from proposal in *Designer Carrots* programme commissioned by Australian Government (2007).

The use of MBIs for biodiversity protection is less advanced than for regulation. MBIs are most likely to be introduced at a national level, possibly within an EC framework. This is an area demanding further research – research topics are included in Annex 1, section A.3.

Not all MBIs are revenue-raising, but an advantage of some policies based on MBIs is that these may provide a much-needed source of funding for action on biodiversity and they may be a means of bringing together economic development and environmental protection. In addition, MBIs may provide opportunities for development of new areas of economic activity, and these may well be in rural areas. MBIs could also lead to the creation of new biodiversity habitats of types which are currently scarce.

Nevertheless, it is more difficult to cover existing stocks (e.g. built stock) or practices other than those which are planned and require permits of some kind. The existence of the MBI may be interpreted as a "licence to trash" sites which are currently valued and, in the case of biodiversity offsets (such as habitat banking), there may be difficulties with identifying suitable sites for restoration/banking and a means of assessing biodiversity values at proposed sites. If the potential replacement of sites or compensation for lost sites is allowed to take place beyond the immediately affected area, there may be threats to the local provision of ecosystem services.

5.3 Insurance

Insurance may be either provided by private companies, which act autonomously or in concert, or sometimes it is provided by government acting as the "insurer of last resort" – notably in connection with disasters and high environmental risk (for example, for coastal flooding). Government may also require insurance to be obtained before certain actions are taken, and could influence the terms under which insurance is obtained.

The July 3 2008 MACIS stakeholder meeting discussed the applicability of insurance-related measures and policies in connection with biodiversity. "Insurance" as a policy option is taken to be a situation where the insurance industry covers a *risk* – this might be the risks of climate change but also the risks associated with biodiversity-friendly actions. It was acknowledged that insurance may be a policy option with less relevance, but some options exist.

Losses from flooding in central Europe in 2002 were Euro 17.4 billion; the "economic costs of coastal flooding (assuming no adaptation) are estimated in the range of 12 to 18 billion EUR per year for Europe in 2080" (EEA, 2008). Requiring the installation of flood compensation and/or storage areas as an insurance measure for new development could also provide scope for wetland development. It is likely that similar responses might be developed in coastal areas in connection with flooding, and it is possible that in other cases where insurance measures are introduced in connection with extreme weather, similar actions could be devised. For example, long periods of drought will increase fire risk in forests. Where water storage is installed against this possibility, this also provides an opportunity for biodiversity. Also, if species selection and planting design in forests includes measures to reduce fire risk (e.g. by selecting less flammable species, or including wider rides, these characteristics may also improve conditions for biodiversity. Opportunities may exist for "insurance measures" related to erosion and subsidence.

It may be that where insurance is not available (e.g. for buildings in flood risk areas, this will have the effect of reducing construction. Whilst this is not recommended as a policy option, this is a further element to be considered when designing MBIs. EEA (2008) notes that "about 90% of all natural disasters which have occurred in Europe since 1980 are directly or indirectly attributable to weather and climate "representing about 95% of the economic losses caused by catastrophic events.

New technology which may benefit biodiversity under CC may face difficulties with obtaining insurance e.g. green roofs and rainwater harvesting. However, there is some evidence (UK Environment Agency website and Gedge, pers. comm.[9]) that in Germany buildings with green roofs incur lower cost costs for fire insurance, as the green roof protects the waterproofing from fire and deterioration (see also: Sarvan, 2006 p 41 relating to green roofs in Sweden). Regulation or other measures may be needed to ensure that the uptake of these technological developments is not restricted by the cost of insurance.

[9] Environment Agency: Green roof toolkit. www.environment-agency.gov.uk/regions/thames/323147/ - states that "75 million m2 of green roofs have been installed in Germany and Switzerland". Also: D Gedge (President, International Green Roofs Association) pers. comm., 17 10 08.

Linnerooth & Rechler (2006) have proposed a two-tiered strategy for using insurance in assisting adaptation to climate change in developing countries. This would entail a climate insurance programme specialized in supporting developing country insurance-related initiatives for sudden and slow-onset weather-related disasters. Various institutional components would contribute to this, including partnering with donor community institutions and a multi-purpose disaster management facility. The main purpose of the strategy would be to establish public-private safety nets for climate-related shocks. The second tier of the strategy would provide disaster relief contingent upon countries making "credible efforts to manage their own risks". It may be that such a strategy could also have application within the EU, both between countries and within countries.

Advantages/strengths of using insurance as a tool of policy include low cost and the possible promotion of innovation as well as more rapid implementation. Nevertheless, the need for insurance may act as a barrier to action and innovation.

5.4 Soft options ("suasive" measures)

Policy instruments within this category are those related to governance, guidance, raising awareness and improving communications. Encouraging "bottom up" actions, rather than imposing "top down" measures are also important for the future – as shown by the public response to community based approaches. Measures indicated below cover information, incentives and standards, codes of practice and engaging stakeholders; the measures are grouped by type of stakeholder (individuals, communities, public and private bodies).

Individuals

- Campaigns to raise public awareness[10] of biodiversity and of ecosystem services and likely impact of climate change, e.g. Natuurkalender (Netherlands) and Springwatch (UK). (Also, for researchers, there are the European Phenological Network and the Agro-phenological Network.)
- Awards/recognition for pioneering work, e.g. in cutting energy use
- Pledge schemes, i.e. where there is an invitation from an organisation to individuals to make a public commitment to a behaviour change in relation to climate change or to biodiversity.

Communities

- Recognition/awards for work to safeguard species and habitats from risks associated with climate change
- Skills development to tackle climate change impacts upon biodiversity
- Community engagement – support for community action (e.g. biodiversity enhancement in Hoekse Waard, Netherlands (VROM, undated)
- Pledge schemes, e.g. along the lines of commitment to the Nottingham Declaration (see www.energysavingtrust.org.uk)

Public bodies

- Skills development to tackle climate change impacts upon biodiversity
- Identification and nomination of additional spaces for biodiversity under land use plans, adaptation strategies, etc. to raise public awareness.

[10] Research undertaken as part of the LIFE III programme suggests that addressing a "general public" is not effective – it is important to focus specifically on the many different groups comprising the community (Sarvan, E (2006, p 37)

- Setting up an information exchange clearing house for data on impacts, vulnerability and adaptation (EEA, 2008)
- Data collection towards a Local Climate Impacts Profile – compiled by the Local Authority and recording exposure to weather and climate, based on vulnerability to severe weather events: how these have affected the community, its assets and the authorities ability to deliver services. (See: UKCIP, undated)

Companies

- Recognition/awards for work to safeguard species and habitats from risks associated with climate change
- Sign –up to best practice charters – e.g. Green Building Council Biodiversity Charter, in preparation.
- Codes for low energy use (e.g. in housing: Eco-homes)
- Awards for pioneering work, e.g. in installing green roofs for biodiversity
- Promotion of work directly linking company/institution carbon-offsetting with biodiversity protection work, e.g. peat restoration/conservation
- Campaigns supported by environmental NGOs for promoting involvement by companies, etc.

Best practice codes may be developed across a range of activities to recommend to each of the above groups what may be done to protect and enhance biodiversity under climate change, and this should also include good practice on cross-sectoral and transboundary nature of adaptation – working together with mitigation actions – to build the resilience of biodiversity and habitats to climate change. Such codes are already being developed in connection with house-building and urban design.

Also included here is "bottom-up" collective action. Some research has been undertaken in the UK on the role of community action both in sustainable development and in addressing climate change (Seyfang & Smith, 2006; CSE and CDE, 2007). These studies provide initial evidence of the potential value of approaches which are based on promoting and facilitating action at community level, with the provision of some funding to assist with costs such as meetings, IT and printing. An example of such an initiative is ClimatExchange for Oxfordshire, bringing together many local communities to take action on climate change and energy use, see: www.climatex.org.

Examples of other UK initiatives to support local action on climate change can be found at the following website – these initiatives are concerned with climate change only, not with biodiversity, but there is scope for amendment: http://www.defra.gov.uk/environment/climatechange/uk/individual/index.htm.

5.5 Research and development

R&D is in progress across a range of issues addressing biodiversity under climate change (modelling, scenarios building, monitoring and data acquisition, etc.). Research into approaches which offer benefits for both mitigation and adaptation might be prioritised (e.g. green roofs). Topics for future work include

- Research in connection with adaptation
  - Connectivity, translocation
  - Biodiversity-friendly land management techniques (zero till in agriculture, etc.)

  - Soils and biodiversity – interaction of impacts under climate change
  - Development of MBIs
  - Barriers and effectiveness of policy and measures
  - Monitoring (regular Europe-wide monitoring for a set of indicators is recommended by EEA, 2008)

- Research in connection with mitigation
  - Biofuels related (reducing adverse impact)
  - Economic impacts and consequences of policy options
  - development of MBIs

- Research linking adaptation and mitigation
  - Demonstration projects
  - Further development of scenarios-based approaches to research; scenarios (of climate change, socio-economic and political change, etc.) are increasingly used as a tool for participative research[11].
  - Better identification of mal-adaptation
  - Economic impacts and consequences of adaptation and mitigation policy options

- Other topics
  - Identification and mapping of future constraints upon habitats and biodiversity movement (ESPACE, 2008a)
  - Approaches for dealing with uncertainty
  - Socio-economic and institutional aspects of vulnerability and adaptation as affecting biodiversity, including costs and benefits, as related to human behaviour
  - Tipping point analysis and biodiversity, analysing how climate change impacts lead to thresholds being exceeded. Example: Ijssel Lake and Marker Lake, conducted by Rijkswaterstaat (ESPACE, 2008a)
  - Adaptive capacity benchmarking – a method for private and public bodies to review their own response (and that of others) to climate change, covering adaptation and mitigation (ESPACE, 2008b)
  - Further modelling of coastal processes and habitat identification (BRANCH, 2006)

As stated above, research and development increases the knowledge base for engagement, buy-in and targeted action; it may provide subsidiary benefits in solidarity and contacts. However, R&D requires considerable funding and long periods of engagement as it may need to cover a great variety of cases and conditions, possibly delaying action.

5.6 Policy options framework, and wider policies

The policy options framework outlined in section 4.2 is used in Table 4 to indicate where the array of available instruments might be used in policy work across the range of climate change, biodiversity and sectoral policies, to protect and enhance

[11] A study of scenario use is being undertaken (mainly by the University of Edinburgh) under this WP and is presented separately as Del WP 4.3. Further work on the design and application of consistent scenarios is needed (EEA 2008 recommends wide adoption of the same set of scenarios). Sheate et al. (2008) detail the use of sustainability assessment of future scenarios in the case of European mountain areas, as part of the BioScene project.

biodiversity under climate change. BioCCA in this table refers to the development of assessment procedures specifically for biodiversity and climate change to accompany both plan and project development. Some work towards the form that such an assessment might take is reported in Treweek et al. (2005) and Levett-Therivel et al. (2004). MACIS Del. 4.1 also suggests some policy tools which may be used in this process in its chapter 6 (Piper et al, 2008).

The array of options and measures listed in Table 4 also need to be developed and applied in a wider set of EC policies, i.e. such as cohesion, competition and external trade. Two other policy areas - sustainable development and the Cardiff process (the integration of environmental policy into all policy areas) - are particularly closely linked to biodiversity issues and climate change. In all these areas regulatory approaches are likely to be important (particularly: SEA and policy impact assessment). Swart and Raes (2007) have discussed the integration of adaptation and mitigation via mainstreaming into sustainable development policies. They point to the need to resolve issues of scale (temporal and spatial), and the differential distribution of costs and benefits. Swart and Raes (2007) conclude that "generally the global, regional and, in most countries – national potential of synergetic options to mitigate and adapt to climate change is relatively low, and both strategies should be considered as complementary". Nevertheless, they identify in the areas of land and water management and urban planning. These authors recommend taking a pragmatic approach – setting aside a search for the theoretically most efficient and least expensive policies – and instead following five principles:

1. avoiding trade offs between adaptation and mitigation (via tools such as design criteria and cost-benefit analyses)
2. identifying synergies for specific climate response options, between greenhouse gas emission reduction and reduced vulnerability to climate change
3. enhancing response capacity – and putting existing capacity into action
4. developing institutional links between adaptation and mitigation policy-makers, between countries and between hierarchical levels.
5. mainstreaming adaptation and mitigation considerations into "broader sustainable development policies" (Swart and Raes, 2007).

Research and development work, especially into interactions and impacts affecting biodiversity which result from these wider EU policies, are also needed. In the case of external trade policy, a further set of policy options will be relevant: conventions and regulations to protect habitats and species in both EU and trading partner countries, fiscal policies such as variable import taxes, and, where appropriate, further development of labelling practice.

Table 4 Policy options and instruments for biodiversity protection under climate change

	Policy Options to safeguard biodiversity				
	Regulation (command and control)	**MBIs and financial instruments** (to preserve and extend choice)	**Insurance** (bd-friendly action associated with risk insurance[12])	**Soft options** guidance, governance, awareness	**R&D**
Biodiversity policy					
Halting loss and enhancing resilience	Site designation, enhancement and creation Species designation Impact Assessment Biodiversity and CC assessment (=BioCCA)	Habitat-banking Biodiversity offsets Conservation tenders Environmental offsets Leveraged private investment Revolving funds for purchase of assets	Requiring bd measures as part of a risk reduction package (e.g. flood defences)	Raising awareness Guidance on connectivity and networks	Policies and activities on biodiversity and CC in new MSs and Accession states
Climate change policy					
Mitigation	BioCCA?	Emissions Trading		Raising awareness Guidance	Explore bd-friendly mitigation alternatives
Carbon capture and storage (CCS)	Regulation of carbon storage BioCCA?	Conservation/CCS tenders	Insurance for C storage?	Raising awareness Guidance	Liability issues on CCS Explore bd-friendly CCS alternatives
Adaptation	BioCCA?	MBIs for energy efficiency [13]	Variable insurance with risk (e.g. flood). Insce. for weather-related disasters	Raising awareness Guidance	Identify bd-friendly adaptation alternatives?

[12] Insurance-related measures may occur where biodiversity-friendly actions are taken as part of a risk reduction approach, or to reduce any risk associated with biodiversity provision

[13] MBI acts globally by reducing emissions; it focuses on "front of pipe" or product life-cycles rather than end of pipe (waste, emissions)

Table 4 contd.	Policy Options to safeguard biodiversity				
	Regulation	**MBIs and financial instruments**	**Insurance**	**Soft options**	**R&D**
Sectoral policies					
Agriculture	Impact assessment (e.g. of agric. Intensification) BioCCA	Agri-env stewardship MBI to support organic food production		Raising awareness Guidance Environmental performance targets	Impacts of A&M in agriculture on biodiversity
Construction/Built environment	Impact assessment BioCCA Compensation and enhancement	Environmental offsets Subsidy/rebates on local taxes for green roofs, rainwater harvesting Tax on soil-sealing	Variable cost: higher in flood plain therefore more biodiversity Discount for provision of ecosystem services components. Insce. to be available for new technologies	Raising awareness Codes Environmental performance targets Declaration of "Urban biosphere" Local Climate Impacts Profile	Impacts of A&M in construction & built environment on biodiversity
Energy generation	Env care, Impact assessment BioCCA	Environmental offsets	Insurance against severe weather affecting renewables infrastructure?	Raising awareness Guidance Environmental performance targets	Impacts of A&M in energy generation on biodiversity
Transport	Impact assessment BioCCA	MBI affecting imported goods and fuel?	Variable insurance with risk (e.g. flood) Discount for provision of ecosystem services components.	Raising awareness Codes Environmental performance targets	Impacts of A&M in transport on biodiversity
Water (resources, treatment, wastewater)	Water Framework Directive Impact assessment BioCCA	MBI to reduce demand, collect rain-water or build reed-bed water systems. Water trading in drought-prone areas (cap & trade)	Variable insurance cost with risk (e.g. flood)	Raising awareness Guidance Environmental performance targets	Impacts of A&M in water resources & management on biodiversity

6. Policy option appraisal

6.1 Appraisal criteria

The appraisal of the policy options outlined here might be undertaken using a standard set of criteria. Conventionally, the OECD and governments have reviewed their policy options against a number of criteria, which typically include criteria such as environmental effectiveness, costs, efficiency of application, equity and policy integration (see for example OECD 1989 and UK Dept of Environment (1994). These criteria may be grouped as those which aim at optimality and those which demonstrate conformity with other policies.

In its preparation towards the Adaptation White Paper, DG Environment has worked with the following "principles"

Preparation for EC White Paper on Adaptation to Climate Change

"Possible principles for action"

- *Synergies*: Priority to measures good for mitigation and adaptation.
- *No regrets*: Priority to measures beneficial irrespectively of uncertainties
- *Precautionary principle*: consider worst-case scenario measures, even if uncertainties are high (cases where the costs or the magnitude of the impacts in such scenarios would be unacceptable)
- *Solidarity:* between MS, regions, social groups
- *Flexibility and subsidiarity:* - Adaption policy should be dynamic and flexible (to account for uncertainties and rapid changes, local conditions and multi-solutions)
- *Knowledge based:* Adaption policy should be based on scientific evidence
- *Proportionality:* measures must be cost-effective and proportionate
- *Sustainability:* Measures must be in line with overarching EU objectives on sustainable development

Source: Stakeholder consultation on Adaptation Green Paper, Brussels, May 16, 2008

This set of principles has been used in Table 5 to appraise the policy options that have been discussed in the preceding sections. They are grouped as relating to:

Optimality:	**Conformity:**
Sustainability	Synergies: policy integration, M&A measures
Flexibility & subsidiarity	Precautionary principle
Knowledge based	Solidarity/equity
Proportionality: Econ/admin. efficiency	
No regrets	

This appraisal is illustrative only – certain instruments within a group will have different characteristics. In a real case it would be necessary to submit each option/instrument to careful assessment, using the criteria, the available data and a set of thresholds or indicators. See below, section 6.2.

Table 5 Preliminary appraisal of options (illustrative)

	Policy options (see note)			
Appraisal criteria	**Regulation**	**MBIs and financial instruments**	**Insurance**	**Soft options**
Optimality:				
Sustainability	G	?	M	M
Flexibility & subsidiarity	M	G	G	G
Knowledge based	M	M	M	?
Proportionality: Econ/admin efficiency	M/P	G	G	P
No regrets	G	?	M	G
Conformity:				
Synergies: policy integration, M&A measures	G	M/P	G	M/P
Precautionary principle	G	?	G	M
Solidarity/equity	M	P	P	P

Key:

G	Good
M	Moderate
M/P	Moderate/Poor
P	Poor

Notes:
Whilst the above figure gives a broad-brush appraisal for a policy option group, appraisal of an individual policy instrument might well vary. For example, whereas congestion tax as a fiscal instrument can ensure that polluters pay, carbon offsetting and emissions trading (MBIs also placed in this group) are less likely to achieve conformity.

R&D (Research and development) is not included as a column here as it has a supporting role to play in all the array of policy options and the instruments they cover, to provide the data needed, to identify those most suitable in given cases, to provide monitoring, etc. Topics for research and development are given in section 5.5. The value of R&D across the range of criteria is assessed as Moderate to Good.

6.2 Appraisal process

The process of selecting and implementing policy options/instruments should entail the evaluation of each proposal in terms of the criteria listed in 6.1 using, for example, a decision-tree approach and, where necessary, indicators or thresholds. The process might take individual options for assessment, or might compare two or more options. The process might be similar to that shown in Figure 1 above for MBIs, i.e.

1 Establishing the policy context
2 Identifying the case for action via an option/options
3 Using a policy option decision tree
4 Evaluating the options shortlist
5 Detailed design of the proposed policy instrument/s
6 Implementation

Data required for the analysis would include costs and benefits in economic, social and environmental terms, and forms of modelling might be required in view of the likely absence of much of this data.

Steps in the decision-making process would be informed by the criteria for the policy instrument (as above) plus desired consequences and effects to be avoided – see Figure 2, which lists issues associated with administrative practicability alone.

Figure 2 Administrative practicability issues for biodiversity policy instruments

Desired ends and aims

- Appropriate level of uptake
- Acceptability to public and administrators
- Appropriate innovation
- Flexibility of implementation
- "Fairness" in costs and benefits to all parties, and access to opportunities
- Equal access to information for parties involved

Effects to be avoided:

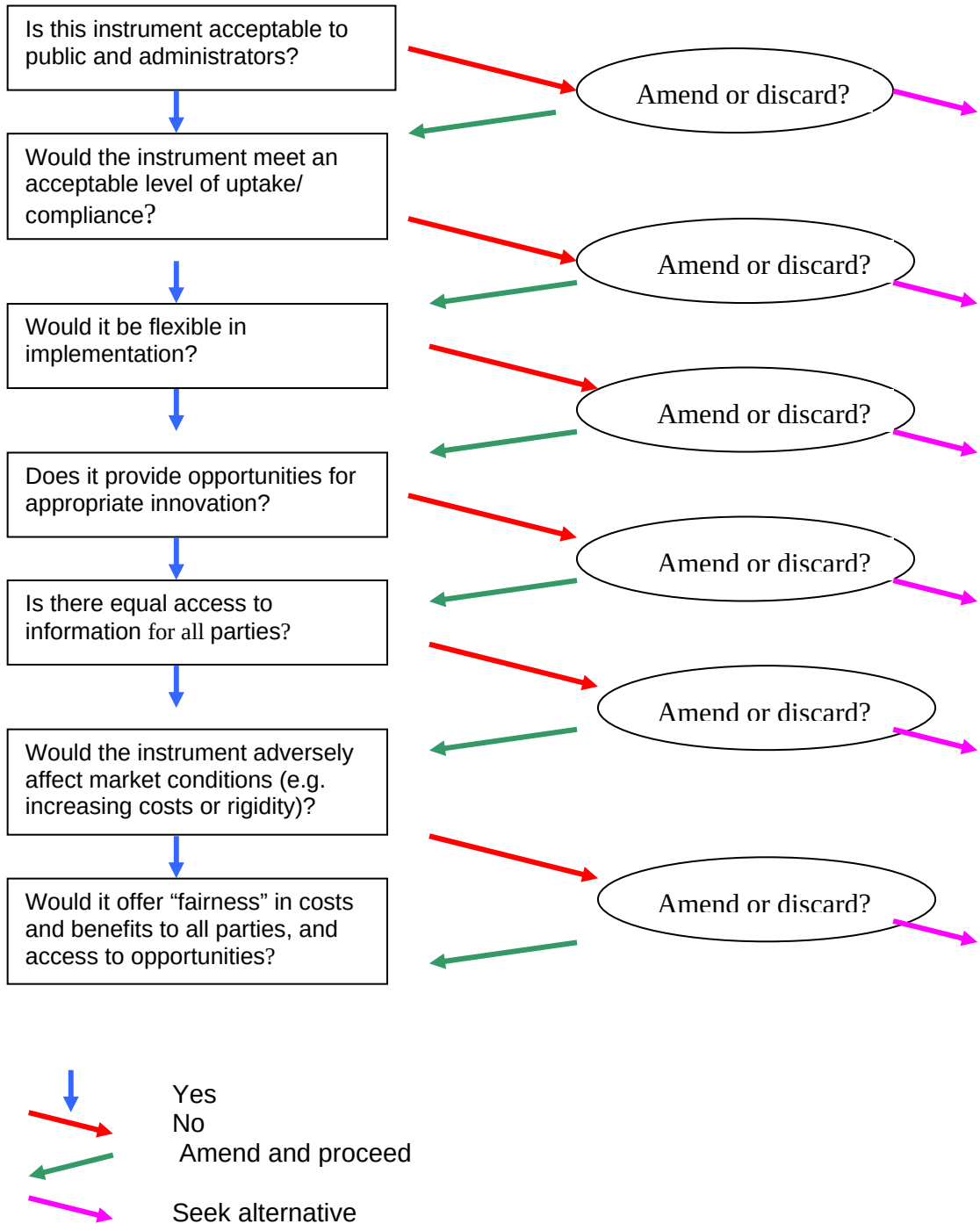
- Raising costs unnecessarily (including admin costs)
- Making markets rigid
- Introducing time lags and inefficiencies
- Inhibiting innovation
- Increasing risk

Things at issue

- Whether impacts and access should be uniform for all players and sites

The policy option decision tree would essentially be a series of questions, structured to elicit yes/no or graduated answers, leading to further questions and eventually to a recommendation. A simplistic example is given in figure 3, restricted to administrative efficiency issues. The order of the questions might change, and others might be added, in specific situations.

Figure 3 Decision tree – administrative efficiency and practicability



The results of the appraisal process should make possible a pair-wise comparison of options, leading eventually to a decision on policy (which could include a combination of options). See Figure 4, which quotes a comparison of regulation and MBIs as policy instruments.

Figure 4 Comparing regulation and MBIs

"…there would be a greater likelihood of being able to craft an MBI that would be superior to a regulatory instrument where:

- there is a known, established and enforceable **duty of care**;
- regulation would be difficult to design, implement and administer or enforce;
- there are a large number of potential market participants;
- there is flexibility in the range of responses that will deliver the desired outcome;
- impacts of similar actions (e.g. land use change and management action) vary across the landscape; and
- there is scope for innovation in improving land management for NRM [Natural Resources management] outcomes."

Source: Designer Carrots Decision Support Tool

7 Conclusions

This deliverable has shown that an array of policy options exists for addressing both mitigation and adaptation to climate change and that there are available means to assist with the necessary integration not only of biodiversity and climate change policies but also of many sectoral policies if mal-adaptive policies and measures are to be prevented. Given the uncertainties surrounding future rates and impacts of climate change, as well as gaps in knowledge and uncertainties of responses to policy initiatives, a precautionary approach to policy development would be the use of a variety of policy options. This could also be a route to policy integration.

We recommend that as EU and Member States further develop their strategies on climate change, adaptation and mitigation, and biodiversity, the array of policy options presented here should be considered, and where necessary further research into their application should be undertaken.

The policy options have been discussed here under five categories: regulation, MBIs, insurance, soft options, and research and development. Although the majority of these options are "top-down", i.e. imposed by government at different levels (EU to local), it is also apparent that "bottom-up" methods also have an important role to play; these may need to be supported by government to some extent, and must be designed to which raise awareness and commitment amongst the public.

Policy impact assessment is an important step in policy formulation and selection, and other forms of assessment (SEA, EIA) will be required at subsequent stages where plans and projects are proposed. The essential questions to be asked by policy-makers in such assessments include the following, in additional to examination of the costs and benefits of the action considered:

- What are the effects of this policy/strategy/project on climate and upon biodiversity through GHG emissions?
- What effects will climate change have on the long term sustainability of this policy / strategy /project?
- What effects will climate change have on the impacts from this policy /strategy /project?
- What further policies /strategies /projects interact with this to either increase or offset effects upon biodiversity and biodiversity resilience under climate change?
- What mitigation can be proposed and what are the residual impacts for the resilience of biodiversity under climate change?

As discussed in Del. 4.1, the implementation of policy, as well as of action plans, also involves the identification of sources of funding and of partners to be engaged in implementation, and the allocation of responsibilities, with timelines for action and specified outputs and desired outcomes.

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ANNEX 1 MARKET BASED INSTRUMENTS AND BIODIVERSITY

This annex briefly introduces seven types of MBI which already have a recognised role (e.g. in the USA, Australia and the EU) in safeguarding biodiversity from development and other impacts. The MBI types are:

A.1.1 Cap and trade
A.1.2 Habitat banking
A.1.3 Conservation tenders
A.1.4 Revolving funds
A.1.5 Market friction approaches
A.1.6 Fiscal incentives
A.1.7 Working within the current market

Section A.2 outlines the process of incentive design via MBI as proposed to the Australian Government, and section A.3 proposes a set of research topics for MBI design and development.

A.1.1 Cap and trade

This procedure consists in setting a limit on use of a natural resource (e.g. emissions to air or water, or use of a source of water), issuing permits for use which can be traded, and progressively reducing the level of the cap over time. The EU Emissions Trading Scheme already uses an instrument of this kind to reduce carbon dioxide emissions. The instrument could also be useful in areas where water resources are scarce, as a means of allocating water, provided that not only is water allocated so that high value and efficient uses are encouraged but that a proportion of the funds raised are then devoted to conservation of the resource, protection of the water environment and of its biodiversity.

Cap-and-trade measures are most likely to have a use in biodiversity protection under climate change in connection with water management, where the measure ensures a reduction in water use over time, or increasing availability at times of seasonal scarcity if funds collected are used to create structures/systems which retain water or improve its management for biodiversity. The EU Water Framework Directive is primarily designed to "contribute to the progressive reduction of emissions of hazardous substances to water" rather than scarcity. However, the Commission's Communication on the challenge of water scarcity and droughts (CEC, 2007) suggests that "The existing legal framework in the WFD offers ample room for tackling both water scarcity and droughts through [MBIs]". Member States are required, by Article 9, to ensure "that water-pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of this Directive". CEC 2007 indicates that despite the Article 9 provisions, economic instruments have not been widely used by Member States to that date, and notes that without metering or registration of most water abstraction, even "very well designed pricing policies can prove totally ineffective". In its Article 11, the WFD requires the implementation of systematic control over water abstraction.

A.1.2 Habitat banking

In response to the Green Paper on MBIs (see above) the EC is commissioning research into habitat-banking as a form of biodiversity offsetting (DG Environment ENV.G.1/ETU/2008/0043). In the UK research into biodiversity offsetting/habitat banking has been commissioned by Defra (July, 2008). In the USA, where the

practice has been used since 1983[14] it is used as a system to transform environmental liabilities into marketable assets, and almost always takes the form of the creation of wetland banks and species banks. Each "bank" is a parcel of land containing natural resource values (habitats, species) that come to be managed and conserved in perpetuity as a means to offset impacts incurred elsewhere by development on similar species and habitats. Thus, conservation objectives continue to be met, though in a new location and theoretically there is no net loss of total biodiversity value or of the services provided by the ecosystems. It is desirable that suitable equivalent sites have already been identified and acquired before loss of value at the development site, and restoration/recreation measures are already being implemented. Rather than a straightforward replacement rate where l ha of bank equals 1 ha of habitat lost, instead values are converted to credits based on area and/or quality that can be sold on the market. Developers or others causing an impact on biodiversity can thus purchase credits and use them to offset damage and deterioration. If the availability of "new habitat" is delayed, this will affect its ability to offset adverse effects.

It is argued that cost-effectiveness is achieved where a given conservation objective is met at lowest cost, i.e. where those providing conservation services are those who have the lowest opportunity costs. Moreover, habitat banking schemes are intended to help integrate biodiversity conservation with economic activities and change behaviour. Caroll *et al.* (2008, p 4) suggests that experience in the USA has shown that its greatest strategic advantage is probably that "causing damage to species and ecosystems costs more, while conserving species and ecosystems becomes profitable." It is also argued that compensatory sites may be located so that they contribute to large-scale ecological coherence – with additional gains for biodiversity in terms of size of habitat areas, or connectivity.

On the other hand, it has also been argued that existing species assemblages and habitats will only be partially replicated in new locations and that compensatory measures should only be applied to protected areas (notably Natura 2000 sites) as a last resort.

Compensatory biodiversity offsetting has also been developed in Germany in a manner in line with EU legislation with regards to location, etc. Around 1000 "pools" holding land for conservation purposes, have been established there since 1998 (Wätzold, pers. comm.) US banking history and its problems and successes have been assessed by several research teams (most recently by Bean *et al.* 2008).

A.1.3 Conservation tenders

Conservation tenders may be used to help fund conservation work on private land where land managers have little or no incentive to do such work without financial support. The objectives might include erosion control, biodiversity protection, water quality and flows, carbon sequestration, etc.

The process is that landowners or managers are invited to submit bids to carry out conservation work on their land – this might include changing from current use to one with value for biodiversity, by taking measures such as woodland planting or rehabilitation of streams and streambanks. Bids submitted are assessed, ranked

[14] The US Dept of Agriculture's Fish and Wildlife Service published interim guidelines on "mitigation banking" in 1983, updated by federal guidance in 1995. In 1988 there were 16 extant banks, of which one was commercial. In 2002 there were 219 extant banks, of which 135 were commercial (Miller, Paralia Nature Workshop, 2005)

and funded on the basis of value for money and the work is undertaken subject to a formal agreement between the funder and the property manager. The funder could be government, or it could be a private company seeking an environmental offset. Cost-effectiveness is claimed to be an advantage of the conservation tender process.

A.1.4 Revolving funds

A revolving fund MBI involves a process that:

- identifies and purchases properties with high conservation values
- negotiates a legally enforceable, permanent conservation covenant with the appropriate authority
- sells the covenanted properties to conservation-minded buyers
- provides assistance to new owners with access to expert advice, support and (in some cases) incentives.
- Then, the sale proceeds are returned to the fund so that the cycle can be repeated.

Land adjacent to, or close to, areas with high or strategic conservation value will be preferred, in order to create broader conservation benefits, e.g. by connecting fragmented or remnant habitat, or as a buffer for a designated protection area, to create broader conservation benefits. (Example: Bushbank Fund, Western Australia).

A.1.5 Market friction approaches

These are MBIs which aim to reduce the "friction" of trade in a resource by improving flows of information in the marketplace and lowering transaction costs. For biodiversity, such approaches could include the labelling of biodiversity-friendly farm produce, or web-based systems to facilitate contacts between funders and providers of conservation values.

A.1.6 Fiscal measures

This group of MBIs covers those that would impose taxes upon actions "unfriendly" to biodiversity or the environment, or which provide subsidies or tax concessions/rebates to support types of behaviour that are sought-after. For biodiversity, these could include:

Taxes on adverse actions	Tax on sale of semi-natural land for construction Tax on soil-sealing (e.g. front gardens)
Incentives for desired actions	Subsidy for enhancement of land (agricultural, brownfield, or within urban environment) for biodiversity. Subsidy for measures that permit natural recreation of wetland (e.g. removal of mole drains) Subsidy for green roofs, rainwater harvesting, etc.

A.1.7 Working within the current market

Leveraged private investment involves cooperation between 'public' and 'private' markets. Whilst public (government) investors seek outcomes with benefits for the environment or other public benefit, private financiers and private equity seek profitable enterprises. Leveraging brings these two sides together with cash co-investment approach in near-commercial projects with sustainability benefits, rather than focusing only on public-good environmental outcomes.

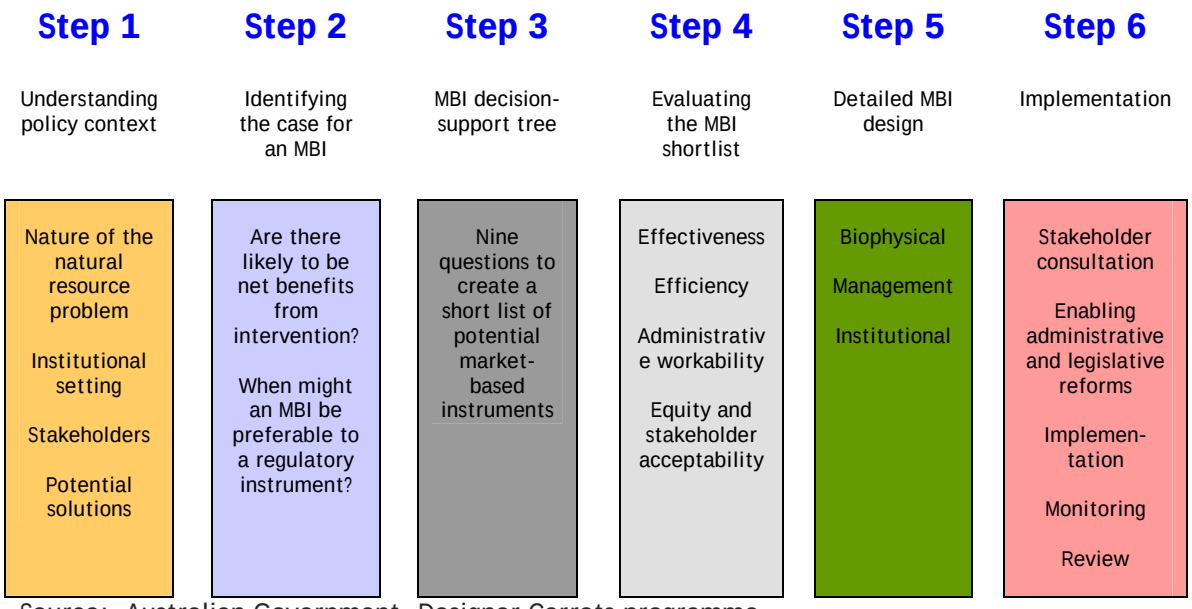
Where projects offer a level of environmental benefits that is not sufficient to justify 100% public investment and where commercial returns are low, co-funding by the private and public sectors, with the public sector covering the shortfall in any commercial returns in order to attract private-sector investment, may enable the projects to go ahead. This approach relies on access to a pool of public funds and a thorough assessment of the environmental and commercial benefits, and the risks of competing proposals. Proposals are selected for funding the difference between the commercial rate of return and required investment, based on their combined commercial and environmental attributes.

A.1.8 Incentive design

Work commissioned by the Australian government and other bodies has led to the development of a decision-making tool for the process of determining whether and what sort of MBIs might be appropriate in given circumstances. The process is described as one of understanding the circumstances in play and identifying whether any MBI might be appropriate, then selecting – on the basis of criteria – which MBI types should be evaluated, leading to the design and implementation of a "tailor-made" MBI to address the policy need. Further information on the process and decision-tree is available at: http://marketbasedinstruments.gov.au/

Figure A.1 sets out the six-step process.

Figure A.1: Steps in MBI design



Source: Australian Government, Designer Carrots programme

Step 3 questions:

The Designer Carrots decision-support tool's step 3 includes six questions to create a short-list of potential MBIs for a given situation. Of these, the first four explore market failures within existing or associated markets that are affecting goals of natural resource management. Where such failures exist, market friction MBIs alone may be sufficient to achieve the desired goal.

However, where natural resource markets are incomplete or missing, other types of MBIs will be needed, those concerned with price or quantity. Questions five to nine explore the suitability of alternative instruments where this is the case:

- Q. 5 explores possible inclusion of the agricultural sectors through the use of voluntary mechanisms where some urban or industrial activities are already regulated.
- Q. 6 is intended to rule out cases where there is not enough variability in the private costs between land managers of making NRM improvements to warrant an MBI.
- Q. 7 evaluates the degree of willingness to impose liabilities which will lead to opportunities to use market-creation or negative price-based instruments.
- Q. 8 considers whether circumstances are such that market creation is an option.
- Q. 9 assesses which is more appropriate: a positive or a negative price-based instrument.

See the Designer Carrots programme website for further details: www.marketbasedinstruments.gov.au/

A.1.9 Research issues for MBIs

Some of the issues to be addressed in the case of biodiversity affected by climate change have been discussed in consultation responses to the EC Green Paper on market based instruments (e.g. Greyson, 2008), and include:

- The difficulties associated with the likely complexity of a situation in which various MBIs are in place in different countries, influencing markets.
- The extent of the behaviour change that can realistically be expected and maintained without increasing perceived "rights" to use natural resources; whether MBIs can replace other mechanisms and market distortions resulting from regulation.
- Many MBIs are focused on "end of pipe" solutions – on emissions and waste, whilst MBIs which focus on product life-cycles are also needed (e.g. green labelling). Any possible areas of conflict need to be identified and considered.
- Do any MBIs increase the risk of damage to ecosystems – who would pay for this?
- Biodiversity protection is needed at local, regional and global levels; MBIs may have both local and global impacts, some benefits may not accrue locally – how can these be counted?
- How can cost-effectiveness and innovation be maximized without making MBIs too prescriptive? They must preserve or extend market choice, not merely raise prices; this means providing financial help for reducing impacts at the same time as increasing resource availability.
- Do resource-focused MBIs (e.g. on wetland development) offer equal or better benefits than energy-focussed MBIs?
- If MBIs are revenue-raising (e.g. taxes) where and how is this revenue to be spent- can it be hypothecated to further the aims of policy or will it be spent on damaging actions?