The Mitigation of Climate Change
New Challenges for AR 5

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• Pathways for Mitigating Climate Change
• Technology, Sectors and Infrastructure
• Integrated Risk and Uncertainty Assessment
• Regional Sustainable Development
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The Task of WG III

- Population (Pop)
- Per Capita Production (GDP / Pop)
- Energy Intensity (E / GDP)
- Carbon Intensity (CO₂ / E)
- CO₂ Released (CO₂(A)/CO₂)

**CO₂ Emissions**

**Carbon Cycle**

**Ocean Acidification**

**Impacts**

**Radiative Forcing**

**Climate Change**
Assessing the Solution Space

- Life-Style Change Technologies
  - Per Capita Production (GDP / Pop)
  - Energy Intensity (E / GDP)
  - Carbon Intensity (CO₂ / E)
- Non-Fossil Energy
- CO₂ Capture at Plant (CCS)
  - CO₂ Released (CO₂(A)/CO₂)
- Population
  - Pop
- Energy Intensity
  - E / GDP
- Carbon Intensity
  - CO₂ / E
- CO₂ Emissions
- Carbon Cycle
  - Radiation Management
- Other GHG Emissions
  - Agricultural Practices etc.
- Radiative Forcing
- Climate Change
  - Impacts
  - Adaptation

Radiation Management

Ocean Acidification

Carbon Management
Interaction between WG II and III

- Population
- Per Capita Production
- Energy Intensity
- CO₂ Capture at Plant (CCS)
- Life-Style Change Technologies
- Non-Fossil Energy
- CO₂ Released
- CO₂(A)/CO₂
- CO₂ Emissions
- Carbon Cycle
- Ocean Acidification
- Impacts
- Climate Change
- Adaptation
- 2º/3º/4º Policies
- Agricultural Practices etc.
- Carbon Management
- Radiative Forcing
- Radiation Management
- Other GHG Emissions
- Radiation Management
- 2º/3º/4º Policies
How to Assess the Solution Space?

Identifying Acceptable Portfolios of Options:
• Cost-Benefit Analysis
• Cost-Effectiveness Analysis
• Multi-Criteria Analysis and Sustainability

Exploring Robust Portfolios of Options
• Integrated Risk and Uncertainty Assessment
• Multiple Fat Tail Distributions in the Solution Space
• Scenario Analysis
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Comparison of Scenarios in AR5

Idea for the conceptualization of scenarios which should be integrated in the IPCC scenario process

Baseline and Policy Scenario should be self-consistent
Comparison of Scenarios in AR5

mitigation effort
RCP

uncertainty in policy
2nd best worlds

BAU

high fossil fuel price / little optimism in low carbon energies
coal renaissance
low growth / fragmented world
Malthusian world (non-sustainable population growth)
low fossil fuel price / optimism in low carbon energies
fragmented carbon market
heterogenous
Ex-post clustering of scenarios defines a storyline for each cluster. Clustering is essential to derive policy-relevant messages.
Mitigation and Adaptation

• WG III intends to explore policy costs including the costs of action and non-action.

• Impacts have to be assessed and evaluated for different policy targets.

• Strong interaction between WG II and WG III required.
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• Pathways for Mitigating Climate Change
  - Delay of Participation
  - Limited Availability of Technologies
  - Advanced Carbon Management & Direct Control of Radiative Balance
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Delay of Participation

• Incomplete participation increases the global costs of mitigation.

• Incomplete participation can increase the long-term costs not just for early entrants, but also for late entrants.

• Better understanding of coalition formation with game-theoretic tools might be very helpful.

• Explicit understanding of expectation formation might have a strong impact on the results.
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Limited Availability of Technologies

- All options for 450 ppm-only
- No CCS
- No biomass beyond its use in the baseline
- No renewables beyond its use in the baseline
- No nuclear beyond its use in the baseline
- No CCS, no nuclear beyond its use in the baseline

RECIPE: Model Comparison - Luderer et al. (2009)
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Advanced Carbon Management & Direct Control of Radiative Balance

Schematic representation of various climate-engineering proposals (courtesy B. Matthews).

David W. Keith (Nature, 2001)
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Misleading Assessment of Technologies

For the 450ppm pathway, GHGs have to be reduced by 18 Gt – that corresponds to 95% of technical abatement potential of 19 Gt identified for 2020.
As called for in AR4, the SRREN is an assessment of renewables within the context of mitigation, based on a review and synthesis of scientific literature including:

- Technological feasibility: Reliability and integration
- Economic potential: Competitiveness, costs
- Potential of renewables to reach climate targets
- Social acceptability
- Risks and uncertainty: e.g. unintended side effects
- Financial and policy instruments
Comparing Bottom-up and Top-down Assessments

Relative emission mitigation potential per sector

Dynamic Sectoral Wedges

450 ppm-CO$_2$

Luderer et al. (2009)
Infrastructure: A Bridge into the Future

Infrastructure investment in emerging markets
2008-17 forecast, $trn

- China 9.3
- India 2.8
- Other Asia 2.4
- Middle East 0.9
- Russia 2.2
- Brazil 1.1
- Other 3.1

Total: $21.7trn

Growth in infrastructure demand
2008-17 forecast, %

- Air travel
- Electricity
- Telephones*
- Roads

Sources: Morgan Stanley; Goldman Sachs; The Economist

*Fixed and mobile

Expert Meeting on Human Settlements and Infrastructure

• Infrastructure investments (e.g., BRIC countries have planned $22 trillion in long-term investments for the next decade) will determine future emission pathways, vulnerability of cities and adaptive capacities.

• There has not yet been a comprehensive assessment on the role that urban planning and infrastructure investments can play in adaptation and mitigation.

• An expert workshop - possibly feeding into a Special Report on Human Settlements and Infrastructure - will be held in March/April 2010 with cooperation from WGII and WGIII.
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- Stabilization Targets, Impacts and Costs
- Technology, Sectors and Infrastructure
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Integrated Risk and Uncertainty Assessment

Stakeholders want the *whole range* of scenarios to be assessed.

Risk and uncertainty need to be broadly characterized and must comprise the following elements:

1) Description of the space of possible outcomes

2) Assessment and characterization of outcomes in terms of:
   - Cost
   - Risk profile (e. g. multiple fat tail distributions)
   - Barriers

3) Attachment of likelihoods
Integrated Risk and Uncertainty Assessment

Can a framework be developed for integrating risk and uncertainty assessments that is flexible and qualitative enough to be adopted by all IPCC Working Groups?
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• Possible Structure of AR5
Carbonisation Pathways

Kaya Decomposition: China

Kaya Decomposition: OECD Europe

Kaya Decomposition: India

Kaya Decomposition: USA

Jan Steckel (2009)
Crucial Aspects for AR5

• Integrating adaptation and mitigation as response strategies to climate change

• Identifying adaptive and mitigative capacities at the regional level

• Exploring synergies and trade-offs between M&A and the millennium development goals

• Embedding M&A in sustainable development
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Further Aspects that Need to be Addressed

• Life style changes

• Impacts of CC response strategies on income groups, countries, regions

• Inter- and intragenerational justice of mitigation and adaptation measures (e.g. distribution of mitigation and adaptation costs)
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Policies and Finance

- International Cooperation
- National Policies
- Sub-national Policies (e.g. Infrastructure Planning, Urban Design)
- Linkages between capital market, energy trade and permit markets
- Lessons from the current financial crisis for designing policy instruments
National ETS and International Cooperation

Canada ETS
Max 740 Mt CO$_2$eq
Start: 2010?

US ETS
Max 7,000 Mt CO$_2$eq
Start: ?

RGGI ETS
170 Mt CO$_2$
Started: 2009

EU ETS
2,000 Mt CO$_2$
Started: 2005

Swiss ETS
3 Mt CO$_2$
Started: 2008

South Korea
Max 590 Mt CO$_2$eq
Start: 2013?

Mexico ETS
Max 640 Mt CO$_2$eq
Started: 2012?

Japan ETS
Max 1,400 Mt CO$_2$eq
Start: ?

Midwestern GHG Accord
? Mt CO$_2$eq
Start: ?

WCI ETS
800+ Mt CO$_2$eq
Started: 2012

Tokyo ETS
Max 55 Mt CO$_2$
Started: 2010

Australia ETS
Max 560 Mt CO$_2$eq
Start: 2011?

New Zealand ETS
98 Mt CO$_2$eq
Start: ?

Flachsland (2009)
Policies and Finance

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Outcome of the AR5 Scoping Meeting

I. INTRODUCTION
1. Introductory Chapter

II. FRAMING ISSUES
2. Sustainable Development – Common and Specific Regional Aspects
3. Ethics & Equity & Climate Policy
4. Integrated Risk and Uncertainty Assessment of Climate Policy
5. Economic Analyses of Climate Policy

III. PATHWAYS FOR MITIGATING CLIMATE CHANGE
6. Mitigation Options and Pathways In Context
7. Energy Systems
8. Human Settlements - Transport and Buildings
9. Industry and Waste
10. Agriculture, Forestry and Other Land Use (AFOLU)
11. Transformation Pathways

IV. POLICIES AND INSTITUTIONS
12. International Cooperation, Agreements & Instruments
13. National Policies
14. Sub-national Policies

V. FINANCING TRANSFORMATIONS
15. Regional Development
16. Investment and Finance