Mainstreaming action on climate change through participatory appraisal

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Abstract: Climate change is a complex phenomenon. Responses in the form of decisions and actions on mitigation and adaptation measures, what balance among these should be preferred and how preferred options might be implemented are needed across many different levels in the governance structure and across many contexts of application. These will have to be developed from a very low starting position, often in conditions of ignorance of the urgency of the issues, uncertainty and dispute. If society is to respond effectively, climate change will need to be 'mainstreamed' into routine forward planning and decision-making activities. We argue that this calls for a generic 'capacity' that would be applicable across scales and contexts to explore responses. Most usefully, this should be built around principles of participation, experimentation and social learning, with appraisal conceptualised as an active process used instrumentally to transform the prospects for responding effectively to climate change.

Keywords: climate change; mitigation; adaptation; participatory appraisal; social learning; Integrated Sustainability Assessment; ISA; Methods and Tools for Integrated Sustainability Assessment; MATISSE; Adaptation and Mitigation Strategies; ADAM.

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1 Introduction

Climate change is characterised by complexity.[1] There are many greenhouse gases and many sources of greenhouse gas emissions. Causes and effects of climate change are separated over space, time and scale and are mediated by non-linear relationship and irreversibility. Both the threat of climate change and vulnerability to its potential impacts vary across space, affected parties and systems, infrastructures and activities. The 'human' systems that interact with the relevant geo-chemical cycles are characterised by dispersed agency and by a separation between a responsibility to secure responses to climate change threats and the agency needed to implement these. Both the human system and bio-physical systems that are implicated in climate change are essentially unpredictable, so responses to climate change threats and opportunities must be worked out with awareness that there will always be uncertainty surrounding these. There is, nonetheless, a growing consensus that the climate is changing owing to anthropogenic interference in atmospheric chemistry and that responses are now needed.

Responses to the threat of climate change – in the form of mitigation and adaptation measures, decisions about what balance among these might be targeted and how preferred options might be implemented – are needed across many different levels in the governance structure and will have to be developed from a low starting position. The current 'framing' of the climate change issue as a 'problem' may unnecessarily constrain ways of thinking about mitigation and adaptation options, which adds to the difficulties faced in developing innovative responses in contexts where there may currently be little or no sense of urgency, let alone a sense of opportunity in addressing the subject.

There is therefore an emerging need to 'mainstream' the climate change issue and to reframe the context within which the issues are discussed so that these provide scope for innovative strategies and responses more capable of adding value and appealing to the self-interests of those holding agency on the issues. How else will nations develop, coordinate and implement their responses to climate change unless responsible actors in all sectors, regions, planning authorities and companies begin routinely to ask:

- What is our contribution to climate change?
- How will climate change affect us?
- Which activities, structures and people for whom we have some responsibility are vulnerable to climate change?
- Where is the threshold between a level of climate change that is tolerable and within the scope of reasonable adaptation and a level that would give rise to unacceptable problems and costs?
- What type of information, capacities and relational skills do we need to develop to deal with climate change threats and opportunities in our context of action?
- How can we respond to climate change? What mitigation, adaptation and burden sharing options are open to us?
- Of these, which are likely to be the most cost-effective, technically feasible, socially robust and politically acceptable?
- How can we develop networks of actors capable of implementing preferred responses, action plans to which they will commit, and a receptive context?
- How might we reframe the issues so that we create opportunity in addressing them?

The growing importance of the climate change issue in the political process is likely to lead in the short- to medium-term to an increasing requirement to address the climate change dimension explicitly in any relevant major decision-making or forward planning process. The pressure for this may come indirectly through price incentives or by fiscal pressure or more directly via regulation. It is possible that planning authorities might in the future be mandated to integrate climate change into their forward plans and strategies in the same way as the use of Environmental Impact Assessment (EIA) or Strategic Environmental Assessment (SEA) is mandated today in some jurisdictions, such as in the European Union. It is conceivable, for example, that mainstreaming could be required of development agencies responsible for economic regions, ministries responsible for particular sectors of the economy (*e.g.*, tourism and transport), river authorities responsible for specific watersheds, urban authorities responsible for their towns and cities, and so forth. It is likely, also, that there will be increasing interest paid in the issues by those who see climate change and responses to it more as a source of economic and social opportunity than as an ecological threat. Responding effectively and efficiently at the societal level to climate change may well depend heavily on finding ways to reframe the issues to provide such opportunity.

As climate change is mainstreamed many more people will need to incorporate climate change in their decision making, whether for the purposes of supporting negotiations processes at the national and bloc levels, forward planning at the regional and local levels, strategic planning at the level of sectors, or business planning at a corporate level. Mainstreaming therefore calls for a 'capacity' that would be applicable at all scales and in all contexts for exploring responses to climate change.

Integrating climate change aspects into routine activities is a far from trivial exercise. The subject matter is complex and specialised. Furthermore, the time and resources available to support forward planning and decision-making processes will always be limited. What is required, then, is a generic capacity, adaptable to many application contexts that can stimulate innovation and creativity, reduce very substantially the amount of work and effort required in any single application, deliver improved strategies and help reframe the contextual conditions for developing and implementing these. Ideally, strategies should be cost-efficient, ecologically effective, socially robust and politically acceptable; and they should hold a high probability of being implemented successfully by virtue of appealing to the enlightened self-interest of those with agency in their delivery.

This has been recognised in Europe where the challenge is being addressed explicitly by a research project on Adaptation and Mitigation Strategies (ADAM) supporting European climate policy, which is financed by the European Commission. The core objectives of the ADAM project include:

- To assess the extent to which existing and evolving EU and world mitigation and adaptation policies can achieve a socially and economically tolerable transition to a world with a global climate no warmer than 2°C above pre-industrial levels, and to identify their associated costs and effectiveness.
- To develop and appraise a portfolio of longer-term policy options that could contribute to addressing shortfalls between existing mitigation policies and the achievement of the EU 2°C target, and between existing adaptation policy development and EU goals and targets for adaptation.
- To develop a novel policy assessment framework and apply it both to existing and evolving climate policies and to new long-tem policy options in a set of case study policy domains. These include: European and international climate protection strategy in post-2012 Kyoto negotiations; the restructuring of International Development Assistance; the EU electricity sector; and, regional spatial planning within the EU.

In an entirely independent but concurrent development, the recently launched Clinton Climate Initiative (CCI), in partnership with the Large Cities Climate Leadership Group, has identified a set of three priority actions for making tangible progress against climate change in large urban areas. These include action by the CCI to:

> "create and deploy common measurement tools and internet based communications systems that will allow cities to establish a baseline on their greenhouse gas emissions, measure the effectiveness of the program in reducing these emissions and to share what works and does not work with each other". (Clinton Foundation Press Office, 2006)

These initiatives under the auspices of the EC and ICC, respectively, are responses to a perceived emerging need for a 'capacity' to facilitate decisions and forward planning processes that involve a climate change aspect. At issue is what form this 'capacity' might take and what features it should incorporate. Mainstreaming and making climate change integration easier and cheaper to do well go hand-in-hand. Integrating climate change into routine activities will depend upon making appropriate information, tools, methods and processes available for this to happen, as well as on building awareness of the need for integration and related capacities. But mainstreaming also depends upon lowering the resource cost and barriers to integration to levels that makes integration a realistic and attainable goal across a wide range of contexts. At a minimum, it is likely that the 'capacity' should be in the form of an appraisal process for evaluating mitigation and adaptation options and proposals. This said, the routine questions just posited that ought to be addressed by an appraisal process suggest that the starting point for any appraisal is less likely to be a policy proposal in abstract, but rather a system of interest that has an ongoing relationship with the climate system and with climate change.

The starting point for appraisal is thus to obtain an understanding of the nature of the relationship between the climate system (the system of reference) and a system of interest that is contributing to climate change, that will be affected by it, or that has a potential role in the development of mitigation and adaptation options so that we can identify points of leverage, vulnerability and/or opportunities. This last aspect, concerning climate change as a source of opportunity, should not be overlooked since it could well be that mitigation and adaptation strategies may be driven as much by the opportunities for added private gains that may be created through innovative responses as by any concern to limit climate change or its impacts. Indeed, innovative mitigation and adaptation strategies that open opportunities for added private gains and thus hold appeal to actors with agency who would benefit from them financially or in other ways are among the most likely to be implemented, with any ecological gains to society emerging almost as indirect benefits. Thus, an appraisal approach and steering tool is needed to provide the capacity to assess innovation strategies that might be framed and justified by the new 'context of action' that is posed by climate change and not only to cope with the 'threat' of climate change. It is needed, also, to help reframe the 'context of action' so that this stimulates and rewards effective innovation.

To be fit-for-purpose a generic appraisal process for climate change responses would need to combine at least three elements: an architecture for an appraisal process; guidance on a set of procedural tasks for developing, exploring and appraising options for action on climate change; and a set of embedded resources that can be called upon as needed, such as guidance notes, tools, models, databases of already-tabled strategies and policy options, climate change scenarios and illustrative examples of appraisal processes and outcomes for particular sectors and regions. There is good reason to suppose that support for social learning should be an important design feature of the appraisal procedure. Social learning refers to a process of enhancing the capacities of agents to change the original institutional conditions and/or context within which the problems and solution options are framed and of introducing progressively more robust and grounded knowledge about how the system of interest and the system of relevance are related. Social learning is an open-ended process in which individuals and groups continuously learn how to frame and reframe the issues at stake in a more socio-ecologically robust way, how to integrate the potential for innovation and creativity derived from social conflicts, how to deal with competing worldviews in a constructive and cooperative way, and how to create social collective capabilities to deal with common problems.

The rest of this paper is structured around an expansion of these design issues from the perspective of seeking a solution to the major challenge of designing an appropriate architecture for an appraisal process capable of being used to mainstream climate change into routine decision making and forward planning by providing a capacity to explore possible responses and support continuous social learning. In the section that follows, we consider in greater depth the need for mainstreaming and the policy needs that mainstreaming could serve. In the section thereafter, we look at traditional appraisal processes and critique these using the design requirements that we have just identified. Traditional appraisal processes based on cost-benefit, cost-effectiveness and risk analysis are considered insufficient for the mainstreaming purpose, because they are too narrow and static to cope with the indeterminacies inherent in issues of climate change or to provide scope for enhancing innovation prospects. Additional design requirements that emerge from this critique are then discussed, such as for an explorative appraisal process that might provide a forum for social learning and context reframing, and a mechanism for social capital and capacity building. In the section thereafter, we describe an emerging new appraisal approach that combines participation, modelling and policy analysis and that could usefully be adopted for appraising responses to climate change. In a final discussion, we draw conclusions about how best to respond to the need to develop appraisal capacity for mainstreaming climate change and about associated research needs.

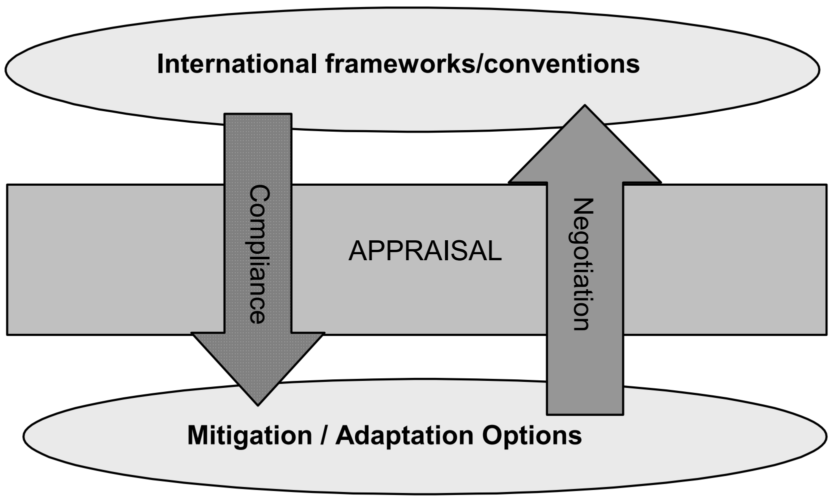
2 Mainstreaming and the policy context for climate change

It is useful to begin by considering what is needed at a national and supranational policymaking level (the level of regional blocs, such as the EU) in order to address the climate change issue and to consider what these needs imply for an appraisal process. Examples of such needs are:

- To inform the national negotiating position as regards post-2012 arrangements concerning CO_2 thresholds, carbon (and other greenhouse gas) abatement targets, burden/risk sharing at the global level, policy instruments, *etc.*
- To explore prospective adaptation and mitigation measures and portfolios of measure to be deployed nationally and at the level of supranational blocs to assess their cost-effectiveness and adequacy in meeting existing and prospective international obligations and coping with climate change.
- To explore supporting policies for responsibility, burden and risk sharing at various scales.
- To explore means for integrating climate change (including vulnerability reduction, mitigation measures and adaptation measures) into sectoral policies and horizontal policies (*e.g.*, investment, R&D, *etc.*).
- To explore means for integrating climate change (including vulnerability reduction, mitigation measures and adaptation measures) into development aid policy and trade policy agendas.

Some of these needs have an external orientation in that they concern relations between specific nations or blocs of nation and the rest of the world; others have an inward orientation, since they concern what can be done within national blocs or individual nations to respond to climate change. We can also structure these needs in relation to the global framework conditions for climate change policy. There is a need to establish the future (post-2012) global framework conditions of climate change, including emission reduction goals and supporting policy instruments, and there is a need to explore ways to handle climate change within the existing framework of the UNFCCC[2] and Kyoto-Protocol, and any potential new framework(s). Clearly, these two aspects are related dynamically, since the negotiating position on post-2012 arrangements needs to reflect an understanding not only of the threat of climate change, but also of the prospects for mitigating and/or adapting to climate change. There is, thus, a potential for dynamic interplay between a 'top-down' and a 'bottom-up' approach to establishing the global framework conditions. Both approaches are legitimate and any system for appraisal should provide a capacity that is able to meet the need both to ensure compliance with existing negotiated framework conditions and to provide information that informs negotiations on future frameworks (Figure 1).

Figure 1 Top-down and bottom-up



In order to compare different mitigation and adaptation options and in order to get some feel for the adequacy (top-down) or capacity (bottom-up) of policy portfolios in respect of achieving particular levels of protection (2°C, 5°C thresholds, *etc.*) and dealing with the ensuing climate change, we need to have some appreciation of the likely costs and effectiveness of options; *e.g.*, what will be the cost per tonne of carbon abatement; what will be the value of abatement in terms of impacts avoided, *etc.* The problem, as is widely appreciated, is that climate change is a complex policy area that is both highly uncertain and highly contested.[3] There are few hard facts and there is virtually no scope for scientists to act in the usual capacity of experts able to provide reliable and objective answers to definitive questions. The history of discussion surrounding the climate change issue is illustrative. There has been considerable dispute, already over several years, over the potential cost of climate change mitigation. Hawken *et al.* (1999) argue that the perception that climate protection would be prohibitively costly is widely held "because the assumption that this is the case is built-into the best-publicised (though not most broadly accepted) economic models".[4] Hawken *et al.* report Samuelson (an influential economic columnist in the USA) as commenting that without a breakthrough in alternative energy, adequate climate protection measures would "crush the world economy". Samuelson mentions solar and nuclear as possible alternative energies. By contrast, a recent report by Lackner and Sachs (2005) argues that:

> "preventing carbon dioxide emissions from rising to potentially dangerous levels could cost far less than originally projected – less than 1 percent of gross world product as of 2050 – but a major shift in the way energy is found, transformed, transported and used will be necessary."

Albeit anecdotal, the differences of perspective just outlined illustrate several important points about climate change policy. First, the costs and benefits of mitigation and adaptation options are uncertain. Second, we can assume that, whatever the costs might be, they are certainly not 'fixed'. This is because costs are contingent on many factors, such as potential technological breakthroughs, which are as yet unknown. Third, we need to distinguish between the potential effectiveness of any mitigation or adaptation options and actual effectiveness. The latter depends, especially, on the social and political acceptability of the option and also on the capacity for successful implementation. These, too, are not fixed. Fourth, the climate change 'problem' may also turn out to be an 'opportunity', since we may be able to find profitable or beneficial ways of mitigating climate change that might appeal to those with agency in delivering the response.

Thus we can consider that appraisal, in addition to giving support to the political decision-making process through 'products' of the appraisal, such as information about the prospective impacts of options, should also have a set of procedural outcomes that meet the following needs:

- to provide a means for ensuring 'good' governance, legitimacy and the 'social robustness' of knowledge
- to build scientific, social and institutional capitals and capacities (trust, networks of actors, action plans, simulations of transition pathways, new forms of communication, experience in transdisciplinarity, *etc.*) that are needed to improve the prospects of successfully implementing options
- to improve the context into which options will be introduced so that it is more receptive and conducive for successful implementation; *e.g.*, by raising awareness of the threats of climate change, of the policy options and their potential impacts
- to reduce or, if not possible, unveil, assess and find a way to cope with the level of uncertainty surrounding the likely costs and effectiveness of options (through all of the above).

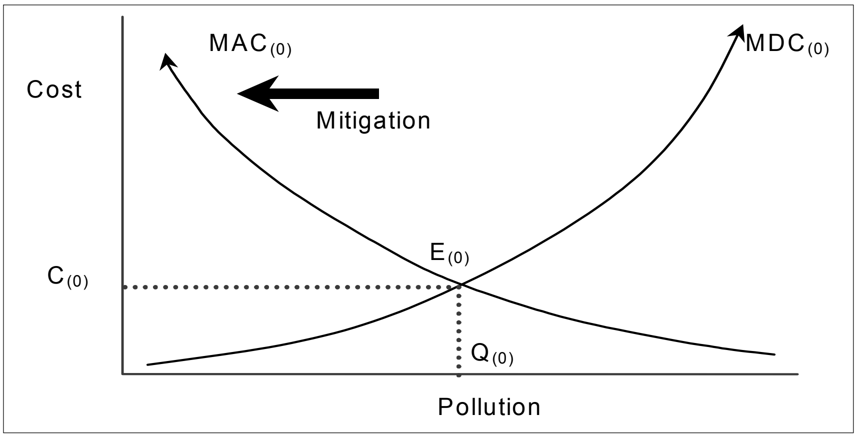
3 Traditional approaches to appraisal

Against this background, it is important to note that part of the work of the Intergovernmental Panel on Climate Change (IPCC) has been to collate a wide range of possible climate change mitigation and adaptation strategies. Its reviews have taken in those options that have been described in scientific publications. Equally, there exists a range of established 'technocratic' approaches for evaluating prospective policy options, based upon using models to project developments in our systems of interest and reference with and without enactment of the policy option, estimating the impacts of the option and drawing conclusions about cost-effectiveness, the balance of costs-and benefits implied by the policy option and the risks of action or inaction. Traditionally, the way of appraising the options prior to political decision making would be through Cost-Benefit Analysis (CBA), cost-effectiveness analysis, risk analysis, and related methods that use the neo-classical theory of environmental economics to inform decision making about the 'best' policy options.

Within the framework of this theory, the objective is to seek an economically efficient balance between the benefits provided by economic activities that generate pollution and the costs or disbenefits of damages caused by that pollution. The concept of economic optimality suggests that it is worthwhile tolerating pollution only so far as the benefits of the economic activities that generate pollution at the margin exceed the costs of pollution at the margin. We should therefore seek to abate pollution so long as the marginal abatement cost (through reduced production, fuel switching, efficiency measures, or the deployment of cleaner technology, *etc.*) is lower than the marginal damage cost of pollution. In the same vein, we should deploy adaptation measures so long as the marginal benefits of adaptation (in terms of damage costs avoided) exceed the marginal costs of adaptation. In the case of climate change, mitigation measures have the effect of reducing emissions and/or slowing the build-up of greenhouse gas concentrations in the atmosphere and, so, of restricting both the level of climate change experienced by a particular date and the marginal cost of pollution. By contrast, vulnerability reduction measures and adaptation measures have the effect, at each level of carbon concentration, of lowering the damage costs of climate change at that level. It is, of course, possible that some measures can reduce vulnerability or provide for adaptation to climate change while simultaneously contributing to mitigation.

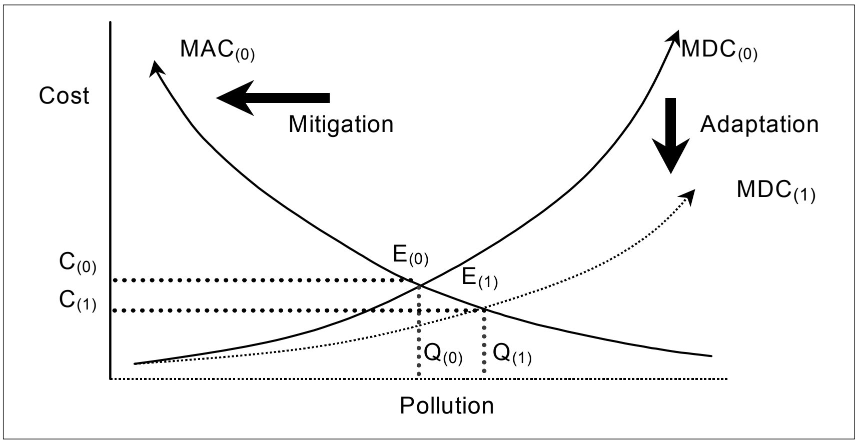
The essentials of neo-classical economic theory as might be applied to finding the best balance between accepting pollution, attempting to mitigate it and seeking to adapt to environmental changes resulting from it are presented in Figures 2–4. It should be pointed out that the theory assumes simple cause-effect relations and full knowledge. Figure 2 illustrates a typical pollution damage cost curve. As the level of emission of pollution increases, the damage cost of each incremental unit of pollution is successively higher. The Marginal Damage Cost curve (MDC) therefore has a typically exponential form. One response is to abate the emissions. Abatement lowers the level of pollution, but incurs an abatement cost. At high levels of pollution and low levels of abatement, the cost of reducing emissions is typically small, since the lowest cost abatement technologies can be deployed first. As we seek to reduce pollution levels further, each additional unit of abatement is typically more expensive to achieve. This is shown by the exponential shape of the Marginal Abatement Cost (MAC) curve. As we deploy more effort to reduce pollution levels, the marginal cost of abatement rises and eventually is equal to the marginal damage cost of pollution (point $E_{(0)}$ in Figure 2). There is no economic sense in reducing pollution below this level. Point $E_{(0)}$ represents an economically optimal balance between avoiding and accepting damage from pollution.

Figure 2 CBA and economic optimality: mitigation



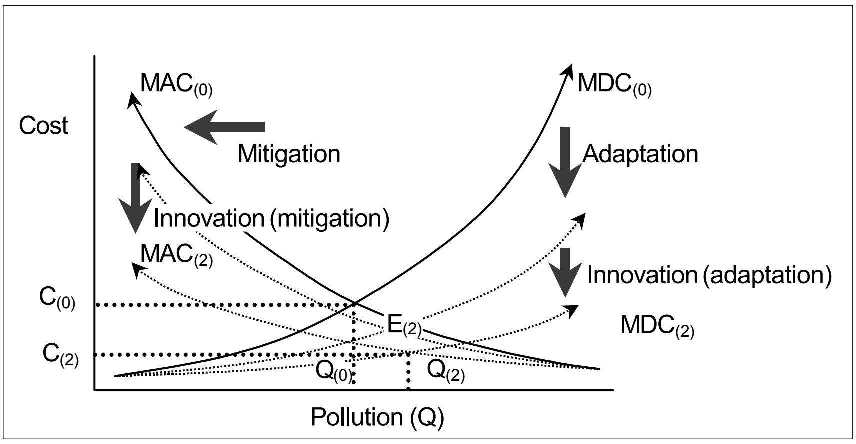
We can also seek to adapt to pollution and the environmental changes it induces (Figure 3). Successful adaptation has the effect of lowering the costs of damage that we incur at each level of pollution. Adaptation therefore brings a benefit in terms of damage cost reduction, but also incurs costs in terms of adaptation measures deployed. As with abatement, we should deploy adaptation measures so long as these deliver net benefits. When adaptations that deliver net benefits are possible, their deployment has the effect of pivoting down the MDC curve. The $MDC_{(1)}$ curve demonstrates the effect of deploying net-benefit adaptation measures. By lowering the net marginal damage costs, adaptation means that we can tolerate a higher level of pollution, which means that there is less need to deploy pollution abatement measures. There will be a new optimal balance between pollution, abatement and adaptation, which will be achieved at a higher level of pollution but at a lower marginal cost both of pollution and abatement ($E_{(1)}$).

Figure 3 CBA and economic optimality: adaptation



We may deploy currently available abatement and adaptation options, but we may also seek to improve the available options through innovation; for example, through new and better technologies. The effect of innovation is to lower the cost of adaptation and/or mitigation, which is represented in Figure 4 by the pivoting downward of both the MDC and MAC cost curves. Improvements in abatement that lower abatement costs will lower the level of pollution we should tolerate. Improvements in adaptation that lower the damage costs of pollution will enable us to accept more pollution. Improvements in either or both abatement and adaptation have the effect of lowering the costs associated with the pollution problem. Again, a new optimal balance between the level of pollution to tolerate and the level of mitigation and adaptation effort to employ is implied ($E_{(2)}$).

Figure 4 CBA and economic optimality: innovation



4 The implications of complexity

This begs the question: why is it not sufficient for policy towards climate change to draw upon the IPCC as a source of policy options on the one hand, existing models of our systems of interest, and on traditional CBA and related methods as means for appraising the capacity and adequacy of these options and for establishing preferences among them? Although this question may be construed to be somewhat naïve, it is deliberately posed here because of the insights it offers into the complexities of policymaking and decision making for climate change. This complexity owes to the nature of the climatic change problem and the characteristics of the ecological and human systems that are concerned in climate change in terms both of causes of climate change and of potential responses to it. These characteristics include:

- the multidimensionality of the climate change issue that engages environmental, economic, social and institutional dimensions, many of which are not quantifiable or reducible to simple metrics
- non-linearity, threshold effects, contingency, irreversibility, recursivity, the potential existence of multiple quasi-stable states and the possibility of 'destabilising' the present climate regime upon which we all ultimately depend[5]

- inherent uncertainty, which sometimes is irreducible
- high stakes, multiple stakeholders, multiple values, many perspectives and disputed facts
- impacts that cross boundaries of time, space and scale, such that there is no necessary correspondence between responsibility, agency, vulnerability and impact
- the need and opportunity for innovation at the systems level that engages synergistic innovations on multiple innovation fronts[6]
- a 'distributed' innovation system engaging multiple innovation actors and agents.

Against this backdrop, a stand-alone technocratic approach to appraisal, such as CBA is insufficient. Such an approach is too reductionistic and mechanistic. Such approaches are suitable for situations where all or most costs and benefits are known with reasonable surety and can defensibly be monetarised and, if necessary, represented in terms of 'net present value'. This is not the case with climate change where uncertainty and indeterminacy combine with high stakes and disputed values so that the scientist is unable to deliver clear-cut, objective and reproducible answers about which options are better than others. Climate change is therefore best characterised as a post-normal threat (Funtowicz and Ravetz, 1994) not amenable for handling though only traditional scientific approaches (Mode I Science).

However, even accepting that climate change is an issue for treatment through Mode II Science (Gibbons *et al.*, 1994; Nowotny *et al.*, 2001), it is still useful to think more about the ultimate purpose of appraisal in Mode II Science. Is the purpose simply to support decision making, with the caveat only that this support is provided through a deliberative process that adds 'social robustness' to the list of criteria for selecting among options and makes this operational through a participatory deliberative process that engages with a wide range of stakeholders? Any appraisal process for climate change must be capable of evaluating the potential cost-effectiveness of mitigation and adaptation options and innovation. Ideally it should also contribute to improving climate change governance, its quality and transparency. But we argue here that, for maximum impact, it must be capable of doing more than this. First, it cannot be assumed that the existing set of tabled policy options is exhaustive or that each option as presently defined is optimally designed. Thus the appraisal process itself should provoke creativity to expand the range and quality of the set of options. Equally, there is no necessary guarantee that a prospective policy that in principle is acceptable to stakeholders and has the potential to be effective will be implemented in practice, since there is no central authority with the power to guarantee implementation even of potentially effective and socially acceptable options.

In this context, is it important to make a distinction at least between actors and stakeholders and between stakeholders who hold responsibility but not agency and those with agency. 'Actor' is a generic term that refers to individuals or organised groups, alliances, institutions or organisations in the system of interest that play a role in and have knowledge about the problem. 'Stakeholder' refers to those actors who have a legitimate interest (a stake) in the problem (because they are affected by it) or in the potential solutions (because they will be impacted by solutions, whether directly or indirectly, positively or negatively). These can be governmental stakeholders, scientific stakeholders, business stakeholders, and societal stakeholders. In order to ensure that a policy appraisal addresses appropriate levels of involvement of power, legitimacy and influence, the term 'agency' becomes important. Some actors can be distinguished from others either by their responsibilities in respect to resolving problems or by their power of agency in respect of implementing – or frustrating – the options being assessed. There is no necessary coincidence in the distribution of agency (the power to contribute to the implementation of solutions) and the incidence either of responsibility for problem solving or vulnerability to the potential impacts of climate change. Thus agency and its distribution are functions of each particular climate change adaptation and mitigation option. Agency and its distribution will change depending on which option is being assessed, albeit that there is likely to be considerable overlap such that some actors will have powers to contribute to the implementation prospects of many options.

The goals for an appraisal process in support of climate change policy should include the usual technical goals of evaluating policy options; but this evaluation should be done with awareness of the need for a dynamic, recursive and therefore iterative or cyclical process involving interactions and feedbacks between the options under evaluation, the context within which these have emerged, those participating in the evaluation as stakeholders or experts and the wider implementation context for options. Appraisal is likely to be more constructive if it is conceived as an active process of improving options and their chances of being implemented successfully and of transforming the original conditions in which such options were framed and developed in the first place. This means that the goals for an appraisal process in support of climate change policy must be broader than those surrounding usual appraisal processes. The appraisal process should be seen as an instrument for change, for removing institutional or other contextual constraints on innovation, and for building critical awareness, capitals and capacities that will be needed to develop and implement effective, socially robust options. Specifically, appraisal should seek to:

- raise the level of awareness of the severity and urgency of the climate change issue and what might be done about it together with its potential for economic, social and political innovation
- build new networks of actors around promising mitigation, adaptation or vulnerability-reduction options, build mutual trust among these actors and develop action plans
- explore mechanisms and instruments for incentivising and orchestrating individual members of networks of innovation actors
- stimulate creativity in defining new options and refining existing options in order to expand and improve the portfolio of options from which to choose
- explore mechanisms for responsibility, cost and risk sharing
- unveil the limitations of current institutional systems in the definition and development of strategies to cope with global warming and creating new opportunities for adaptive social change accordingly.

Thus, we should not consider the options already tabled as the 'only' options or that each option has a fixed set of intrinsic properties that are to be revealed by a static appraisal process. Rather, to support innovation, an appraisal process should be designed as a dynamic, creative and transformative exploration in which the options, the actors, stakeholders and contextual conditions should all be seen as potentially fungible through dynamic interplay. This interplay is constituted in part through social learning and in part by capacity-building through elements of the appraisal process itself, such as is represented by the process of bringing together sets of formerly independent and unconnected stakeholders to explore the issues and how best to handle these. The appraisal process might thus be used to introduce formerly independent stakeholders, for these to explore together – at first within the context of the process – the possibility of creating a project in which interests are shared, to build trust and to develop agreed 'action plans' that establish needed actions, their sequencing and appropriate time lines as well as to ascribe specific responsibilities to specific agents. Such networks can ultimately coalesce to form self-standing innovation networks committed to implement specific options even after the formal 'appraisal process' is concluded. They add to relevant social capital in respect of mitigation and adaptation capacity.

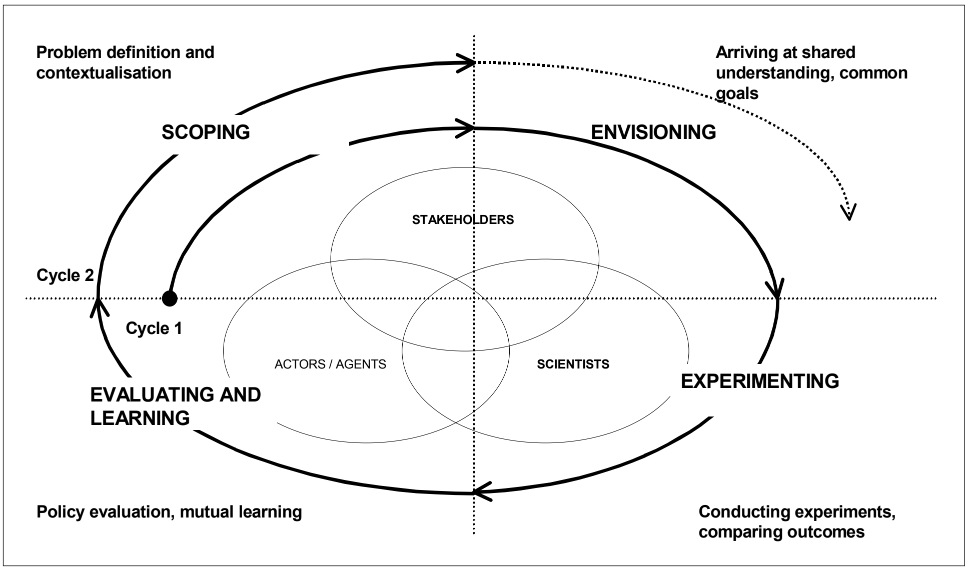
The success criteria for an appraisal are therefore related less to whether the appraisal can provide a static judgement about the relative cost-effectiveness, acceptability, implementability and risks of options, but whether the appraisal process can be used actively and dynamically as an instrument for adding-value to options and gaining knowledge about them or by providing a platform for exploring innovative and creative approaches that might appeal to the enlightened self-interest of those with agency. At issue, therefore, is whether appraisal is conceptualised as an end-of-pipeline static evaluation of a given set of policy options or whether it is conceptualised as a creative exercise that is designed to build innovative capacity by helping stakeholders reframe the context within which options are developed, to explore those factors upon which the effectiveness of options is contingent and to create actively the conditions needed for effectiveness, acceptability and successful implementation.[7]

5 Innovative appraisal approaches

The methodological challenges of social learning and transformation that are faced in appraising climate change responses are also faced in other policy arenas that must deal with complexity. Indeed, these are shared challenges faced in common in many contexts across the spectrum of the sustainable development research and action agenda. Fortunately, after a decade of developments on public participation in sustainability science and global environmental policies (Kasemir *et al.*, 2003; Tàbara, 1998), the time is now ripe for an encompassing methodological framework able to integrate different tools, sources of knowledge and ways of framing, assessing and developing capacities to cope with complex issues in a socially and ecologically relevant manner at different scales of action. Recently, considerable methodological progress has been made in the field of sustainability assessment. Innovative approaches and methods for sustainability assessment that address the same challenges as those faced here in appraising climate change responses have been developed and are being tested in the EC research project Methods and Tools for Integrated Sustainability Assessment (MATISSE), including a generic process-architecture for an appraisal process (Weaver and Rotmans, 2005).

Sustainability assessment covers a broad range of actual and potential assessment methods. Across the 'spectrum' of many different assessment types, different sustainability assessments are distinguished essentially by their purpose and premise. Often, sustainability assessments make use of similar tools and methods. How the tools and methods are used and for which purpose distinguishes one type of assessment from another. This has the implication that sustainability assessments cannot be evaluated in abstract, but must be evaluated in context and in relation to their intended purpose according to 'fitness for purpose' criteria. An important distinction has recently been drawn between 'pragmatic' and 'strategic' sustainability assessment. Pragmatic sustainability assessments are used for screening initiatives or for evaluating actual developments as part of routine, institutionalised processes for ensuring that policy initiatives are consistent with each other and with the intent and interpretation of sustainable development within the relevant context or jurisdiction. Pragmatic sustainability assessment is a 'paradigm-applying' process, since its purpose is to ensure that initiatives are consistent with the prevailing policy paradigm and its interpretation of sustainable development. By contrast, a more strategic form of sustainability assessment has been proposed that is not yet well developed, but whose purpose is to explore solutions to persistent problems of unsustainable development, their acceptability to stakeholders, and the policy paradigms within which these might be viable and consistent. This type of sustainability assessment, which has been termed Integrated Sustainability Assessment (ISA), is more deliberately sustainability-oriented, constructive and exploratory (Weaver and Rotmans, 2005; Weaver, 2005b; Turnpenny *et al.*, in press).

Figure 5 An iterative four-stage ISA cycle



Source: Weaver and Rotmans (2005)

The purpose of ISA is to provide a platform for exploring the problem-solving potential of alternative policy paradigms to those now in place and for learning in the course of this exploration process. ISA seeks simultaneously to define acceptable solutions to problems and the policy paradigm with which these would be consistent and within which they could be implemented feasibly. The goal of a currently running EC-funded research project, MATISSE, is to design and test a sustainability assessment process from first principles that has the capacity to perform this more strategic, exploratory and constructive role. In the MATISSE project, ISA has been defined as:

> "a cyclical, participatory process of scoping, envisioning, experimenting and evaluating through which a shared interpretation of sustainability for a specific context is developed and applied in an integrated manner in order to explore solutions to persistent problems of unsustainable development". (Weaver and Rotmans, 2005)

This description of a cyclical, participative ISA-process is depicted in Figure 5.

The critical point is that the repeating four-stage cycle of ISA potentially provides a simple, but appropriate, generic process architecture that can suitably be adopted for the purpose of addressing the methodological challenges faced in appraising climate change responses and for managing complexity.[8] It involves:

1 Scoping

In the scoping stage, the targeted outcomes from the appraisal are defined in broad terms. The system is defined and its situation in relation to climate change is explored as a basis for identifying possible responses (*i.e.*, problems, opportunities and options). These responses are used as a basis for strategies involving sets or sequences of actions. The broad issues implied in formulating and implementing responses are determined, such as what level of mitigation and/or adaptation and/or burden sharing to attempt. Stakeholders, actors and agents are identified and their interests mapped. Initial ideas for appraisal questions are explored.

2 Visioning

In the visioning stage, visions are developed of future states for the system so that it can contribute to mitigation of and adaptation to climate change. The visions are defined and explored in terms of criteria and conditions that should be met and interventions that might be developed. These are then refined in the form of strategies for mitigation, adaptation and/or burden sharing. This stage may also include consultation with stakeholders on precise appraisal questions, the selection of appropriate impact indicators and the selection of analytical tools.

3 Experimenting

In the experimenting stage the initial appraisal questions are refined and addressed through formal modelling exercises and less formal qualitative procedures, which are used to explore, contrast and rank or otherwise compare the impacts of different strategies, reveal the contingencies of these and expose the surrounding uncertainties.

4 Evaluating

In the evaluating stage of the appraisal, the insights, experience and outcomes that have been achieved are reviewed and evaluated in a social learning exercise to enhance awareness and understanding of the issues and the context and to promote capacity building. The outcome may lead to a reframing of the issues and another cycle of the process or to some decision on which responses to implement and how to implement these.

The process is iterative, so that the four stages represent one complete cycle. A full appraisal process will ideally involve more than one full cycle in order to allow for the issues to be reformulated on the basis of insights learned from the first cycle.

6 Conclusion: the role of appraisal in responding to climate changes

Our argument has been that procedures for appraising climate change responses should be built around principles of participation, experimentation and social learning. A co-evolutionary and adaptive approach is needed in which the options, their impacts, the contextual conditions for their success and the risks implied are not considered as 'fixed' attributes to be 'revealed' by the appraisal, but qualities that are dynamic and open to be influenced by the appraisal process. This depends upon using the appraisal process for building awareness, capacity and capitals upon which successful and effective conceptualisation, development and implementation of mitigation and adaptation options depends. The goals and objectives of each appraisal need to reflect this mindset: effectiveness, acceptability, implementability and social robustness are not qualities to be assessed, but qualities to be improved through appraisal. The context from within which options first emerge and the set of options to be assessed are also not fixed. There is scope to reframe these through an appraisal if this is suitably designed and, so, scope also to use appraisal to build innovation capacity.

Opportunity is provided by recent advances in integrated sustainability assessment that provide a general framework and architecture for appraisal processes in support of social learning and reframing. Tailoring the general framework to the climate change arena depends upon distinguishing challenges and needs according to a hierarchy: some challenges and needs (such as to support social learning) are common to all sustainability problems; some are specific to climate change (such as the need for climate change scenarios, for spatially disaggregated scenarios of climate change, for methods to calculate contributions to climate change forcing and for methods to assess vulnerability to climate change); and some are application-specific (such as the need for traffic forecasting models in the context of applications in transport and tourism). These distinctions suggest the possibility of adopting the generic architecture for an exploratory appraisal process, incorporating some special design features to meet shared needs in the climate change arena, and the use of guidance notes to help those conducting appraisals in selecting tools, methods and information appropriate to the specifics of each context, based on best practice.

First steps in this direction have already been taken in the context of innovative research projects, such as MATISSE and ADAM. In the ADAM project, the ISA methodology developed in MATISSE has been extended and refined for the case of climate change, providing a generic appraisal framework (Figure 6) within which a set of different tasks are identified. These are to be carried out sequentially and iteratively together with stakeholder engagement (Figure 7). Once available, a proto-type climate change response appraisal tool should be made widely available, most appropriately as a web-based tool, so that it might be further enhanced and improved through interaction with users. The provision of such a tool in the context of the ADAM project will pave the way to avoiding unnecessary duplication of efforts across applications and should help achieve higher quality and more consistent appraisals at lower overall cost, making it possible for appraisal to be extended widely across many nested and overlapping systems of interest.

Figure 6 The outer level of the Policy Appraisal Framework (PAF) for climate change responses developed in the ADAM project

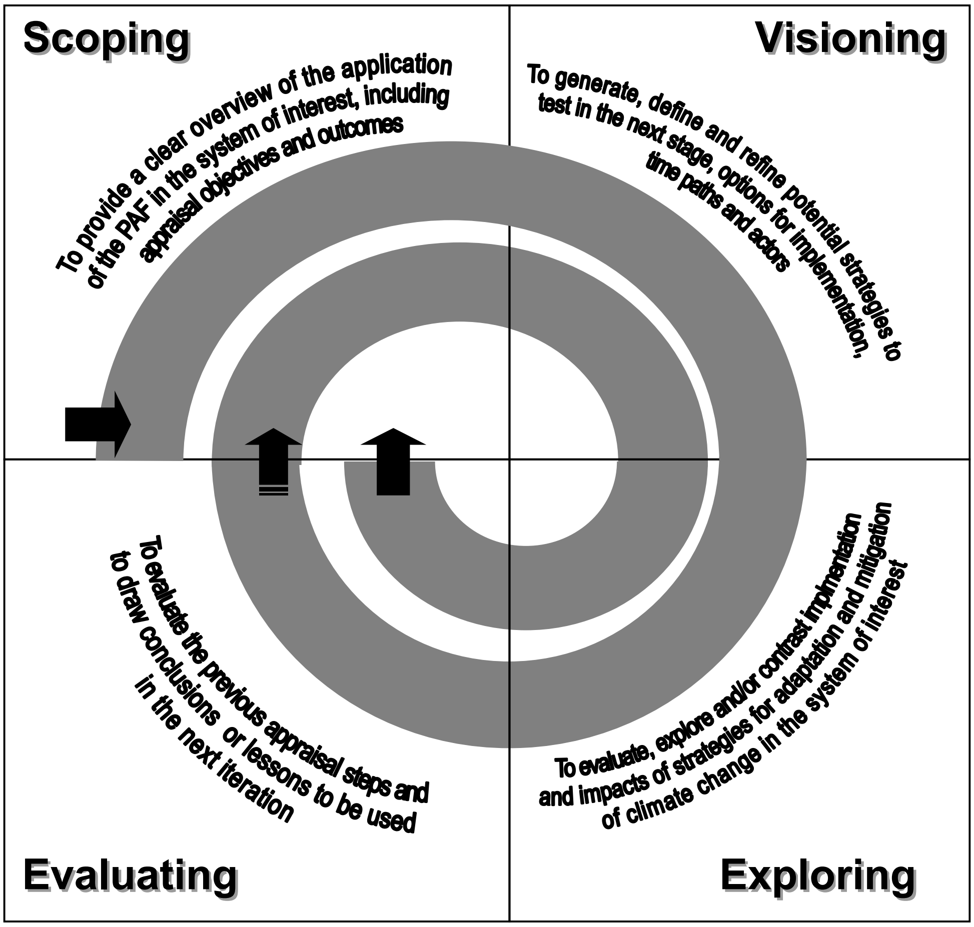
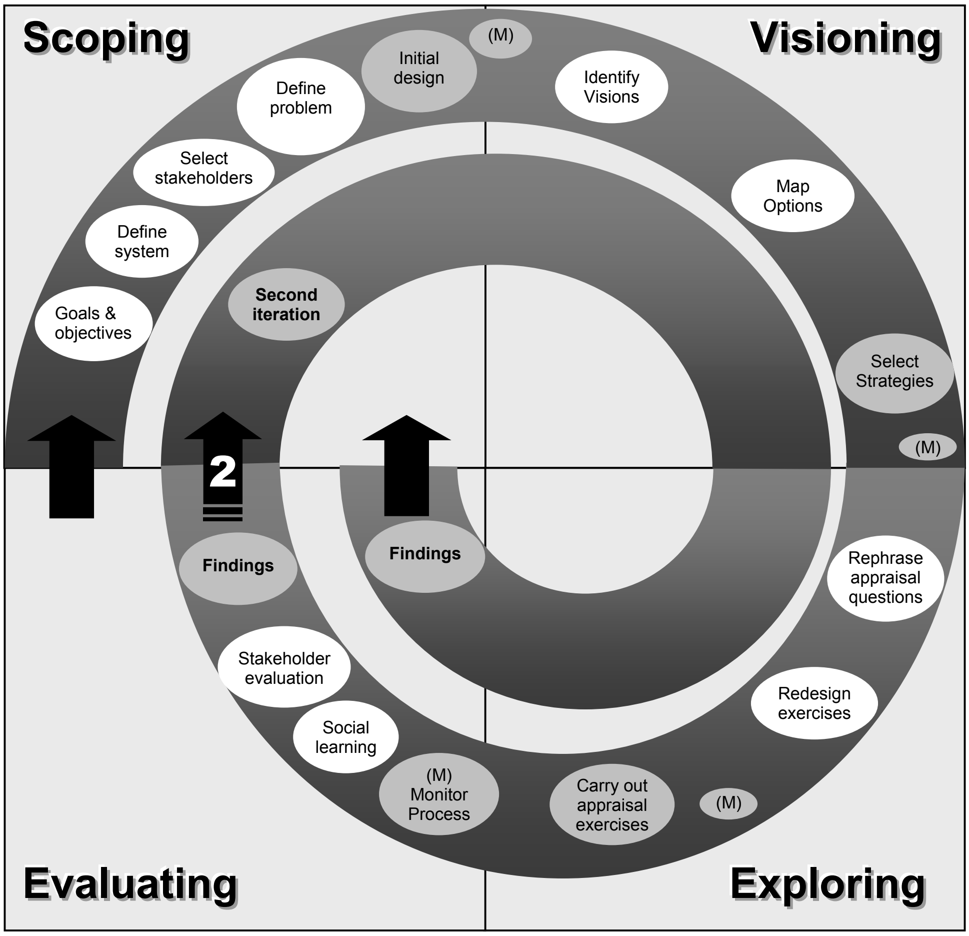


Figure 7 The inner level of the Policy Appraisal Framework (PAF) for climate change responses developed in the ADAM project



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Notes

1 Complexity has a very specific meaning in this usage, since it refers to the nature of the systems involved in climate change. A simple system can be captured in theory and practice by a deterministic, linear causal analysis. A complicated system requires more variables for explanation or for control than can be neatly managed in its theory. With complexity, we are dealing with phenomena of a different sort. In a complex system, elements and subsystems are defined by their relation within hierarchies of inclusion and function. A complicated system can be modelled reliably despite the large number of elements and relationships involved. A complex system, by contrast, is characterised by multiple potential equilibria and cannot be accurately or reliably modelled. Systems that are complex are not merely complicated; by their very nature they imply deep uncertainties and a plurality of legitimate perspectives (Funtowicz and Ravetz, 1990; Funtowicz *et al.*, 1998).

2 United Nations Framework Convention on Climate Change.

3 However such disputes on the influence of anthropogenic drivers on climate change remain now more in the domain of policy than of science. As shown in the extensive review published in *Science* (Oreskes, 2004), out of 928 scientific papers on climate change none of them disagreed about the influence of human action on climate.

4 Hawken *et al*. (1999, p.242) write: "This assumption masquerading as a fact has been so widely used as the input for supposedly authoritative models, which have duly disgorged it as their output, that it is often deemed infallible".

5 In common with all issues concerning the sustainability of development, the climate change issue concerns interactions between the ecological system and the human system and its component subsystems or elements. However, since climate change is a 'global-scale' phenomenon, the need for a precautionary approach at this scale is especially important

6 An important aspect is that responding effectively to climate change through mitigation and/or adaptation measures will require a step change from business-as-usual approaches. The scale of the needed responses requires that this is the case. Incremental improvements made within the framework of prevailing approaches to development are unlikely to be sufficient.

7 It is worthwhile noting that an earlier research project funded by the European Commission on the design and evaluation of science for sustainable development (the AIRP-SD project – Adaptive Integration of Research and Policy for Sustainable Development) proposed and tested a set of hypotheses for the appropriate management and design of science programmes for sustainable development. The AIRP-SD demonstrated the potential for well-designed research programmes to influence recursively the contextual conditions for innovation (Hinterberger, 2003; Weaver, 2005a).

8 An integrative approach to complexity needs to integrate both realism and constructivism. In particular, a socio-ecological system is complex not only to the extent that crucial aspects of its dynamics cannot be captured using one single perspective but also because different human and non-human forces interact with each other and cause-effects relationships operate at different temporal and spatial scales. Hence, all notions of sustainability are associated to particular assumptions about complexity. In ISA, the assessment of the level of complexity in a socio-ecological system of reference is important to trace the changing nature of the objects and subjects to be sustained, to know the way they interact with other similar objects and subjects, and to analyse how these relate to the wider environment upon which they depend. However, the recourse to complexity can be used almost for everything: as the ultimate explanatory cause of any kind of socio-environmental process or as its final consequence. To a large extent, the different conceptions and the strategic uses of complexity in science and policy discourses reproduce similar dilemmas, contradictions, and tensions as are embedded in the discussions of the social and environmental sciences at large. For instance, a social constructionist approach to complexity would argue that small things are equally complex as big ones and it is only the *perception of complexity*, which mostly depends on the point of reference of the observer and not of the actual object observed, that is of relevance for the

analysis. On the contrary, realists would reject this view and would search for the measure and quantification of complexity, often, from a fixed point of reference which could be given by 'science', by a given idea of the 'human scale', or from a 'taken-for-granted' social or biophysical boundary. Taking either an extreme social-constructivist position or an extreme realist one is of little help for the advance of sustainability science. Both positions need to be integrated and made operational in the design of new tools and methods for ISA (see, *inter alia*, Raynor and Malone, 1998; Schlumpf *et al*., 2001; Social Learning Group, 2001; Arvai *et al*., 2006).