WORKING GROUP III CONTRIBUTION TO THE IPCC FIFTH ASSESSMENT REPORT (AR5)

Guidance Note for Authors

MITIGATION OF CLIMATE CHANGE

GUIDANCE NOTE FOR AUTHORS
to the
APPROVED OUTLINE FOR THE WG III CONTRIBUTION TO THE AR5

1. Background & Introduction

The proposed outline for the WG III contribution to the AR5 was prepared during the five day Scoping Meeting in Venice, Italy (13-17 July 2009). Government comments were received and were then incorporated during the 40th session of the Bureau (17-18 September 2009). The outline was approved during the 31st Session of the IPCC (26-29 October 2009) in Bali, Indonesia.

This cover note describes the rationale behind the outline and provides additional information as put forward by the experts that participated in the Scoping Meeting, the government comments received and the subsequent Bureau discussions. In addition, clarifications and supporting comments by governments as highlighted and agreed during the Plenary session have also been included.

In the Fourth Assessment Report (AR4), the core of the description of mitigation options was structured according to the emitting sectors in the short and medium terms. Framing issues accompanied the introduction to the report, and the final section gave an analysis of the literature on international cooperation.

2. WG III AR5 Outline

2.1 Outline Overview

To build on the success of the AR4 and incorporate crucial dynamics across sectors, thereby improving the usefulness of the report to decision makers, the proposed outline for the WG III contribution to the AR5 is comprised of four parts:

Part I: Introduction (Chapter 1)
Part II: Framing Issues (Chapters 2-4)
Part III: Pathways for Mitigating Climate Change (Chapters 5-12)
Part IV: Assessment of Policies, Institutions and Finance (Chapters 13-16)

Following the introduction, Part II deals with several framing issues that lay out methodological foundations and underlying concepts for the detailed assessment of bottom-up and top-down approaches in the subsequent sectoral and cross-sectoral chapters of Part III. Part IV assesses policies on various scales and financing issues.

In comparison with previous assessment reports, there is a need to improve the treatment of the conceptual issues covered in Part II. This is particularly true for the intregated risk and uncertainty assessment of climate change response policies (Chapter 2) and some of the social, economic and ethical concepts and methods presented in Chapter 3. Taken

together, the literature on these issues is too extensive to be covered on an ad-hoc basis within the chapters of Parts III and IV. Therefore, Part II presents these framing issues in a dedicated section as short and concise chapters that clarify important concepts ahead of Part III. The overall length of the report is thereby reduced and its coherence and readability will be improved. To ensure an integrated application of the framing issues presented, the last chapter in Part II (Chapter 4) is dedicated to discuss them in the context of sustainable development.

Part III will provide an integrated assessment of possible transformation pathways and the respective sectoral contributions and implications. This fully integrated, dynamic assessment combines top-down and bottom-up information from the chapter on transformation pathways (chapter 6), the sectoral chapters (Chapter 7-11) and from Chapter 12 (Human Settlements, Infrastructure and Spatial Planning). The Memorandum of Understanding produced as a result of WG III's 'IPCC Expert Meeting on Modeling Renewable Energies: Coherence Between Model Assumptions and Latest Technological Knowledge', that was held within the writing process of the Special Report on Renewable Energy Sources and Climate Change Mitigation, describes a roadmap for integrating bottom-up and top-down perspectives that will be an integral part of the AR5 process.

Part IV assesses policies across all scales. Beginning with international cooperation, it will proceed to the regional, national and sub-national levels. Part IV concludes with a chapter that assesses cross-cutting investment and financing issues.

2.2 General Issues Addressed in the WG III Outline

In close cooperation with WG II, *links with adaptation* will be examined in an integrated assessment. As different stabilization levels imply different adaptation needs and since feasible paths are determined by mitigative and adaptive capacities alike, mitigation and adaptation are interdependent. Due to the different scales at which mitiation and adaptation activities take place, a comparative assessment of these is generally unfeasable. With respect to financial implications, however, both mitigation and adaptation can be addressed jointly which will be covered in Chapter 16 (Cross-cutting Investment and Finance Issues).

Regional differences and commonalities will be addressed throughout the contribution of WG III where relevant. In cooperation with WG II and where possible based on available literature, definitions of geographical regions will be combined with additional information, e.g. on socio-economic regions, in order to enhance regional specification.

The insights from the *Special Report on Renewable Energy Sources and Climate Change Mitigation* (SRREN) will be housed in various parts of the WG III contribution: Renewable energy technologies (including bioenergy) will be covered in Chapter 7 (Energy Systems), bioenergy-issues in terms of land-use aspects will be covered in Chapter 11 (Agriculture, Forestry and Other Land Use), scenarios will be assessed in Chapter 6 (Assessing Transformation Pathways) and related policies will be covered in the policy chapters of Part IV.

Frequently Asked Questions will be introduced in each chapter of Part II, III and IV. Answers to these questions will address policy-relevant aspects of the topics discussed in more detail and will be presented in a separate box that is inserted in the text where appropriate.

In the following, the four parts of the AR5 are presented in more detail with a presentation of chapter-by-chapter content specifics. It should be read in reference with the WG III AR5 Table of Contents.

2.3 Chapter Specifics of the WG III Outline

2.3.1 Part I: Introduction (Chapter 1)

Chapter 1 will provide an introduction to the WG III contribution and set the stage for the subsequent chapters. It will describe the lessons learned from the AR4 and the new challenges the AR5 is facing. The chapter will give a brief overview of historical, current and future GHG emission trends. The section on mitigation challenges will discuss the issues involved in climate change response policies including the ultimate objective of the UNFCCC (Article 2) and the human dimensions of climate change (including sustainable development). Furthermore, stabilization scenarios, including mitigation and adaptation, and low GHG development pathways including system interactions (lock-in, inertia, barriers, risks) will be introduced as well as the implications of long-term perspectives on short-term actions. Mitigation actions will be covered on the global, regional, national and sub-national level including knowledge and technology cooperation, development and transfer, as well as public and private investments & financing. Finally, a roadmap will outline the structure of the report.

2.3.2 Part II: Framing Issues (Chapters 2-4)

As mentioned above, Part II will lay out the methodological foundations and underlying concepts for the detailed assessment of the bottom-up and top-down approaches in the subsequent sectoral and cross-sectoral chapters of Part III and the policy analyses of Part IV. Each chapter will address key overarching issues (Chapter 2: Integrated Risk and Uncertainty Assessment of Climate Change Response Policies; Chapter 3: Social, Economic and Ethical Concepts and Methods; Chapter 4: Sustainable Development and Equity) by way of a thorough assessment of the literature. In this matter, they will provide support for subsequent chapters by acting as reference points where the in-depth discussions of these general issues are located. The last chapter in Part II (Chapter 4) will have an integrative function by assessing the previously presented concepts in the context of sustainable development. All framing chapters are to be short and concise, will be based on peer reviewed literature and avoid any policy prescriptive language. They will explore general themes and provide insights to answer specific questions that are addressed in more detail by the individual chapters.

Chapter 2: Integrated Risk and Uncertainty Assessment of Climate Change Response Policies

Chapter 2 will provide a discussion of the methods used for integrated risk and uncertainty assessments of climate change response policies. Although this issue is a cross-cutting method across working groups (see section 3.1), the basic concept should be laid out in the respective WG contributions as a stand-alone reference, clarifying those aspects that are specific to the individual WG. Therefore, risk and uncertainty has been dedicated its own chapter in the WG III outline, and consistency with WG I and WG II will be inherent to its text.

The chapter will begin with a section on risk perception including psychological and sociological approaches. That is, it will deal with attitudes towards risk, risk communication, ignorance and societal institutions that manage risk. The next section will assess risk and uncertainty in the context of climate change by explaining the scale and nature of the problem, the properties of probability distributions (e.g., thin vs. fat-tailed) and the time scales of learning and response. Then, different types of risk and uncertainty, including the reduction of uncertainty due to learning, will be characterised and various metrics for estimating uncertainty and risk will be introduced. The relationship between the uncertainty categorizations used in AR4 and throughout AR5 will be established. This will be followed by a discussion on managing uncertainty, risk and learning in a policy context, including decision frameworks for the evaluation of policies under uncertainty and an introduction to the principles of insurance and derivative markets including hedging strategies and option values. The section on tools for the analysis of uncertainty and risk will include sensitivity and scenario analyses, expert elicitations and sampling strategies. All concepts, measures, frameworks and tools will be assessed in the context of the scale and nature of climate change and the resulting implications for response policies.

Chapter 3: Social, Economic and Ethical Concepts and Methods

Chapter 3 will explore the interrelations between social, economic and ethical concepts and methods to assess policy choice. Based on peer-reviewed literature the analysis will not derive any ethical recommendations or policy-prescriptive conclusions. Due to the interlinkages between adaptation and mitigation in the economic analysis of climate policy, synergies and tradeoffs need to be identified (in cooperation with WG II) to enable an integrated assessment.

The various socio-economic methods of policy choice will be assessed in the first section, including cost-benefit analysis (CBA), cost-effectivity analysis, other methods of evaluation (e.g. multi-criteria analysis, weighted CBA), treatment of equity, international comparisons of costs and benefits, treatment of discounting, incidence (households and firms), game theory and supra-national agreements, shadow prices and market prices as well as a critique of the economic paradigm, distortions and second-best solutions, and non-price models of consumer behavior. The section on ethical and socio-economic principles will begin with introducing various aspects of ethical reasoning, including consequentialism (i.e. utilitarianism as a broad theory), welfare economics, social choice and ethics. Furthermore, rights-based theories, human rights, climate and other environmental rights and virtue ethics will be included. The third section of the chapter will assess different metrics of costs and benefits including gross domestic product

(GDP), balanced growth equivalent, willingness to pay, willingness to accept, different measures of welfare as well as engineering cost vs. economic cost, social cost of carbon, avoided costs, employment, US dollars per ton. Furthermore, the implications of alternative metrics (global warming potential and other) for the timing of multi-gas abatement options (in cooperation with WG I) and related implications for adaptation (in cooperation with WG II) will be assessed.

The next section will focus on economics, rights and duties, i.e. on the linkages between economic theories and different types of ethical reasoning. This will include theories of economics and income distribution, non-monetary values rights and duties as well as the interrelations of risks, uncertainty and rights. Furthermore, the literature on discounting versus the rights of future generations as well as on tradeoffs and weighing goods will be discussed. This is followed by an assessment of the literature on the concepts of justice, equity and responsibility and their application to climate change, including intra-, inter- and transgenerational as well as compensatory and transitory justice. Then, the economic analysis will be broadened to an assessment of the literature on behavioral economics and culture, which will also address relevant aspects of psychological and sociological approaches. These approaches, however, will be treated primarily under 'Risk Perception' in Chapter 2 (Integrated Risk and Uncertainty Assessment of Climate Change Response Policies).

The section on policy instruments and regulation will assess the literature on economic instruments to address climate change, including the identification of market failures and the need for complementary policies, policy failures, the general principles of insurance markets, mixed economies and the public sector, as well as commonalities and differences between developed and developing economies. While this chapter will assess the general principles of insurance in the literature, its specific applications and implications will be assessed in Chapter 16 (Cross-Cutting Investment and Finance Issues) where applicable. Since the focus will be on principles and mechanisms from an economic perspective, it will be distinct from the assessment of policy instruments covered in Chapter 15 (National and Sub-national Policies and Institutions). The economic analysis of technological change and related uncertainties will look at the history of technical change and evalute the effects of learning by doing. It will assess the process of technological and technical change including the process of research, development and demonstration (from basic science onward), discuss economic incentives for R&D, price-induced technical change, and spillovers as well as the transformational dimensions of technical change and the diffusion of technology and transitions theory. The section will also assess the conceptual differences and the differing representations in models of induced endogenous vis-à-vis exogenous technological change, as this has significant implications on forecasted cost and possible transition pathways.

Political feasibility considerations and non-economic policy options will be assessed in Chapter 15 (National and Sub-national Policies and Institutions). As a framing chapter, Chapter 3 will assess social, economic and ethical concepts and methods and will therefore be distinct from the issue of systems perspective (treated in Chapter 5: Drivers,

Trends and Mitigation) and the integrated analysis of combining top-down and bottom-up approaches (treated in Chapter 6: Assessing Transformation Pathways).

Chapter 4: Sustainable Development and Equity
Chapter 4 will lay out the determinants and drivers of as well as the barriers to sustainable development with regard to climate change, introducing different development and other suitable indicators. The focus of the chapter will be on mitigation and mitigative capacity with respect to sustainable development. That is, development objectives at the national and sub-national level will be analyzed with respect to synergies and tradeoffs between sustainable development and mitigation policies. Because of the interrelatedness of the issues, links to adaptation and adaptive capacity, in particular opportunities, constraints and limits, will be considered in cooperation with WG II. Integrating these two aspects, different possible development pathways will be laid out, considering the beforementioned possible synergies and tradeoffs between development and mitigation objectives. Furthermore, the interrelations between consumption patterns and carbon accounting will be analyzed. The section on the integration of framing issues in the context of sustainable development will revisit the intregated risk and uncertainty assessment of climate change response policies as well as social, economic and ethical concepts and methods discussed in the previous framing chapters. It will link these to sustainable development objectives to provide insights into their specific applicability. The chapter will conclude with a section on the implications for subsequent chapters, providing a discussion on the consistent understanding and use of the different concepts presented. In addition, sustainable development challenges in the face of climate change and the transformational climate policy nexus will be examined.

2.3.3 Part III: Pathways for Mitigating Climate Change (Chapters 5-12)

Part III will provide the integrated assessment of transformation pathways combining top-down and bottom-up perspectives. The top-down assessment will lay out various transformation pathways in order to present a fully integrated, dynamic analysis with input from the sectoral chapters (Chapters 7-11) and Chapter 12 (Human Settlements, Infrastructure and Spatial Planning). Chapter 5 (Drivers, Trends and Mitigation) will prepare the background and context for Part III.

In order to assure consistency in assumptions on mitigation potentials, there will be an iterative process between Chapter 5, Chapter 6, and Chapters 7 through 12, in which relevant information will be exchanged, assessed and fed back for incorporation, see Figure 1. Ideally, data on sectors and technologies would be transferred to the integrated assessment modeling (IAM) community, who would then incorporate this information into their models, reflecting the dynamics across sectors. Model results would be returned to the sector and technology specialists for assessment in an iterative process.

This procedure will clarify differences across chapters and will ideally lead to more convergence, ensuring strong interaction among Chapter 5, Chapter 6, and the sectoral chapters. In practice, this will allow Chapter 6 to utilize precise sectoral numbers and

Chapters 7 through 12 to take the context of transformation scenarios, e.g. the dynamics of sectors, into account when assessing the scenario outcomes. This iterative process will be an added value of the AR5 from AR4. As initiated in WG III's 'IPCC Expert Meeting on Modeling Renewable Energies: Coherence Between Model Assumptions and Latest Technological Knowledge', this iterative process is planned take the form of back-to-back meetings with AR5 lead author meetings.

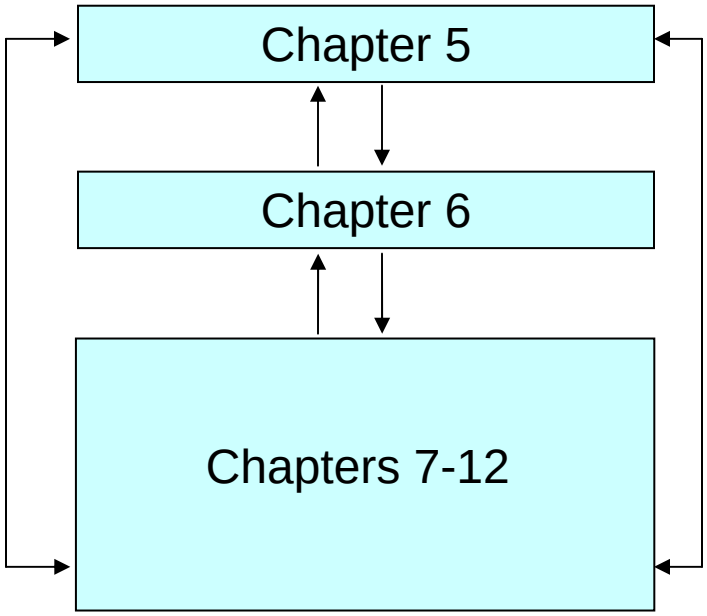

Figure 1: Information exchange within the iterative process of AR5.

The time horizon of analysis is 2020 for the short term, 2030 for the medium term and 2050 and beyond for the long term. A consistent use of the time horizons across Working Groups, in particular with respect to a common understanding in terms of the RCPs, needs to be ensured. The main focus of Part III will be on mitigation, but (in cooperation with WG II) it will also address linkages to adaptation.

Chapter 5: Drivers, Trends and Mitigation

This chapter is intended to provide the context for the subsequent sectoral chapters (7: Energy systems; 8: Transport; 9: Buildings; 10: Industry; and 11: Agriculture, Forestry and Other Land Use) and Chapter 12 Human Settlements, Infrastructure and Spatial Planning. To begin with, global trends in stocks and flows of greenhouse gases (GHGs) and short-lived species, ensuring close cooperation with WG I and WG II, will be discussed. This will include black carbon, new GHGs and other short-lived pollutants and provide a geographical/regional identification of sources. The role of coastal zones and marine ecosystems as carbon sinks will be covered, as well as the different metrics of global warming potentials (GWP) and their effect on costs and implications for mitigation. Then, key drivers of global change, such as water, urbanisation and food production systems will be identified. A section on production, consumption and trade patterns will assess the impacts of life style choices on stocks and flows (mobility patterns, diets, energy and other consumption) alongside the effects of production

patterns and trade (inlcuding emissions from international bunker fuels). The discussion will continue with an assessment of the contributions of technological and behavioural change to mitigation. Here, the contribution of cutting-edge technologies should also be highlighted. 'Co-benefits and trade-offs of mitigation including air pollution' will direct the focus to the links between climate mitigation activities and other environmental objectives such as reduction in local and transboundary air pollution (e.g. the UN Convention on Long-Range Transboundary Air Pollution), benefits to human health and energy security. Health delivery systems will also be covered here.

Geoengineering is discussed under the title 'Carbon and radiation management and other geoengineering options including environmental risks'. Because it is one option in the portfolio of mitigation options, it has been included as a component of one chapter - rather than its own chapter. This will ensure that it is treated in an even balance across technologies, e.g. in cost comparisons and other relevant analyses. The section will cover, inter alia, CO_2 capture from ambient air, ocean carbon management and enhanced weathering, stratospheric sulfates, space borne reflectors and cloud seeding and will require strong coordination with WG I. The concluding part of the chapter addresses the systems perspective and is envisaged to link sectors, technologies and consumption patterns.

Chapter 6: Assessing Transformation Pathways

Chapter 6 will assess transformation pathways in a fully integrated and dynamic analysis by combining top-down approaches of scenarios with the bottom-up information of the following sectoral chapters. Hence, it will provide a synthesis of information of the subsequent chapters. It should be noted that the scenarios/pathways assessed here constitute the backbone of consistency between the three working groups.

The chapter will begin with a discussion of the tools for integrated analyses, including integrated assessment models, bottom-up approaches and qualitative assessment tools. Integrated assessment models may consist of a number of model types and may include a number of components such as energy systems, macro-economics, computational general equilibrium models (CGEs), land-use & agriculture, carbon cycle, atmospheric chemistry, and climate. Links to one or both of the other working groups will be necessary in connection with land-use & agriculture (WG I & II), the carbon cycle (WG I), atmospheric chemistry (WG I) and the climate (WG I). Possible inputs and outputs of the integrated assessment models include drivers (e.g. demographics, economics, infrastructure choices), policies & institutions, decision making rules and technology assumptions.

In addition, a number of climate stabilization concepts will be assessed. As a basis, four representative concentration pathways (RCPs) have been defined as emission profiles that relate to four different forcing levels. The agreement on four RCPs are strong tools to reach consistency between WG I, II and III[1]. However, it should be noted that the full

[1] In order to increase consistency among WG III and II concerning the socio-economic scenarios that can underly each of the four RCPs a joint IPCC Expert Meeting, to be held in 2010, was approved at the 31st session of the IPCC.

range of pathways available in the peer-reviewed literature needs to be taken into account in the AR5. These will include: Not-to-exceed and overshoot pathways, defining individual GHG concentrations, aerosols and gases related to the Montreal protocol. The assessment of stabilization targets will also cover co-benefits such as reduced ocean acidification, reduced air pollution and other goals. In addition, fully closed scenarios will be assessed, ensuring a consistent treatment of emission reductions, climate change impacts, adaptation and socio-economic implications and assumptions of baseline scenarios. Different sets of policy scenarios will be considered: a 1st best set of policies without externalities will be examined as the benchmark, while a 2nd best set of policies will take uncertainties with respect to possible outcomes into account (timing, delayed participation, limited availability of mitigation options, fragmented markets and market power, etc.). The macro-economic analysis, using methods such as cost-benefit and cost-effectiveness analyses, will assess the costs of stabilization scenarios and the impacts of mitigation strategies on GDP and other macroeconomic parameters.

In order to make the assessment as comprehensive as possible, long- and short-term perspectives will be integrated to include the implications of long-term transformation paths for short-term measures as well as the implications of lock-in effects from short-term measures for the long-term. The integration of technological and societal change will cover social acceptability, social impacts and benefit of transformation. The issue of sustainable development and transformation pathways (incorporating differences across regions) will be considered, and examine co-benefits and externalities, such as air pollution, as well as environmental, economic and social side effects. This section will also address undiversified economies (small and large), including case studies. The risks of transformation pathways will be explored by assessing the tails of extreme scenarios and comparing them with the risk from unabated climate change.

The concluding section of Chapter 6 will reconcile bottom-up and top-down approaches by integrating sectoral analyses and transformation scenarios. This means *inter alia* synthesizing sector specific costs with macroeconomic costs, and integrating the timing between sectors and with the overarching macro-economy. As mentioned above, the Memorandum of Understanding produced as a result of WG III's 'IPCC Expert Meeting on Modeling Renewable Energies: Coherence Between Model Assumptions and Latest Technological Knowledge' describes a roadmap for integrating bottom-up and top-down perspectives that will be an integral part of the AR5 process. This will be an added value compared to AR4 and will allow for reports on scenarios at a macro scale but also in technological and sectoral resolution. In addition, implications of sub-regional constraints for global transformations will be assessed, such as infrastructure effects, capital constraints, market distortions, and other barriers of implementation (e.g. institutional, informational, and technological). Different methods for bridging scales will be examined, such as hybrid models, soft coupling, dynamic cost curves and agent based models.

Chapters 7-11 (Sectors)

The sectoral chapters are all to be similarly structured to ensure coherence across them, with variation where there are sectoral specificities. With some exceptions in Chapter 11

(Agriculture, Forestry and other Land Use (AFOLU)), they will all assess 'New developments in emission trends and drivers' where care needs to be taken to avoid double descriptions and double countings (e.g. with respect to sectoral chapters on transport, buildings and human settlements). Then the chapters move through discussions of 'Mitigation technology options and practices (including energy efficiency)', 'Infrastructure and systemic perspectives', 'Climate change feedback and interaction with adaptation', 'Technological, environmental and other risks and uncertainties, and social acceptability', 'Co-benefits, trade-offs and spill-over effects' (including air pollution, black carbon and health, and energy security), 'Barriers and opportunities (technological, physical, financial, institutional, cultural, legal etc.)', 'Sustainable development and behavioural aspects' (including impacts on poverty and gender, as well as the water/energy nexus), 'Costs and potentials' (static and dynamic as well as short- and mid-term) and conclude with 'Gaps in knowledge and data'. As indicated above, Chapter 11 will deviate from this template because of the unique characteristics of the sector – all variances are listed in its chapter description below. All sections will consider regional specificities as appropriate to developed and developing countries and economies in transition.

Chapter 7, Energy Systems, will focus on energy production, conversion, transmission and distribution and will include, where relevant, insights on renewable energies from the IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN). There will be a description of mitigation technology options and practices (including energy efficiency), assessing all electricity and heat generation technologies, CHP, CCS (including storage capacity in geological formations and other reservoirs), liquid and solid fuels, conversion including CTL, poly-generation, storage, transmission and distribution technologies including centralised and decentralised generation and smart grids, demand side management and hydrogen routes to decarbonization. In this same section, sectoral chapters 7-10 will all cover technology maturity, diffusion and deployment rates, saturation, short- and long-term dynamics in mitigation options, and synergies/tradeoffs/interactions with adaptation and other mitigation options including systemic considerations. In addition, impacts of climate on mitigation options and interaction with adaptation will be assessed. The section on infrastructure and systemic perspectives will look at the issues of system integration and intermittency, and provide life-cycle emission assessments for different bioenergy sources (including the use of biofuels and other alternative fuels in aviation, taking into account cross-sectoral issues). Unlike the other sectoral chapters, there will also be a thorough discussion of resources and resource availability, covering both conventional and unconventional resources.

Chapter 8, Transport, will cover both freight and passenger transport on land, air, sea and water. With respect to air transport, updates on global aviation traffic and GHG emission trends and the interdependencies between aviation noise, emissions and air quality based on the latest understanding should be included. The descriptions of mitigation technology options and practices (including energy efficiency) will be similar to Chapter 7 (Energy Systems) but will specifically include lifestyle, culture, efficiency, transport technologies, modal split and fuel substitution. The discussions on infrastructure and systemic perspectives will include partially or fully electrically powered vehicles used for

electricity storage and multi-gas trade-offs in product life cycles. Due to the link between this chapter and Chapter 12 (Human Settlements, Infrastructure and Spatial Planning), cross-fertilisation between the two chapters should be ensured.

Chapter 9, Buildings, will cover commercial, residential and public buildings. Its descriptions of mitigation technology options and practices (including energy efficiency) will be similar to preceding sectoral chapters, but will also specifically address lifestyle, culture, low energy architecture, energy efficient appliances and energy controlling systems, as well as energy efficient, zero energy and energy plus buildings and building components, building integrated renewables, heat pumps, micro-polygeneration and other socio-technical measures. Infrastructure and systemic perspectives will incorporate literature on community heating and cooling.

Chapter 10, Industry, will consider new developments in extractive industries, manufacturing and services (including tourism). The chapter will have a section on material substitution (taking account innovations in materials), material reuse and waste, unlike the other sectoral chapters, that will address mitigation potential in terms of e.g. improved recycling of materials. The assessment of mitigation technology options and practices (inlcuding efficiency improvements, household and industry waste) will again be similar to the other sectoral chapters and will specifically include efficiency improvements in heavy and light industry, new processes, CCS, cradle-to-cradle approaches, and multi-gas tradeoffs. Its 'Infrastructure and Systemic Perspectives' section will discuss embodied emissions and life cycle assessments.

Chapter 11, Agriculture, Forestry and Other Land Use (AFOLU), will reflect the structure of the other sectoral chapters with some deviations due to the nature of the sector. It will begin with an introduction to the integrated assessment of AFOLU and address land-use mitigation, covering amongst others mitigation opportunities, synergies with other sectors, co-benefits and trade-offs, as well as effects on soil and land degradation/enrichment and biodiversity (e.g. water table management, afforestation and reforestation). This same section will address in addition the vulnerability of AFOLU actions and effects on mitigation efforts (e.g. extreme events, natural disturbances), and assess both direct (e.g. sustainable forest management, forest conservation) and indirect effects (e.g. CO_2 fertilization, N deposition). 'Emission trends (including agricultural productivity) and drivers', will attempt a separation of direct and indirect, and natural effects in agriculture, forests, grassland on emissions. For this purpose, the IPCC Expert Meeting report on "Revisiting the Use of Managed Land as a Proxy for Estimating National Anthropogenic Emissions and Removals" should receive special attention.

A further deviation in Chapter 11 from the structure of other sectoral chapters is the inclusion of a section on 'Competition and opportunities for land-use', addressing energy, food, feed and timber production as well as housing, nature conservation, biodiversity and other land uses. 'Mitigation Technologies and Practices in Forestry, Agriculture (e.g. Biochar), and Livestock Farming' will cover forest management, the reduction of emissions from deforestation and forest degradation, aforestation and forest conservation, address biochar, enhanced productivity and soil carbon management, and discuss

enhanced productivity and nitrification inhibitors with respect to livestock farming. Traditional communal practices and community engagement (e.g. indigenous peoples and traditional communities) will also be included.

Also unique to Chapter 11 will be a discussion on mitigation effectiveness including non-permanence, such as the human and natural impacts of natural disturbance from e.g. fires, floods, storms and pests, and the displacement of activities, biomass and soil saturation. The 'Systemic perspectives' section will provide an integrated land use assessment, taking into account all aspects discussed in the 'Introduction to Integrated Assessment of AFOLU' at the beginning of the chapter. The section on climate change feedback will focus on natural disturbance and extreme events and require close coordination with WG I. 'Environmental and other risks and uncertainties' will address social, economic and environmental aspects of mitigation opportunities.

The remainder of the sections in Chapter 11 will mirror the structure of the other sectoral chapters. 'Sustainable development and behavioural aspects' will cover additional topics concerning the impacts on employment, land ownership, food and water. Where relevant, insights on bioenergy from the IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN) will be included.

Chapter 12: Human Settlements, Infrastructure and Spatial Planning
This chapter will constitute an integrative summary of all sectoral chapters, and will include insights from the joint WG III/WG II Expert Meeting 'Human Settlements and Infrastructure – Mitigation and Adaptation Strategies' to be held in 2010. It was agreed by the 31st Session of the IPCC that the WG III Bureau and the authors have the mandate to revisit the structure and the title of the bullets in this chapter based on the outcome of this expert meeting.

In the current outline, Chapter 12 begins with a section on urbanisation challenges and opportunities for climate change mitigation. The discussion could then focus on settlement structures, density, forms and lifecycle assessments, followed by descriptions of 'Infrastructure, spatial planning and mitigation' and 'Lifestyle changes and efficiency'. The chapter will also contain an assessment of the mitigation potential of all aspects of waste (excluding industrial waste which is found in Chapter 10 (Industry)) and will focus on e.g. methane from landfills and incineration. The analysis of the water/energy nexus could be followed by the concluding section on human settlements and climate change, which will discuss experiences across countries.

2.3.4 Part IV: Assessment of Policies, Institutions and Finance (Chapters 13-16)

Part IV will assess policies on all scales, ensuring a consistent flow of information in both directions, from international to national and back. Insights from the Special Report on Renewable Energy Sources and Climate Change Mitigation (SRREN) regarding policies and finance will be included where appropriate.

Chapter 13: International Cooperation: Agreements and Instruments
After the general introduction, Chapter 13 will begin with a consideration of the relevant framing concepts and provide an assessment of means for international cooperation. This will include the global public goods problem, intra- and intergenerational equity, cost-effectiveness and implications for sustainable development. Next, examples of international agreements will be analysed and lessons for climate policy will be derived. From the international relations and political science literature compliance, participation, effort sharing, information collection and dissemination, etc will be assessed. Such an assessment of previous and existing policies might provide insight into the mechanisms by which cooperation and policy harmonization can influence the outcome and efficiency of the transition to a low-carbon economy. Further, market-driven agreements and other initiatives will be assessed and a literature review on international emission trading schemes will be undertaken. The Kyoto and post-2012 climate treaty mechanisms, including policies to reduce GHG emissions from aviation, will also be assessed. Multilateral and bilateral agreements across different scales will be considered (international: UNFCCC, MEF, G20, G8, etc.; regional: OECD, ASEAN, NAFTA, COMESA, SADC, APP, CARICOM, MERCOSUR, ALADI, etc.).

For climate policy architectures, a taxonomy of generic elements will be defined considering goals and targets, participation and burden sharing. Alternative approaches to international climate policy architectures will be considered by analyzing and evaluating existing literature that discusses experiences with centralized policies, harmonized domestic policies, decentralized and coordinated national policies and multilateral environmental agreements. Furthermore, possible mechanisms for international cooperation concerning the development, transfer and diffusion of knowledge and technology will be evaluated and all aspects of capacity building will be addressed.

The following sections will focus first on the linkages between international and national policies, evluating amongst others competitiveness effects and hybrid instruments, and then on the linkages between international and regional cooperation. Interactions between climate change mitigation policy and trade will also be assessed by considering, for example, the implications of WTO and Regional Trade Agreements (RTAs) on climate change. Subsequently, the performance of policies and institutions including market mechanisms will be assessed. The sections on ‘Finance and Investment’ and ‘The Role of Public and Private Sectors and Public-private Partnership’ will focus on the international level and provide a detailed assessment of existing activities. Chapter 16 (Cross-Cutting Investment and Finance Issues) will then supply an integrated assessment across different scales, i.e. the international, regional, national and sub-national.

Chapter 14: Regional Development and Cooperation
After the general introduction, Chapter 14 will assess opportunities of and barriers to regional cooperation. In this context, economic regions will be identified and the issue of leapfrogging will be addressed. The chapter will then evaluate current development patterns and goals, and analyse the interactions between energy and development, and urbanization and development. Consumption and production patterns in the context of development will be assessed, and the opportunities of and barriers to low carbon

development will be investigated. This will involve looking at the interactions, i.e. synergies and conflicts, between sustainable development and mitigation policies. While Chapter 4 (Sustainable Development and Equity) will assess the literature on sustainable development on a conceptual level incorporating regional information and differences, Chapter 14 is placed within the framework of the policy chapters and will therefore be more focused on the assessment of literature discussing regional policies, and cover sustainable development only in the context of concrete regional development and cooperation efforts. Subsequently, links between mitigation, adaptation and development will be assessed.

The sections on 'Finance and Investment' and 'The Role of Public and Private Sectors and Public-private Partnership' will focus on the regional level and provide a detailed analysis of existing activities. Chapter 16 "Cross-Cutting Investment and Finance Issues" will then supply an integrated assessment across different scales, i.e. the international, regional, national and sub-national.

Chapter 15: National and Sub-national Policies and Institutions

After the introduction, Chapter 15 will begin with a characterisation and classification of policy instruments and packages, which will include an assessment of direct and indirect policies to control GHG emissions. For the direct policies this will comprise emission taxes, tradable permits, GHG intensity standards and voluntary measures. For the indirect policies, measures aiming to support renewable energy (renewable portfolio standards, renewable fuel standards, feed-in tariffs, production tax credits) and energy efficiency (energy taxes, appliance standards, building codes, subsidies, labelling and information programs, government procurement) will be evaluated. Furthermore and importantly, investment in technologies, such as RD&D, and human and physical capital investments will be assessed. Performance analyses of each policy instrument will be based on criteria such as economic efficiency, certainty of environmental outcomes, etc.

The approaches and tools used to evaluate policies and institutions will include: Environmental effectiveness, cost-effectiveness, implications for economic development, aspects of poverty alleviation, distributional incidence, implications for trade and competitiveness, implications for investment in technological innovation and deployment, impact of market structure on regulation, technological innovation and diffusion, political feasibility and administrative cost and, ultimately, an explicit consideration of the actual policy's objectives. The differences in applicability of policy instruments between developed and developing countries will be discussed.

In the assessment of policy instruments, policies to advance research and development will receive a special focus. In addition, an assessment of the literature describing experiences with multi-sectoral or economy-wide, sector-level and voluntary policies and measures will provide insights into their performance. Experiences from both developed and developing countries (including LDCs) will be analysed, taking into account development level and capacity. The use of non-English as well as non-peer-reviewed literature will be of relevance in this context. The policy assessment in this chapter will use the role of institutions and governance in developed as well as developing countries

as a framework. It will investigate capacity building measures and the links across national, state and local policies as well as the relevant links to adaptation. The analysis of synergies and trade-offs among policies, e.g. the co-existence of policies and the dynamics of policy evolution and path dependence, will be an integral part of this examination, as will the assessment of options for policy design.

The sections on 'Finance and Investment' and 'The Role of Public and Private Sectors and Public-private Partnership' will focus on the national and sub-national level and provide a detailed analysis of existing activities. Chapter 16 "Cross-Cutting Investment and Finance Issues" will then supply an integrated assessment across different scales, i.e. the international, regional, national and sub-national. To conclude the chapter, he role of stakeholders including NGOs will be discussed.

Chapter 16: Cross-Cutting Investment and Finance Issues
Chapter 16 will deal with the role of investment and finance for mitigation. Opportunities, key-drivers and barriers to finance low-carbon investments will be assessed. This assessment will include global institutional investors, carbon markets, the financing of R&D, micro-finance and the issue of finance and deforestation. The financing of mitigation activities in developed countries and the financing of mitigation activities in and for developing countries including for technology development, transfer and diffusion will also have to be discussed. Another focus of the chapter will be on financing infrastructure and institutional arrangements, which will consider long-term investments and financing infrastructure in developed and in developing countries.

Synergies and trade-offs between financing mitigation and adaptation will be assessed. The discussion of financial aspects (needs and trade-offs) of adaptation and mitigation is one area in which a direct comparison is possible. In most other contexts a comparison is more difficult due to the very different scales on which mitigation and adaptation activities would occur.

The remaining sections of Chapter 16 will address means to direct and leverage private financing and discuss innovative financing approaches (including all relevant aspects such as domestic, bilateral and international financing). In addition, approaches and different scales of financing at national, regional and international level in the short-, mid- and long-term, as well as the requirements for enabling environments will be discussed.

3. Cross-cutting Issues

There are a number of methods and issues that concern more than one working group (WG). These methods and themes require additional coordination efforts in order to achieve a consistent treatment across the WGs and to strengthen the coherence of the AR5. The cross-cutting methods (CCM) and cross-cutting themes (CCT) are laid out in more detail in a dedicated document to the 31st plenary session (IPCC-XXXI/Doc. 4). Their relevance for WG III is described here, including a description of where these methods and themes are housed in the WG III contribution.

3.1 Cross-Cutting Methods (CCM)

Consistent Evaluation of Uncertainties and Risks
As risk and uncertainty is one of the framing issues outlined in Part II of the WG III outline, this CCM will be vital to the contribution of WG III. The methodological foundations will be addressed in Chapter 2 (Integrated Risk and Uncertainty Assessment of Climate Change Response Policies) and later applied in the sectoral and cross-sectoral chapters of Part III as well as the policy chapters of Part IV.

Costing and Economic Analysis
Similarly to risk and uncertainty, economic analyses of climate policy is a framing issue in the WG III outline, so this CCM will also constitute an integral part of the WG III contribution. Here, the methodological foundations will be laid out in Chapter 3 (Social, Economic and Ethical Concepts and Methods) and the application will take place in Chapter 5 (Drivers, Trends and Mitigation) containing general discussions of mitigation options, and in the other sectoral and cross sectoral chapters of Part III. The issue of costing and economic analysis will be at the heart of Chapter 6 (Assessing Transformation Pathways) integrating bottom-up and top-down information of part III and will assess the various types of models and associated costs. Finally, chapter 16 (Cross-cutting Investment and Finance Issues) will address matters of finance and investments.

Regional Aspects
Regional aspects will also be an integral part of the WG III contribution and will be addressed wherever appropriate. Common and specific regional aspects will be specifically addressed in Chapter 4 (Sustainable Development and Equity) and will be considered in all the sectoral and cross-sectoral Chapters 6-12. Finally, Chapter 14 (Regional Development and Cooperation) is explicitly devoted to regional development and cooperation, while Chapter 15 (National and Sub-national Policies) will specifically take regional aspects into account in a more focused discussion of national and sub-national policies.

3.2 Cross-Cutting Themes (CCT)

Water and Earth System: Changes, Impacts and Responses
This CCT will be covered in various places in the WG III contribution. Issues of side effects on mitigation technologies (and vice versa) will be covered in Chapter 5 (Drivers, Trends and Mitigation and will include CCS, Geo-engineering and desalination as well as in Chapter 12 (Human Settlements, Infrastructure and Spatial Planning) covering infrastructure-related issues. Issues related to bio-energy (incl. land use changes) will be covered in Chapter 11 (Agriculture, Forestry and Other Land Use).

Carbon Cycle Including Ocean Acidification
This CCT will be part of the assessment of Chapters 5 (Drivers, Trends and Mitigation) and 6 (Assessing Transformation Pathways) since different mitigation targets are associated with different GHG emission and concentration levels. The latter two have an

effect on carbon reservoirs (incl. ocean acidification) and agricultural productivity, influencing the attractiveness of land-use policies as a mitigation option. Furthermore, synergies and tradeoffs between carbon reservoir management on the one hand and bio-energy policies and associated land use changes on the other hand will be assessed in Chapter 11 (Agriculture, Forestry and Other Land Use). Interrelations between carbon pools due to land use changes caused by human settlements, infrastructure policies and spatial planning will be assessed in Chapter 12 (Human Settlements, Infrastructure and Spatial Planning).

Ice Ssheets and Sea-level Rise
The issue of sea level rise (SLR) is particularly relevant for densely populated mega-deltas. It will be dealt with in Chapter 12 (Human Settlements, Infrastructure and Spatial Planning), as this has an effect on infrastructure policy and spatial planning.

Mitigation, Adaptation and Sustainable Development
Mitigation comprises the essence of the WG III contribution, and therefore this CCT is present throughout the WG III outline. The links between mitigation, adaptation and sustainable development will be addressed in Chapter 4 (Sustainable Development and Equity), in the sectoral and cross-sectoral chapters of Part III as well as in the chapters on policy and regional development of part IV.