ADaptation And Mitigation Strategies: supporting European climate policy

Proposal Acronym: ADAM

Sub-Priority 1.1.6.3:	Global change and ecosystems
Sub-priority research area I.3:	Mitigation and adaptation strategies
Sub-priority research topic I.3.1:	Adaptation and mitigation strategies
Type of instrument:	Integrated project
3rd Call:	17 June 2004
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Abstract

The core objectives of the research proposed by the ADAM (**AD**aptation **A**nd **M**itigation) Consortium are:

- To assess the extent to which existing and evolving EU mitigation and adaptation policies can achieve a tolerable transition (a 'soft landing') to a world with a global climate no warmer than 2degC above pre-industrial levels, and to identify the costs and effectiveness of these policies [mention 5degC somewhere?];
- To define a portfolio of strategic options for EU mitigation and adaptation policy development in selected areas such as science and technology, energy, transport, agriculture, infrastructures, trade, development assistance, natural resources management and environmental protection that can address any shortfalls; and
- To develop a novel policy options appraisal framework and apply it to existing and evolving policies and to new, long-term strategic policy options, so as to inform European and international climate protection strategy in the context of post-2012 Kyoto negotiations.

A mature climate strategy for Europe will integrate mitigation and adaptation policies and embed (mainstream) them within other non-climate policy realms. The ADAM project will lead to a better understanding of the complementarities, trade-offs and distinctions that exist between adaptation and mitigation policies and policy options, in the EU and internationally. ADAM will support EU policy development in the next stage of the development of the UN FCCC and the Kyoto Protocol, in particular negotiations around a post-2012 global climate policy regime, and will inform the emergence of new adaptation strategies for Europe. In research on adaptation policy options, special attention will be paid to the role of extreme events as both exposing vulnerability and as a signal for change. The top-level impact of the ADAM project will be improving the quality and relevance of scientific contributions to the development and evaluation of climate change policy options within the European Commission. This will help the Commission to deliver on its current medium-term climate policy objectives and help inform its development of a longer-term climate strategy.

B The Case for Support

B.1 Relevance to the Objectives of the Sub-Priority

Climate change presents a new set of challenges for the development of public policy. This is because the time-scales involved between policy implementation and desired outcome are much longer than in other policy areas; because many areas of policy planning need simultaneously to be addressed, therefore placing a greater demand on the integration of policy across different realms; and because the truly global nature of the problem requires national or regional policies to be designed within some framework of global strategy. These challenges are true for all nations, yet are particularly acute for the European Union (EU) given its leading role to date in the design of humanity's response to our unprecedented perturbation of the global climate.

Appropriate European climate change policies therefore need simultaneously to secure long-term climate protection goals, to be integrated across multiple-sectors, and to be designed to resonate with emerging international agreements and geo-political discourses. They must also be acceptable to Europe's citizens. These are challenging objectives which the EU is nevertheless determined to meet. In order to do so, however, it will need to harness available scientific expertise to identify, illuminate and appraise the available policy options. These options must address the demands a de-stabilised climate will place on protecting citizens and valued ecosystems – *adaptation* – as well as addressing the necessity to stabilise humankind's perturbation to global climate at a minimum desirable level whilst safeguarding and transforming economic activities – *mitigation*. The appraisal of these options must recognise the existence of multiple criteria, such as cost-benefit, cost effectiveness, equity, legitimacy and environmental integrity. Such an appraisal must also identify where policy options can contribute to both objectives – *adaptation and mitigation* - and where policy trade-offs may emerge.

The core objectives of the research proposed by the ADAM (**AD**aptation **A**nd **M**itigation) Consortium are therefore:

- To assess the extent to which existing and evolving EU mitigation and adaptation policies can achieve a tolerable transition (a 'soft landing') to a world with a global climate no warmer than 2degC above pre-industrial levels, and to identify the costs and effectiveness of these policies [mention 5degC somewhere?];
- To define a portfolio of strategic options for EU mitigation and adaptation policy development in selected areas such as science and technology, energy, transport, agriculture, infrastructures, trade, development assistance, natural resources management and environmental protection that can address any shortfalls; and
- To develop a novel policy options appraisal framework and apply it to existing and evolving policies and to new, long-term strategic policy options, so as to inform European and international climate protection strategy in the context of post-2012 Kyoto negotiations.

The ADAM project will therefore lead to a better understanding of the complementarities, trade-offs and distinctions that exist between adaptation and mitigation policies and policy options, in the EU and internationally. A mature climate strategy will integrate mitigation and

adaptation policies and embed (mainstream) them within other non-climate policy realms. In particular, the project will support EU policy development in the next stage of the development of the UN FCCC and the Kyoto Protocol, in particular negotiations around a post-2012 global climate policy regime, and will inform the emergence of new adaptation strategies for Europe. In research on adaptation policy options, special attention will be paid to the role of extreme events as both exposing vulnerability and as a signal for change.

In terms of policy development, the principal time horizon of the project will be from the present to 2025, while the time horizon for policy appraisal will be out to 2100. The dominant unit of analysis for the project will be the EU and its current member states, but will specifically include global analyses where this clearly affects the interests of EU citizens and states (for example, international emissions trading; development assistance, etc.). The ADAM Consortium will work with a small number of 3rd Country collaborating partners (in India, China and the USA) to ensure that our research is grounded in a global perspective.

The deliverables from this three-year ADAM project will be:

- D1: Improvements in economic modelling tools for use in analysing the effects and costs of mitigation and adaptation options (including areas of technology dynamics, innovation, spillovers, economic externalities, and emissions trading within Europe).
- D2: blah, blah. Ottmar et al. to complete from cluster M2.
- D3: A quantitative assessment, including a digital atlas, of vulnerability to [average??? temperature] climate change in Europe, and proposed options for reducing this vulnerability;
- D4: A quantitative assessment of Europe's economic vulnerability to extreme weather events, and proposed options for reducing this vulnerability by decreasing and sharing disaster losses.
- D5: A novel policy options appraisal framework which uses both formal modelling and deliberative processes to illuminate policy options according to multiple criteria.
- D6: An appraisal of EU's current climate policy trajectory and the feasibility and cost effectiveness of this trajectory in meeting emerging adaptation objectives and existing mitigation goals.
- D7: An appraisal of a range of new (i.e., beyond business-as-usual) mitigation and adaptation policy options as applied to four worked examples spanning a range of scales and sectors, including post-2012 global climate regimes.

Meeting and delivering the research objectives stated above requires a major European research effort such as can only be funded under an EU FP6 Integrated Project. All individual member states in the EU recognise the dimensions of the challenges outlined above, and some member states have research institutions which can tackle individual components of the problem or can provide research underpinning of national climate policy planning. No member state, however, even less any single institution, is capable of providing the integrated research support that is needed at the level of European climate policy planning. Given the breadth of disciplinary skills that are needed – e.g. economics, policy, climate science, environmental science – together with the range of research tools that need to be deployed – e.g. modelling, policy analysis, integrated assessment – a large-scale Integrated Project is the most appropriate and effective research instrument in Europe that can deliver the stated objectives. The ADAM Consortium brings together many of Europe's leading national research capacities which have not only been working at the climate science-policy interface for many years, but all of whom share the same intellectual outlook of disciplinary integration

and policy relevance which such a project needs. The ADAM project will be able to exploit many years of national and European research investment in climate change and build on these institutional capacities to deliver a truly innovative and unique series of processes and products in support of EU climate policy.

B.2 Potential Impact

Strategic impact

The top-level impact of the ADAM project will be improving the quality and relevance of scientific contributions to the development and evaluation of climate change policy options within the European Commission. This will help the Commission to deliver on its current medium-term climate policy objectives and help inform its development of a longer-term climate strategy in the context of (a) the UN FCCC and the post-2012 negotiations; and (b) existing and emerging sectoral policy objectives within the EU.

The EU has a stated climate policy objective of stabilising global climate at no more than 2°C above pre-industrial levels. This is equivalent to a further warming of no more than about 1.3°C above today's temperature. Achieving this objective will probably require CO_2 concentration to rise no higher than ~450ppmv. Reaching this goal will require contributions from all the world's industrialised and industrialising nations and will not be easily achieved. Even under such a stabilised climate, Europe and the wider world will experience changes in the frequency, distribution and severity of climate risks, some of which will cause considerable loss of life, economic disruption and ecosystem damage. Under this scenario, mitigation will present the major challenge, but serious attention to adaptation options will also be needed.

A different scenario may see global temperature reach 5°C above pre-industrial levels by 2100, with a sea-level rise commitment of 1m or more in the next century. The risks associated with extreme weather events in *this* scenario would be significantly greater than in a 2°C warmer world and the danger of exceeding irreversible critical thresholds (e.g. melting the Greenland ice sheet) will also be commensurately larger. Under this scenario, whilst successful mitigation efforts may be restricted to a small number of nations, and perhaps only be pursued half-heartedly elsewhere, the challenge for our societies to adapt to such large changes in climate will be immense.

The world may well develop in a way that falls between these two futures, yet it is clear that we will only safely navigate this coming century of climate change by paying serious attention to combinations of policy options that both mitigate climate change and adapt society so as to be better protected against the residual climate risks. It seems likely that many of these policy challenges will take us well beyond those options currently in place or under negotiation. For example, EU-15 greenhouse gas emissions in 2002 were only 2.9% below 1990 levels, compared to the Kyoto target of 8% by 2008-2012. Indeed, to adequately address both the mitigation and adaptation challenge is likely to require innovative technologies, new forms of solidarity and loss sharing, entirely novel forms of policy intervention, and perhaps quite radical transformations of our societies. The necessary transition from our current development trajectories to those required for climate protection are not immediately obvious, nor is it clear what combinations of changes in technology, behaviour, institutions and policy would deliver them. Within Europe, this transition should be achieved without compromising

the objectives of the Gothenburg Declaration on sustainable development and the Lisbon Strategy for European as an innovation-driven, knowledge-based economy.

The ADAM project, using the above diagnosis as a framing of the problem, will evaluate Europe's current predicament and develop portfolios of strategic climate policy options in selected domains which will contribute to the achievement of long-term climate goals for Europe and for the world. These portfolios will be subjected to a novel options appraisal framework, paying especial attention to European competitiveness, cost effectiveness and social justice. Such an appraisal framework will help inform the development of a sustainable climate protection strategy for Europe, in the context of an evolving international climate policy regime.

Innovation, exploitation, dissemination

The ADAM project will develop an innovative policy options appraisal framework (PAF) and apply it to a number of strategic climate policy domains. We will also advance the current generation of economic modelling tools that are used to evaluate climate policy options and complete a quantitative vulnerability assessment for Europe. These tools, within the context of the PAF, will allow for comparative analysis of mitigation and adaptation options, and an examination of their interaction. Through our worked examples we will develop and appraise a set of novel policy portfolios as applied to the challenges of climate change in Europe.

Our work will be informed by a cycle of six-monthly climate science-policy EU workshops and we will hold a major final ADAM Conference in Brussels in the winter of 2008/09. The six-monthly workshops will facilitate the dialogue between Europe's climate policy community and the ADAM Consortium which will shape and guide our work, and allow our work to inform and support the EU negotiating process on climate change. Our work will be reported to the international Framework Convention process through successive COP/MOP events and to the wider scientific and policy communities through conventional science and policy journals. Through our 3rd Country collaborators, the relevance and applicability of the ADAM policy options appraisal framework in other world regions will be tested.

Contribution to policy and regulation

[Anything more to add here?] The ADAM project will view DG Environment as its key client, but will maintain close interaction with its sponsor, DG Research, and with other appropriate DGs (e.g. Energy, Transport, Agriculture) and with the European Environment Agency. The four worked examples will be agreed and then developed in conjunction with significant European policy advisors, for example the Climate Change Unit in DG Environment responsible for negotiating post-2012 global climate regimes.

Added value of European approach

The development of adaptation and mitigation strategies for managing climate change is an area where the value of co-operative European research is self-evident. The EU plays a crucial function within the international climate negotiations and EU negotiating positions need to be informed by the best possible analysis from European researchers. At the same time, many of the challenges of adaptation (e.g. new insurance regulations) and mitigation (e.g. emissions trading) policy have to be set at an EU scale. Here, again, a research capacity such as that offered by the ADAM Consortium will be crucial in drawing national expertise and experiences of tackling these issues into a series of more coherent and co-ordinated strategies which can be implemented across Europe.

Relation to other research initiatives

[Anything else to say here?] The ADAM partners have led, or been significantly involved in, many on-going or recently completed EU-funded research projects relevant to ADAM's objectives; for example, EFIEA-2, ATEAM, CCASH, DINAS Coast, MICE, PRUDENCE, MATISSE, Sustainability A-TEST and NEWATER [add others please]. We are therefore well-placed to exploit and harness this knowledge base for the purposes of ADAM. Where we do not have direct formal involvement in relevant European–scale projects, our national and European networks allow us to gain access to such work. For example, the newly started ENSEMBLES Integrated Project will be one such important companion activity, as will Carbo-Europe [other please also?]. Several of the senior staff [name them? Klein, Adger, Berkhout, Barker, etc.] in the ADAM Partners contributing to the project are Convening or Lead Authors for the IPCC 4th Assessment Report, ensuring that our work is fully cognisant of new insights arising from the IPCC.

B.3 Scientific and Technical Excellence

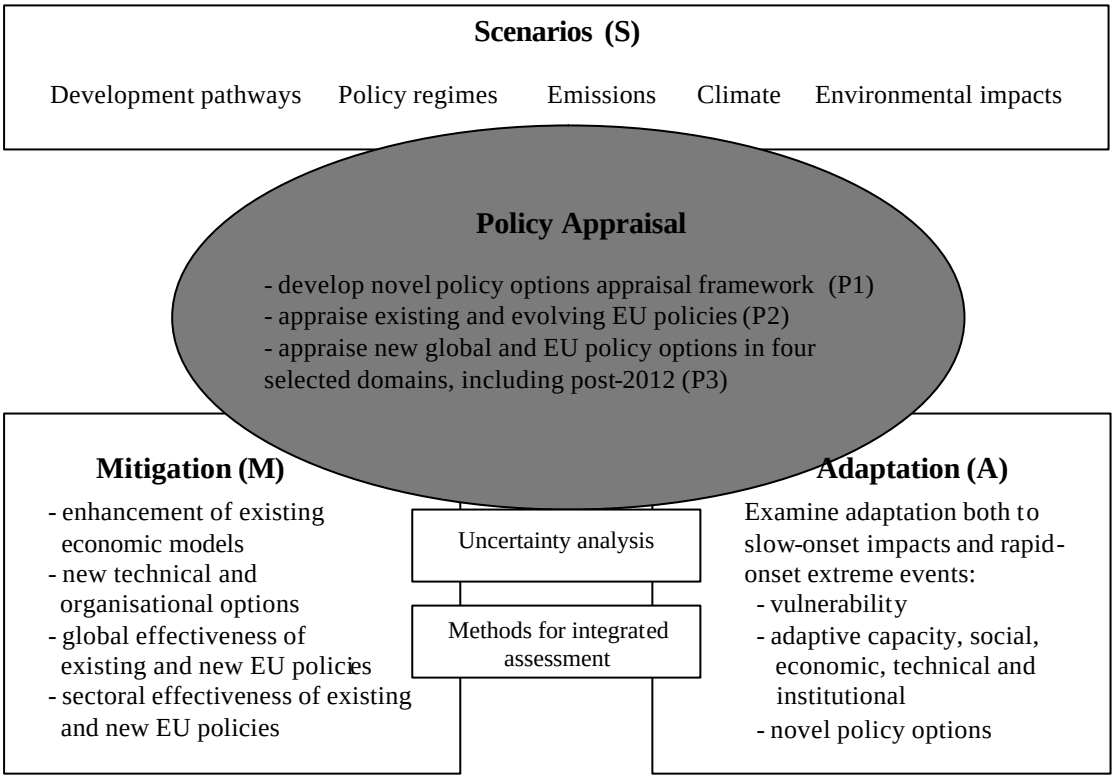
Research strategy

The ADAM work programme is structured around four primary work Domains as shown in the accompanying diagram: Scenarios, Mitigation, Adaptation and Policy Appraisal.

The Policy Appraisal Domain will provide the central component of ADAM, namely the development of an innovative Policy-options Appraisal Framework (PAF). The PAF will be both a major deliverable of the project and also the key mechanism for providing policy-relevant outputs from the project. The PAF will be used within ADAM in two major exercises: (i) to appraise a broad range of existing and evolving EU policy measures with respect to stated mitigation and adaptation targets; and (ii) to appraise portfolios of novel policy options as might be applied to four selected domains with global, regional or sectoral reach. Deliberative appraisal will use both quantitative economic and environmental modelling and qualitative analysis produced by the other work clusters within the ADAM project.

The Scenarios Domain will lay out the four framing scenarios that will guide and contextualise the ADAM analysis. These scenarios will be global in scope, but with more detail for Europe, and will encompass development pathways, policy regimes and associated climate futures and environmental impacts. In simple terms, the four scenarios will span a range of climate futures from 2°C global warming, in which the primary challenge will be to mitigate, to a 5°C warming in which the primary challenge will be to adapt.

The Adaptation Domain will develop a quantitative knowledge base on Europe's vulnerability to climate change, providing the EU and other stakeholders with the rationale for a concerted focus on adaptation and mitigation. It will also study the interactions between climate change (especially changing extreme weather events), non-climatic developments and sectoral policies, and thus provide insights into the complex societal processes that define vulnerability to climate change. By modelling the process of adaptation within selected sectors in Europe, social, technical and environmental factors that influence adaptive capacity will be identified. This Domain will also define policy options to reduce Europe's vulnerability to climate change by analysing the way in which current developments and policies influence potential climate change impacts and the capacity to adapt to these impacts.



[We do not say much about the uncertainty analysis and methods for IA. Does this matter?]

The Mitigation Domain will evaluate the costs and effectiveness of different mitigation options at the EU level and estimate their corresponding contribution at the global level in the illustrative ADAM scenarios. This Domain will also conduct, at the EU level, an evaluation of mitigation efforts in specific sectors. These global and sectoral evaluations will take into account the main channels of interaction between the EU and other world regions, namely: technology transfer, foreign direct investment, trade of used products and investment goods, development aid and international trade (i.e., physical and financial capital flows). These are all areas where the EU can play an important role. Special attention will also be paid to the role of technology spillovers and technological change and innovation, including an assessment of the impact of emissions trading and other policy instruments.

The ADAM project will interact closely with EU institutions, in particular DG Environment, and will include a major consultation exercise with European policy-makers comprising a formal review of the policy mapping and appraisal at the end of Phase One of the project. The interaction with policy-makers will be maintained throughout the project duration using a cycle of six-monthly ADAM science-policy workshops, building on the recent success of the two EFIEA-2 climate science-policy workshops organised by RIVM and the Tyndall Centre in August and November 2004.

Work Domain S: Scenario Analysis

[Do we need a deliverable here? Is the scenarios work sufficiently picked up elsewhere?]

The Scenarios Domain will lay out the four framing scenarios that will guide and contextualise the ADAM analysis. These scenarios will be global in scope, but with more detail for Europe, and will encompass development pathways, policy regimes, land use change, and associated

climate futures and environmental impacts. The scenarios help to ensure integration and synthesis within ADAM by providing a common context of self-consistent scenarios that provide qualitative and quantitative information on a range of plausible development pathways, mitigative and adaptive capacity, climate change and impacts of climate consistent with multi-gas scenarios and stabilisation levels at a range of atmospheric greenhouse gas concentrations.

The set of four main scenarios will span a range of climate futures from 2°C global warming by 2100, consistent with the EUs stated climate policy objective, in which the primary challenge will be to mitigate, to a warming scenario in a rather unconstrained carbon world in which the primary challenge will be to adapt. Intermediate scenarios will represent future global policy regimes in which there is 'early' or 'late' consensus over the scale of mitigation that is needed; and that explore the consequences of various combinations of adaptation and mitigation action. The exact stabilisation levels of these two scenarios will be determined within the project, but probably will aim for stabilisation at 2.5° and 3°C.

Clearly, over the past few years important scenario work has been performed, including IPCC SRES, UNEP's Global Environment Outlook and the work of IPCC post-SRES stabilisation scenarios. Most of this work did not consider the full suite of radiatively active gases, and did not consider impacts and adaptation. The ADAM work will aim to close these gaps, including checking the internal consistency of the economic scenarios allowing for Purchasing Power Parity exchange rates, but above all by providing a synthesis of existing work, including new results from other EU projects such as PRUDENCE and ENSEMBLES. In integrated scenarios as described above, uncertainties accumulate across the chain from drivers to final impacts, as a result of which a wide range of impacts are possible at the local scale that are consistent with a certain specification of greenhouse gas emissions. Identifying and communication these uncertainties will therefore be an important aspect of the work.

We re-emphasise that the purpose of this scenarios work in ADAM is to develop the consistent information that is needed for the integrated study of adaptation (**Work Domain A**) and mitigation (**Work Domain M**) as means to developing and appraising portfolios of climate policy options for long-term climate change management.

Work Domain M: Mitigation

Work Cluster M1: Mitigation at the EU level – options, costs, and impacts

This work cluster will evaluate the cost and impacts of the four ADAM scenarios (**Work Domain S**), particularly of the "mitigation challenge" scenario, portraying the EU target of global temperature change of 2°C. This analysis will illustrate, to the extent possible, potential synergies and trade-offs between mitigation and adaptation options using a new methodological framework [what is this framework? How does it relate to the PAF in P1?] for the joint assessment of adaptation and mitigation. The "adaptation challenge" scenario (5°C), which portrays high investments in adaptation and associated costs, could play the methodological role of a reference ("business as usual") scenario for the mitigation analysis. In examining complementary sets of mitigation and adaptation strategies, the role of uncertainty in key assumptions and parameters of the coupled social-economic-technical-natural system, most notably long-term responses to oil price shocks and the climate sensitivity (but also the long term effects of changing energy and emission prices on innovations), will be incorporated.

Regarding the mitigation options in the EU, traditional technical options (in the field of energy use and conversion as reported in the IPCC TAR) will be complemented by new knowledge and additional empirical research on material efficiency and substitution, on recycling and intensification of the use of products, vehicles and investment goods by pooling; they will also include all non-energy related emissions and related mitigation. As the technical options for adaptation (protective measures against heavy storms, heat waves, floods, avoidance of stranded investments, use of two harvests per year, etc.) have not yet been systematically analysed, working with **cluster A2**, a major effort will be the identification, quantification and economic assessment of those adaptation options. This will include their cost reduction potentials and their synergies with mitigation options.

Finally, the impacts of mitigation and adaptation on the economy (economic development, employment, competitiveness, and foreign trade) at the EU level and in selected member states will be analysed in detail for the next three decades and with less detail for the decades thereafter. The technical and organisational options will also be discussed with regard to obstacles, market imperfections, drivers, and interests of parties involved or affected in their pathways from research and development to market introduction and diffusion. This information will be used as basis for the policy design and appraisal in **Work Domain P**. How mitigation and adaptation policies could affect the competitiveness of the EU in the global context will be analysed, allowing for changes in market exchange rates. Attention will also be paid to the role of technology spillovers and technological change and innovation and, in particular, to assess the impact of emissions trading and other policy instruments on them. Particular emphasis is put on impact assessment of policies of the European Commission (to be specified in **Work Domain P**), specifically in the implementation of its sustainable-development strategy (Gothenburg process) and in view of the potential role of the EU in post-Kyoto climate negotiations and other associated policy proposals.

The models to be used in the analysis will be process-oriented models of a simulation or optimisation type (e.g. MARKAL, IKARUS, POLES, SERVE, RESIDENT), I/O-models (e.g. ISIS), and macro-economic models of equilibrium or non-equilibrium type (e.g. E3MG). Most of these models have to be enhanced by including adaptation or specific sub-models to be developed within this work cluster. Some of the results will have to be used in the economic models of **work cluster M2**.

Deliverable D1: Improvements in economic modelling tools for use in analysing the effects and costs of mitigation and adaptation options (including areas of technology dynamics, innovation, spillovers, economic externalities, and emissions trading within Europe).

Work Cluster M2: Mitigation - the global context

[Text still too long. Mention of models to be used here – MIND, E3MG, GMM??]

The effects of EU mitigation policies in a post-Kyoto global context will be examined in this work cluster, taking into account the main channels of interaction between the EU and other world regions, namely technology transfer, foreign direct investment, development aid and international trade (i.e. capital flows), all areas where the EU can play an important role.

In the last decade, a growing consensus has emerged that international trade in permits can reduce the climate protection costs because greenhouse gas emissions are abated at locations with least-costs. Moreover, there is also a consensus that tradable permits are efficient in a

globalised and fully integrated world market. At a first glance, this implies that if large emitters do not accept an emission cap, smaller emitters can loose some comparative advantage in international trade. However, most economic models used for climate policy advice only allow for the trade of goods and emission permits, but omit the crucial aspect determining the comparative advantage of countries – trade in capital goods. Within the ADAM project, work cluster M2 is designed to inform relevant stakeholders within the EU about the consequences of climate policy targets on economic growth and comparative advantages under different scenarios.

One major concern of European climate policy is the comparative advantage of European firms on globalising world markets. It is assumed that if only Europe was committed to emission reductions during a decade or two (without USA and Russia), emission-intensive European firms could loose some of their comparative advantage. It will be clarified whether, and for what firms, it is a realistic assumption for European policy to improve the comparative advantage of its domestic firms by relaxing emission caps or if other more effective policy instruments are available. This analysis will focus on the role of technological spillovers (short-term and long-term) and identify potential linkages between climate policy and trade policy.

In accordance with carbon leakage effects (pollution havens), ambitious emission caps in Europe could induce a flow of emission-intensive goods (like cars, trucks, etc.) and industrial activities to China and India. Moreover, used power plants and energy-intensive basic industries could end up being exported even faster from Europe to economies with high growth rates. Over the next three decades, re-investments in the electricity sector will increase substantially within the OECD, but even more new investments in transformation and in developing countries. This requires an in-depth analysis of how different emissions reduction scenarios and international trade regimes influence the electricity and basic industrial sector in Europe and in countries like China and India. It has to be analysed whether there is a potential for Europe to export new highly efficient or carbon capturing and sequestration technologies to these countries (leap-frogging). This is a new research area analysing the impact of international trade in capital goods (and capital mobility) on climate change issues.

Most models that have already analysed the impact of emissions trading (and other Kyoto instruments like CDM) on mitigation costs have often completely omitted the impact of emissions trading on international capital flows and vice versa. A crucial question is whether emissions trading and trading capital goods are complements and substitutes and how these two trading regimes determine the mitigation costs for Europe and other world regions in the short-term and how they influence adaptation cost in the long-term. These insights are crucial for Europe in defining a position in the second commitment period of Kyoto and developing a position for WTO negotiation on this issue.

International trade on the one side may reduce the vulnerability of some regions and may increase the vulnerability of other regions. It will depend on the trade pattern in the business-as-usual scenario and on the trade pattern influenced by climate policy. In this research focus, the impact of international trade on European adaptation costs and vulnerability in the longer term will also be analysed, as well as the impact of European climate, trade and development policy on selected world regions such as Asia or Latin America.

Deliverable D2: blah, blah. [Ottmar et al. to propose]

Work Domain A: Adaptation

Work Cluster A1: Vulnerability assessment

Over the past years, a range of impact and adaptation studies have been carried out to assess the potential impacts of and vulnerability to climate change in Europe. All relevant studies carried out within former EU Framework Programmes as well as sub-national, national, regional and sectoral studies will be analysed and synthesised. This European meta-analysis will provide a comprehensive overview of potential impacts of climate change and of opportunities to adapt to these impacts.

Second, the meta-analysis will provide information that will be the basis for the development of a unified framework that allows for formal interpretations and assessment of vulnerability. This framework will be rooted in systems theory and should capture the most important unifying features of existing formalisations. We will show how the framework relates to the vulnerability studies considered in the meta-analysis, and analyse the practical benefits derived from basing vulnerability assessment on a formal framework.

Third, the meta-analysis will produce a list of actors (individuals, sectors, institutions, etc.) who are either affected by climate change, in a position to reduce vulnerability, or both. They operate on scales ranging from local to European. Using actor-oriented modelling, the behaviour of these actors will be analysed within a small number of worked examples (linked to **work cluster P3**). This will provide insights into the process of adaptation, including non-climatic factors that promote and constrain adaptation.

In parallel with the in-depth actor-oriented modelling, a macro-scale assessment will be carried out of the inter-relationships between vulnerability to climate change and vulnerability to social pressures in the EU, including unemployment, income distribution, poverty and transfer requirements. This assessment will distinguish between different social groups, and result in improved knowledge of adaptive capacity to climate change and how it is determined by social and economic conditions.

Collectively, these activities, as well as those carried out in **work cluster A2**, will contribute to the development of a digital atlas of Europe's vulnerability to climate change. It will build on the results of the EU FP5 project ATEAM. Activities in the Adaptation Work Domain will result in two major improvements: a more detailed and realistic assessment of adaptive capacity, and a monetisation of potential impacts, using a consistent economic valuation framework. The digital atlas will enable users to identify hotspots of vulnerability to climate change, and obtain insights into the climatic and non-climatic processes that create this vulnerability. Thus, it will be an important tool to stakeholders faced with the challenge of reducing vulnerability to climate change.

Deliverable D3: A quantitative assessment, including a digital atlas, of vulnerability to [average??? temperature] climate change in Europe, and proposed options for reducing this vulnerability.

Work Cluster A2: Coping with extremes

Given escalating losses from weather-related disasters, and the IPCC's predictions of increased intensity and frequency, this Cluster will give special attention to assessing risks and vulnerability to slow- and sudden-onset extreme events, such as floods, landslides, droughts,

heat waves, and wind storms. Based on the medium- and long-term scenarios from **Work Domain S**, and drawing on existing studies, historical records and expert judgments, this cluster will quantify weather-related extreme risks (likelihood and losses) to humans and economies at the relevant sub-national, national, regional and sectoral scale throughout the EU member states. This will also be done, selectively and in association with our 3rd Country collaborators, for highly exposed developing countries. Focusing primarily on macro-economic impacts and vulnerability, the projected risks will take account of changes in land use, capital movements, population and climate. The risks will be combined with *financial* coping capacity to quantify the *economic* vulnerability of the relevant geographical location or sector depending on possibilities to reduce the losses - through structural and non-structural technological paths - and absorb them– through solidarity and insurance instruments. This will yield a European map of economic vulnerability in the EU and, to some extent, globally, which will complement the vulnerability map of **work duster A1**. Building on **cluster A1**, more nuanced and detailed assessments of risk and vulnerability to extreme weather, including social, institutional, economic and environmental factors, will be carried out as part of the Policy Assessment Framework worked examples (**cluster P3**).

Special emphasis will be placed on identifying innovative technologies [cf. Eberhard's concerns about technology modeling] (e.g., portable levees), innovative policies (e.g., new forms of humanitarian disaster assistance based on newly emerging financial instruments) and institutions (e.g., public-private, incentive-compatible insurance systems) for reducing and transferring the risks within Europe, and in light of Europe's global responsibilities, in developing countries. Specifically, we will propose adaptation options that are robust to uncertainties in the assessments, including policy instruments for reducing the losses in a sustainable manner and transferring the risks through new forms of European solidarity (e.g., novel uses of the European catastrophe fund). This will mean identifying opportunities for mainstreaming disaster risk management within the EU's existing directives and policies, as well as those of its member states. This will also mean examining "proactive" loss-reduction and financing measures for restructuring Europe's current (post-disaster) role in providing development and humanitarian assistance, as well as the EU's possible role in restructuring climate adaptation funds, for example, as part of the Global Environment Facility. The policy options will serve as input to the Policy Assessment Framework (**cluster P1**).

Deliverable D4: A quantitative assessment of Europe's economic vulnerability to extreme weather events, and proposed options for reducing this vulnerability by decreasing and sharing disaster losses.

Work Domain P: Policy Options Appraisal

Work Cluster P1: Development of a policy-options appraisal framework

[Text still too long] A central component of ADAM will be the development of an innovative Policy-options Appraisal Framework (PAF). The PAF will be both a major deliverable of the project and the key integrating mechanism for providing policy-relevant outputs from the project. The PAF will have two main innovative components:

- An integrated appraisal framework bringing together quantitative and qualitative components, enabling a *multi-criteria appraisal* of policy options working independently and in combination with other policies. The direct and indirect impacts of policies will be analyzed. The framework will also be used both to assess the contribution of sectoral

policies to existing macro-level climate policy targets and, in a prospective, normative way, to appraise alternative policies in the longer-term.

- Structured interaction between analysts and stakeholders (including citizens) in a process of *deliberative appraisal*. Building on procedures already developed in environmental policy analysis and integrated assessment, the appraisal framework will build-in an interactive approach from the outset, linking knowledgeable and interested parties in the analytical work of the project.

Work cluster P1 will thus: a) iteratively develop the PAF through a structured interaction with identified end-users of the policy option appraisals; b) apply the PAF through **work clusters P2 and P3** and using analysis provided by the **Mitigation and Adaptation Work Domains**; and c) in support of the policy-options appraisals in **P2 and P3**, perform meta-analysis of the academic literature and results from work carried out in ADAM. Deliberative appraisal will use both quantitative economic and environmental modelling, together with qualitative analysis produced by the other work clusters within the ADAM project.

Once a set of policy options has been defined, the framework will involve applying a multi-criteria appraisal (MCA) to a broad range of analyses produced by other work clusters and covering:

- *Environmental integrity* - use of mainly quantitative models to assess: a) emissions reductions; b) contribution to adaptation goals; c) other environmental benefits (or damages) of climate policy (such as reduced air pollution or environmental impacts of bio-fuels production).
- *Costs and valuations* - use of economic models to produce a range of cost estimates and cost distributions at global and intra-EU spatial scales, including Cost-effectiveness, Cost-Benefit Analysis and valuation of externalities.
- *Political feasibility* - analysis of the political feasibility of a policy option, drawing upon a range of analysis including global context, national costs and relative national costs, distribution of costs domestically, flexibility, and public perception and acceptability.
- *Equity, Legitimacy, Efficiency* - analysis of the equity, legitimacy and efficiency issues surrounding the policy option.

For each criterion, the appraisal may be conducted by either defining a quantitative target/s or, where appropriate, by defining looser principles. Comparative appraisal of different policy options can also be conducted (without necessarily requiring targets or principles to be defined). Targets can be developed based upon stated EU policy goals or they can be defined through deliberative exercises with both experts and lay people. Both approaches will be employed in ADAM. The criteria used may also be expanded/reduced/changed in different deliberative exercises. An MCA will then be conducted by gathering the relevant analysis and information for each of the criterion, together with the corresponding set of targets/principles and, in some cases, a set of weightings for combining criteria. The aim, however, will be to produce appraisals in the sense of gaining insights into, and comparison and exploration of, the implications of various policy options, rather than a formal assessment in the technocratic sense.

Deliverable D5: A novel policy options appraisal framework which uses both formal modelling and deliberative processes to illuminate policy options according to multiple criteria.

Work Cluster P2: Policy mapping and appraisal

[can we state any links to the M Domain?] Based on the PAF developed in **work cluster P1**, work cluster P2 will investigate existing climate policies and governance systems in the European Union in the global context. The cluster will inventorise European policies relevant to climate change adaptation and mitigation. We would aim to include measures currently recognised as climate policies, but include also policies in other sectors including agriculture, trade and environmental protection. Policy mapping will identify and analyse potential interactions (negative and positive) between EU policies and instruments, and between EU policies and international policies (including within international climate agreements and the world trade regime). The aim of the appraisal will be to determine whether current EU policy objectives can be achieved, to establish where major shortfalls are likely, and to assess (in a link with **work clusters A1 and A2**) how EU vulnerability and resilience will be influenced as a result. Drawing on these results, **work cluster P3** will investigate for selected examples how identified weaknesses and vulnerabilities (and unexploited opportunities) may be handled over the longer term, through an analysis of alternative strategies.

To fulfil these objectives, the research team will: (1) create a database (qualitative and quantitative) of mitigation and adaptation policies and governance systems in the European Union;[1] (2) conduct a series of case studies in a representative sample of member states to assess the effects of EU policies, taking into account both mitigation and adaptation and their interlinkages; (3) conduct a special case study focusing on the EU-internal and external effects of the European emissions trading scheme; (4) attempt to explain variation in effectiveness across countries and across policies, to assess the overall effectiveness of European mitigation and adaptation governance, and to identify problems and stumbling blocks that impede effective climate governance in Europe; (5) analyse possible governance challenges under specific changed future environmental and political conditions (linked to the scenarios from **work cluster S**), including results from other ADAM work clusters; and (6) develop detailed recommendations to European decision-makers at all levels on possible reforms of policies and of policy-making systems in the short-term [what is meant by short-term here?].

Deliverable D6: An appraisal of EU's current climate policy trajectory and the feasibility and cost effectiveness of this trajectory in meeting emerging adaptation objectives and existing mitigation goals.

Work Cluster P3: Portfolio development and appraisal through worked examples

This work cluster will apply the ADAM PAF (**cluster P1**) to four 'worked examples' to show how a portfolio of novel and tangible adaptation and/or mitigation policy options might be applied within Europe or globally, and what their consequences might be. Each example of a regional, sectoral or policy domain will be selected using the following criteria: where business-as-usual climate policies will not deliver strategic objectives (cf. **cluster P2**); where there is a strong European resonance, even if the analysis is not restricted solely to Europe; where there is scope for innovative policy intervention related both to adaptation and mitigation, whether or not these policies are synergistic or conflicting; not necessarily constrained to existing EU policy sectors; where there is a match with the skills profile and expertise of the ADAM Consortium.

The final choice of examples will be crucial to the success and relevance of ADAM and a final selection will not be made until Stage 2 of the proposal. This selection would be made in

[1] This database would be used by other researchers in the consortium, and would be a project output.

association with officers in DG Research, DG Environment and others DGs as appropriate. We believe that one worked example should certainly relate to the design and implementation of a post-2012 global climate regime. Here, we would develop a portfolio of global design principles (e.g. budern-sharing, blah, blah,) and EU policy options (e.g. compensation measures, blah, blah) which could deliver a 2100 global climate consistent with Article 2 of the UNFCCC and consistent with other international goals, treaties and conventions (e.g. Millennium Development Goals, WTO, Biodiversity and Desertification Conventions). These options would be such to an options appraisal using the ADAM PAF.

A short-list of candidate topics for the other three examples is suggested to illustrate our thinking (although we cannot elaborate them in Stage 1):

- transition to a hydrogen energy economy;
- the implications of new EU climate policies for a selected member state (e.g. for a newly acceded member state);
- re-designing European agriculture;
- international development assistance;
- forestry and biodiversity;
- water resource management in southern Europe;
- managing extreme weather events and impacts.

The idea is deliberately not [why? this sounds rather timid] to be comprehensive in our appraisal of long-term climate policy options for Europe, but to demonstrate the value of our policy appraisal framework in a small number of high profile and high impact examples. The development of the portfolio of innovative policy options for each example will draw heavily upon the work in the **Adaptation and Mitigation Domains**, but will be further co-produced with pertinent European (and global) stakeholders.

Deliverable D7: An appraisal of a range of new (i.e., beyond business-as-usual) mitigation and adaptation policy options as applied to four worked examples spanning a range of scales and sectors, including post-2012 global climate regimes.

Implementation plan

The ADAM Consortium consists of 19 partner institutions from eligible European countries, together with three institutions in 3rd Countries with whom we will develop a strategic alliance to deliver on the ADAM objectives. We also have identified a number of reserve partners, whom are not formally part of the Consortium in this Stage 1 proposal, but whom may be able to offer relevant skills as our ideas – in particular the four worked examples in **cluster P3** - are further developed in a Stage 2 proposal.

The ADAM Partnership – Stage 1 European Partners [please check]

Partner	*Participant Organisation Name*	*Country*	*Representative(s)*
01 UEA	University of East Anglia and Tyndall Centre	UK	M.Hulme; A.Haxeltine
02 PIK	Potsdam Institute for Climate Impact Research	Germany	O.Edenhofer; R.Klein
03 IVM	Institute for Environmental Studies, Free University of Amsterdam	Netherlands	F.Berkhout; F.Bierman
04 CICERO	Centre for International Climate and Environmental	Norway	K.O'Brien;

	Research - Oslo		G.Eskelund
05 WUR	Wageningen University and Research Centre	Netherlands	P.Kabat; S.Werners
06 IIASA	International Institute for Applied Systems Analysis	Austria	J.Bayer
07 PSI	Paul Scherrer Institute	Switzerland	A.Wokaun; L.Barreto
08 LUND	Centre for Environmental Studies, Lund University	Sweden	L.Olsson
09 ICIS	International Centre for Integrative Studies, University of Maastricht	Netherlands	P.Martens; J.Rotmans
10 IEST	Institute of Environmental Science and Technology, University of Barcelona	Spain	D.Tabara
11 PAS	Research Centre of Agricultural and Forest Environment, Polish Academy of Sciences	Poland	Z.Kundewicz
12 RIVM	Netherlands Environmental Assessment Agency	Netherlands	M.Berk; T.Kram
13 Fh-ISI	Fraunhofer Institute for Systems and Innovation Research	Germany	E.Jochem
14 CAM	Department of Applied Economics, University of Cambridge	UK	T.Barker; J.Köhler
15 JRC	European Joint Research Centre, ISPRA	EU	F.Raes
16 DISAT	Department of Agronomy and Land Management, University of Florence	Italy	M.Bindi
17 SEI	Stockholm Environment Institute, Oxford	UK	T.Downing
18 IEPE	IEPE, Université Pierre Mendès France, Grenoble	France	P.Criqui
19 HAS	Hungarian Academy of Sciences	Hungary	Someone

The ADAM Partnership – Stage 2 Candidate European Partners

Partner	*Participant Organisation Name*	*Country*	*Representative(s)*
A 01 CAS	Chinese Academy of Sciences, IAP/START	China	C.Fu
A 02 TERI	Tata Energy Research Institute, New Delhi	India	L.Srivastava
A 03 GCRI	Joint Global Change Research Institute, Batelle PNL Washington DC and University of Maryland	USA	J.Edmonds; R.Moss

The ADAM Partnership – Stage 1 3rd Country Collaborators

Partner	*Participant Organisation Name*	*Country*	*Representative(s)*
C 01 IERSD	Institute for Environmental Research and Sustainable Development, National Observatory of Athens	Greece	D.P.Lalas
C 02 FEI	Finnish Environment Institute	Finland	T.Carter
C 03 LSHTM	London School of Hygiene and Tropical Medicine	UK	S.Kovats
C 04 HIIE	Hamburg Institute for International Economics	Germany	A.Michaelowa
C 05 JR	Joanneum Research, Graz	Austria	B.Schlamadinger
C 06 LJU	Agronomy Department, University of Ljubljana	Slovenia	L.Kajfez-Bogataj

The composition of the ADAM Consortium reflects most importantly the inter-disciplinary skills and climate change research experience that are needed to advance the ability of science to underpin public policy in relation to climate change. We therefore have partners which balance social science, natural science, economics and engineering disciplines and partners who have played leading roles in the climate change science-policy interface within their own countries. A number of the ADAM partners have long experience of working together on European and global scale research projects, but we have also included a number of partners who bring new and specific skills which will be needed to deliver the ADAM objectives.

The senior partners in the ADAM Consortium have considerable experience in managing and delivering European-scale research projects. IVM are co-ordinating the EFEIA-2 Concerted Action; PIK co-ordinated the ATEAM project; ICIS and UEA are jointly running the MATISSE Integrated Project; WUR etc. [other examples please]. We are also experienced at working at the science-policy interface, either with our own national climate policy

communities (e.g. UEA in the UK; RIVM in the Netherlands; examples etc.), but also at a European scale (e.g. RIVM with the European Environment Agency; JRC, IEPE – others? - with the European Commission).

The successful management of ADAM will be a key element in delivering our objectives. We envisage a number of different levels and functions of the management structure. The lead partner – Tyndall Centre at UEA – has successfully managed a large, inter-disciplinary multi-site UK consortium over the last five years (and will continue to do so for 2005-2010) and will bring this management experience to the ADAM Consortium. We propose the following management functions which will be fully elaborated in our Stage 2 proposal: a Project Co-ordinator (the lead scientist); a Project Manager (full-time); a Financial Manager (part-time); a Scientific Core Group (comprising work cluster leaders); an ADAM Council (representatives from all partners); the ADAM Assembly (all researchers working within ADAM; to meet at least annually); a Stakeholder Consultation Group (drawn from policy, business and civil society organisations). We will invest in a professional knowledge management platform to facilitate information exchange and structured dialogue and exploit new Access Grid technologies for virtual interactions.

The ADAM work plan will be broken down into two equal 18-month phases: [still need to insert the information about indicative resource allocation by cluster and by partner].

Phase 1: The scenarios work (**Domain S**) will be completed within the first six months of the project and will provide one of the integrating frameworks for the duration of ADAM. Work cluster P1 will also complete its work during this phase (**Deliverable D3**), establishing the policy options appraisal framework for use in **P2 and P3**. **Work cluster P2** will commence work and will have completed the EU policy mapping exercise. **Work clusters M1, M2, A1 and A2** will all commence work during this Phase, establishing baseline data, improving models and establishing methodologies. Preparatory work on the four worked examples (**P3**) will be completed. .

Phase 2: **Work clusters M1 and M2** will complete early in this phase the improvements to economic models (**Deliverable D1**). **Work cluster P2** will complete its work (**Deliverable D4**) by using the options appraisal framework to evaluate existing and evolving EU climate policies. **Work cluster A1** will complete a quantitative vulnerability assessment for Europe (**Deliverable D2**). **Work cluster P3**, in association with other clusters, will have established the portfolios of policy options to be appraised under each worked example. In association with **clusters M1, M2, A1, and A2**, **work cluster P3** will use the options appraisal framework to complete the four worked examples by the end of the ADAM project (**Deliverable D5**). Six-monthly science-policy workshops will be organised throughout both phases and a final ADAM science-policy conference will be organised in Brussels.