INTERGOVERNMENTAL PANEL
ON CLIMATE CHANGE

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THIRTIETH SESSION
Antalya, 21-23 April 2009

Agenda item: 4
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SCOPING OF THE IPCC 5TH ASSESSMENT REPORT

Comments from Governments and Organizations

Note by the Secretariat:

Attention is also drawn to comments received before IPCC-28 which are contained in documents IPCC-XXVIII/INF.1 and INF.1, Add.1 and the synthesis of those comments contained in document IPCC-XXVIII/Doc.7.

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GERMANY

Dear Renate, dear colleagues,

Please find attached the submission from the German Government on policy questions and cross-cutting information we wish to be considered in the AR5 process in order to support the international climate policy process, in particular the UNFCCC process. This submission by the German IPCC Focal point also makes use of a broad consultation recently held with German scientists including AR4 authors, as well as users of IPCC products.

We would also like to refer to our submission from 18 February 2008 on our views on the future of the IPCC including its structure, work programme and main products.

Best regards
Ursula Fuentes,
on behalf of the IPCC Focal Point

Policy Questions and Cross-cutting issues for the IPCC AR5

Submission by the German Government

Introduction

We would like to use this opportunity to submit our initial views on the policy questions and cross-cutting information we wish to be considered in the AR5 process in order to support the international climate policy process, in particular the UNFCCC process. This submission by the German IPCC Focal point also makes use of a broad consultation recently held with German scientists including AR4 authors, as well as users of IPCC products.

We would also like to refer to our submission from 18 February 2008 on our views on the future of the IPCC including its structure, work programme and main products, which already gave some general input in terms of the IPCC contribution to understanding and solving the problem of climate change and its impacts in the time available to avoid dangerous climate change and how this compares to the UNFCCC time scale.

Synthesis Report

We would like to highlight that the Synthesis Report, in our view, plays a crucial role in answering policy relevant questions, as many of these questions are by their nature cross-cutting in relation to the IPCC working groups. As we already pointed out in our submission from 18 February 2008, the process should be improved in order to have a stronger Synthesis Report. In particular, its preparation should start earlier. This has in principle been agreed by the IPCC in its 28th session in Budapest. Specifically, as we already pointed out, the Synthesis Report should be anchored right from the first scoping of the AR5 with guiding questions that are clear from the start for each WG.

We would therefore make two suggestions related to the process of scoping the AR5:

- The Scoping meeting in July should devote sufficient time to also scope the Synthesis Report and to identify specific issues that need to be addressed by the Working Group reports to be able to address the questions of the Synthesis Report. Lessons should be drawn from the experience with the TAR and AR4 in this regard.

- For the approval of the structure of the Working Group reports, the IPCC plenary should look at the draft structures approved by the individual Working Groups from the perspective of addressing the questions to be addressed by the Synthesis Report. By starting with the questions to be answered, the WG structure can be (re)designed to deal with these coherently in one WG or across WGs. It has to be emphasized that this is of course aimed solely at the structure of the WG reports for consistency's and comparability's sake, not at their contents or results.

This implies a somewhat iterative approach to approving the structure of the Synthesis Report, with an initial structure (identifying main questions and issues) that should be already approved by the Plenary and used in their deliberations to approve the individual Working Group reports.

It should also be ensured that the authors of the Synthesis report get a clear mandate to do a real synthesis – including producing new figures that truly synthesise the content of the Working Group reports – and not primarily a cut-and-paste exercise as happened in the AR4. In this regard, it is also important to improve the treatment of cross-cutting issues. One example could be crosscutting authors as has been proposed.

Policy Questions and Crosscutting Issues

From our point of view, many of the policy questions that need to be addressed by the AR5 are still the same as the ones addressed by the SYR of the TAR and the AR4, such as:

- What can scientific analysis contribute to what constitutes „dangerous interference with the climate system“? How can a “safe level” be defined?
- What is the evidence of past and observed climate change and its consequences?
- What are the risks for extreme events and abrupt/non-linear/irreversible/large scale events and feedback effects implied with a range of emissions scenarios, including ambitious mitigation scenarios?
- Which impacts of climate change/which risks can be avoided with a range of emissions scenarios and at short/mid- and long term timescales?
- What are potentials, options and strategies to achieve emissions reductions that avoid different level of climate change and serious impacts?
- What are the options to cope with unavoidable climate change?
- What are costs implied with different scenarios and strategies/options for mitigation and adaptation?
- What are the benefits, including co-benefits of mitigation and adaptation measures?
- What are the implications of uncertainty with regard to future developments in the context of an analysis of risks?
- What are the climate impacts as well as economic consequences of delaying action on climate change?

In addition, there are some new questions that the AR5 would need to address, as it would be published in 2014, that is, with a context of increasing experience with climate policies at national and international level:

- What are the experiences gained so far with climate policies and strategies?
- Are we on track regarding achievement of long-term goals that have been decided or proposed by the international community or by countries/groups of countries?
- Are strategies and policies regarding mitigation and adaptation delivering the intended results?
- What is the role of public and private financing in different climate policies and strategies?
- Is Stabilisation of GHG emissions concentration on a very low level still feasible?
- What are costs and appropriate strategies if one considers an imperfect world?
- What can be done in the short-, mid- and long term both on mitigation and on adaptation?
- What are opportunities and costs of several policy instruments?

Some of the key crosscutting aspects that need to be handled better in the AR5 include

- Consistent assessment of very low emissions mitigation scenarios (consistent with long-term targets being discussed in the UNFCCC negotiations), including their socioeconomic, technological and climate system and climate change impact implications over relevant time scales (many decades to centuries). Emission scenarios that keep global mean warming below 2 degree C with a higher probability need to be treated explicitly both from the standpoint of technologies and economics.

- a consistent assessment of risks at global, regional and local levels, in particular a consistent description and assessment of plausible scenarios with resulting high impact but low probability, such as rapid sea-level rise;
- evaluation and treatment of uncertainties, including assessment of policy implications of uncertainty;
- evaluation of the main findings from an economic point of view (economics of climate change);
- consistent treatment of regional information including that which may only be relevant to a few areas;
- consistent treatment related to extreme events;
- relationship between climate policies and sustainable development;
- relationship between climate policy and land use/land-use change;
- assessment of new technologies and their potential effects on other systems;
- a common language and understanding of how to approach risk and uncertainty across the WG report writing teams should be developed, e.g. by developing a cross cutting guidance document;
- findings in the SPMs should not be restricted to “high confidence” findings, as many findings can be highly relevant, even if they are uncertain, e.g. if they are related to high-impact events.

Berlin, 15 April 2009

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15 April 2009

Dear Renate

RE: UK views on scoping the AR5 and further Special Reports

The UK would like to share its views on the scope of the AR5. As well as being largely supportive of the Paper Produced by the team looking at the AR5 Scoping Process and the IPCC Future, we would like to add further thoughts to the debate. These are provided in bullet form at Annex A.

Also we have been thinking carefully about further special reports. We would like to suggest that the following possibilities should be considered:

a) *An update report on current climate trends and emerging science*. It is becoming clear that some aspects of the climate are changing faster than even foreseen in the AR4, yet the next major assessment is 4/5 years away. In our consultations with our policy colleagues it has become clear that there is a requirement for an update on current changes as well as key emerging science. We suggest this could be done as a special report but be very focussed on key results. Ideally we would like to see this within 18- 24 months

b) *Investment required to transfer to a low carbon economy.* There is interest in the investment issues surrounding the transformation to a low carbon economy. We would like to explore how this could be addressed ahead of the AR5.

c) *Impacts on Ocean Ecosystems.* The impacts of climate change and increasing CO2 on marine ecosystems is of growing concern. A lot of new work has emerged since the AR5 and given the relative lack of information on this subject within the AR4, would like to suggest a potential special report on this subject. An outline proposal is attached at Annex B.

I would be grateful if you could make these proposals available to the Panel.

Yours Sincerely,

David Warrilow

CC Dr R K Pachauri

Annex 1 Summary of UK views on the Scope of the AR5

Lessons from previous reports

Synthesis should be built in from the beginning. We need to avoid being restricted by WG structure.
Essential to identify key policy relevant questions. Worked well in the AR3.
Increase focus on live policy and science issues
Have a clear communication strategy at the beginning

Areas needing enhanced / new consideration

Ocean issues and Sea level Rise
Geo-engineering
Emissions from aviation and shipping
Security and CC
Economics; Investment patterns and trade
Life cycle assessment
LULUCF; REDD; Agriculture and food security
Nuclear (fission and fusion)
Links to other policy areas – air pollution, desertification, deforestation, biodiversity
Human behaviour and societal issues
Integrate paleo-studies into all relevant parts of the report

Style of report

Synthesis should take pre-eminence. In fact the whole report could be prepared as a synthesis.
Policy relevant questions essential to meet policy community needs and to give an overall structure to the report. Will help deal with cross cutting issues and provide basis for synthesis if well posed. Helpful to organise around policy needs rather than scientific disciplines.
Aim for less of a text book
Could be helpful to break into smaller volumes and have some sections written jointly by WGs. This would help synthesis.

Nature of scoping agreement

Scope is about content and structure.
Scope should be enabling and not limiting.
Avoid putting science into a straight jacket.
Scoping process should cover subject areas and questions .
Identify “users” for different parts of the report and consult them.

Straw-man outline for the whole report

1. Past and current climate change and its effects. (WG1,2)
2. Future climate change and risks, with BAU emission scenarios (WG1,2,3)
3. Avoiding dangerous climate change – risks and mitigation pathways (WG1,2,3)
4. Mitigation policies and measures (WG3)
5. Mitigation technologies (WG3)
6. Adaptation options, methods and approaches (WG2)
7. Economics of climate change (WG2,3)
8. Human behaviour and climate change (WG2,3)
9. Vision for a low carbon society (WG2,3)
10. Specialised science-policy issues; e.g. REDD, LULUCF, Bunkers, CCS
11. Specific regional issues (WG 1,2,3)
12. Interaction with other policy issues (e.g. biodiversity, agriculture, water, health etc) (WG1,2,3)
13. FAQs

Annex 2 Climate Change impacts, including Ocean Acidification, on Marine Ecosystems

1. Summary

1.1. Previous assessment reports of the IPCC have correctly concentrated on biogeochemical and temperature effects of anthropogenic carbon on the oceans. Whilst this emphasis is driven by the key effects that the IPCC has been considering, impacts on global carbon cycling, temperatures and sea level, another important issue has also emerged in recent years that of ocean acidification. The effects of this, combined with other better understood changes such as temperature, salinity and ocean currents, are likely to have major effects on marine ecosystems and marine productivity.

1.2. Wide ranging implications of these interactions could be impacts on dominant planktonic and benthic species. Changes in these large scale ecosystems would have impacts on the global carbon cycling through marine ecosystems, impacts on key marine animals and impacts on the key exploitative interaction between man and marine ecosystems; marine fisheries. Damage to marine ecosystem services provided globally would more severely impact coastal communities and those reliant on the sea in poorer countries.

1.3. The last IPCC assessment report noted the issue of ocean acidification, explaining that *projections based on Special Report on Emissions Scenarios give a reduction in average global surface ocean pH of between 0.14 and 0.35 units over the 21st century [IPCC 2007 Synthesis report 3.3.4]*. However the report also noted that the effects of observed ocean acidification on the marine biosphere were as yet undocumented.

1.4. It may be therefore an appropriate time, before the next global assessment, to consider latest understanding on the impacts of the changes in ocean pH, and in concert with other climate change impacts such as temperature change, what the overall impacts on marine ecosystems might be.

1.5. The rapid and direct nature of ocean acidification offers the global community further evidence of the need to take rapid action to mitigate anthropogenic induced climate change.

2. Marine Ecosystems Services

2.1. Marine ecosystems have a major role in the maintenance of global biogeochemical cycles. In addition, coastal and marine resources are of increasing importance for human well-being.

2.2. The coastal region provides critical services for over 2 billion people worldwide who live within 100km of the coast or estuaries. The degradation of coastal and marine resources poses critical challenges for the maintenance of ecosystem services and poverty alleviation.

2.3. The world's 200 million full and part-time fisher-folk (fishers, fish processors, traders and ancillary workers) depend on resources that are vulnerable to human-induced climate change. For poorer countries this reliance on fisheries is crucial. 26 million poor people fish for a living (FAO, 2007). Fish supplies >50% of the essential animal protein and mineral intake for 400 million people from the poorest African and South Asian Countries (FAO, 2007). The fisheries sector makes important contributions to local development in coastal, areas, through employment and multiplier effects. Maintaining or enhancing the benefits of fisheries in the context of a changing climate regime is an important challenge in climate change adaptation.

2.4. Coastal zones and their ecosystems also provide a wide range of other ecosystem services: coastal protection, sink for domestic and industrial wastes, a source of income and employment, destination for tourism and as well as sites of human habitation. Coral reefs, which are acknowledged to be sensitive to temperature change and ocean acidification play an essential role in many tropical fisheries and in tourism employment.

2.5. Such systems are already at risk of being seriously degraded by population increases in coastal areas, increasingly levels of pollution, aquaculture development, increasing human mobility, and the spread of invasive species. Climate change and ocean acidification is likely to further exacerbate these trends through sea temperature change, shifts in the range of fish species, change in ocean currents affecting upwelling zone fisheries, coral bleaching affecting reef fisheries, disruption to fish reproductive patterns and migratory routes

2.6. The poor in coastal communities, even under diverse circumstances have in common their high levels of direct dependence on ecosystem services and their high level of exposure to risks posed by climate change. These high levels of vulnerability to climate changes will potentially undermine the important contributions made by marine ecosystems and fisheries to poverty alleviation and nutritional security at local, regional and sometimes national levels

3. Ocean acidification

3.1. Over the last 200 years the oceans have absorbed about 25% of the CO2 emitted into the atmosphere from human activities, effectively reducing CO2 in the atmosphere and therefore buffering climate change (Sabine et al. 2004). This has resulted in the measurable alteration of surface ocean pH and the concentrations of CO2, and dissolved carbonates (HCO3-, and CO32-), as well as the reduction of the saturation state and shoaling of the saturation horizons of calcium carbonate minerals. This change in ocean carbonate chemistry is termed "Ocean Acidification" and is increasing in response to rising atmospheric CO2.

3.2. Since pre-industrial times ocean pH has decreased by a global average of 0.1 (equivalent to a 30% increase in acidity) (Sabine et al. 2004) and unmitigated CO2 emissions will cause ocean pH to decrease by as much as 0.4 [percentage change ?] in total by the year 2100 and by 0.77 by 2300 (Calderia and Wicket 2003). These will be the most rapid and greatest changes in ocean carbonate chemistry experienced by marine ecosystems for many millions of

years . It will take tens of thousands of years for the changes in ocean chemistry to be buffered through neutralization by calcium carbonate sediments (Archer 2005, Ridgwell & Zeebe 2005). The level at which ocean pCO2 will eventually stabilize will be lower than it currently is (Archer 2005, Ridgwell & Zeebe 2005). Ocean acidification is a large-scale, long-term problem and with unmitigated CO2 emissions is likely to result in widespread impacts on ocean biogeochemistry, biodiversity and the services that the oceans provide to the whole Earth system (Royal Society 2005, MCCIP 2008).

3.3. Two key components of marine biological structural minerals are likely to be affected by increasing acidification, these are aragonite and calcite. Aragonite is used by organisms such as corals for skeleton structure whilst carbonate is used by organisms such as clams to make their shells. Both materials may be found as key structural components of plankton. Normally aragonite or calcium saturated waters are at now at risk of becoming under saturated in these minerals by acidification. Under-saturation leads to risk of dissolution of aragonite or calcite.

3.4. Already shoaling of the aragonite saturation horizon (ASH) may be bringing increasingly corrosive waters to the productive, shallower shelf seas along the western coast of North America (Feely et al. 2008). Cold-water corals are abundant off the coast of Northern Europe (Guinotte et al 2006). Deep-water forming in the North Atlantic is already reflecting the lowered pH conditions due to anthropogenic CO2 additional and hence organisms living in this water mass, such as cold-water corals with aragonite skeletons may be particularly vulnerable to shoaling of the ASH (Guinotte et al 2006). Shelf sea models project similar rates and levels of acidification in European waters to those predicted for the global ocean (Blackford and Gilbert 2007), so ocean acidification may represent a substantial risk to commercially important fisheries and aquaculture. If we continue to emit CO2 at the same rate, models project that parts of the Southern Ocean will be under saturated in the important carbonate mineral aragonite (used by many organisms such as pteropods to make their shells) by the middle of this century with the whole of the Southern Ocean under saturated by 2100 (Orr et al. 2005).

3.5. In the Arctic ocean aragonite under-saturation is projected to occur earlier (Steinacher et al. 2008) with 10% of its waters under saturated in the next decade (Orr et al. 2008 [Monaco]). By 2060 80% of Arctic waters are projected to be under saturated in both aragonite and calcite and organisms are likely to find calcification in these corrosive waters metabolically very demanding. As these organisms play a key role in food webs the consequences to food webs are of great concern. Measurable impacts may occur earlier than this due to a lowering of the carbonate ion concentration impacting calcification and other processes, but our knowledge of these is currently too sparse to make predictions.

3.6. Observations of natural CO2-rich seawater and studies of previous ocean acidification events in Earth's history indicate that these changes are a threat to the survival of organisms using CaCO3 to produce shells, tests and skeletons (e.g. coccolithophores, pteropods, foraminifera, corals, calcareous macroalgae, coralline algae, mussels, oysters, echinoderms and crustaceans) . Other experiments (reviewed in Kleypas et al. 2006, Fabry et al. 2008) reveal that

other biological processes (productivity, internal physiology, fertilization, embryo development, larval settlement and communication) are also vulnerable to predicted future changes to ocean chemistry. There could also be changes to ocean biogeochemistry that have a direct feedback to the Earth system and to climate through carbon and nutrient cycles (e.g. through air-sea gas exchange, sedimentation of material through the oceans and changes to rates of calcification and ocean productivity).ref)

3.7. Adult fishes may be able to buffer against changes in ocean acidity, adapt relatively quickly (Larsen et al 1997; Pörtner et al. 1998) and may be less vulnerable than some benthic invertebrates. However, the physiology, metabolism, reproductive biology, behavioural patterns, cognitive abilities, feeding rates, prey selection and larval development of some fish may be significantly impaired and this would have serious consequences for long-term population survival and fisheries yields (Pörtner et al. 2004; Ishimatsu et al. 2004). Many commercially important fin-fish species rely heavily on benthic invertebrate species (e.g. bivalves, crabs and echinoderms) as a major food source, and are therefore also likely to be indirectly impacted by ocean acidification. Additionally, as most fish larvae feed selectively on copepods and other planktonic invertebrates, year-class strength in many fin-fish species is highly dependent on the planktonic food sources available during this early life stage. In years where insufficient food is available, starvation mortality can be considerable and hence populations are impacted long into the future.

3.8. The impacts of changes in planktonic, benthic and fish species will of course have implications for other species further up the food change such as marine mammals and seabirds.

4. Current global research on Ocean Acidification

4.1. The UK has played a major role in bringing the potential serious consequences of ocean acidification to the attention of national and international stakeholders. The Royal Society (2005) in its Report on ocean acidification called for a rapid investment by stakeholders, equivalent to that of climate change and called on climate change policy negotiators to consider ocean acidification in their CO_2 emission reduction targets. The Scientific Advisory Board for the German Government for Climate change (WGBU) has also highlighted this issue, as well as the European Union in its 7th Framework Programme which issued a call for proposals on ocean acidification resulting in the funding of the European Project on Ocean Acidification (EPOCA) in 2008. Other programmes addressing the topic have since emerged (e.g. BIOACID from Germany) or are emerging (e.g. USA Senate Bills on ocean acidification) that will increase this investment.

4.2. IGBP, UNESCO and SCOR have recognised the significance of ocean acidification in their Science Plans and with other funders supported the series of symposia *"Oceans in a High CO2 World",* the second of which, held in Monaco in October 2008, resulted in *"The Monaco Declaration".* This called on climate change negotiators to take ocean acidification into account.

Scientists consider that the only way to minimise the risk of these large-scale and long-term changes to the oceans is through urgent and substantial reductions in anthropogenic CO_2 emissions. Ocean acidification is therefore a strong additional argument for united global societal action in future climate change negotiations.

5. Issues to be addressed by an interim report on the state of knowledge on climate change impacts on marine ecosystems, in particular with regard to interactions with ocean acidification.

5.1. A Special Report could address the following issues:

- State of knowledge on rates of global and regional ocean CO_2 uptake and associated acidification.
- The state of knowledge on the impact and interaction of temperature, salinity and circulation changes and acidification on ocean biogeochemical processes and feedback with climate.
- The state of knowledge on the potential impacts and interactions of temperature etc and ocean acidification on key global ecosystems, species, communities, habitats.
- The state of knowledge of the impact and interaction of temperature changes etc and acidification on those ecosystems with direct socio-economic impacts, for instance fish and corals.
- The state of knowledge on regionally specific impacts of ocean acidification and other climate change drivers.
- The state of knowledge on how geo-engineering proposals to abate climate change may impact ocean acidification.

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Subject: Scope of the IPCC 5th Assessment Report

Ref.: 1) FCCC/SBSTA/2008/L.17 of 8 December 2008 in IPCC-XXX/INF.1 of 18.2.2009
2) My note to IPCC of 3 July 2008 (RTD D(2008) 550871)

Dear Dr. Pachauri, dear Dr. Christ

At the last Conference of the Parties to the UN Framework Convention on Climate Change (COP 14/SBSTA 29) in December 2008 the IPCC made a statement on the fourth assessment report (AR4) and plans in regards to the next assessment and invited Parties to the UNFCCC to inform IPCC about scientific and technical questions and information that they wish to be considered in the process for the fifth IPCC assessment (AR5).

Referring to this invitation and the related SBSTA conclusions, the European Community would like to provide some key issues for consideration by the Panel in relation to the scoping of the AR5. It is important to emphasise that the AR4 was an extremely valuable source of information towards the identification of climate policy options. Thus the AR5 can build on a robust fundament.

In order to further strengthen the scientific assessment in AR5 including the policy relevance we consider important to allow for enhanced coherence and stronger integration between the various issues relating to the physical science basis (WG I), impacts, vulnerability and adaptation to climate change (WG II) as well as mitigation of climate change (WG III). Starting the process with a view to a final synthesis may facilitate both the policy relevance and the communication of the scientific assessments.

In the annex to this note you will find further key points for the consideration of the Panel. I am looking forward to a successful 5th Assessment Report.

Yours sincerely,

José Manuel SILVA RODRÍGUEZ

Enclosure: Annex.

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ANNEX

Key points forwarded by the European Community for the scope of the 5th IPCC assessment report

1. General points

Despite the considerable advancements of climate change science in recent decades - evident by the IPCC Assessment Reports -, important uncertainties and knowledge gaps still remain. It is now widely recognised, especially after the IPCC AR4, that we have enough evidence to start acting through adaptation and mitigation; however, a better understanding of the causes and evolution of climate change and its impacts on humans, and ecosystems will allow us to act with greater efficiency.

Given the complexities of the earth system, the global economy and the need to deviate significantly from business as usual development paths, thus given the magnitude of the challenges, an integrated approach in climate change research needs to be employed. This need for integrated research is widely recognised since long. There is a clear need for closer cooperation within and across the three IPCC Working Groups (WGs) to address more efficiently cross-cutting issues (some examples of these areas for interaction are indicated below). To that respect, better integration of natural, social and economic aspects, will be essential in order to achieve a robust scientific understanding of the functioning of the Earth-climate system and be able to answer, with higher confidence, fundamental scientific questions that are of high policy relevance.
Integration of solid scientific analyses, undertaken in all 3 WGs, around policy needs and questions, will maximize the relevance and impact of the findings, especially in relation to global efforts to combat climate change.

The scope of the AR5 and it's working group contributions should open-up options rather than restrict them. In particular it should allow and encourage contributing to assessing key cross cutting questions from the perspective of individual working groups, where this is necessary. This would prepare and enable a solid basis for an integrated assessment in a synthesis report. This opening-up options including enabling interaction between working groups is in particular relevant some time after the UNFCCC COP 15 in Copenhagen will have concluded a new global approach to tackling climate change, which may bring up new - yet unknown - policy needs.

There is a need to move the assessment towards a more holistic view, where synergies and trade-offs of various policy options and actions are better taken into account. We would hope that the AR5 - based on a robust assessment of the physical science basis - could strengthen its assessment on the economics of climate change. This relates to both main policy strategies: adaptation and mitigation. Most helpful are assessments of costs of adaptation including cost of impacts, as well as the potential and cost of mitigation options. Cost estimates are essential for policy measures and choices at regional scale. Consistent

cost metrics and relevant uncertainty estimates should also be communicated with indications on the harmonized methods used for the treatment of uncertainties across the disciplines covered by AR5.

There is also a need to better identify barriers for the uptake of useful adaptation and mitigation measures and in particular approaches how to overcome them. The AR4 sections are often of a very general nature, and a more regional approach would be helpful, possibly in the form of case studies.

In particular, we believe that a Synthesis Report, being such a key document for informing policy making, should be worked on right from the start. With a view to integrate and synthesise the findings, rather than selectively summarize them in the second place the three Working Groups may wish to organise their work both in terms of structure and development process, with a defined scope of the synthesis report and areas for cooperation and integration in mind. It is also essential that the development of AR5 is accompanied by a communication strategy.

2. The physical science basis - WG I

Obviously we would like to see an increased effort on the key uncertainties as identified in the AR4. The AR5 will have to address these - and indicate clearly the progress made since AR4- as they are often related to significant reasons for concern, such as sea-level rise or high-impact, low-probability extreme events. The AR5 should provide information in particular on the following issues where we see the need for in-depth assessment:

- Carbon cycle and other greenhouse gases (notably CH4 and N2O) in terrestrial ecosystems and in particular issues related to: vulnerability of carbon sources/sinks under future climate conditions and land-use change and practices; links with nitrogen and hydrological cycles; the role of agriculture, forests, peat-lands, biomass and soil; emissions in relations to thawing of permafrost. Strong cooperation with WGII and WGIII is needed.

- Changes in the CO2 uptake capacity of the oceans under a changing climate and implications for ocean acidification (in cooperation with WGII).

- Better understanding and quantifying carbon-climate feedbacks and the implications for mitigation efforts (the latter in cooperation with WGIII)

- Improved understanding of thresholds and tipping points likely to lead to abrupt changes in the earth-climate system.

- Trends and projections in key climate variables (e.g. temperature, precipitation, frequency and strength of cyclones, glaciers, sea level, ice sheets in particular Greenland and West Antarctic ice sheet).

- Links between atmospheric chemistry, air pollution and climate change. Cooperation with WGII (e.g. impacts on human health) and WGIII (synergies and trade-offs between air pollution and climate change mitigation options and policies) will be essential.

- Processes related to aerosols and cloud formation and their impact on climate change.

- Detection, attribution and projections of climate change/climate change variability at regional scale, and implications for vulnerability and impacts assessment (in cooperation with WGII).

3. Impacts, adaptation and vulnerability – WG II

The AR4 Working Group II report has been extremely helpful for developing adaptation policies in the Europe and a key reference for concepts such as vulnerability and adaptation For AR5, we would hope for even more focus on providing the elements for an integrated assessment modelling of adaptation options. These include:

- Assessing climate change impacts at different levels of projected temperature (e.g. +2°C, +3°C, +4°C) and identify most vulnerable regions and sectors. Special effort should be devoted to regions where such information was missing (e.g. Africa, SE Asia, low-lying islands).

- Costs of adaptation actions –as well as cost of no action- need to be assessed in detail.

- Resilience thresholds beyond which human systems and ecosystems are no longer capable to maintain the required functions. In that respect, it is important to assess climate change, water resources, biodiversity, water quality and land-use changes in an integrated way (in cooperation with WG I).

- More accurate estimation of impacts in the agriculture and forestry sectors based on finer spatial scales and shorter time-frames will benefit planning of future management requirements and adaptation measure in view of a changing climate (in cooperation with WG I) .

- Overview of adaptation measures (i.e. state of actions) based on past legislative instruments (such as National Adaptation Strategies), as well as a review of these together with the state of play on adaptation indicators.

- Assess critical global interactions: impact on migrations, impact on global trade from changes in availability and demand of natural resources and productivity, impact on security and conflicts.

- Assess and update indicators of vulnerability for different regions and sectors that would help identifying the most urgent areas for adaptation action.

- Specific assessments linked to impacts on water systems and the way adaptation options are designed in the context of integrated water resources management, in particular measures linked to climate change-related extreme events such as droughts and floods (in cooperation with WG I)

- Assess state-of-play on ocean acidification due to CO2 uptake by marine ecosystems and climate change (in cooperation with WG I)

- Ways to handle uncertainty for medium and long-term impacts and how to translate it into risk assessment and management.

4. Climate change mitigation -WG III

Development of low greenhouse gas stabilisation scenarios need to be assessed and developed in line with limiting global average temperature increase well below levels associated with considerable impacts exceeding the adaptive capacity of systems and increasing considerably the risk for irreversible effects. In particular also a global average temperature increase of 2°C above pre-industrial should be a focus area of the assessment of related mitigation options but also remaining impacts (cooperation with WG I and WG II)

- Economics are key. The AR4 has done considerable work at assessing mitigation potentials at various assumed carbon prices. However, we would like to see in-depth assessments on what kind of mechanisms would give efficient results. There are a number of low-cost mitigation measures which do not materialise due to failures in the economic/social structures.

- A portfolio of policy measures should be assessed (e.g. market based focusing on emission trading, legislative) in terms of technical feasibility, environmental impact and cost effectiveness, considering regional specificities (cooperation with WG II)

- The mitigation potential of agriculture and forestry needs to be addressed in an integrated way globally and for key regions (e.g. including enhanced biomass use, changes in deforestation, links with food security and international trade, effects on droughts and floods on crop yield). Further work is required to incorporate recent scientific knowledge in the assessment of mitigation options in the sector, where uncertainties are particularly high, and multiple inter-linkages between different sources of emissions exist. More detailed information is needed on the feedback mechanisms that might be of relevance (e.g., how mitigation measures like bioenergy can have an impact on the C cycle). Furthermore, there are a lot of methodological issues still open concerning that relate, not only, to accounting/monitoring, but also to what type of policies are appropriate for mitigation (both in reduced deforestation and degradation –REDD- and concerning LULUCF in general), how much they cost, and how they relate to the carbon market. Strong interaction/cooperation between all three WGs will be needed.

- Going beyond the assessment of the AR4, often presenting what could happen in an ideal world (a perfect market or a universal carbon tax), we would hope that the AR5 could also consider the literature which increasingly becomes now available on what is likely to happen given real-life situations (gradually developing carbon market, imperfect participation, costs and uncertainties of monitoring, issues related to time scale). This could inform the policy debate concerning LULUCF, the Clean Development Mechanism (CDM) and concerning cap and trade systems, including an OECD-wide carbon market by 2020.

- There is a further need to assess the cost data for different types of policies as this would inform the policy debate later on. This helps to define what is the appropriate own action

for all countries, including developing countries, and it gives more information on what costs are involved and how they could be financed. It will be useful to provide more insights on the timing issues: the need to act by when (mitigation and adaptation) and how this could drive down costs over the longer term.

- More coherence in the assessments would help the policy relevance significantly. There are significant trade-offs among mitigation actions, like between bioenergy production and carbon sequestration on the same piece of land. Often, mitigation options are not independent of each other, not fully scalable and not additive. These were not sufficiently brought out in AR4, which properly listed all options, but often did not put them into context.

- Novel options to combat climate change (including geo-engineering) should be assessed in an integrated way (technical and economic feasibility, effectiveness, consequences and unintended 'side-effects' /feedbacks, as well as social, ethical and governance issues)