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FURTHER WORK OF THE IPCC ON EMISSION SCENARIOS

Recommendations by the IPCC Task Group on New Emission Scenarios (TGNES)

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Final Report

Recommendations on New Emission Scenarios

Prepared by the
IPCC Task Group on New Emission Scenarios (TGNES)
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Executive Summary

1. The TGNES addressed the following items, as requested by the Panel in its 24th Plenary Session:
   - the deliverables of the emission scenarios development process, drawing on the user needs and scenario characteristics as outlined in the Laxenburg Workshop Report,
   - the process and timeline that should be followed for the development, assessment and use of the new emission scenarios,
   - the kind of facilitation or coordination that needs to be undertaken by IPCC with the scientific community for development of scenarios,
   - the organizational arrangements and a timetable for IPCC's own activities related to facilitation or coordination, assessment and use of scenarios in a possible AR5,
   - the possibility of encouraging, but as IPCC not itself facilitating, a wider family of scenarios within which emissions scenarios might sit.

2. On the substance of scenario deliverables and user needs, the TGNES main findings are:
   - Scenario characteristics need to address a wide range of user needs. The main user groups are: 1) climate modellers, 2) impact, adaptation and vulnerability analysts, 3) mitigation analysts, 4) climate change policy makers, and 5) assessment bodies;
   - Scenarios should enable use for vulnerability and adaptation analysis at the regional and local scale requiring adequate coverage of socio-economic aspects;
   - More short-term and regional detail should be included in the scenarios than was the case in the SRES scenarios;
   - Most scenario users, particularly the policy-making community, prefer a limited set of scenarios for reasons of clarity and communication;
   - From the point of view of assessment needs, consistency between scenarios used for studying climate change, climate change impacts and adaptation and mitigation would facilitate the work. For IPCC assessments this means that a greater degree of consistency in the scenarios used in studies that are assessed would help the respective assessments of the three Working Groups;
   - Comparability of scenarios by using common approaches and assumptions is important to get a better idea of the influence of methodology and model sensitivities and uncertainties and is therefore an important characteristic of new scenarios.

3. Given the diversity of scenario users and their needs it may be helpful to distinguish three different categories of scenarios:
   - Category 1: long-term, global emission scenarios (time horizon of 100 years and more) for a limited number of regions and sectors based on a few story lines with appropriate reflection of socio-economic drivers in order to assess the impacts on the climate system of possible emission trajectories and its impacts on human and natural systems and the possible adaptation and mitigation requirements. Specific issues of importance are:

    - information that allows downscaling to finer temporal and regional levels in order to harmonise category 1 with category 2 or 3 scenarios and preserving consistency across scales,
    - availability of regional experts involved in choosing assumptions, in order to make sure the scenario exercise is sufficiently rooted within regional realities,
    - inclusion of feedbacks of climate change and climate change impacts and of socio-economic feedbacks,
    - use of narrative approaches (storylines) and the use of probabilistic approaches.
  - Category 2: short-to-mid-term global emission scenarios (generally looking 20-40 years ahead) for a larger number of regions and sectors based on reference or "best-guess" scenarios with appropriate sensitivity analysis (or moderately diverging scenarios), using probabilistic assessments for major drivers and parameters. These scenarios should reflect historical trends and, if possible, future transitions and they should incorporate developing country dynamics properly. They may be based on storylines and would preferably be consistent with the long-term scenarios of category 1.
  - Category 3: short-to-mid-term emission scenarios (generally up to 50 years ahead) for specific regions or nations with considerable detail, which would primarily have a regional or national function in terms of climate change policy development and evaluation (both mitigation and adaptation); these scenarios would preferably be consistent with the scenarios described under category 1 and 2.

4. On linkages of the development of new emission scenarios with the non-climate change scenario community the main findings are:
   - Undertake an inventory of scenario activities extending the efforts of AR4 to also include other scenarios looking at the development issues mentioned above.
   - Draw lessons on both process and content, particularly their relevance for meeting users' needs, including providing basic elements of new scenarios;
   - Encourage groups/experts from these other scenario exercises to be involved in the development of new scenarios.
   - These activities should be undertaken as part of the preparatory phase and should include an interagency meeting, involving, as appropriate, representatives of organizations from e.g. World Bank, FAO, OECD, IEA, and UNEP.

5. The main findings regarding the process and timeline for scenario development and assessment are:
   - Assessed scenarios should be available well ahead of a possible AR5.
   - The scenario development and assessment process can be divided in five tasks: preparation, development, assessment and application of new scenarios, and assessment of literature in a possible AR5.
   - There should be an integrated process of scenario development, where climate analyses and IAV and mitigation analyses are started in parallel with the development of new emission scenarios, allowing integration of feedbacks of

climate and climate change impacts on socio-economic and emissions scenarios (see figure 4.1). After completion of assessment of newly developed scenarios, assessed scenarios are used in climate, IAV and mitigation analyses.

- The results of all Working Groups reports in AR4 could be utilized for selecting benchmark emission trajectories to be used at an early stage for GCM studies. IAV studies need the non-climate features of emission scenarios relating to demographical, economical and technological developments, in addition to the consequences for the climate system of emission scenarios as calculated in GCM studies or simplified climate models calibrated to these GCMs. It is recommended to have a Technical Paper summarising the AR4 results, or, alternatively, an additional IPCC expert meeting considering those AR4 outputs.
- The assessment of new scenarios could be done through a formal IPCC Special Report on Integrated Scenarios.
- Invite the scientific community and other stakeholders to participate at an early stage.
- Ensure proper participation of developing country and EIT experts and organisations in the development stage.

6. On the role of IPCC and options for facilitation and coordination the main findings are:
   - There is general agreement that IPCC will be responsible for the assessment of new emission scenarios.
   - In the development stage there is a possible role for IPCC in facilitation and/or coordination.
     - In this report the word "facilitation" is used for activities in support of the development of new scenarios, such as helping to identify user needs and requirements (wish list), identifying benchmark scenarios from AR4, organising expert meetings, and helping to bring funding agencies into the discussion on resources for scenario development groups,
     - "Coordination" is used for activities involved in the actual process of developing the scenarios, such as encouraging common assumptions by participating scenario and modelling groups on the number and character of qualitative storylines and assumptions on key drivers for emissions and the bandwidth of quantitative values, etc., in the interest of getting comparable and consistent results of scenario quantifications.
   - There is general agreement that IPCC would specify desirable scenario features for the scenarios to be developed by the scenario community, based on the needs of user communities and taking into account the capabilities of scenario development and modelling tools. This is referred to in chapter 4 as the construction of a "wish list". Such a list could be produced through an IPCC expert meeting involving scenario development and user communities.
   - Regarding the role of IPCC in the development of scenarios three options were identified, in addition to organising an expert meeting to produce a "wish list" (see figure 5.1):
     - B1A: Development will be left to the scientific community (may or may not self-organise)

    - B1B: IPCC will be involved in facilitating the establishment of a coordinating mechanism from within the scientific community. A possible candidate for such a coordination role would be a joint arrangement between the international scientific coordination programmes WCRP, IGBP and IHDP. Whether the required arrangement could be achieved within the timeframe specified in this report needs to be further explored. An alternative could be an ad-hoc consortium of key institutes, with arrangements to ensure transparency and openness.
    - B2: IPCC provides coordination of scenario development.
- The various options were compared to specific aspects that are important in considering what the best approach would be:
    - integration of the scenario development process
    - consistency and comparability
    - integration with non-climate scenarios
    - resource implications
    - IPCC independence as an assessment body
    - developing and EIT country participation
    - timely delivery
    - transparency

Overall, a large majority of participants to the Seville expert meeting favoured an additional coordination mechanism (either B1B or B2). However, some participants questioned the value and need for such additional coordination and preferred option B1A.

- A key TGNES recommendation is not to take a decision on the process options now, but to allow more time for a thorough discussion of the best possible way to organise the development process. This is particularly important because the proposed integrated scenario development process poses particular challenges to the organisation of the process. To that effect, it is proposed to set up a new IPCC Task Group on scenarios with representation of all three IPCC Working Groups, TGICA and experts from the relevant scientific and user communities. The mandate of this Task Group is to enter into a dialogue with the scientific community to work out a joint process for the development of scenarios. In this dialogue the organisational arrangements will be further specified. The Task Group could report back to the IPCC Plenary in May 2007 on the results.
- Adequate arrangements to separate scenario development and assessment responsibilities in terms of both content and expert involvement are required. If strict adherence to this principle were likely to endanger the quality of scenario assessments, it would be wise to relax conditions on separation of scenario development and assessment responsibilities.
- A limited IPCC facilitation role for category 2 scenario development is recommended.
- IPCC could prepare methodological support material for category 3 scenario development.

1 Objectives and organisation

This section summarises the main tasks to be addressed and the organisation of the Task Group on New Emission Scenarios. It also presents an outline of the report.

1.1 Mandate of the Task Group on New Emission Scenarios

Following up on the results of the Expert Meeting on Emission Scenarios in Washington (January 2005) and the Workshop on New Emission Scenarios in Laxenburg (June 2005) the 24th Plenary Session of the IPCC (September 2005) decided to establish a temporary Task Group on New Emission Scenarios (TGNES). The Task Group is asked to formulate a flexible implementation plan for the development and assessment of new emission scenarios to be facilitated and coordinated by the IPCC in preparation of a possible AR5. The TGNES is instructed to deliver the report well before the 25th Plenary Session of the IPCC (April 26-28, 2006). The report of TGNES should be based on a broad consensus among and commitment from scenario builders and scenario users. The composition of the TGNES should reflect the diversity of the global scenario community and a preliminary report should be discussed at an Expert Meeting on New Emission Scenarios[1] in advance of the 25th Session.

The decision of the 24th Plenary Session has been formulated in annex 5 of the Session Report in the following verbatim terms:

> "1. There is a need for new emissions scenarios, to be produced by the scientific community, with facilitation or coordination by the IPCC, to be available well before the completion of a possible AR5.
>
> 2. A Task Group (with a lifetime up to IPCC-25) be set up for the purpose of further defining:
>
> 2.1 The kind of facilitation or coordination that needs to be undertaken by IPCC with the scientific community for development of scenarios.
>
> 2.2 The deliverables of the emission scenarios development process, drawing on the user needs and scenario characteristics as outlined in the Laxenburg Workshop Report in Table I, IPCC-XXIV/INF. 1.
>
> 2.3 The process and timeline that should be followed for the development and use of the new emission scenarios.
>
> 2.4 The organizational arrangements and a timetable for IPCC's own activities related to facilitation or coordination, assessment and use of scenarios in a possible AR5.
>
> 2.5 To consider the possibility of encouraging, but not itself facilitating, a wider family of non-climate scenarios within which emissions scenarios might sit. This could be achieved by having members of the Task Force and participants of its workshop include those experts, for example, in other international organizations such as World Bank and the FAO, who are

[1] This meeting is an Expert Meeting according to the decision of the IPCC Plenary. This means that no specific nominations from governments and organizations have been requested. Nominations made for the Laxenburg Workshop and recommendations from Task Group members have been used in inviting experts.

concerned with characterization of world futures in a wider context than the IPCC."

The formulation of the mandate of the Task Force might suggest an exclusive focus on emission scenarios. It should be understood, that emission scenarios are derived from underlying socio-economic and technological scenarios that are also essential for the assessment of impacts, vulnerability, adaptation and mitigation. For the purpose of this document reference to emissions scenarios should therefore be interpreted as inclusive of the underlying driving scenarios of economic development and technological change.

1.2 Background information on previous IPCC scenario activities

Since its inception in 1988 the IPCC has been involved in scenario development and assessment. In the context of the preparations for the first Assessment Report (1990) one of the tasks of the Response Strategies Working Groups (RSWG) established under Working Group III was to prepare some initial scenarios of possible future greenhouse gas (GHG) emissions for the use by Working Group I in its assessment of future climate change. These so-called SA90 Scenarios comprised a reference scenario up to 2030 based on submissions from 21 countries, on which a Business as Usual scenario was built. Scenarios B, C and D assumed policies that would lead to reduced growth of greenhouse gas emissions.

In the 1992 IPCC Supplementary Report the SA90 scenarios were reviewed and the IS92 Scenarios developed. The six alternative IS92 Scenarios spanned a broad range of possible futures, including an update of the 1990 reference scenario. The IS92 Scenarios were evaluated in the 1994 Special Report keeping in mind four possible purposes for scenarios, (1) input to evaluating the environmental/climatic consequences of "non-intervention"; (2) input to evaluating the environmental/climatic consequences of intervention to reduce GHG emissions; (3) input to examining the feasibility and costs of mitigating GHGs from different regions and sectors; and (4) input to negotiating possible emission reductions for different countries and geographic regions, while noting that the IS92 Scenarios were only designed for purpose 1. The report also made recommendations for future scenario development, in particular it suggested that IPCC or another suitable organisation act as "umbrella" and that such a process emphasizes openness, pluralism, comparability and harmonisation. It was also noted that in order to serve purpose (3) it is important to also assess the costs and benefits of impacts.

In 1996 the Plenary decided that a new set of scenarios would be needed. It agreed that the scenario development would draw upon the expertise of all researchers in the relevant community, and that the scenarios would not assume any additional climate policy initiatives. The set of SRES emissions scenarios that was published in the IPCC Special Report on Emissions Scenarios (2000) is based on an extensive assessment of the literature, six alternative modelling approaches and an "open process" that solicited wide participation and feedback. Four alternative scenario families were developed, characterised by storylines that assume distinctly different directions of future development. They encompass a wide range of key future characteristics and emissions. The SRES were widely used by researchers and projections of the future atmospheric composition and future climate, based on SRES scenarios, were assessed in the IPCC

Third Assessment Report (TAR). Studies analysing mitigation strategies, using SRES as baseline led to "post SRES mitigation scenarios". They were also assessed in the TAR. Assessment of new scenarios literature is also an important task of the IPCC Fourth Assessment Report (AR4).

1.3 Organisation of the Task Group on New Emission Scenarios

The organisation of the Task Group was devised in consultations between the IPCC Chair, the IPCC Bureau and the TSU of WGIII. The TGNES was presided by the co-chairs of WG III (Bert Metz and Ogunlade Davidson) or a designate on behalf of the co-chairs. The TGNES had a member who functioned as secretary to the Task Group and was responsible for formulating and editing the substance of the deliberations and decisions of the TGNES (Jos Bruggink). A deputy secretary assisted the secretary in matters of organisational procedures and practical arrangements (Mary Jean Bürer). The TGNES secretariat worked under the responsibility of the Head of the TSU of WGIII (Leo Meyer) who functioned as liaison between the IPCC WG III co-chairs, the TGNES Secretariat and the IPCC Geneva Bureau. Appendix 1 lists the members of the TGNES. The list was composed with due attention to a broad participation from all scenario user groups and the three IPCC Working Groups. Moreover, an effort was made to broaden membership to representatives of multilateral agencies outside the climate change domain, who are active in global scenario development and use. The TGNES operated primarily through teleconferencing and e-mail communication except for the mandatory Expert Meeting on the final stretch of delivery. The plan of work and time schedule followed is outlined in appendix 2 of the recommendations. The 2nd IPCC expert meeting on New Emission Scenarios was held in Seville, Spain on March 20-22, 2005. The conclusions of the Seville meeting were taken into account in the final recommendations of TGNES. Appendix 4 contains the list of participants of the Seville Expert Meeting.

1.4 Outline of the report

In addressing the items of the mandate TGNES has taken due notice of the results of the Washington Expert Meeting and Laxenburg Workshop. TGNES has also taken into account the comments made during the discussion of the outcomes of the Laxenburg Workshop at the 24th IPCC Plenary Session. Finally, the draft recommendations have been discussed in the Seville Expert Meeting. The chapters of this report correspond to the five tasks mentioned in the mandate, but the presentation in the report follows a different ordering for reasons of clarity. The report first addresses the deliverables of scenario development in relation to user needs (second task of the mandate). Then it addresses the challenge of providing a better linkage between new emission scenario activities and the non-climate oriented scenario-building community (fifth task of the mandate). Because the process, organisation and timeline of scenario activities by the scientific community and IPCC are intrinsically related, the third and fourth tasks of the mandate are discussed jointly in chapter four. Finally, the fifth and last chapter (first task of the mandate) discusses the potential role of IPCC in facilitating or coordinating scenario development.

2 Substance of scenario deliverables and user needs

This chapter summarises and elaborates the results of the Laxenburg Workshop with respect to possible scenario deliverables and user needs. It makes a distinction between three categories of scenarios and discusses how this distinction is related to user needs.

2.1 Scenario characteristics need to address a wide range of user needs

User needs of different user groups
The Laxenburg Workshop devoted much attention to the classification of emission scenarios according to the needs of different user groups (climate modelling, impact, adaptation and vulnerability studies, mitigation analysis, climate change policy making, assessment bodies), using all kinds of criteria such as regional, temporal and sectoral detail, methodological foundations and policy relevance. Appendix 3 summarises the Laxenburg conclusions in this respect. A condensed compilation of user needs would include the following items:

- Climate modelling:
  - To facilitate comparability with earlier scenario sets and diagnosis of climate model development, any new scenario set should include at least one scenario that has the equivalent forcing of a scenario in the previous set (at least as well mixed GHGs are concerned).
  - A small number of runs must cover the plausible range, yet be sufficiently different to yield distinguishable outcomes.
  - The representation of reactive gases, local air pollutants and land-cover change, including their geographic distribution, needs to be improved, compared with earlier exercises.

- Impacts, adaptation and vulnerability analysis (IAV):
  - Extended storylines should provide sufficient, qualitative detail to facilitate regional, country and local analysis.
  - Global scenarios should be constructed in such a way that downscaling of major variables and parameters is potentially feasible.
  - A traceable account of how global scenario information is aggregated should be carefully maintained so that the information can be accurately disaggregated for impacts/vulnerability analysis.
  - Climate scenarios constructed from climate models data should include trends in mean, changes in variability and extreme events, and abrupt and irreversible changes.

- Emissions and mitigation analysis
  - Socio-economic scenarios developed for emissions and mitigation analysis should identify coherent sets of drivers of emissions and other factors consistent with the needs for IAV outlined above.

  - The storyline/quantification practice has proven valuable and should be retained in future work. In addition, alternative approaches are to be pursued to capture uncertainty using conditional probability estimates for key drivers to project emissions ranges and distributions.
  - Emissions trajectories should provide full coverage of sources, sectors (including LULUCF), and gases (GHGs, pollutants, aerosols, ozone precursors, etc.) for evaluation by climate models.
  - For analysis at smaller scales, it is highly desirable to have quantitative information on the larger scale scenarios.

- National and International Policy Making and Assessment
  - Scenarios should be limited in number and be comparable with respect to climate change projections, impacts, and mitigation and adaptation policies.
  - Scenarios should be seen as legitimate and have the confidence of a wide geographic range of countries and a broad range of modelling and assessment groups globally.

Consistency between different types of assessment and comparability of scenarios is desirable

From the point of view of assessment needs, consistency between scenarios used for studying climate change, climate change impacts and adaptation and mitigation would facilitate the work. For IPCC assessments this means that a greater degree of consistency in the scenarios used in studies that are assessed would help the respective assessments of the three Working Groups. Important aspects of consistency are:

- The assessments of impacts, adaptation and vulnerability should be consistent with views on the evolution of climate change, which in turn should be consistent with views on emissions trajectories.
- The assessment of emissions should be consistent with views of socio-economic drivers and land-use change and take account of feedbacks from climate change impacts and policies to reduce them.
- Finally, impacts, adaptation and vulnerability are in their turn dependent on those socio-economic drivers and land-use change.

However, the use of common scenarios does not guarantee a consistent outcome, since interpretations of studies and capabilities of models differ significantly. Therefore, other approaches may be needed, such as using integrated assessment models with built-in climate and impacts modules, to help achieve consistency across the various dimensions.

Comparability of scenarios by using common approaches and assumptions is important to get a better idea of the influence of methodology and model sensitivities and uncertainties and is therefore an important characteristic of new emissions scenarios. Comparability of scenarios is of particular importance for the policy making community and assessment bodies.

Three different categories of scenarios

Given the diversity of end users and their needs it may be helpful to distinguish three different categories of scenarios. It should be understood, that the choice of these

categories is based on a simplification of the richness and diversity of scenarios available and desirable. This simplification was necessary in view of the main goal of the TGNES in terms of clarifying the possible role of IPCC in the development, assessment and use of scenarios. The categories distinguished are:

- Category 1: long-term, global emission scenarios (time horizon of 100 years and more) for a limited number of regions and sectors based on a few story lines with appropriate reflection of socio-economic drivers in order to assess the impacts on the climate system of possible emission trajectories and the possible adaptation and mitigation requirements;
- Category 2: short-to-mid-term global emission scenarios (generally 20-40 years ahead) for a larger number of regions and sectors than for category 1 scenarios, usually based on reference or "best-guess" scenarios with appropriate sensitivity analysis or probabilistic assessments for major drivers and parameters. These scenarios should reflect historical trends and, if possible, future transitions and they should incorporate developing country dynamics properly. Category 2 scenarios may be based also on storylines. They should be connectable with the long-term scenarios of category 1;
- Category 3: short-to-mid-term emission scenarios (up to 50 years ahead) for specific regions or nations with considerable detail, which would primarily have a regional or national function in terms of climate change policy development and evaluation (both mitigation and adaptation); these scenarios would preferably be consistent with the scenarios described under category 1 and 2.

There is only a weak link between geographical and time scales and the indicated time scales for each category of scenarios must be interpreted as reflecting general tendencies. A further discussion of time scales can be found in section 2.2 below.

2.2 Characteristics of long-term, global scenarios

User needs, regional and sectoral detail and downscaling

Category 1 scenarios describe the range of potential emission trajectories both without mitigation policies and for a number of intervention cases (e.g. stabilisation levels). Although in principle, such scenarios should contain sufficient socio-economic detail to allow use in IAV studies in addition to mitigation studies, this may be difficult to achieve in practice, because IAV studies generally require sub regional detail. For instance, while in mitigation studies population volumes are often more relevant, in adaptation studies population distributions can sometimes be more important. This is why the involvement of users from different scientific communities is needed when defining the socio-economic detail that could be most optimal for both kinds of studies. In any case, inputs and outputs should include information that allows downscaling to lower temporal and regional levels in order to harmonise category 1 with category 2 or 3 scenarios and to preserve consistency across scales. Providing guidance material on interpreting storylines and results on the sub regional scale could enhance such harmonisation encouraging the further development of derivative regional scenarios that extend to longer time horizons. It is equally important to have regional experts involved in choosing assumptions, in order to make sure the scenario exercise is sufficiently rooted within regional realities.

Moreover, the discussion of scenario outcomes with regional experts would help to strengthen their usefulness. In this respect, lessons learned in on-going scenario exercises in multilateral institutions not dealing exclusively with climate change should be taken aboard (see chapter 3). To allow the use of these scenarios for policy purposes in the short- to medium term and to facilitate smooth transitions with category 2 scenarios, the resolution of these scenarios in terms of the number of regions and sectors distinguished may vary over time.

Treatment of climate change feedbacks
Emission scenarios are dependent on the evolution of socio-economic conditions, but also on climate and climate change impacts through various forms of feedback. Such feedback mechanisms are very important in generating stabilisation scenarios defined to meet a specific target of atmospheric greenhouse gas concentration or global climate change. Although inclusion of the full feedback from climate change on emission trajectories is very difficult to achieve, as part of the proposed development of new scenarios, to some extent the feedbacks can be covered. As a minimum, models used to generate long-term emission scenarios should take into account physical and biogeochemical feedbacks from climate change impacts on land use and economic development with the help of simplified models of the climate system. A better integration of feedbacks can be realised if analyses with Earth System Models of Intermediate Complexity (EMIC) and IAV studies are started in parallel with development of socio-economic and emission scenarios. These issues will be further discussed in chapter 4.

Treatment of socio-economic feedbacks of response actions
Apart from the physical feedbacks related to climate change, there are important feedbacks in the domain of economic development trajectories. Such feedbacks have to do with the implications of adaptation and mitigation measures in response to climate change. The importance of such feedbacks can be inferred from on-going discussions on the impacts of climate change policy costs and benefits and economic growth perspectives and international trade. Such feedbacks should receive more attention in long-term, global scenarios than was the case in the past.

Choice of time horizon
With respect to the long-term time frame, global scenarios with a time horizon of 100 years and more must be viewed essential. In particular for stabilisation scenarios and for evaluation of impacts with great inertia such sea level rise and melting of polar ice caps much longer time horizons are necessary. However, for socio-economic developments a time horizon of 2100 already poses a substantial challenge. Given the difficulties inherent in delineating quantitative socio-economic key drivers for periods past a few decades, it is probably wise to aim for some form of extrapolation of emission trajectories beyond 2100 that are not directly driven by socio-economic key drivers and for which no regional and sectoral details are provided.

2.3 Characteristics of short-to-midterm global scenarios

Single or multiple baselines
Category 2 emission scenarios (generally 20-40 years ahead) can use either a single baseline scenario to which a number of variants are added or a set of contrasting scenarios or multiple baselines as is the case for category 1. Regional detail should be consistent with actual developments in specific regions. Historical trends are therefore very important for these short to mid-term scenarios. The IEA World Energy Outlook scenarios are a typical example of category 2 scenarios. The choice between single and multiple baselines depends on the perceived degree of structural uncertainty and inertia in socio-economic systems over the long run.

Policy interventions must be included
Category 2 scenarios form a main tool for mitigation and adaptation policy studies and that is why policy cases should be included. For category 2 scenarios a careful and detailed translation of storylines into socio-economic drivers is a prerequisite for developing useful policy cases, because the impacts of policies must be distinguishable from exogenous forces.

Using a single baseline may have advantages
The use of a single baseline is not necessarily equivalent with assuming that such a single baseline is the "best-guess" scenario. A single baseline may also be used as a reference scenario reflecting a continuation of present policies and trends. A reference scenario is not necessarily a "best guess" scenario, but it can function as an early-warning signal for policy makers or as a point of departure for exploring alternative strategies of mitigation or adaptation.

2.4 Characteristics of short term to mid-term regional and national scenarios

Category 3 emission scenarios (generally up to 50 years ahead) are produced mainly for national use. Many industrial countries are using them for purposes of evaluating policy responses to climate change and developing countries have begun to do the same. It is important that such scenarios can profit from the results of category 1 and 2 scenarios in terms of content and methodology.

2.5 Key substantive issues to be addressed

During the process of developing the recommendations many questions of substantive importance for the construction of long-term, global scenarios (category 1) came up repeatedly. The present mandate and timeframe for TGNES, however, is focussed on guiding the Panel in arriving at a decision on the process and timeline of scenario development, assessment and use. These issues should therefore be addressed during the preparatory phase of new emission scenario activities in meetings between appropriate experts and scenario developers. Such meetings should involve scenario developers and users in addition to wide representation from the non-climate change scenario building community. Some key issues that have come up during the formulation of the present recommendations and that should be addressed specifically in the preparatory stage are the following:

- There is an on-going debate on the proper methodologies and adequacy of information for modelling long-term economic development. This debate does not only concern the kind of metric to be used for measuring economic growth or the range of economic growth rates to be considered, but also the role of international trade and finance, the conditions and likelihood of convergent growth between nations, the character and direction of endogenous technological change and the design of sustainable development paths. Irrespective of the ultimate consequences of this debate for the global level of greenhouse gas emissions, any future global scenario development process should seek to develop a transparent modelling approach while using the most up-to-date insights in crucial economic processes and parameters. It should also acknowledge when existing data and methods are unable to do a good job of providing otherwise desirable information.
- The scenario development approach followed by SRES and based on a deterministic set of scenarios and storylines could be supplemented by different approaches such as those based on probabilistic methods. The balance of benefits and weaknesses of different approaches could perhaps be improved by a hybrid approach. User communities value both the use of narrative approaches (storylines) and the use of probabilistic approaches. Storylines can help to choose coherent assumptions about important variables and to explore futures that are very different in their socio-economic evolution. However, storylines do not always result in consistent quantitative choices or outcomes for key variables by the modelling community, so their use is inherently subjective and does not guarantee consistency. Probabilistic methods would help to provide users with an understanding the uncertainties involved in scenarios, but they also involve subjective choices. However, because scenarios depend fundamentally on assumptions or expert judgement concerning important factors, it is impossible to devise objective means to associate probabilities with scenarios or families of scenarios. As concluded during the Washington Expert Meeting, it would be desirable to continue to pursue ways to combine these approaches to benefit from their differing perspectives.
- The issue of maintaining inter-scale consistency is considered crucial for effective scenario use. Scenarios with a long time scale and global coverage cannot be viewed in isolation from scenario activities at the regional and national scale and with a shorter time scale. For instance, if story lines are developed for the global level, consideration should be given to their applicability at lower temporal and geographical resolutions. Similarly, key quantitative drivers like demographic and economic development should be specified in such a way, that they can be readily disaggregated at least at the regional level and to some extent at the national level. The issue of inter-scale consistency and linkage has proved to be a crucial aspect of recently finished and on-going global, long-term scenario studies such as the MA, GEO4 and GECAFS. Issues of scaling and connection are also relevant when considering the inclusion of such existing scenario exercises in future global scenario developments.

3 Lessons from and linkages with the non-climate change scenario community

This section indicates that it is important to incorporate the lessons and experience from scenario exercises based on other perspectives than climate into new scenario activities. These include scenarios on (macro) economic, social, environmental and technological global developments. These scenarios vary in terms of time frames, geographic coverage, and use of single or multiple baselines. As such, they are not limited to any single category as defined in 2.1. Some recommendations on actions to facilitate drawing lessons from and improving linkages with these other activities are suggested.

3.1 Need for linkages between emission scenarios and other scenarios

The need to position emission scenarios into a much broader set of scenarios including general sustainable development issues is widely felt in the climate change community and has now been included in the requirements for new scenarios as outlined in the mandate for TGNES. The obvious link between climate change problems and (sustainable) development paths has often been mentioned and past controversies on the use of the SRES scenarios are often related to socio-economic drivers and metrics. Related to this is the need to include more experts from the wider community of non-climate oriented experts and experts from developing countries into IPCC related development and assessment teams. The IPCC Washington Expert Meeting and Laxenburg Workshop explicitly addressed some of these issues, but did not come up with any clear recommendations.

3.2 Actions to be taken to improve linkages

The following actions are recommended:

- Undertake an inventory of scenario activities extending the efforts of AR4 to also include other scenarios looking at the development issues mentioned above.
- Draw lessons on both process and content, particularly their relevance for meeting users' needs, including providing basic elements of new scenarios; and
- Encourage groups/experts from these other scenario exercises to be involved in the development of new scenarios.

A key recommendation is, that the above activities should be undertaken as part of the preparatory phase and should include an interagency meeting, involving, as appropriate, representatives of organizations from e.g. World Bank, FAO, OECD, IEA, UNEP. At such a meeting, scenario development procedures, methodology and content could be discussed. In chapter 5, it is indicated that this work could be taken up under the mandate of a new IPCC Task group.

Past and on-going scenario activities that may be relevant in this respect include:

- global and sub-global scenarios of the Millennium Ecosystem Assessment;
- global, regional, and national scenarios developed as part of the UNEP-GEO process (e.g. GEO3, GEO4, LAC2, AEO2, etc.);

- scenarios being developed in the Global Environmental Change and Food Systems project;
- scenarios being developed as part of the International Assessment of Agricultural Science and Technology for Development;
- scenarios developed in EU projects (e.g. Advanced Terrestrial Ecosystem Analysis, VLEEM, etc.);
- scenarios developed as part of the Arctic Council - Arctic Climate Impact Assessment;
- IEA/OECD World Energy Outlooks;
- scenarios of the World Energy Council;
- scenarios developed as part of the OECD Environmental Outlooks and activities of the OECD International Futures Programme;
- scenarios developed as part of the World Bank Prospects for the Global Economy reports;
- scenarios developed by the Food and Agricultural Organization (e.g. AT2030); and
- scenarios/forecasts developed by the UN Population Division.

In the inventory of these and other scenario activities, it is important to consider both process and content issues. Topics that could be documented may include process issues, such as:

- coordination;
- funding;
- involvement of institutions and experts from developing countries and countries with economies-in-transition;
- linkages between and across geographic scales (e.g. inclusion of regional perspectives in global scenarios).

The content issues should contain:

- issue focus (e.g. climate, water, land use, etc.);
- regional, temporal, and sectoral scope and resolution/level of disaggregation;
- incorporation of linkages between and across geographic scales, e.g. inclusion of regional perspectives in global scenarios;
- inclusion and nature of surprise elements;
- treatment of uncertainty within individual scenarios
- narrative elements – storylines, perspectives, range of stories developed;
- quantitative elements - types of quantitative models used, parameters and variables quantified, exogenous assumptions vis a vis endogenous calculations, and range of outcomes produced.

4 Process and timeline for scenario development and assessment

This section discusses issues having to do with planning of the scenario development and assessment process. It does so independent of the question of the precise role of IPCC in process of development and use, which is discussed in the next chapter. Issues addressed here concern the need for a formal assessment step and the need for better integration between different types of climate change studies.

4.1 Focus on category 1 scenarios

In describing the possible process and timeline for developing and assessing scenarios the focus will be on category 1 scenarios, because the availability and consistency of this category of scenarios is of major importance. Category 2 scenarios are already developed and sponsored by independent, non-climate oriented multilateral organisations, multinational companies and research institutes. The process and timeline of such scenarios are not likely to be primarily determined by the needs of the climate change analysis community. Nevertheless, their results and approaches can be adopted if useful and lessons learned should be incorporated. With respect to category 3 scenarios the development is so location specific that no need for coordinated development exists, although assistance to local developers to provide methodological guidance would be useful.

4.2 Provide assessed scenarios well ahead of a possible AR5

During the Laxenburg Workshop it was generally acknowledged that new scenarios should be available in time for studies dependent upon them, to be assessed in the context of a possible IPCC AR5. This would allow studies to use comparable scenarios, which greatly assists in the assessment tasks. This requires a realistic planning schedule for scenario development and assessment. A major point regarding the timeline is what kind of IPCC assessment of new emission scenarios is needed in advance of a possible AR5. Many experts in the scenarios user community stressed the importance of an IPCC assessment of new scenarios so that those scenarios could be used in later studies and assessments. A formal IPCC assessment procedure would help to support the acceptability and transparency of new scenarios, but would require a minimum of 1.5 years for completion. This is the minimum period for an IPCC Special Report. However in this case it is considered realistic, because it is assumed that preparations for the Special Report (author selection, planning) would start ahead of this 1.5-year period allowing an efficient process. It should be stressed here, that the added value of a Special Report as suggested in the following paragraphs exceeds its significance for use in new scenario studies in preparation of a possible AR5.The policy making community could benefit from an earlier available assessment focussed specifically on integrated scenario analysis.

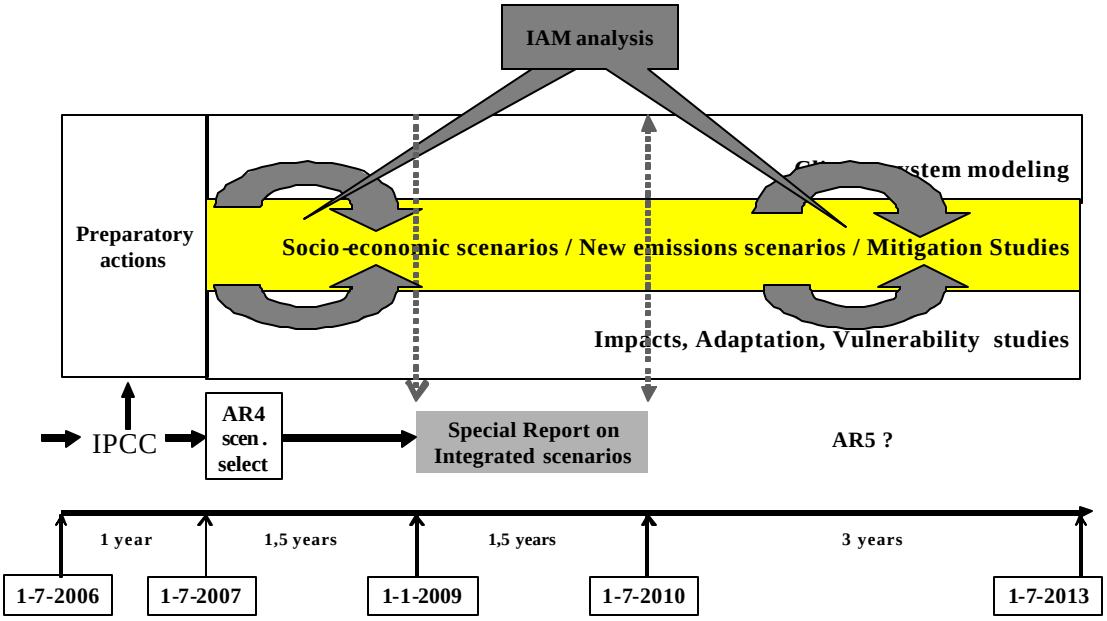
4.3 Undertake an integrated scenario development and assessment process

Improving integration between the main types of climate change studies
A key recommendation of the TGNES is to broaden the scope of scenario development and use activities in several important respects compared to past practice. There is a clear need to integrate climate system feedbacks at an early stage within IAV and mitigation studies and not wait until the results of GCM model runs become available. In recognition of time lag limitations and the need for integration, research groups have developed integrated assessment model frameworks. These models contain socio-economic drivers, emission projections, and simplified climate models. These models can be run quickly to produce climate inputs for IAV analyses and for exploring climate feedbacks to socio-economic evolution and emissions. There is also a need to facilitate a more rapid exchange and linkage of information between different types of independent model-based assessments. With respect to issues of downscaling scenarios to smaller scales as has been discussed in chapter 2 on user needs, there are still considerably methodological bottlenecks to be solved and such results are unlikely to be available ahead of the Special Report and are more likely to be available for a possible AR5.

Select benchmark emission trajectories from AR4 for climate change studies
Another key recommendation concerns the possibility of utilising the results of all Working Groups reports in AR4 for selecting benchmark emission trajectories to be used at an early stage for GCM studies. New GCM runs should be based on a sufficiently wide range of scenarios (including diverse patterns of forcing over space and time), to explore the non-linearities of the response and the effects of aerosols and land use change, but they do not use the details of the underlying socio-economic scenarios. IAV studies need the non-climate features of emission scenarios relating to demographical, economical and technological developments, in addition to the consequences for the climate system of emission scenarios as calculated in GCM studies or simplified climate models calibrated to these GCMs. It is recommended to have a Technical Paper summarising the AR4 results, or, alternatively, an additional IPCC expert meeting considering those AR4 outputs (see section 5.3).

Explore linkages with broader scenario developing community
Finally, another way of improving integration within the scenario development community is to explore opportunities for linkages with a broader community of scenario developers outside the climate change domain that could lead to improved efficiency and quality through mutual learning both in terms of content and in terms of process (see chapter 3).

Figure 4.1 Integrated process and timeline for scenario activities



List of tasks and actions

In principle the following tasks are relevant:

- Task 1/ **Preparatory actions**:
  - Formulate a wish list of desirable and feasible global scenario characteristics as outcome of an expert meeting with representatives from the scenario development and scenario users communities. Discuss wish list with Special Report in mind;
  - Mobilise the scenario building community to become involved in a next round of global scenario development and reflect on the financial resource implications of coordinated action (see section 4.4);
  - Make an inventory of experiences from other scenario processes and explore opportunities for improving inter-scale consistency and communication across different categories of scenarios;
  - Organise an interagency expert meeting to explore potential for mutual learning;
  - Initiate steps to design a scoping proposal for a Special Report on Integrated Scenarios;
  - Ensure involvement of developing countries and economies in transition (see section 4.5).

- Task 2/ **Scenario development:**
    - In order to derive benchmark emission trajectories, prepare a Technical Paper summarising the AR4 results, or, alternatively hold an additional IPCC expert meeting to consider those AR4 outputs;
    - Establish better integrated scenario development activities by stimulating interaction among the different domains of climate change studies and use of integrated assessment models;
    - Promote consensus on common storylines, critical drivers, bandwidth of quantitative values and choice of intervention cases, but leave room for scenario developers to provide "modellers choice" cases, based on their own judgement to avoid the potential drawbacks of considering a limited, common set of scenarios;
    - Discuss transparency requirements for the scenario development process related inter alia to the availability of data and accessibility of model codes;
    - Stimulate understanding and consensus building where possible on key issues of methodology and modelling such as sustainable development paths and probabilistic versus storyline approaches;
    - Facilitate the scientific dialogue between developers and users of category 1 and 2 scenarios;
    - Develop common formats for reporting inputs and outputs in category 1 and 2 scenarios; and
    - Develop scenarios in line with mutually agreed upon user needs and wish lists.
- Task 3/**Scenario assessment:**
    - Assess category 1, 2 and 3 scenarios in the light of stated user needs and preferences leading to the publication of a Special Report on Integrated Scenarios. The outputs from IAV and mitigation analyses of importance, as feedbacks to emissions and climate, could also be assessed. In addition, socio-economic and technological drivers consistent with given emission scenarios should be evaluated with a view on their application in IAV and mitigation analyses. After completion of the assessment of scenarios, a comparison could be made with the range of emission trajectories used initially in GCM models to evaluate their coverage and need for additional model runs.
- Task 4/**Scenario application**:
    - Use the scenarios assessed by IPCC in step 3 in new scenario applications by research groups from the climate change system, IAV and mitigation domain as well as the broader climate change policy community.
- Task 5/**Possible AR5 assessment:**
    - The IPCC standard assessment procedure is followed for all climate change studies using scenarios with emphasis on those using scenarios assessed by IPCC as having a preferred status in terms of consistency, comparability and other user requirements.

4.4 Invite the scientific community to participate at an early stage

Clearly, the success of scenario development, assessment and use of global scenarios would ultimately depend on the willingness, ability and resources of research groups throughout the world to embark on global scenario development studies fairly soon. In this respect, an early exploration of interested parties and teams would be helpful. It is recommended to extend an open invitation to potential partners and not select particular groups. It will be important to stress and guarantee open access to any follow-up scenario development, so as to inhibit a closed-shop image or reality. Also, the financial implications for scenario development groups that want to participate in this exercise need to be addressed at an early stage in order to secure broad participation. It is recommended that formal invitations to participate in the preparatory phase of scenario development may be useful for scenario groups who could possibly use such a formal invitation to secure sufficient funding.

4.5 Improve participation of developing countries and economies in transition

The involvement of sufficient experts from developing countries and economies in transition poses a challenge when compared to the traditionally strong participation of experts from developed countries. In terms of future additions to emissions and in terms of present and future vulnerability the developing world plays a pivotal role, yet the general feeling is that they are underrepresented in scenario development and assessment circles. It is likely that the organisations able to launch large-scale global scenario activities are located in developed countries although they often have close ties to scenario experts in developing countries. The Laxenburg workshop noted this weakness of the B option for scenario development and assessment (as opposed to the C option), but indicated that this weakness could be addressed by providing financial support for experts and organisations from developing countries. The TGNES recommends the following parallel actions beginning in the preparatory phase and beyond to deal with this problem:

- Facilitate the participation of experts and organisations from developing countries and economies in transition in scenario development through twinning arrangements and fellowships inter alia in the framework of existing programmes;
- Involve experts and organisations from developing countries and economies in transition in IPCC expert meetings and secure funding through IPCC for travel and invite individual experts from those countries when deciding upon major methodological and substantive issues;
- Rely on experts already involved in national communications activities in developing countries and economies in transition;
- Seek to promote capacity building and retention in scenario development and use by flagging existing needs to multilateral organisations with the appropriate mandate in this respect;
- Improving the accessibility of data and methods of scenario activities undertaken elsewhere.

5 Role of IPCC and options for facilitation and coordination

This chapter presents a proposal on the role of IPCC with regard to the facilitation and coordination of emission scenario development. It is pointed out that IPCC involvement should be different for each category of scenario activities. Recommendations regarding the role of IPCC and corresponding actions are formulated in the form of three basic options characterised by an increasing degree of involvement.

5.1 Different degrees of IPCC involvement in scenario development

With respect to the active involvement of IPCC, the Laxenburg Workshop discussed the merits and weaknesses of four different modalities of operation for IPCC in coordinating and facilitating scenario development with an increasing degree of IPCC involvement. The verbatim formulation of these four modalities was as follows:

- "A: IPCC completes assessment of the available literature on scenarios only
- B1 IPCC identifies a "Wish list" of issues that need to be included in the input and/or output of scenarios; subsequently, independent modellers develop scenarios; these scenarios are assessed by IPCC.
- B2: IPCC coordinates a process where common narratives and input and output parameters are jointly produced by scenario/ modelling groups; results are produced independently.
- C: IPCC develops new scenarios under full IPCC control and produces an 'IPCC product' ('SRES +')."

The general consensus in the Laxenburg Workshop tended towards option B with different opinions with regard to sub options 1 or 2. In the following sections the modalities for option B will be presented in further detail.

5.2 Possible IPCC activities related to scenario assessment and development

IPCC involvement related to scenarios can in principle focus on the following types of activities, in accordance with the principles, rules and procedures of IPCC:

- Producing comprehensive Assessment Reports including research related to scenarios based on a full scientific and technical assessment and prepared according to IPCC procedures;
- Producing a Special Report on integrated scenarios prepared according to IPCC procedures;
- Facilitating communication among scenario developers and users through workshops and expert meetings and distributing resulting reports (type(i) Supporting Material);
- Providing Supporting Material (type(ii)) commissioned by IPCC Working Groups in support of the assessment process and which the IPCC Panel designates for wider distribution;
- Supporting the research, policy and assessment community by forming Task Groups that have specific mandates, responsibilities and work programmes.

The role of IPCC with respect to emission scenarios has essentially two distinct elements:

- To assess the scientific quality of emission scenarios developed by independent researchers and published in the open literature;
- To facilitate or coordinate the development of emission scenarios.

There is general agreement that IPCC will be responsible for the assessment of new emission scenarios through a Special Report, as outlined in chapter 4. But on the degree to which IPCC would be involved in facilitating and coordinating scenario development there are different opinions.

5.3 Defining facilitation and coordination

What is facilitation and coordination?

In this report the word "facilitation" is used for activities in support of the development of new scenarios, such as helping to identify user needs and requirements (a wish list), identifying benchmark scenarios from AR4, organising expert meetings, and helping to bring funding agencies into the discussion on resources for scenario development groups. "Coordination" is used for activities involved in the actual process of developing the scenarios, such as encouraging common assumptions by participating scenario and modelling groups on the number and character of qualitative storylines and assumptions on key drivers for emissions and the bandwidth of quantitative values, etc., in the interest of getting comparable and consistent results of scenario quantifications. It should be stressed that this coordinating role does not imply decision-making authority. It would be a truly coordinating role, where consensus building amongst scenario developers and scenario users is the envisaged mechanism.

What is a wish list?

There is general agreement that IPCC would specify desirable scenario features for the scenarios to be developed by the scenario community, based on the needs of user communities and taking into account the capabilities of scenario development and modelling tools. This is referred to in chapter 4 as the construction of a "wish list". Such a list could be produced through an IPCC expert meeting involving scenario development and user communities. Such a list could include agreements on the following points:

- coverage of emissions (greenhouse gases, aerosols),
- coverage of sectors (number and sector boundaries, including land use change and forestry),
- coverage of driving factors and their dynamics (population, economic development, technology),
- guidance on the level of disaggregation and on downscaling methods for use of scenario results elsewhere (e.g. in IAV analyses), and
- ways to include climate feedbacks in the development of emission scenarios.

Identifying benchmark emission trajectories from AR4

There is general agreement for IPCC to undertake the identification of appropriate emission trajectories as input into the integrated scenario development process as described in chapter 4. This identification would be based on the outcomes of the AR4

and to make the results usable for the climate modelling community, it is recommend having a Technical Paper summarising the AR4 results, or alternatively an additional IPCC expert meeting considering those AR4 outputs. A Technical Paper can provide more detail than the assessment reports themselves. It also provides a selection process with more standing, transparency and credibility. However, disadvantages of a Technical Paper are the additional time and resource requirements and the lack of flexibility to consider issues that may be important for the GCM modellers.

5.4 Three options for IPCC involvement in category 1 scenario development

Three different options for IPCC involvement

Regarding the role of IPCC in the development of scenarios three options were identified, in addition to organising an expert meeting to produce a "wish list":

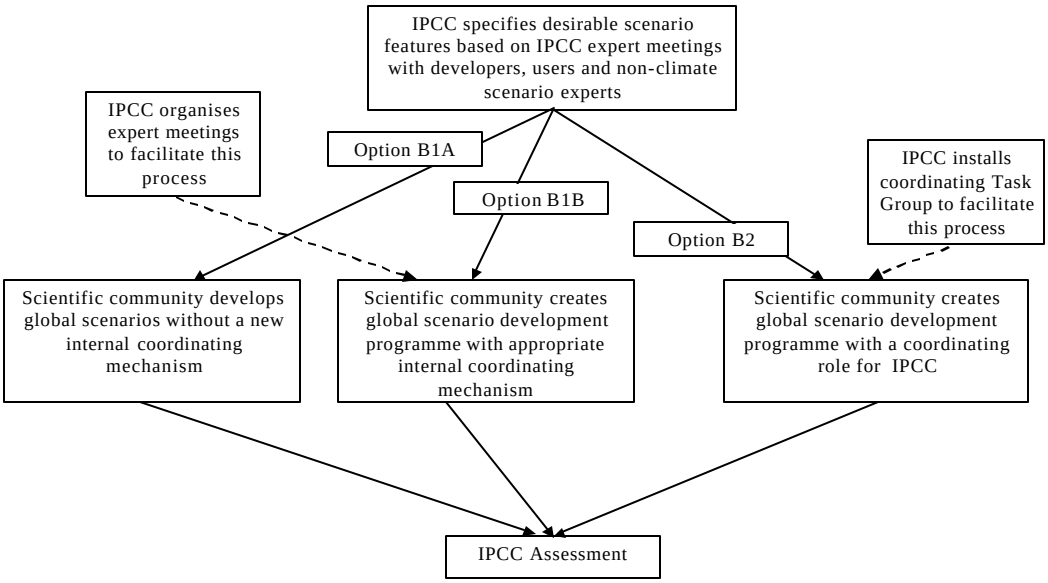
- B1A: Development will be left to the scientific community (may or may not self-organise).
- B1B: IPCC will be involved in facilitating the establishment of a coordinating mechanism from within the scientific community. A possible candidate for such a coordination role would be a joint arrangement between the international scientific coordination programmes WCRP, IGBP and IHDP. Whether the required arrangement could be achieved within the timeframe specified in this report needs to be further explored. An alternative could be an ad-hoc consortium of key institutes, with arrangements to ensure transparency and openness.
- B2: IPCC provides coordination of scenario development.

The various options for IPCC involvement are depicted in figure 5.1 below.

How would IPCC perform its role?

It is recommended that the involvement of IPCC in facilitation and/or coordination of scenario development would be implemented through a new IPCC Task Group, in which scientific experts could be included from the scenario development and user communities. This would give the best guarantee that there is a strong involvement of all IPCC Working Groups and the Task Group on data and scenario support for Impact and Climate change Analysis (TGICA) and that there is adequate representation from the scientific community and scenario user groups. Of course, for the production of a Special Report on Integrated Scenarios, the regular IPCC procedures apply. It is recommended to set in motion the process for determining the terms of reference for the SR during the preparatory stage, so that these terms of reference could be taken into account in the scenario development process, including the formulation of the so called "wish list".

Figure 5.1 Options for IPCC involvement in the scenario development process



5.5 Pros and cons of the suggested options

In comparing the various options the TGNES has considered several aspects that are important for an effective and efficient process. They will be briefly discussed below.

Integration of the scenario development process
The envisaged development of integrated scenarios as described in chapter 4 implies a strong collaboration of experts from the climate modelling, IAV, mitigation and scenario community. Such a process would benefit from an additional coordinating mechanism (as in B1B or B2).

Consistency and comparability
During the Laxenburg Workshop and the subsequent IPCC Plenary discussions the importance to the user community of global scenarios that are internally consistent and mutually comparable has been stressed. Such scenarios assist exploring possible futures in a research and policy context. This is clearly indicated by the wide use of the IPCC SRES scenarios over the past 5 years. The availability of consistent and comparable scenarios could be expected to assist the assessment process of a possible AR5 considerably. A higher degree of coordination (as in B1B or B2) would be an advantage in this respect.

Integration with non-climate scenarios
Integration of experiences and results from non-climate global scenarios with the new integrated scenarios (as described and recommended in chapter 3) would benefit from an additional coordinating mechanism (as in B1B or B2).

Resource implications
The integrated scenario development process would require large resources from the scenario and modelling community. An additional coordinating mechanism (either B1B or B2) would require additional funding and, more importantly, would imply additional time that scenario groups would have to spend on coming to agreement on a number of common assumptions. On the other hand, having either IPCC (in B2) or the scientific community (in B1B) involved in a coordinating role might make it easier for scenario groups to mobilise the required funding and the coordinating organisations might be able to facilitate fundraising.

IPCC independence as an assessment body
In case IPCC would be performing the coordination function for the scenario development process (B2), this could be seen as potentially conflicting with its assessment role, although provisions could be made to strictly separate the coordination work from the assessment work. The B1A option in this respect would provide the clearest separation between assessment and development, since there would be no involvement of IPCC other than the wish list production and the benchmark selection.

Developing country and EIT participation
Involvement of developing country and EIT experts and organisations is recommended to be a crucial aspect of a new scenario development process, as described in chapter 4. This involves capacity building in various ways, which for other things than the process organisation (e.g. additional resources) is important. In terms of the options for the organisation of the process, options B1B or B2 are considered to have a better chance of reaching the objective of developing country participation because of the convening power of coordinating organisations. IPCC's coordinating role is considered to be stronger in this respect (B2).

Timely delivery
Setting up a coordinating mechanism through the scientific community (B1B) might require some time. The other options are easier to implement.

Transparency
Involving IPCC in the coordination process will increase transparency.

Overall, a large majority of participants to the Seville expert meeting favoured an additional coordination mechanism (either B1B or B2). However, some participants questioned the value and need for such additional coordination and preferred option B1A.

5.6 Allow more time to design best possible organisational arrangement

A key TGNES recommendation is not to take a decision on the role of IPCC in relation to the development process options now, but to allow more time for a thorough discussion of the best possible way to organise the development process. This is particularly important because the proposed integrated scenario development process poses particular challenges to the organisation of the process. To that effect, it is proposed to set up a new IPCC Task Group on scenarios with the mandate to enter into a dialogue with the scientific community (the scientific organisations as well as scenario developers and modellers) to work out a joint process for the development of scenarios. In this dialogue the organisational arrangements will be further specified. The Task Group could report back to the IPCC Plenary in May 2007 on the results.

5.7 Limited IPCC facilitation role for category 2 scenarios

With respect to category 2 emission scenarios (covering a period of 20-40 years) it should be clear that there are already many on-going scenario activities of multilateral and academic scenario groups that are directly relevant for IPCC scenario activities. These studies are being assessed explicitly in the ongoing AR4 process and the lessons learned will be of significant value for future scenario activities in the domain of category 1 and 2 emission scenarios. The results of the Laxenburg Workshop also indicate that there is a demand for improving the relevance of these scenarios for the climate change user community and that consideration should be given to how such scenarios could better meet user needs and requirements, for instance in the area of impacts, adaptation and vulnerability. One or more IPCC initiated expert meetings involving scenario developers and modellers of both the category 1 and 2 climate change and non-climate change community, could help in exploring the potential for mutual learning. The need for IPCC involvement in category 2 scenarios however would be of a different nature than that required for category 1 scenarios and would not exceed a limited facilitation role, for instance, with respect to the level of improving and maintaining consistency across scales and issues. This is also a necessary limitation from a practical point of view: the IPCC capacity would be insufficient to play a more active role.

5.8 IPCC could prepare methodological support for category 3 scenarios

Finally, there has been a discussion on IPCC involvement in category 3 emission scenarios on a much lower temporal and spatial scale, in particular concerning the development and use of climate-change oriented reference and intervention scenarios in developing countries lacking sufficient internal capacity for such efforts. Development and assessment of such scenarios is beyond the IPCC mandate. Perhaps the only appropriate step that IPCC could take is stimulating the provision of guidelines and templates for such activities in particular by providing information on linking such scenarios with methods and data available from regional and global scenario exercises. A database/website may be designed to help in accessing and comparing national scenarios. The TGICA could play a useful role in this regard. Alternatively, a process and organisation similar to the support of methodologies for emission inventories could be followed. Other multilateral organizations could possibly be persuaded to enhance capacity building efforts in this domain.

5.9 Separation of scenario development and assessment responsibilities

With respect to the relation between assessment and development activities, the consensus is to keep those responsibilities separate in terms of both content and expert involvement. This implies in principle, that scenario developers involved in producing new scenarios should not be part of a team of independent assessors and that, vice versa, scenario assessors involved in AR5 assessments should be selected from the broader scenario building and using community and could also involve scientists not involved in modelling. The limited number of global scenario experts may pose some practical constraints in this respect. If strict adherence to this principle is likely to endanger the quality of scenario assessments, it would be wise to relax conditions on separation of scenario development and assessment. In any case, the coordinating lead authors of an IPCC scenario assessment should have no active role in the scenario development process and any lead author team needs to ensure balanced representation in this respect.

Appendix 1 List of TGNES members

MEMBERS OF THE IPCC TASK GROUP ON NEW EMISSION SCENARIOS

Mandated by the 24th Session of IPCC, 26-28 September 2005, Montreal, Canada

Mustafa	Babiker	Arab Planning Institute	Kuwait
Philip	Bagnoli	OECD	France
Igor	Bashmakov	Center for Energy efficiency (CENEF)	Russian Federation
Olivier	Boucher	Hadley Centre	UK
Jos	Bruggink	Energy research Centre of the Netherlands	Netherlands
Mary Jean	Bürer	IPCC -WMO	Switzerland
Eduardo	Calvo	Universidad Nacional Mayor de San Marcos	Peru
Timothy	Carter	Finnish Environment Institute, SYKE	Finland
Renate	Christ	IPCC-WMO	Switzerland
Ogunlade	Davidson (co-chair)	IPCC co-chair WG III (Mitigation of Climate change)	Sierra Leone
Francisco	Delachesnaye	US EPA	USA
Seita	Emori	National Institute for Environmental Studies	Japan
Brian	Fisher	Australian Bureau of Agricultural and Resource Economics	Australia
Brian	Flannery	Exxon Mobil Corporation	USA
Ursula	Fuentes	Ministry of Environment	Germany
Amit	Garg	UNEP-Risoe Centre on Energy, Environment and Sustainable Development	Denmark
Bill	Hare	Greenpeace	Germany
Francis	Ibitoye	Center of Energy Research and Development, Obafemi Awolowo University	Nigeria
Kejun	Jiang	Energy Resource Institute	China
Mikiko	Kainuma	National Institute for Environmental Studies	Japan
Tom	Kram	Netherlands Environmental Assessment Agency	Netherlands
Emilio	La Rovere	Federal University of Rio de Janeiro - COPPE/UFRJ	Brazil
Bert	Metz (co-chair)	IPCC co-chair WG III (Mitigation of Climate change)	Netherlands
Leo	Meyer	IPCC Head Technical Support Unit WG3	Netherlands
Nebosja	Nakicenovic	IIASA and Vienna University of Technology	Austria
Ian	Noble	World Bank	USA
Martin	Parry	Co-chair Working Group II IPCC (Vulnerability and Adaptation)	UK

Walter	Reid	Millennium Ecosystem Assessment, Stanford University	USA
Dale	Rothman	Macaulay Institute	UK
Jean-Pascal	Ypersele, van	Institut d' Astronomie et de Géophysique, Université Louvain - La Neuve	Belgium
Monika	Zurek	Millennium Ecosystem Assessment Scenario Group ESAC/ FAO	Italy

Appendix 2 TGNES time schedule of activities

SCHEDULE OF ACTIVITIES TASK GROUP NEW EMISSION SCENARIOS

- First Teleconference Friday 9 December 2005 in two time slots (based on initial scoping note)
- First draft of TGNES recommendations distributed for written comments by 14 of January 2005
- Second Teleconference Wednesday 25 January 2005 in two time slots (based on first draft of TGNES recommendations and preliminary schedule for Seville Workshop)
- Second draft of TGNES recommendations distributed for written comments by 12 of February 2006
- Third Teleconference Wednesday 22 February 2006 in two time slots (based on second draft of TGNES recommendations and revised schedule for Seville Workshop)
- Final draft of TGNES recommendation distributed for comments by 6 of March 2006
- Final recommendations and programme to participants Seville Workshop by 14 March 2006
- Second IPCC Meeting on New Emission Scenarios, Seville, Spain, 20–22 March 2006
- Drafting of final report of TGNES, 22 March 2006
- Editorial finalisation of TGNES report for IPCC-25
- IPCC 25th session, 26-28 April 2006, Mauritius

Appendix 3 List of requested scenarios (Laxenburg Workshop)

Table I: Summary on requested types of scenarios

Users have requested:	But…
Single baselines	
• Reference scenario + variants; useful for ST, next 25 years • For decision makers increases simplicity	• Does not reflect the range of possible futures in the long term and therefore may be misleading
Multiple baselines	
• For longer term analyses important to capture more of the socio-economic range and wide range of futures • Uncertainty can be better incorporated	• For GCM models no variation in results if range is not large
Storylines (+quantification)	
• Important to increase consistency between emission scenarios and IAV (Impact, adaptation & Vulnerability), particularly for longer time scales	• Transparency in the quantification of underlying driving forces (e.g. GDP, population, policies) is required, especially for decision makers
Baseline scenarios	
• For non-intervention futures and climate risk • Basis for calculating mitigation costs	• Baseline should include all relevant announced policies (e.g. baseline should include Kyoto and other established climate policy), this is difficult
Policy intervention scenarios	
• Distinction between ST mitigation & adaptation and LT stabilization;	• They need to be politically acceptable • Is it useful to have "representative" mitigation or stabilization scenarios?
Short Term (20-30 years)	
• Specific mitigation policy analysis • More policy relevant compared to LT scenarios • Combined with regional and sectoral disaggregation	• Data intensive and needs regular updating • Needs to ensure continuity between ST and LT
Long Term (> 30 years)	
• For understanding issues related to risk, technology development, avoided damage, etc.	• Also relevant to short term policy decisions
Inclusion of more issues, not just GHG emissions	
• Useful for assessment, address more questions. • Important to include LULUCF and air pollution, SD. • May also be developed as building blocks	• Specific questions may not be well addressed. • It may be more difficult to communicate the outcomes o Different audiences
Regionally and sectorally disaggregated	
• Needed for IAV community and policy	• Data and technical resources intensive

makers; e.g. for feedbacks mitigation and adaptation	(especially for DC) • For downscaling and upscaling guidance is needed • "Mappability" into larger regions important
Probabilistic	
• Assessing effects of uncertainties in input on output.	• Difficult if based on expert judgments • Sensitivity analysis would be partial solution

Appendix 4 List of participants (Seville Expert Meeting)

Mrs. Sara Aagesen
Ministerio de Medio Ambiente
Spain

Mr. Aysar Ahmed Al-Tayeb
Environmental Consultant
Saudi Arabia

Mr. Michail Antonovskyi
Institute for Global Climate and Ecology
Russia

Mr. Mustafa Babiker
Arab Planning Institute
Kuwait

Mr. Philip Bagnoli
OECD
France

Mr. Igor Bashmakov
Center for Energy efficiency
Russian Federation

Mr. Brad Bass
Meteorological Service of Canada
Canada

Mr. Gerardo Bazan Navarette
National Autonomous University of Mexico (UNAM)
Mexico

Mr Prithiviraj Booneeady
Mauritius Meteorological Service
Mauritius

Mr. Olivier Boucher
Hadley Center
United Kingdom

Mr. Jos Bruggink
ECN
Netherlands

Mrs. Mary Jean Bürer
IPCC Secretariat
Switzerland

Mr. Eduardo Calvo
Universidad Nacional Mayor de San Marcos
Peru

Mr. Timothy Carter
Finnish Environment Institute (SYKE)
Finland

Mrs. Wenying Chen
Tsinghua University, Beijing
China

Mrs. Renate Christ
IPCC Secretary
Switzerland

Mrs. Laura Cozzi
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