IPCC Fourth Assessment Report

Expert Review of the First-Order Draft

Chapter 2

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
0-1	A	0	0			I limit my comments to a few overall observations. My major objection against the report is that the caveats have not been spelled out, which makes the report less than scientific. Its is based on the assumption that anthropogenic GHG, particularly CO2, represent major climate forcings. However, new doubts have arisen whether this is really the case. The ('peer-reviewed') literature which is sceptical of the man-made global warming hypothesis, has been growing quite impressively over de the last few years. It has been completely ignored. Many observations (e.g. on temperatures and CO2 concentrations, and their development over time) do not match the man-made global warming paradigm. They offer a multitude of 'anomalies' (in the vocabulary of Thomas Kuhn). This should be recognised. If not, the whole exercise runs the risk of being dismissed by critics as being biased by 'cherry-picking'. Model-based attribution of the different forcings, influencing the (minor) rise in surface temperatures since the middle of the previous century, cannot be construed as proof of the anthropogenic greenhouse effect, because no single model has ever been validated. The report posits that 450 ppmv CO2 concentration equals 2 degrees warming over the 21 century. In the light of the previous comments on the relationship between the two, this is not proven. It could be argued that these observations do not fit into the Report of Working Group III and that they should be addressed elsewhere. But as far as I know, this has not been done. Anyhow, the authors should make their assumptions explicit in the preamble of the document, so that the reader will be able to form his own opinion in the light of all available views and/or information. Moreover, nowhere reference has been made of the critical report on 'The Economics of Climate Change', which was issued, in early July 2005, by the British House of Lords Select Committee on Economic Affairs, and the discussion ensuing therefrom. Furthermore, at the recent G-8 Summit at Gleneagles and the Montreal Climate	Noted, the link between poverty alleviation and SD is taken into consideration in the editing

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						Conference, it has become clear that the first phase of the Kyoto (sort of European mini-Kyoto) will not get any follow-up. This is a crucial fact, which will drastically overturn the outlook presented in earlier IPCC reports. Somehow and somewhere, the authors should deal with this issue and its implications in the document. At various places in the report, it is suggested that (man-made?) climate change (if any) will disproportionably hurt the poor (especially in Africa). However, the causal relationship between the two, has not been convincingly substantiated to my mind. It is, furthermore, suggested that mitigation and sustainable development can be realised without impairing the fight against poverty (in the traditional meaning of the words). Undoubtedly there are many examples where this is true. At the same time, there are many opposite examples, where this is not the case. The relationship is simply more complex than the text wants us to believe. Therefore, a more elaborate and balanced presentation of pros and cons is called for. Another element which is missing is the impact of Kyoto (plus, plus) on our (socio)economic system. It is true, this issue has - so far - hardly been addressed in the climate change literature. But it is nevertheless of utmost importance. Emission trading, which, according to the logic of Kyoto, should be progressively extended to more and more sectors of the economy, will fundamentally change the main features of our (socio)economic system: from a basically free enterprise system to an more centrally planned system, with heavy (international) government intervention. This aspect has, so far, been almost totally ignored in the climate change policy literature. For an elaboration of this line of reasoning, see: http://www.tcsdaily.com/article.aspx?id=120304A As regards sea levels, no acceleration in sea level rise has been recorded, which is inconsistent with the statement that there is a discernable human influence on climate since the middle of the previous century. Only very rarely reference has been made to cost/benefit analysis. Where this has been the case, the relevant passages were on the whole overstating the benefits and	

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						understating the costs. The PPP approach concerning future real growth cum emissions, has not been covered (allegedly because of the fact that most of the literature is still based on market exchange rates). Let's hope that there is still sufficient time to include the outcome of new OECD work on that score which can be expected in the months to come. ---Leimuiden, 4 January 2006. (Hans H.J. Labohm, 0)	
0-2	A	0	0			It is very good indeed that in the report climate change is being placed in the context of sustainable development (SD) and the Millennium Development Goals (MDG). What has not been worked out to the full in this repect is the fact that SD and MDGs will not be reached in a reasonable time given the fact that there simply is not and will not be enough money available. In this respect the concept of Global Public Good, which has received a lot of attention of the last couple of years, could play a role (other than what has been denoted in e.g. chapter 1, paragraph 1.5.2.). It has been proposed as a new frontier of finance for international development. See especially Inge Kaul, Isabele Grunsberg, Marc A. Stern, Global Public Goods (International Cooperation in the 21st Century), UNDP and Oxford University Press, 1999, Inge Kaul, Pedro Conceicao, Katell Le Goulven, Ronald U. Mendoza, Providing Global Public Goods, UNDP, Oxford University Press, 2003. On the basis of the notion of Global Public Good innovative mechanisms for dealing with the climate change issue from a world-wide perspective; e.g. a CO2-tax, have been proposed. Through such a tax the environmental and development dimension of climate change could be clearly interlinked. This relates to the concept of the environmental footprint (Wackernagel and Rees, 1996; chapter 12, page 25, line 45) but is a more direct derivation of global warming. The CO2-footprint has been introduced by the World Wildlife Fund. The CO2-footprint of every inhabitant in the world could be related to the intrinsic capacity of the earth to absorb carbon dioxide from the atmosphere (about two tons of CO2 per year). Payment, in preferably an international fund, should start when this threshold is passed. The	Noted

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						average emissions per year in most developing countries are still below 2 tons of CO2. They will receive money. Industrialized countries have to pay on the basis of their per capita footprint. Such a system could generate a lot of money for development and at the same time provide an economic incentive to reduce emissions. See in this respect: A, Sandmo, Environmental Taxation and Revenue for Development, in: A.B. Atkinson, 2005, New Sources for Development Finance, UNU-Wider Studies in Development Economics, Oxford University Press. See also D. Bradford, Improving on Kyoto: Greenhouse Gas Control as the Purchase of a Global Good, CEPS Working Paper No. 96, January 2004 (Gert de Gans, Kerkinactie)	
0-3	A	0	0			The units are different among the chapters. For example, the unit of CO2 emissions, GtC in fig.3.17, Mt-CO2 in Fig.5.28. The unit should be uniformed. (Toshihiko Masui, National Institute for Environmental Studies)	Noted
0-4	A	0	0			In general, I found the quality of the report to be very uneven. The chapters that address mitigation potential in individual sectors that I managed to scan were far superior to the cross-cutting chapters 1, 12 and 13 that I reviewed in greater depth. The latter chapters generally do not constitute a systematic assessment of the state-of-the-art, based on publicly-available information, but are often anecdotal, reflecting only the view of the author or a very limited number of references or examples, even in cases where there is a rich literature on the subject. It will be crucial that these chapters are improved to meet the same standards of rigor that the WG1 report does, or the credibility of the IPCC as an independent assessment panel will be compromised. (Anne Arquit Niederberger, Policy Solutions)	Noted
0-5	A	0	0			General comment: The level of detail of the draft text on co-benefits is uneven across chapters. Some discussions are relatively detailed, and some are very cursory. It would be better to have greater consistency across chapters and sections.	Noted

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						(Mark Heil, U.S. Environmental Protection Agency)	
0-6	A	0	0			GENERAL COMMENT: Good treatment of SD linkages. Developing country (DC) literature on sustainable development could be used more, since it provides a different viewpoint. Some recent publications have been left out: e.g., the most up-to-date and comprehensive reference is (MMRS 2005) = Munasinghe, M. and Swart, R. 2005. Primer on Climate Change and Sustainable Development, Cambridge Univ. Press, UK. (Mohan Munasinghe, Munasinghe Institute for Development (MIND))	Noted, attention will be payed to integrating more of this literature
0-7	A	0	0			Innovation is present in the whole report, yet how to steer innovation in the desired direction is not clear. How succesfull are policies directed at innovation, when sustainability or CO2-emissions rather than financial succes is the most important criteria? Presently, I am preparing research on this issue, and would like to take topics around climate and energy as a special case. (Tineke van der Schoor, Sustainability Centre Lauwersoog/ RUG-Bedrijfskunde)	Noted, this is coordinated with chapters 3 and 11
0-8	A	0	0			In general, the importance of the public, of education, of changing behavior, could be more worked out as a separate issue. How to reach the public, how to involve consumers, what do consumers want, and then think again about technology, this is being overlooked. Many technological development paths as sketched in this report, but also in a lot of other publications (like the 'energy transition' in the Netherlands, are very technocratic in nature and fail to note people. Human beings seen as subjects, not as objects. As continually choosing, problemsolving, thinking individuals. The same comment goes for the integration of sustainable development in the curricula of schools. Not as a separate topic, but integrated in the normal courses. This issue is taken up in the Centre for Sustainability, mentioned above. (Tineke van der Schoor, Sustainability Centre Lauwersoog/ RUG-Bedrijfskunde)	Noted and will be considered in the editing
0-9	A	0	0	0	0	The developing world need energy for their development. Therefore denying them access to affordable energy sources through imposing policies that will make energy unaccessable will hinder their development and creat an unfair situation. (Mohammed Alfehaid, Saudi Aramco)	Noted

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0-10	A	0	0	0	0	In general, I found many of the chapters weak in providing references for key statements. While it is nice to save page length by not providing references and thus no bibliographic citations it does a dis-service to the reader. All chapter should take care to make sure that statements are bettere referenced and the TSU should be aware of this as well. Contrast this with WG2 who may have gone too far the other way in some cases.... (Jeff Price, California State University, Chico)	Noted
0-11	A	0	0			I have not made comments on references, since I assumed this is dealt with by the technical support unit. However, I just want to mention that there are citations given in text here and there that does not appear in the list of references. (Göran Berndes, Chalmers University of Technology)	Accepted
0-12	A	0	0			Global climate change is a worldwide challenge and climate protection needs joint efforts by all countries. (James Bero, BASF Corporation)	Noted
0-13	A	0	0			To avoid misunderstandings and errors, it may be helpful to use both Ceq and CO2eq. In most plubications for public and policy makers, greenhouse gas emissions are given in units gCO2eq/kWh or gCO2/kWh, which in itself may be confusing. The chance of wrongly quoted numbers increases with the introduction of two additional units gCeq/kWh and gC/kWh. (Jan Willem Storm van Leeuwen, Ceedata Consulting)	This is a general coordination issue
0-14	A	0	0			Suggestion to use SI units and SI notation throughout the report. For example: 1 Gt (1 gigaton or gigatonne? Metric tonne, short ton, long ton?) is not a SI unit and introduces ambiguities. Suggestion: use 1 Mg = 1 megagram = 1 metric tonne, 1 Gg = 1 gigagram = 10E9 gram = 1000 metric tonnes 1 Tg = 1 teragram = 10E12 gram = 1 million metric tonnes. For example: 0.7 GtC/yr becomes in SI notation: 0.7 Tg(C)/a (Jan Willem Storm van Leeuwen, Ceedata Consulting)	This is a general coordination issue
0-15	A	0	0			General comment: The FAR is a comprehensive, massive and impressive piece of work. Due to its size and depth, however, it is not very easy to digest.	Noted

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						(Jan Paul van Soest, Advies voor Duurzaamheid on request of International Gas Union)	
0-16	A	0	0			There seems to have been little communication between the chapters. In particular, there is a good review of the issues of technological change in chapter 2, that is not reflected in chapter 3, where technological change is of vital importance. The material inchapter 2 is also not reflected in chapter 11, although the macroeconomic intersectoral analysis of chpater 11 requires an assessment of technology. (Jonathan Köhler, Tyndall Centre, University of Cambridge)	Accepted, coordination is going on
0-17	A	0	0			While the Fourth Assessment Report (AR4) of WG III contains a wealth of information, I think it lacks a clear and concise statement (a "vision" if you will) of the mitigation/stabilization problem. While, to be sure, there is much relevant and useful material regarding stabilization throughout the thirteen chapters, it is difficult to find a clear statement of what seems to me the crucial question: What will it take to "stabilize climate" (by which I mean stabilize the atmospheric concentration of GHGs--or at least CO^2)? There are, of course, differing views regarding the answer to that question (the differences mainly centered on the importance, availability, and scaleability of carbon-emission free energy technologies--more on this later). It would be very helpful, therefore, if this question was explicitly posed up front, and, as well, explicitly acknowledged that among experts in the field there are different views and different approaches to answering this key question. I think the appropriate place to pose the "what will it take" question is in the Introductory Chapter (Ch 1), perhaps on p.5 after the conclusion of section 1.2 on article 2 of the FCCC convention. It might also be helpful to briefly set out the differing views about what it will take to "stabilize climate". For example, material in the last paragraph on p.68 of Chapter 2 could be usefully employed in Chapter 1. I think the AR4 report needs to acknowledge, from the outset, an important implication of the SRES emission scenarios, and scenarios that are similar to the SRES. The implication to which I refer is a general tendency to understate (perhaps greatly so) the costs and general difficulty of achieving stabilization. Because many of the 40 individual SRES reference scenarios have already built into them high long term	Noted

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						(110 year) rates of global energy intensity decline (the main exception being the A2 family), and large amounts of carbon-free energy, their use in mitigation/stabilization analysis is likely to substantially understate the magnitude and cost of the stabilization task. Although, there is reference in Chapter 3 to other emission scenarios, it is not clear whether any other (than SRES) reference scenarios were used by the very large number of mitigation analyses that are reported in the chapter. Of particular interest here is whether the EMF-21 modelling scenarios used different baselines than those implied by the SRES. The reason for interest is that, as portrayed in chapter 3, including Figures 3.25 and 3.26, the EMF-21 appears to estimate much higher GDP costs of stabilization than do the great body of other mitigation scenarios. An obvious question is whether the difference in GDP costs of stabilization reflects the way in which the reference (or baseline) scenario(s) were constructed. (Another question is why Chapter 11 appears to have overlooked the EMF-21 findings.) To the Report's credit, it does include, in Chapter 2, a set of Figures (2.9.2) that reflect the excellent work, initially carried out by Edmonds for the IS92a scenario, demonstrating how much technology change is already assumed in reference emission scenarios. Figure 2.9.2 makes clear that the SRES reference scenarios incorporate a very large share of the emission-reducing "gains" from future technological change. What is unclear is the degree to which other parts of the Report take the reference scenarios as given (as if the embedded technological change were supplied as manna from heaven) and focus on what extra is needed for stabilization. For example, in Chapters 4-7, how much of the technological improvements from current practice will be required to meet the technological change incorporated in the reference scenarios? Arguably, most, if not all, will be. If so, then little or nothing is left over to achieve stabilization. The implications for interpreting the findings on the cost of mitigation reported in Chapter 11 are important. The relatively low costs estimates reported there for achieving stabilization (often generated by models assuming a carbon-free backstop technology) may be the result of effectively "double counting" the contribution of technological change, first in the reference scenario and second in	

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						the mitigation/stabilization scenario. Thus while the reader can find scattered statements about just how difficult it will be to achieve stabilization", the cost estimates reported in Chapter 11 make the economic (GDP) cost of stabilization seem small-and they do so in part because of a lack of clarity on the technology-mitigation issue in other parts of the report. One result is to continue to leave the false impression, initially generated in WG III TAR, that if we could only overcome socio-economic and institutional inertia, stabilization can be relatively easily achieved in the 21st century. One way to illustrate the nature and importance of reference scenarios for assessments of the difficulty of achieving stabilization is to contrast the paper by Pacala and Socolow (Science, 2004), which is frequently discussed as well as cited in AR4, with Hoffert et.al (Nature, 1998) which does not appear to be cited at all by AR4 (although there are a number of citations to a subsequent Hoffert et al paper (Science, 2002). Pacala and Socolow (P-S) conclude that (given the rate of growth of GDP) the technologies are available to stabilize emissions for the next 50 years (out to 2054), by assuming that energy intensity decline will automatically decline at a global average annual rate of 1.0%, and that the carbon intensity of energy will decline at a 0.5% rate. Thus, in considering the availability and scaleability of carbon-free energy technologies, P-S only consider what is needed over and above a 1.5% rate of decline in the carbon intensity of output. In contrast, Hoffert et al (Nature,1998) ask how much carbon free energy (power) is required to stabilize (given the rate of growth of GDP), and varying rates of decline in energy intensity, and find that the amounts are generally so large that major technological breakthroughs in the supply of carbon-free energy would almost certainly be required for stabilization. The Hoffert, et al, Science, 2002, article attempted to demonstrate that no individual or combination of carbon-emission-free technologies is up to the task. The Caldeira, et al (Science, 2003) article demonstrated the climate sensitivity implications for the speed and amount of carbon-free energy deployment. One disturbing implication, in my view, of the two Hoffert et.al and the Caldeira, et al, papers, taken together, is that if climate sensitivity is on the high side and if the threshold for acceptable temperature change	

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						is relatively low (say, 2 C), avoiding DAI may be, for all practical purposes, impossible. The possibility that energy technology cannot be changed fast enough, and in the required magnitudes, in time to avoid DAI should be recognized in the Report. It would be useful if the sector-based chapters (especially 4-7) provided a rough idea of the overall (within sector) increase in energy efficiency that is potentially achievable over the course of the 21st century. As the AR4 now stands, while estimates of energy efficiency are given for some individual users of energy, there is no indication of what these add up to on a global and cross-sectoral basis. But it is arguably very important to know something quantitatively about the overall potential for energy efficiency improvement, because that improvement, in combination with sectoral shifts in the share of economic activity, determine the overall decline in energy intensity. As Hoffert et al, (Nature, 1998) demonstrated (using the Kaya identity and a carbon cycle model), the rate of growth in GDP, and the rate of decline in energy intensity, determine the amount of carbon-free energy required for stabilization. Having some idea how much carbon-free energy is required for stabilization not only tells us how much technology change will be required on the energy supply side, but it may shed light on whether, as a practical matter, we can avoid a "dangerous anthropogenic interference" (DAI) with climate, given climate sensitivity and some estimate of how much warming is acceptable (say 2C). There is another reason why it would be useful to have some quantitative idea of what can be achieved on a sectoral basis (on a global scale) in terms of energy efficiency. It would help evaluate the plausibility of reference emission scenarios. In my view this is critical because three-quarters of the 40 SRES emission scenarios have pair-wise energy and GDP growth rates that imply 110 year (1990-2100) global average annual rates of energy intensity decline above 1.1%. Century-long, global average annual rates in excess of 1.1% seem implausibly high for the following reasons. The scope for energy efficiency increases in the electricity-generating sector are likely limited by thermodynamic factors to 100% or less. The same is almost surely the case for the heavy transport sub-sector (including boats airplanes railroads and heavy trucks). Together these	

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						sectors account for about 45% of energy consumed, and that share is likely to increase as more of the world is hooked up to the electric grid. While, 300% increases in energy efficiency are potentially achievable globally (more in the US), over the course of the 21st century, in the automobile/light truck and residential/commercial sectors, the scope for improvement in the industrial sector is more limited. Even if a 200% improvement in energy efficiency in the industrial sector is achievable, the weighted increase in energy efficiency across all sectors would, at most, be 200%.-and probably substantially less. Given the assumed increase in the relative importance of the electricity generating sector, it can be shown that these numbers imply that at best energy intensity in 2100 would be about 30% of the level in 1990. That works out to a 1.09% average annual rate of decline in energy intensity- a rate that we would have to work very hard to achieve. It is a rate that will require important advances in technology, ones that will require a long term commitment to well-funded R&D, and will not happen as if manna from heaven. Yet 30 of 40 SRES reference scenarios have imbedded within them 110 year global average annual rates of decline in energy intensity in excess of 1.09%. Moreover, 25 of the 40 SRES reference scenarios incorporate upward of 350 EJ/yr of renewable energy (including "new", but not old, biomass)-an order of magnitude above current levels. Arguably, the plausibility of most of the SRES emission is in doubt, yet they are used to carry out stabilization analyses. 4. In summary, while I would not quarrel with the chapter outline of the report, I believe that the manner in which the mitigation/stabilization issue is framed in the report could be substantially improved. So too, the individual components of the report need to be tied together in a more coherent and relevant manner-and related to what I believe should be the central theme of the Report, "what will it take to stabilize"? As Chapter 11 makes clear, it is now widely accepted that technology and technological change will be crucial to stabilization. How much technological change, and how to assure the necessary research, development and deployment, remains uncertain and in dispute. The answers to these questions are the key to successful stabilization and to whether stabilization can be achieved before the	

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						threshold of DAI is breached. The science of climate change, as reported by IPCC WG I, convincingly demonstrates that we face major problems from rising emissions and concentrations of GHGs, especially CO^2. Unfortunately, WG III in its TAR fumbled the ball in failing to make clear just how difficult achieving stabilization short of DAI will be, both technologically and economically. Based on my reading of the First Order Draft of WG III AR4, the fumble has not yet been recovered. It is to be hoped that recovery is still possible before final publication. (Christopher Green, McGill University)	
0-18	A	0	0			I am missing in the report the ugency of the geopolitical dimension of climate change in relation to energy provision. (Even more) serious conflicts could arise as a result of the increased demands for oil and other resources by countries like China en India. (Gert de Gans, Kerkinactie)	Noted
0-19	A	0	0			Congratulations on such an excellent start! The emphasis on sustainable development hits the very heart of the GHG problem in the future. (Tao Ren, Utrecht University)	Thanks
0-20	A	0	0			There is much new literature about regional abatement costs of allocation schemes, which are not described in this report. Herewith a brief summary. Studies of energy system-models: Criqui, P. et al.: 2003. Greenhouse gas reduction pathways in the UNFCCC Process up to 2025; den Elzen, M.G.J. and Lucas, P.: 2005, 'The FAIR model: a tool to analyze environmental and costs implications of climate regimes', Environmental Modeling and Assessment 10(2), 115-134; den Elzen, M.G.J., Lucas, P. and van Vuuren, D.P.: 2005b, 'Abatement costs of post-Kyoto climate regimes', Energy Policy 33(16), pp. 2138-2151; Nakicenovic, N. and Riahi, K.: 2003. Model runs with MESSAGE in the Context of the Further Development of the Kyoto-Protocol. WBGU - German Advisory Council on Global Change, WBGU website, http://www.wbgu.de/, Berlin, Germany; Persson, T.A., Azar, C. and Lindgren, K.: 2006, 'Allocation of CO2 emission permits – economic incentives for emission reductions in developing countries', Energy Policy In Press. Also of macro-economic model analyses (although there are many others as well):	Noted

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						Buchner, B. and Carraro, C., 2003. Emissions Trading Regimes and Incentives to Participate in International Climate Agreements. FEEM Working paper 104.03, Fondazione Eni Enrico Mattei (FEEM), Milan, Italy. Böhringer, C. and Löschel, A., 2003. Climate Policy Beyond Kyoto: Quo Vadis? A Computable General Equilibrium Analysis Based on Expert Judgements. ZEW Discussion Paper No. 03-09, Centre for European Economic Research, Mannheim, Germany.; Böhringer, C. and Welsch, H., 1999. C&C - Contraction and Convergence of Carbon Emissions: The Economic Implications of Permit Trading, ZEW Discussion Paper No. 99-13, Centre for European Economic Research, Mannheim, Germany; Bollen, J., C , Manders, A.J.G. and Veenendaal, P.J.J., 2004. How much does a 30% emission reduction cost? Macroeconomic effects of post-Kyoto climate policy in 2020. CPB Document no 64, Netherlands Bureau for Economic Policy Analysis, The Hague. (Michel den Elzen, The Netherlands Environmental Agency)	
0-21	A	0	0			The regional costs implications of post-2012 regimes for the allocation of emission allowances (future commitments) is not described in the overall report. Chapter 3 describes the regional costs of 4 IPCC SRES regions (based on EMF study), based on one (costs-based) regimes based on full IET and marginal costs. This seems rather ad-hoc choice, as there are many allocation schemes based on various equity principles and allocation schemes (i.e. Multi-Stage, Triptych, Contraction & Convergence, costs-allocation etc) (IIASA, WBGU, MNP-RIVM, Chalmers University/Gothenburg, CIRED, University in USA, MIT, etc. etc.). Chapter 13 describes part of these regimes (in fact not the costs-based regimes) as analyzed in the literature, but do not describe the regional costs implications (* see comment-block: in which I have included the some of the new literature in this field). In fact Chapter 11, discusses only one macro-economic study, i.e. Bollen et al. I would recommend discussing the regional costs in Chapter 3, and in Chapter 13 and Chapter 11. I can deliver some text on this issue. (Michel den Elzen, The Netherlands Environmental Agency)	Noted
0-22	A	0	0			WGIII is not the competent IPCC Working Group to assess vulnerability of systems to temperature rise - that is principally the task of WGII and, to an extent,	This is not a Chapter 2 issue

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						WGI. Throughout the WGIII report a figure of 2ºC for DAI is used, however, this has very little explanation or underpinning in the literature cited. For consistency the range of values expressed in the WGII report should be reflected in the WGIII report. (Spencer Edwards, Australian Greenhouse Office)	
0-23	A	0	0			Throughout the sectoral chapters there is no consistency in the dates used to report proportions of sectoral emissions (for example in Chapter 5 - Transport - figures for greenhouse gas emissions in 2000 are used; while in Chapter 6 - Residential and Commercial Buildings - 2004 figures are used). If there is no consistent use of dates/figures across sectors in the literature, this should be clearly explained and accounted for in a framework/consolidation chapter. (Spencer Edwards, Australian Greenhouse Office)	This is not a Chapter 2 issue
0-24	A	0	0			Throughout the report, mitigation efforts are equated with political instruments (particularly the Kyoto Protocol). For example in Chapter 1 at page 2 it is stated that "The entry into force of the Kyoto Protocol in February 2005 marks a first, though modest step, towards the implementation of Article 2". This statement fails to take into account the significant mitigation efforts already being implemented by Parties under the UN Framework Convention on Climate Change and the plethora of national mitigation measures that have been underway in a host of countries for many years. References in the WGIII report should concern specific mitigation activities rather than to compliance (or otherwise) with any particular political instrument. It is, therefore, submitted that a review be conducted of the report to ensure that references to the Kyoto Protocol are proportionate to its role in the body of mitigation literature. (Spencer Edwards, Australian Greenhouse Office)	This is not a Chapter 2 issue
0-25	A	0	0			The use of 2006 references throughout the report, tends to obscure the transparency of the expert review process. If reviewers cannot obtain cited papers, it becomes difficult for an adequate assessment to be made of the literature used to constitute and support the assessment report. (Spencer Edwards, Australian Greenhouse Office)	Noted

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0-26	A	0	0			see my word paper on two proposed Common Methodologies for Priority Assessment of Mitigation Measures (PAMM) and for Priority Assessments of Adaptation (PAA) (Robbert Misdorp, PUM)	Noted
0-27	A	0	0			Each of the sectoral chapters focuses on different regions to provide examples as to mitigation efforts. A more uniform treatment of the regions is necessary to provide a comprehensive summary of each mitigation sector. (Spencer Edwards, Australian Greenhouse Office)	This is not a Chapter 2 issue
0-28	A	0	0			Considered as a FOD, the report is in reasonable shape, and may---given progress already made at this stage--be reasonably expected to be up to (if not actually even over) the high standard already set by previous AR's. As advised, comments below concentrate on attempting to add value to specific content in, and the general direction of, AR4 as specified in its TOR. As also advised, therefore, comments made here specifically exclude any grammatical, linguistic and/or syntactic errors (glaring or otherwise) still present in this draft. In view of the time available to me, unfortunately only selected chapters are reviewed here in detail (naturally, without prejudice to the remainder). That said however (based on an initial, somewhat abridged, reading) I have reservations that a number of the most crucial cross-cutting issues have themselves not been adequately synthesised in terms of an overall requirement to get to grips with a global mitigation challenge that many policymakers still appear to be at risk of failing if Article 2 of UNFCCC is to be ultimately fullfilled. The introduction of Art 2 itself as a cross-cutter provides--it seems to me at least--- an opportunity to situate the challenge more firmly (vis a vis previous reports) where it ultimately belongs---i.e. explicitly within the arena of UNFCCC. Therefore one of the biggest problems (familiar to us all) namely the Annex-1 vs NA1 configuration has unfortunately not been adequately tackled throughout the report in my view. This is unfortunate, as I believe it is certainly highly arguable that a synthesis of the decision and policy-making, sustainable development, regional issues and short vs long-term cross cutting drivers could	Noted

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						reasonably be summoned up as a strong case to incorporate a much larger and wider-spread review of the plentiful literature concentrating on the A1 vs NA1 dialectic. Subsequent comments below are framed against this context. (Pat Finnegan, Grian)	
0-29	A	0	0			Confidence ranges that are used for mitigation technology development could be included. The Working Group II practice of including specific confidence ranges in brackets after a forecast is made (as is done to a small extent in the Executive Summary of Chapter 9) could provide a useful addition to the report. (Spencer Edwards, Australian Greenhouse Office)	This is not a Chapter 2 issue
0-30	A	0	0			chapters 5-10 disregard generaly the social and regional differences when addressing the problems and solutions of these sectors as if these problems emanate from only one single society or region. (Mohammed Alfehaid, Saudi Aramco)	This is not a Chapter 2 issue
0-31	A	0	0			As former Technical Secretary of the IPCC-WGII-Subgroup Coastal Zone Management 1989 - 1994 and present Netherlands Governmental IPCC Peer Reviewer WGII and III, I strongly suggest to the IPCC - Chair: do not shy away, do not introduce the word uncertainties" unnecessarily too much in the text of the FAR. Replace the word "uncertainty", because the cause you are fighting for is a right cause, and too much use of this word "uncertainties" will shy away the needed future investors. And I assume that that is not the intention of IPCC. Furthermore please come up with clear instructions on systematic mitigation and adaptation for each country so that all the 190 member countries will follow your leadership and enjoy the transfer of knowledge provided by IPCC in an harmonized and effective fashion. • I politely invite the chairman of IPCC to announce the introduction of the hereunder proposed Common Methodologies on PAMM and PAA in the IPCC-FAR, which in my view ought to be developed by IPCC. (Robbert Misdorp, PUM)	Noted
0-32	A	0	0			Discussion(s) of carbon sequestration are difficult to identify in the outline of the entire report. There is a clear inclusion of sequestration in the agriculture and forestry chapters -- but it took me a while to find the discussion of sequestration	This is not a Chapter 2 issue

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						related to fossil fuels. (Stan Bull, National Renewable Energy Laboratory)	
0-33	A	0	0			Throughout the whole draft report there is almost a total absence of gender analysis in relation to climate change and mitigation. From the limited research done it is clear that different energy and mitigation options have different impacts on men and women and this should be reflected in this report. See for example: Mainstreaming Gender into the Climate Change Regime 14 December 2004 COP10 Buenos Aires http://www.genanet.de/fileadmin/downloads/Stellungnahmen_verschiedene_en/Gender_and_climate_change_COP10.pdf and Lorena Aguilar (2004) Climate Change and Disaster Mitigation (IUCN) available on-line: http://www.iucn.org/congress/women/Climate.pdf (Lars Friberg, Climate Action Network (CAN) Europe)	Accepted, the gender aspect will be added in Chapter 2
0-34	A	0	0			The sections on innovation and technological change in chapter 2, 3, 4 and 11 need a common view on how innovation processes work. All of them should include the perspective of the systems of innovation literature and the model of feedbacks between all phases of innovation. Chapters 3, 4, and 11 already imply that climate policies also have important feedbacks on generation of technologies. This view should be more thoroughly discussed in chapter 2, which lays out the foundations on how innovation processes work (see comment on chapter 2 below) (Rainer Walz, Fraunhofer Institute Systems and Innovation Research)	Noted, the chapters are coordinated on these issues
0-35	A	0	0			My general impression is that the report should highlight the changes compared to TAR more specifically. In many chapters, the 'delta' to TAR is hard to conceive. (Fritz Reusswig, Potsdam Institute for Climate Impact Research)	Noted
0-36	A	0	0			It is noted that the terms are not used in a consistent manner throughout the whole report. It is strongly encouraged to better harmonize. (Radunsky Klaus, Umweltbundesamt)	Noted
0-37	A	0	0			It is noted that the scope of the WG3 report should be to provide on a comprehensive, objective, open and transparent basis, the scientific, technical and socio-economic information relevant to understanding the scientific basis of climate	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						change mitigation. However, in its current status not all subchapters of the FOD are consistent with that scope. This is because a) the scope has been interpreted too broad and information clearly goes beyond the scientific basis of climate change mitigation, covering e.g. issues of a primarily political nature as the scientific basis of climate change should be mainly limited to methodological and conceptual issues but clearly shall not include issues related to implementation; b) the literature to be addressed should in general be limited to literature published after 1999 as it has to be assumed that the TAR already covered all relevant literature until 1999, c) the report should also be limited to more robust findings that can be based on more than one publication; d) conclusions included in the TAR need not be replicated but providing detailed reference could also help to keep the report concise and short. (Radunsky Klaus, Umweltbundesamt)	
0-38	A	0	0			It is noted that the length of the FOD (about 1300 pages) is considerable above the envisaged length. However, there seems to be room to shorten the report, e.g. be limiting the text to the scope as specified by the IPCC plenary (see below) and by streamlining the text by avoiding addressing the same information more than once. (Radunsky Klaus, Umweltbundesamt)	Noted
0-39	A	0	0			It is noted that the FOD includes whole paragraphs without any linkage to other parts of the report or to literature. This clearly is inconsistent with the requirement of providing information on an open and transparent basis but may be interpreted as an indication that the text reflects the views of the authors but not findings identified in the underlying literature. Any text, that cannot be linked to underlying literature therefore should also be deleted in the SOD. If there are gaps in literature that do not allow to provide information based on literature but that should be provided according to the agreed outline than such findings should also be clearly indicated as that could help to guide future research. (Radunsky Klaus, Umweltbundesamt)	Noted
0-40	A	0	0			I am very concerned that the focus of the Report, and particularly Chapters 3 and 4, is predominantly on the next 50 years, and subdominantly on the remainder of this century. The reality illustrated by the analysis of Wigley, Richels and Edmonds	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(and later analyses provided for example on pages 223-224 of the TAR Climate Change 2001, The Scientific Basis) BUT IGNORED HERE, is that the problem is much longer term than this. Furthermore, the problem is 10x larger in the long term (~50,000 EJ / 50 years) than in the short term (~5000 EJ / 50 years). As part of the resolution of this problem, we need to introduce technologies in the present century that can almost fully replace carbon-emitting technologies in the next century. Thus we need to be advancing new energy technologies with very high total potential, and we need to be moving to energy uses that are consistent with very low CO2 emission. While it is important to pay attention to the near term, this report must absolutely also keep the much larger long term challenge in focus. It is critical that analyses looking to 2200 be included in this report, as they were in the TAR. See the attached analysis of future non-carbon energy needs, labeled "WRE Analysis.pdf". (Robert Goldston, Princeton Plasma Physics Laboratory)	
0-41	A	0	0			Preliminary Comments: My relevant areas of expertise are inverse integrated assessment modeling for climate change decision support and energy system modeling for energy policy support. The integrated assessment modeling is based on the tolerable windows approach (TWA) (other broadly equivalent terms include the guard-rail approach and safe-landing analysis). I have therefore concentrated on those parts of the WG III AR4 (principally chapters 2, 3, and the glossary), where the tolerable windows approach is discussed. As one of the lead developers of the TWA, I paid particular attention to the consistent usage of TWA-related terminology throughout the entire report. And as the AR4 is intended to provide a comprehensive assessment of scientific progress since the TAR, I took the liberty of adding two publications to the cited literature in order to highlight recent advances in the applicability of the TWA method. I have also proposed a substantial revision to the glossary entry for TWA. (Thomas Bruckner, Technical University of Berlin)	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
0-42	A	0	0			IPCC, 2001 and the like are not valid references. The particular chapter of the assessment should be referenced using the lead authors' names. (Nick Campbell, ARKEMA SA)	Noted
0-43	A	0	0			In many of the chapters there should be further reference to relevant sections from WG I and or II FOD report. This would be useful to ensure full consistency of the reported findings and to demonstrate the interactions between the WGs, which do not seem fully optimal at this stage. Such systematic linking work will be time consuming, it is though necessary. (Philippe Tulkens, TERI School of Advanced Studies)	Noted
0-44	A	0	0			Do a clear distinction between "Biological carbon sequestration" involving the enhanced uptake of atmospheric CO2 by plants, forest, soils, and ocean fertlisation, and "Carbon dioxide Capture and Storage (CCS) involving the capture of CO2 from industrial and energy-related sources and its long-term storage. This disctinction is very clear in the IPCC Special Report on CO2 Capture and Storage. It never uses the term "sequestration" for the CCS technology, and mentions explicitely that it does not cover "biological carbon sequestration". Such distinction is for instance clear in Chapters 3, 7, 8, 12 but should be made in other Chapters such as Chapters 4, 5, 11 etc. (CZERNICHOWSKI-LAURIOL Isabelle, BRGM)	This is not a Chapter 2 issue
0-45	A	0	0			Chapter "GLOSSARY": Page 21: Line 35-40: Please replace the old TWA definition by (see cell above): "The tolerable windows approach (TWA) seeks to identify the set of all climate protection strategies that are simultaneously compatible with (a) prescribed long-term climate protection goals, and (b) normative restrictions placed on the emissions mitigation burden. These constraints or guard-rails can include limits on the magnitude and rate of global mean temperature change, on the weakening of the thermohaline circulation, on ecosystem type loss, and on economic welfare losses originating from selected climate damages, adaptation costs, and directed mitigation efforts. For a given set of guard-rails, and assuming that a solution exists, the TWA outputs an emissions corridor which delineates all complying	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						emissions paths. Safe-landing analysis is similar in concept and if no particular research line is indicated, then the term guard-rail approach covers both." (Thomas Bruckner, Technical University of Berlin)	
0-46	A	0	0			The Report do not include any section about reserves, resources and prices, as it was not planned, but now under present conditions and the important relation to mitigation and not conventional technologies I suggest to consider some assessment of latest trends. (Juan Llanes, Havana University)	This is not a Chapter 2 issue
0-47	A	0	0			The integration of the whole report requires much more work. Particularly in the treatment of costs and benefits of mitigation and technology, there is a lack of integration over chapters 2, 3, 4-10 and 11. My suggestion as to how to divide up the costs literature over chapters 2, 3 and 11 is that concepts should be in 2, numbers for 2050 to 2100 should be in 3 and numbers for 2000 to 2050 in 11. However, Figures in chapter 3 may well need data over history and between 2005 and 2050 to make a point. Dividing up the technology literature is more difficult. My suggestion is that chapter 2 covers concepts and definitions, and explains the main ways that technology has been modelled (e.g. covering Clarke and Weyant, 2002) and later developments in the treatment as in Edenhofer, 2006), 3 covers baseline issues and effects of technology in cost-benefit studies which require a very long-term analysis and cost-effectiveness studies of stabilisation covering 2050 to 2100, and 11 covers technology in cost-effectiveness studies and attempts to integrate them with the technologies discussed in 4 to 10. When covering both cost-benefit and cost-effectiveness studies, it should be made clear in chapter 3 that there is a subsantial different between them as regards costs and effects of induced technological change as brought out in (Goulder and Matthai, 2000). There are so many estimates of GDP costs and carbon permit prices in recent literature that a meta-analysis is worth doing to supplement the tabulated comparison on models and qualitative discussion with some quantitative estimates to sort out the reasons for the differences. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University	Noted, coordination is going on

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						of Cambridge)	
0-48	A	0	0			References: only 7.6 percent from developing countries in chapters 1,2,3,11,12.!!!!! (Juan Llanes, Havana University)	Accepted, more references will be added
0-49	A	0	0			Chapter 1, 2 and 12 dedicate more than 70 pages to Sustainable Development, suggest reviewing chapter 2 and 12 overlaps (Juan Llanes, Havana University)	Accepted, coordination goes on
0-50	A	0	0			Also overlaps with regards to ancillary benefits within chapter 11 and 4-10 (Juan Llanes, Havana University)	Accepted, coordination goes on
0-51	A	0	0			Almost all quotations to economic issues relays on the neoclassical approach, other approaches as ecological economics and bioeconomics both with well-known Journals are not included as alternatives to be assessed, specially on chapter 2,3, and 11. (Juan Llanes, Havana University)	Accepted, references will be added
0-52	A	0	0			There is a general problem how to handle the TAR. Should it be summarized or just cited as a reference? THis issue is not dealt with in the same way in the different chapters. (Marco Mazzotti, Institute of Process Engineering)	Noted
0-53	A	0	0			The whole present report gives a good updated material and captures as well new recent information. Chapters 2, 3, 11 and 12 will be in that regard very important, in the sense they are going to capture cross sectoral informations as well as long term perspective consequences of all the relevant informations. I recommend that particular attention is given to these chapters, which will be of added value, for the whole process. (Jean-Yves CANEILL, Electricité de France)	Noted
0-54	A	0	0			Very comprehensive document, but from the Chapters I have carefully read, I would like to see more integration between Ch. 4 and the general aspects covered in Ch. 2, 12 and 13. Presume this also relates to the other sectoral chapters. (Oren Kjell, Norsk Hydro ASA)	Noted
0-55	A	0	0			There are a number of practical consequences of taking such a view seriously. One	Accepted, the aspect will be added

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						is that distributional issues are much more important than commonly recognized. Mainstream economics acknowledges the existence of a "declining marginal utility of income", but with limited exception it is not incorporated into economic analysis. Frankly, there is not - and I would argue cannot be - an "objective" measure of the declining marginal utility of income; in practice it is a choice of the analyst, and - as with the choice of a discount rate - it implies that costs are fundamentally indeterminate, and specifiable only by value choices of the analyst. The few studies (e.g., the work of Richard Tol and Christian Azar) that have taken this up have demonstrated that the conclusions of climate policy analyses are enormously dependent on these choices, but the consequences of this indeterminacy haven't been widely acknowledged. (Paul Baer, Stanford University)	
0-56	A	0	0			One issue that seems to have fallen between the scope of chapter outlines is any analysis of the financial sector. I am not expert in this field but surely it plays an important role and the literature on this should be covered somewhere? (Michael Grubb, Cambridge University)	Noted
0-57	A	0	0			Indeed, if I had one meta-level comment to make about all of the WGIII FOD, it's that the draft needs to be more self-conscious about the deep controversy about values at the heart of the economic paradigm. In particular, the assumption that "utility" is something objective that can be measured through market or non-market valuation, and thus that economic analysis is a useful approximation of "true" values, is only one perspective, albeit the dominant one. What I would consider the primary alternative - that valuation is an ongoing a social process, and that the value of "outcomes" is a question of meaning and choice rather than utility - is not well represented in this document. (Paul Baer, Stanford University)	Noted and will be handled in the editing
0-58	A	0	0			Generally I am surprised there is not an element in the structure that identifies key weaknesses in literature/knowledge to assist future work (Andrew Dlugolecki, university of east anglia)	Noted
0-59	A	0	0			A second practical consequence is that uncertainty becomes much more important.	Accepted, to be reflected in chapter 2

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						Subjective expected utility maximization requires a unique probability distribution for outcomes as well as a unique utility function. Such unique probability distributions do not exist for most parameters of interest (both "scientific" and "economic") in the climate policy debate (see Baer et al 2005 and Baer 2005). The consequences of this kind of multi-dimensional uncertainty for decision-making have barely begun to be explored, but again, it implies that most economic analyses which suppress this uncertainty through unexplained value choices of the analysts, do not provide the kind of "objectivity" that they are presumed to have. (Paul Baer, Stanford University)	
0-60	A	0	0			Whenever data for the European Union are mentioned, it is important to make clear "which" EU it refers to. The EU has been enlarged from 15 to 25 member states in 2004, and it maybe further enlarged by 2007. Some data cannot be interpreted without the knowledge whether it refers to the EU-15, the EU-25 (and perhaps later the EU-27). (Diana Urge-Vorsatz, Central European University)	Noted
0-61	A	0	0			All authors and lead authors must be commended for bringing a large amount of valuable material in this first order draft. There at this stage many redundancies, which should be reduced in the further development of the report. However, despite these redundancies, or perhpas because of them, there are several topics that are not addressed with sufficient scope and detail altogether - or presented in a misleading manner. I shall limit my general comments to two of them: renewables, and long term strategy (though a third one could be discounting, but I hope the detailed comments that follow will be sufficient). 1. RENEWABLE. It is hardly surprising that in a 1255 page draft renewables are only covered in a few pages, and with somehow misleadidng information. First, a global perspective could be given about the overall potential. Solar energy exceeds 8,000 times our primary energy supply. Although the technico-economic potential is certainly orders of magnitude lowers than the overall potential, it is still likely to ultimately cover a large percentage of our needs, if not all. Second, a fair assessment could be made of the "technico-economic potential" that could be reached, say, in 2050 and 2100, for all	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						technologies. For example, table 4.3.1 narrows solar thermal to solar thermal electricity alone - and mixes estimates of overall technical potential, such as indicated for PV (1600 Ej/y), and assessments likely to be derived from technico-economic consideration, such as that for solar thermal (1.7 Ej/y). Although the confusion is in the source, IPCC role is to critically assess the information. What solar technology is more likely to provide more electricity in 2050 or 2100 is hard to guess, but they may end with comparable contributions: PV is handicapped by its costs and intermittent nature, CSP technologies being cheaper and more easily made guaranteed and even dispatachable, but limited to areas with strong direct insulation unless exported. In any case, both technologies may remain outweigthed by far, as they are today, by solar thermal contribution to heating and cooling needs (see comments on chapt'er 4). 2. LONG TERM STRATEGY.The report could perhaps more clearly make three points: 1) cooperative strategies oriented toward research and development, as useful they might be, are unlikely to produce sufficient results by themselves in the absence of carbon prices throughout the economy; 2 Economic instruments, as useful they might be, need to be complemented by other instruments to address market imperfections, including R&D support and some specific financing mechanisms for technologies in their infancy, in order to bring down their costs through learning by doing processes; 3 Uncertainties on both costs and benefits of climate policies conflict with inertia to create a dilemma on long term objective(s): it cannot be defined once for all, but its absence is detrimental to the process. An abundant literature showing firm targets do not really fit the long terme cumulative nature of the climate change problem in the context of uncertainties. Combined with periodic revisions of an educated guess on what we would like to pay for mitigating climate change, the most pragmatic way to drive action by all countries and all players would be set indicative ambitious long term targets while making their full achievement dependent on actual costs - ie a sustained use of price capping mechanisms to accompany tradable permit schemes. This and similar suggestions could be more extensively discussed, in particular, but not exclusively in chapter 13 (see detailed comments).	

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Cédric Philibert, International Energy Agency)	

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
2-1	A	0	0	0		There is considerable overlap in some chapters on scenarios and models. Due to the excessive length of some chapters one of the objectives of the 4AR, to provide a more concise statement on mitigation issues then previous assessments, is not met. While the content of most of the lengthier chapters is generally sound and the style acceptable to good, Chapter 2 would benefit from considerable cutting. The first twelve pages of this chapter could be omitted without loss, and indeed little in the first 18 pages need be retained. (Michael Jefferson, World Renewable Energy Network/Congresses)	This is rewritten and coordinated with chapter 12 to avoid overlap
2-2	A	0	0			I have four general observations. 1. There is considerable overlap between the chapters I looked at, between WG2 and WG3, and even within chapters. A lot of material is simply duplicated, and should be cut to improve readability and reduce size. 2. In a number of instances, authors mainly quote their own work. This is unworthy. In a number of instances, authors mainly quote other IPCC material. This is incestuous. The quoting of IPCC material is most pronounced in the scenario discussion, which can be summarised as "We, the IPCC, declare that all previous IPCC work is great." This is silly. 3. When cutting overlap, please concentrate the material in the chapters with experts among the authors. In many places, the authors are out of their depth; the selection of papers is haphazard, the assessment superficial. I also found too many references that are simply wrong; the authors cannot have read these papers. For a supposedly expert panel, this is very serious. 4. In a number of instances, the draft material reads like a political manifesto rather than a scientific document. In other instances, the authors have tried to hide their political message in pseudo-scientific language. For a supposedly independent panel, this is very serious. (Richard Tol, Hamburg University)	Coordination with various chapters are going on which will take care of this
2-3	A	0	0			Although content and style improve as this chapter goes along, 98 pages seems excessive. Even the material from page 25 onwards could usefully be streamlined.The same goes for some of the Tables and Figures. (Michael Jefferson, World Renewable Energy Network/Congresses)	The chapter is rewritten and shortend
2-4	A	0	0			Synergies and trade-offs of climate change mitigation and energy security have been extensively looked at by Blyth and Lefevre at the IEA. Exact references to follow. (Cédric Philibert, International Energy Agency)	This is more a chapter 4 issue 4

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
2-5	A	0	0	0	0	I am attaching a working paper which may be useful in discussing the relationship between the precautionary principle and models of choice under uncertainty (John Quiggin, University of Queensland)	Thanks
2-6	A	0	0			Excellent review of Climate change linkages with SD. It is especially important to stress the 2-way linkages between CC and SD, as well as the integration of CC policies into national development goals (Mohan Munasinghe, Munasinghe Institute for Development (MIND))	Thanks
2-7	A	0	0			Although the discussion on sustainable development does provide same very good framing information, a clear definition is lacking. Perhaps prminently including a definition (such as ina box) may assist the reader. (Lourdes Maurice, US Government)	Agreed and appropriate material will be added.
2-8	A	0	0	0	0	This chapter realy need to be redefined in terms of issues and contents. (Mohammed Alfehaid, Saudi Aramco)	Noted, the chapter in terms of issues and contents follow the approved outline
2-9	A	0	0	0	0	The authors do a nice job of discussing the difficulties of valuing ecosystems but are almost cavalier in their statements providing no references at all. Yet, there has been a substantial amount of literature on valuing ecosystem services, on whether ecosystem services should be values, etc. References should be provided. There have also been any number of publications where valuation has been attempted over and above the oft cited and oft criticized work by Costanza and his colleagues. The authors should work to provide more background and/or references for the readers of this chapter on this topic. (Jeff Price, California State University, Chico)	References will be added
2-10	A	0	0	0		General- This chapter is too long and overly theroetical bearing in mind the intended audience is not academics and researchers. (Or is it?) (HEDGER MERYLYN, Environment Agency)	Noted, to be considered in the next revision
2-11	A	0	0			It is apparent that figure2.2.1 must be deleted and the remaining figures renumbered. (Jorge Gasca, Mexican Petroleum Institute)	Accepted
2-12	A	0	0			In the context of the cover note and additional material provided herewith, the frequent repetition that we are dealing with a very long term problem needs revisiting. Although climate modellers cannot yet demonstrate the possibility (or replicate such events as demonstrated by paleo-climatologists) it may be that precursor signals of abrupt climate change are already with us and that much shorter term responses are needed than seems to be generally envisaged in this Chapter. Fortunately the holistic strategy offers substantial prospects of this, and, in section 9, the availability of large scale bioenergy as a transition technology till	Noted, some of these issues belong to WGI (climate modelling).WGI On technologies, agreed. Argument that technology decisions structure costs is extensively made in the chapter. Reference to technology lock-in phenomena literature is added in section 2.9.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						the latter half of the century needs to be emphasized (e.g. in the words of line 81/29-30 "successfully demonstrated nearly affordable technical solutions" where Faaij's contribution to the Workshop [second article in the forthcoming MITI special issue - see Annex 2 in the additional material] is particularly relevant). A second general point is that the literature on competing technologies [W. Brian Arthur and co-workers] needs to be more explicitly referenced: the non-linearities and instabilities that are noted in the discussion of technology largely derive from the reality that there are investment bandwagons - if one technology becomes fashionable and gets adopted it gets a lead on other technologies [or can be made to overtake under appropriate policy]. Clearly the competition is broadly between fossil energy and renewable energy [mainly bio-energy under the holistic strategy]. If it becomes fashionable for energy managers to invest in bio-fuel supplies they will, with constrained budgets, stop investing in exploration for [i.e. researching into] fossil fuels so that fossil fuels will get more costly at the same time as there is learning by doing with bio-fuels. This makes costs, and relative costs, a somewhat chimerical concept, since they become the consequence of [appropriate] policy, not the basis of policy selection. Thirdly, it should be noted that the Convention specifically mentions cost effectiveness rather than cost benefit. From a theoretical perspective the foundation of CBA is a governmant that enforces some pattern of income distribution that is accepted. There is no such international government and no acceptance of the international pattern of income distribution. That was the reason for the dispute between the authors of Chapter 6 in the SAR and the plenary meeting which resulted in an SPM different from the Chapter. The compromise adopted by the TAR, to treat all lives as equal begs the question as to what the value should be. Properly, globally equal lives can only be set against economic costs in the context of MCA where the trade off is explicit rather than bound up in a cash total. (Peter Read, MASSEY UNIVERSITY)	Sections 2.5 and 2.7 includes discussions about the assumptions behind CBA and the implications in income distribution, and the discussion also compares cost effectiveness analysis and CBA. Issues related to an "internal government" are also adressed in the decision making section.
2-13	A	0	0			I was very pleased to see discussion of Pacala and Socolow's work on wedges. To add to this discussion -- there needs to be great attention given to the health, safety, security, ecological and economic dimensions of each wedge. In addition, there needs to be a lot of work on the financial instruments to achieve these solutions (Paul Epstein, Harvard Medical School)	It is not in chapter 2 TSU
2-14	A	0	0			• Chapter 2 needs to coordinate with Chapter 12 on defining Sustainable Development.	Acccepted, coordination is going on The length will be reduced.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						There are unnecessarily duplicates analysis in other chapters. The chapter teams, CLAs in particular need to take action on this. At the same time, the length of the report should be reduced. (Capetown Industry Expert Meeting, Industry)	
2-15	A	0	0	0	0	This chapter has a complex task to fulfill. The very long length of the chapter only hinders the message of the authors and thus needs to be reduced drastically in length. Perhaps halving the chapter would increase the readability of the chapter. (Rutu Dave, IPCC, TSU WGIII)	Noted, the revision will address this
2-16	A	0	0			The chapter is a bit heavy on text, and generally the Report could benefit from more graphics that really encapsulate data or messages. One possible such graphic is that of "population vs per-capita emissions" in different regions, because it encapsulates several dimensions of the challenge including current inequalities, potential for future growth, relative scales of industrialised and developing country contributions, and divergence within each group. The most recent version of the graphic is published in M.Grubb, "Kyoto and the Future of International Climate Change Responses: From Here to Where?", International Review for Environmental Strategies, Vol. 5, No. 1. But I could supply the data and package for generating the graphic, with or without attribution. (Michael Grubb, (a) Carbon Trust(b) Cambridge University(c) Imperial College London)	Given our task of reducing the chapter size adding this is not appropriate. The chapter already has adequate reference to per capita
2-17	A	0	0	0	0	Figures 2,9,1 until 2,9,5 are difficult to undertstand and intepret. The long explanations under the figures does not clarify the matter either. Would it be possible to have more clear statements regarding the figures? (Rutu Dave, IPCC, TSU WGIII)	Noted, the revision will address this
2-18	A	0	0			I would like to make a general statement on the way decisoon making and decision support is dealt with in this report.The main problem is the way the concept of decision support is used.The authors seem to confuse economic theory and decision making. In economics one develops results based on usually very simple assumpions . Everything is assumed to be possible to be converted into monetary units and impacts assumed linear and costs typically quadratic. Under such assumptions one tries to prove e.g. the existence of stable equilibria .This is interesting but does not help the real problem at all as the assumptions are far from realistic as the report itself says in many places.Thus statements about the usefulness of game theory such as the claims on the new coalition theory on page 20 are missleading and useless. Here the authors talk about social optimum and at the same time the report acknowledges the difficulties in working with multicriteria	Noted, and will be considered in the revisions of the decision making section and in the cost section. Some of these issues – e.g. game theory – will also be coordinated with the coverage in Chapter 13 The suggested literature on MCA will be assessed. The comments on uncertainty and risks are noted and taken into consideration in the

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(non-market) benefits and costs which are not captured with economic theory.Also a related issue is the long discussion on valuation methods which are rooted in economic theory . The authors seem to ignore theraelity and keep on pushing a discussion on villingness to pay type methods p. 45 ,which have very little relevance in a situation which is intergenerational and global. A reference such as Bennet 2000 which is not easily available in the mainstream literature makes the text evn more strange.The way game theory could contribute to the global warming issue is its use as a setting for developing structured negotiation and mediation processes.See for example the famous PON project in the Harvard Law School.The whole idea in decision support is missed. The way the authors see decision analysis being used shows that they do not know the field. A decision analyst would never enter the weights as claimed 20 page 23.. There are other books than the classic Keeney and Raiffa 1993 which focus more on the process which is the essential part in the analysis see books on MCDA by such authors as Hobbs and Stewart and Belton.(Multiple Criteria Decision Analysis: An Integrated Approach Val Belton and Professor Theodor J. Stewart) The following article also relate to the topic:Bell, M.L., B.F. Hobbs, E.M. Elliot, H. Ellis, and Z. Robinson "An Evaluation of Multi-Criteria Methods in Integrated Assessment of Climate Policy". J. Multicriteria Decision Analysis. vol.10. (2001). pp. 229 - 256. The treatment of uncertainty is deep and philosophical and as such leads the reader to miss the point Even the authors themselves seem to understand that the deep problems lie in what they call structural uncertainty or in other words lack of understanding rather than lack of information. Here it might be better to talk about modelling errors when we do not know the correct structural relationships of factors and variables related to global warming phenomena. All in all this chapter should and could be shortened essentially. The reader does not need an introduction to economic theory .Economic phenomena are naturally important as drivers for the use of energy for development but on a global level there is very little hope in developing a model based equilibrium which could be credible for the real parties involved.The preferences remain non explicit and thus no such agreement based on colaition theory is likely. Coalition theory can give ideas why such agreements do not work but they do provide the process to the agreement. (Raimo Hamalainen, Helsinki University of Technology)	revision of section 2.4
2-19	A	0	0			Chapter 2: I have reviewed only those parts of the chapter where I feel competent to give comments (mostly Section 2.3 and 2.4). Based on this limited evidence, I think that this chapter is already in pretty good shape -- much better than many other	We are adding references

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						chapters I have seen. One weakness of the current draft is the scarcity of references. Some sections do not cite a single reference. (Hans-Martin Fuessel, Stanford University)	
2-20	A	0	0			I have two comments related to Chapter 2. They involve the first and last "framing" issues. I will begin with the latter because to my mind it is the more important. 1) I find it odd that technology is the last of the "framing issues" discussed in the chapter Arguably technology is the crucial factor for stabilization. The studies reviewed in Chapter 11 make clear the crucial role of technology, and the uncertainties associated with it. Unless being placed last is an indication of how important is technology, I think that it would be desirable to move technology up to second place among "framing issues", right after sustainable economic development to which it is related. A repositioning is appropriate because technology and technical change are essential to sustainability. Without technological change, I cannot see how the first sentence of section 1.4.2 of Chapter 1 could possibly be true. It is stated there (Ch 1, p.7, line 46) that: "Climate change mitigation is part and parcel of sustainable development and the two are mutually enforcing". In fact, however, economic growth (which is how most of the developing world is likely to interpret "sustainable economic development") is almost certainly in conflict with mitigation/stabilization, without the intervention of truly momentous changes in energy technology and infrastructure. 2). In chapter 1, there are repeated references to "sustainable economic development" or "economic development to proceed in a sustainable manner", as a factor conditioning DAI. (See especially pp.2, 3 in Chapter 1.) I can therefore understand why "sustainable economic development" would be an important "framing" issue in Chapter 2. But when we get to Chapter 2, the adjective "economic" appears to have been dropped and the term used is "sustainable development". This raises the obvious question whether the two terms "sustainable economic development" (SED) and "sustainable development" (SD) are treated synonymously or whether they are considered by the IPCC to mean different things. If they mean different things, then why the switch from the former to the latter term? If they mean the same thing, then does the argument in section 2.2.3 of Chapter 2, that there is a dual relationship between CC and SD, still hold? As I read the discussion on p.8, it seems to suggest that policies to mitigate climate change and to promote sustainable (economic?) development reinforce each other. Unless "sustainable" is strictly identified with reducing GHG emissions, in which case the relationship is tautological, the evidence suggests that reinforcement may not be the case, that development will continue , whether	Noted, the chapter is discussion sustainable development including economic, social and environmental dimensions. The definitions of sustainable development will be clarified as well as the specific linkages to climate change. The section reordering comment will be kept in view.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						"sustainable" or not, with carbon emissions rising apace. In any event, some clarification is required in Chapter 2, even though the Report devotes a whole, but not particularly enlightening, chapter (12) to SD and mitigation. One reason for some confusion is that it is not clear how "sustainable economic development" is defined by the IPCC, unless it is the same as "sustainable development"(SD). As I understand the Report, it adopts the definition of the World Commission on Environment and Development that SD is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Ch. 2, p. 9). If income per capita is a measure of meeting "needs", then clearly growth in income per capita, including substantial investment in capital stock, will help meet the needs of the future, even if the resulting growth in the use of energy has negative implications for climate. (I assume that the Report is not treating sustainability in a tautological manner: that is, the Report does not intend that economic development is only "sustainable" if it is consistent with climate stabilization/mitigation.) Further, while the chief impediments to economic development/growth may be existing socio-economic and institutional barriers that inhibit economic growth, these are not the chief barriers to climate stabilization, which are mainly energy technological in nature. (Christopher Green, McGill University)	
2-21	A	0	0			Issue of peaking, overshooting and stabilizing concentration scenarios is very briefly discussed here. In particular peaking instead of stabilizing is a cost-effective way to reduce the climate risks and reach for example the 2 degree target. See Meinshausen (2006) - Exeter avoiding dangerous climate change; den Elzen and Meinshausen (2005) - MNP report (www.mnp.nl\en); Other literature: O'Neill - PNAS paper; Wigley- OECD paper/book contribution. This issue is also not analyzed in Chapter 3. Below I give some suggested text about these studies. (Michel den Elzen, The Netherlands Environmental Agency)	This is a chapter 3 issue
2-22	A	0	0			I miss some important literature here about risks management, such as hedging (Yohe, Science paper) and papers of risks of low- or unknown probability of high impacts events: Schneider and Azar (2001), Mastandrea and Schneider, 2004 (Science); papers of Keller, etc. etc.; REFERENCES: Schneider, S.H. and C. Azar, 2001: “Are Uncertainties in Climate and Energy Systems a Justification for Stronger Near-term Mitigation Policies?” in Erlich, E. (ed.), Proceedings of the Pew Center Workshop on The Timing of Climate Change Policies, 85-136. Washington D.C., 11-12 October 2001. ; Mastrandrea, M.D. and S.H. Schneider, 2004: "Probabilistic Integrated Assessment of 'Dangerous' Climate Change",	Suggested references will be considered during the next revision

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						Science, 304, 571-5, 23 April 2004.. ; K. Keller, M. Hall, S.-R. Kim, D. F. Bradford, and M. Oppenheimer: Avoiding dangerous anthropogenic interference with the climate system Climatic Change, 73, 227-238 (2005). K. Keller, B. M. Bolker, and D. F. Bradford: Uncertain climate thresholds and economic optimal growth Journal of Environmental Economics and Management , 48, 723-741 (2004).; etc. etc. (Michel den Elzen, The Netherlands Environmental Agency)	
2-23	A	0	0			This chapter does not seem to flow or have a defined scope/ function, as many of the questions addressed here are then repeated and subsequently addressed in later chapters. Without significant revision that provides clear guidance as to the coverage and the issues treated in the WGIII report and includes examples of the practical application of the framework issues, this chapter will have limited utility. (Spencer Edwards, Australian Greenhouse Office)	Noted, the chapter revisions will take this into consideration
2-24	A	0	0			excellent analysis. The literature is very well covered, including recent modelling developments and theoretical analyses. Just a minor comment, given the high level of importance of this document, and the level of critique and scrutiny, I would suggest including more robust statistics that justify the mostly philosophical and lengthy discussions. The same text could increase in value by including specific consideration of the numbers and their projections. (Stephan Halloy, Universidad Mayor de San Andrés)	Thank you, numbers are represented in other chapters
2-25	A	0	0			(Notwithstanding comments on the Introduction) this chapter is already in pretty good shape in my opinion. (Pat Finnegan, Grian)	Thank you.
2-26	A	0	0			The chapter suffers from several weaknesses that make it difficult to read and to discern its substance (which, undoubtedly, is there). In particular, I think that 1.) the presentation is opaque in many places, suffering from reiteration of common sense statements with different words, from a sometimes remarkable lack of presenting concrete results that might help to illustrate the framing issues, and from an often poor explanation of scientific arguments and reasoning; 2.) the chapter overemphasizes generalities at the expense of precise statements about basic findings, hypotheses and controversies (which, in fact, are the substance of the framing issues, the reader wants to learn about); 3.) the chapter shows a regrettable lack of aspiration in structuring the debate and laying out the broad picture of a research agenda for the coming years. This seems to be a missed opportunity as the IPCC AR4 WGIII chapter on framing issues is a paramount location for such an	Noted, the chapter follows the guidance from the IPCC process, and the contents are confined to the chapter outline. We are improving the whole text.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						attempt. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	
2-27	A	0	0			It seems that some of the subchapters are more advanced than others. Subchapters 2.2, 2.3, 2.4 and 2.7 seem to be less advanced compared to other chapters. It is recommended to carefully check those chapters whether all parts are consistent with the specific objective of the report (see also above the general comments). (Radunsky Klaus, Umweltbundesamt)	Noted and will be considered in the revision
2-28	A	0	0			The whole chapter is particularly interesting and well illustrated. But is is rather difficult to imagine it being "summarized" in a few words for policymakers. Maybe one missing element would be to conclude that the serious and complex decisions for the level of mitigation required by the menace of Climate Change cannot be replaced by a few technology initiatives or investments late in the century. (Antoine BONDUELLE, E&E_Consultant)	Noted
2-29	A	0	0			General Comment: This draft, with the complete text, is much easier to comment on than the ZOD. The chapter provides a good orientation to the framing issues, continuing and new, covered in the WG3 report. Unfortunately, it is so long that the people who could benefit most from reading it are unlikely to. No signal was given in the invitation that suggested areas to shorten would be welcomed; therefore, I will not take the time to do that. However, there are many sections where the detail provided does not add much if the intent is simply to provide an overview of the issues. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Noted and the revision will consider reducing the length
2-30	A	0	0			General Comment: Each 2nd-level section should remind the reader that this is a framing discussion, with a reference to the chapter(s) where a fuller assessment can be found. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Accepted
2-31	A	0	0			This chapter is very abstract and too long. Wouldn't it be better to have this later when examples from other chapters can be used to support the discussion? (Marco Mazzotti, Institute of Process Engineering)	We cannot change the chapter sequence. We will consider including more examples.
2-32	A	0	0			There is considerable overlap with chapter 1, particularly in sections 1.4, 1.5, 1.7; consider to merge chapters (Bert Metz, IPCC)	Coordination is done
2-33	A	0	0			figure numbers wrong (2.2.1 = 2.2.2 etc; 2.2.1 not belonging to ch 2) (Bert Metz, IPCC)	Noted and changed
2-34	A	0	0			Current sequence of sections is not helpful for logical flow. Suggest different sequence: 1) CC&SD, 2) Mitigation, vulnerability and adaptation relationships, 3)	Noted, the section reordering is under consideration and we will also keep in view

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						Risk and uncertainty, 4) Decision making and implementation, 5)Distributional and equity aspects, 6) Costs and benefits concepts, 7)Technology, 8) Regional dimensions (see TS draft) (Bert Metz, IPCC)	this comment
2-35	A	0	0			Chapter needs to be much more concise and much more focussed on definitions, concepts and general notions that are used througout the report, That is the role for ch2: put together those issues that frame the rest of the report, avoiding such issues to be repeated in many places, but leaving the assessment of the findings on those issues to the respective chapters. In this draft the chapter wanders into lengthy descriptions and textbook material, leaving the reader with questions on why this material is there and not answering the key questions on how things are defined in this report. It also contains in places material that should be left to other chapters (see detailed comments). The chapter needs major editing in this respect. In this editing proces it is also necessary to integrate material that belongs to ch 2, but is now in other chapters (see also detailed comments) (Bert Metz, IPCC)	Noted and some exchange with other chapters are going on
2-36	A	0	0			Surely this chapter is way over page length. The topic areas also have significant overlaps with other material in the AR4, notably: Section 2.2 (with WGIII Chapter 1, also WGII Chapter 18); section 2.3 and 2.4 (to some extent with WGIII Chapter 3, but mostly with WGII Chapters 2 and 18); section 2.5 (with WGIII several chaptes? also WGII Chapter 20; Section 2.6 (with WGII Chapters 17, 18, 19) (Michael Grubb, Cambridge University)	Noted, overlaps will be minimizes as appropriate
2-37	A	0	0			A Chapter I read with great interest. However, my main impression is that many of the theoretical discussions and aspects are not picked up in the sectoral Chapters that follows. So I hope more work will be done to clearly stating which of the issues that have to be treated for each sector. (Oren Kjell, Norsk Hydro ASA)	Agreed, we will coordinate with other chapters
2-38	A	1	0	85		This is an extremely interesting chapter throughout, generally well written though some sections seem to be by authors for whom English is not their native language (e.g. the first two). (Peter Read, MASSEY UNIVERSITY)	Thanks, and the language will be edited
2-39	A	2	28			Section Executive Summary. I would suggest repeating in the executive summary of Chapter 2 the finding from section 1.7.1 in Chapter 1. (p.12 L.55 to p.13. L.1). Sustainable development policies are extremely difficult to implement and require much change in the decision making-process of most countries in the World. However, as stated in Chapter 1, sustainable development policies may be the most	Noted, and will be considered in the revision

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						effective policy framework to address the climate change issue effectively. Section 2.2.5 refers to alternative development paradigms and Iam wondering whether it would be possible remind the readers on the advantages and disadvantages of dirrerent development paradigms in the climate change context. Such a comparison, possibly available in the literature (however I have no reference to provide) might rank the sustainable development approach as of the most effective options. (Philippe Tulkens, TERI School of Advanced Studies)	
2-40	A	2	29			Executive Summary: The ES provides a good description of the content of the chapter. However, very little information is given what the most important developments were since publication of the TAR, and where the state of knowledge of the TAR has been largely unchanged. (Hans-Martin Fuessel, Stanford University)	Noted, and will be considered in the revision
2-41	A	2	30	4	10	The Executive Summary could usefully be cut, excluding the more obvious statements. (Michael Jefferson, World Renewable Energy Network/Congresses)	Noted, and will be considered in the revision
2-42	A	2	30	4	10	A general comment for this chapter, and the ES in particular, is that there appears to be an unclear division between the terms such as "policy" and "issues", and there is not a clear description of what "Framing" means. Suggest that there be some definition of public policy framework (or architecture), public policy (international, national), issues, framing, and actions. Some sections of this chapter refer to mitigation as policy while others do not. Public policy (and policy architecture) is just one aspect of mitigation issues. Suggest that discussion of policy be more explicit, and separate, from other framing issues related to mitigation or development. (Haroon Kheshgi, ExoonMobil Research and Engineering Company)	Noted, coordinated with chapter 13 13
2-43	A	2	49	3	8	This is not focused enough to be part of an executive summary (Marco Mazzotti, Institute of Process Engineering)	Noted, and will be considered in the revision
2-44	A	2	0			Executive Summary: The first paragraph to subchapter 2.1 informs that chapter 2 provides conceptual frameworks. However, the executive summary does not inform about the most relevant conceptual frameworks for the WG3 report of AR4 and also not about the strengths and limits of those frameworks or even lacks of frameworks. It also does not inform about the actual implementation of such frameworks. If the executive summary would focus on those issues chapter 2 could add a lot of value to the other parts of this report. (Radunsky Klaus, Umweltbundesamt)	Noted, will be considered in the editing
2-45	A	3	5	3	7	While the sentence beginning "It is important …" should be obvious, it is too often	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						forgotten in policy discussions. This sentence should be retained and emphasized in future drafts. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
2-46	A	3	10	3	12	Subchapter 2.5 shows that there are significant limits to assess costs and benefits of mitigation to climate change. It is proposed to add some qualification, e.g. … can be assessed to some extent because otherwise a wrong impression would be given to the reader. (Radunsky Klaus, Umweltbundesamt)	Noted, see the specific comments related to section 2.5
2-47	A	3	12		25	Seems pretty detailed for a introduction. Here, talk more generally about costs of time. Move this discussion to section 2.3.3.2 (pp. 19-20). (Elizabeth L Malone, Pacific Northwest National Laboratory)	Noted, will be shortend
2-48	A	3	39	3	40	Traditional economic approaches do not "assess equity in terms of the aggregated welfare consequences of adaptation and mitigation policies." They do not assess equity at all. They assess the "goodness" of a policy on the basis of aggregate utility, but have nothing to say about equity. (Paul Baer, Stanford University)	Accepted, will be modified
2-49	A	3	40	3	41	Rights based approaches do not assume that rights come from a social contract. (some do, but not all). (Paul Baer, Stanford University)	Accepted
2-50	A	3	41			editorial change: REPLACE "...whether the…" BY "...whether they…" (Mohan Munasinghe, Munasinghe Institute for Development (MIND))	Accepted
2-51	A	3	41	3	41	change "the" to "they" (H-Holger Rogner, IAEA)	Accepted
2-52	A	3	42		43	Aggregate welfare is not only an economic concept; this paragraph generally and these lines specifically seem to blur economic and non-economic aspects of welfare, but the discussion of equity should explicitly include both. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Accepted, revisions will be made
2-53	A	3	52	3	52	While technology development and diffusion is a lengthy process,a century seems excessive. What are some examples of technology development and diffusion that take a century? (Lourdes Maurice, US Government)	Accepted, will be changed to say “longer”
2-54	A	4	14	5	41	Is this chapter scoping section necessary? It is pretty obvious stuff and adds little (if anything) of value. (Michael Jefferson, World Renewable Energy Network/Congresses)	Noted, and will be considered in the revision
2-55	A	4	47	19		(not 1000 m and greater) but 800 m and greater (MICHEL PAILLARD, IFREMER)	This seems not to be related to chapter 2 TSU

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
2-56	A	5	10	5	10	There is a mistake in the Figures above Figure 2.2.1 - the IMCP chart should not be here. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Accepted
2-57	A	5	10	5	29	Figure 2.2.1 from the TAR has a number of weaknesses, discussed in detail in (Barker, 2003). There is a strong case for improving it, to make it clearly a stocks-and-flows chart showing (1) the greenhouse effect, (2) the fact that mitigation reduces the need for adaptation and (3) the effects of non-climate-change stresses adding to climate-change stresses. The TAR figure also has an over-emphasis on adaptation. A most important point omitted from the discussion here, is that mitigation reduces the uncertainties throughout the the system, whereas adaptation reduces uncertainties very partially at at the final stages of effects of climate change. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Noted, will be taken into consideration in the introduction to 2.2
2-58	A	5	13			I'm glad your examples are suitable. (Richard Tol, Hamburg University)	Noted
2-59	A	5	15	5	16	It is noted that the distributional issues are more complex. It might be useful to also consider also distributional issues between groups of countries, between people of different age, between different economic sectors etc. (Radunsky Klaus, Umweltbundesamt)	Noted, will be considered in the editing
2-60	A	5	15	5	16	This framing of the distribution of damages as a long-term concern is misleading; arguably climate-change induced damages are already occurring, and it is certaintly not to early to start figuring out issues related to liability (in part because liability for funding for proactive adaptation is also related to damages - see Baer in press, manuscript attached.) (Paul Baer, Stanford University)	Noted, the reference will be assessed
2-61	A	5	18	5	21	See comments on p.3 lines 39-40 and 40-41. (Paul Baer, Stanford University)	Noted
2-62	A	5	39	5	39	Erratum: learning-by-doing (FÉLIX HERNÁNDEZ, IEG-CSIC)	Accepted
2-63	A	5	43	16	41	this section heavily overlaps with ch 12; keep general concepts and definitions here (and remove material from ch 12 and integrate it), leave specific findings to ch 12 (Bert Metz, IPCC)	The section is being coordinated with chapters 12 and 3
2-64	A	5	43	9	16	the structure of this section on CCand SD is confusing, leading to overlapping sections and an unnecessarily lengthy text. 2.2.1, 2.2.2 and 2.2.3 are all introducing	We will check for overlaps and look for reductions. and then consider of collapsing is

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						the general concepts and the two-way nature of of the relationship between CC and SD. So they can be collapsed making a more concise text possible. (Bert Metz, IPCC)	a good idea.
2-65	A	5	44			Section 2.2 is a good illustration for the points I have raised in my general comment on the chapter. At this stage, it might be premature to come up with a (set of) theory(s) about the linkage between SD and climate change. But what about case studies that illustrate these linkages (e.g., on the impact of flooding on education in Bangladesh, or the impact of hurricanes on community development in the US)? I suggest to add substance to the section by illustrating general statements with results from case studies. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	We can add short examples but not full case studies which are going to be covered by chapter 12
2-66	A	5	45	13	39	Sections 2.2.1. to 2.2.6.add little value and contain many obvious statements. Suggest deletion. (Michael Jefferson, World Renewable Energy Network/Congresses)	The issue has been requested by the plenary, so the issue will be kept, but we will consider editing that makes it more linked to other chapters and more conceise.
2-67	A	5	45	16	41	This section would be much stronger and more understandable if the authors included a case study or example of how the various sustainable development concepts they are discussing affect an actual policy decision. Without such an example the discussion is too abstract. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	We will add a short example in section 2.2.6 page 12.
2-68	A	6	14	6	16	The refererences to Figure 2.2.1 seem to refer to Figure 2.2.2 in the appendix. Other cross-references do not match either. (Hans-Martin Fuessel, Stanford University)	Accepted
2-69	A	6	16			Figure 2.2.1: This figure and its title are mismatched. (Toshihiko Masui, National Institute for Environmental Studies)	Accepted
2-70	A	6	16	6	16	Shouldn't this read Figure 2.2.2? It appears that Figure numbers are all off by one. (H-Holger Rogner, IAEA)	Accepted
2-71	A	6	16	6	16	The figure to be inserted should be 2.2.2 instead of 2.2.1 as given in the FOD. (Philippe Tulkens, TERI School of Advanced Studies)	Accepted
2-72	A	6	18	6	21	This explanation corresponds to figure 2.2.2. (Jorge Gasca, Mexican Petroleum Institute)	Accepted
2-73	A	6	18	6	21	The figure 2.2.1 do not correspond to the explanation (Jorge Gasca, Mexican Petroleum Institute)	Accepted
2-74	A	6	18	6	18	Isn't this figure 2.2.2 (Marco Mazzotti, Institute of Process Engineering)	Accepted
2-75	A	6	22			Why is this limited to SRES?	We will delete the reference to SRES

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Richard Tol, Hamburg University)	
2-76	A	6	22			the text "explored in the Special Report …. Scenarios" is unnecessarily restricting the description of the general relationships reflected in fig 221; delete (Bert Metz, IPCC)	We will delete the reference to SRES
2-77	A	6	32	6	32	MMRS (2005) is also a comprehensive and useful reference to add here. (Mohan Munasinghe, Munasinghe Institute for Development (MIND))	We will consider the reference and see if it is relevant
2-78	A	6	32	6	37	I don't where the distinction is clear. Most of the literature available have many confusing and uncertainties that do not make clear line or close to that, between the two. So any policies that will be taken hastely may well spell disasters rather than benefits for the whole world. (Mohammed Alfehaid, Saudi Aramco)	We will delete “clear” and add s to distinction
2-79	A	6	48	7	21	These paragraphs are difficult to understand (what is the point?) and do not fit in the general description of the concepts that this section 2.2.2 is supposed to give; delete or strongly modify (Bert Metz, IPCC)	Will be modified, it is a key observation. The concepts of consumption and welfare will be further explained
2-80	A	6	0			figure 2.2.1 does not correspond to description (Stephan Halloy, Universidad Mayor de San Andrés)	Ok
2-81	A	7	15		18	Lehtonen may come to a conclusion that social capital concepts are not at a stage of practical application, but others -- particularly in the sustainable development literature -- are not so dismissive. There is a large literature on social indicators, for instance, that defines indicators of social capital. Putnam's associational indicators have been reviewed for their application to climate change, for instance (Douglas, Mary, Des Gasper, Stephen Ney, and Michael Thompson, 1998, "Human needs and wants," in Human Choice and Climate Change, Volume 1: The Societal Framework, Steve Rayner and Elizabeth L. Malone, eds., Battelle Press, Columbus, OH; Putnam, Robert, 1993, Making Democracy Work: Civic Traditions in Modern Italy, Princeton University Press, Princeton, NJ). Hazel Henderson is one prominent researcher in social indicators. The fuzziness of the concept in use notwithstanding, many analysts agree that the ability of civil society to work together is important both for development and for resilience to climate change. (Elizabeth L Malone, Pacific Northwest National Laboratory)	We will add references and a short discussion
2-82	A	7	17	7	17	"usefull methafors" should be "useful metaphors" (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Ok
2-83	A	7	23	7	31	A practical tool applied in several countries called Action Impact Matrix (AIM) has proved very useful to identify, prioritise, and address mitigation-adaptation-	We will consider the reference and see if it is relevant

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						development synergies (MIND 2004, MMRS 2005). The AIM approach shows how mitigation and adaptation policies can be developed in view of the country's develoment goals. (Mohan Munasinghe, Munasinghe Institute for Development (MIND))	
2-84	A	7	28			editorial change: replace '…that not are...' with '…that are not…' (Mohan Munasinghe, Munasinghe Institute for Development (MIND))	Ok
2-85	A	7	30			reword sentence to read: "Furthermore, climate policies that do not take economic, environmental and social considerations into account might not be sustainable in the long run." (Mohan Munasinghe, Munasinghe Institute for Development (MIND))	We will write:….. economic and social and environmental….
2-86	A	7	33		42	This is an excellent summary -- move it to the top of the section? The "serious tradeoffs" in the last sentence should be further specified. (Elizabeth L Malone, Pacific Northwest National Laboratory)	It will have a key position in 2.2
2-87	A	7	36	7	39	Erase since: "Examples……. energy technologies" Justification: the policy examples given to both categories are extremely controversial. It depends on the geographical, technological and socioeconomic context where the policies are adopted. (Ana Yábar Sterling, Institute of Environmental Studies)	Add that it depends on the context
2-88	A	7	39	7	40	Change: "actual impact of all these policy examples" by "impact of those policies" Justification: coherence of the paragraph (if the previous comment is accepted) and to eliminate the actual state of knowledge, because it is obvious. (Ana Yábar Sterling, Institute of Environmental Studies)	Accepted
2-89	A	7	44			figure 2.2.2 (=2.2.3) does not add much to fig 2.2.1 (=2.2.2) and actually confuses matters; better leave it and the corresponding paragraphs out and , if necessary, provide some comments in the text when describing the first figure. (Bert Metz, IPCC)	The figure is under revision
2-90	A	7	46	8	23	Figure 2.2.2. and the explanatory text miss the fact that climate change impacts on human systems are not mediated ONLY via ecological services, but also directly, as is the case for a large class of impacts, e.g., storm damage on capital stock, sea level rise on coastal settlements and heat stress on urban settlers. This dimension should not be neglected. In this respect, Fig. 2.2.1. is more accurate. In addition, I find the separation in direct and indirect SD policies unfortunate. Take the example of an emission trading system. This is a measure aimed at mitigating GHG emissions, but it is aimed equally well at enhancing "society's productive base" (in terms of spurring technological innovation and by the same time protecting its natural resources). Hence, I find that Figure 2.2.2. makes little sense in its current	The figure is under revision

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						form. I propose to revise figure 2.2.2. and the explanations in the text accordingly, and to remove figure 2.2.1. because many aspects of the two figures are redundant. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	
2-91	A	7	49			Climate is not part of nature? (Richard Tol, Hamburg University)	The figure is under revision
2-92	A	7	49	8	6	The figure 2.2.2 do not correspond to the explanation (Jorge Gasca, Mexican Petroleum Institute)	Accepted
2-93	A	7	0			Figure 2.2.3 (wrongly denoted as Figure 2.2.2): The current figure mixes the description of (a) sub-systems, (b) relationships between sub-systems, and (c) specific policies. Different graphical symbols should be used for each of these elements. Do the different widths of the arrrows have a meaning associated to them (e.g., are ecological services considered to be less important or valuable than adaptation policies)? (Hans-Martin Fuessel, Stanford University)	We will make a new version of figure 2.2.3
2-94	A	7	0			Figure 2.2.3 (or is it 2.2.2?): The "floating policies" box should be attached to the socioeconomic system to preclude the "policies from nowhere" implication. If adaptation policies stem from the SE system (and they do), why not more basic policies? (Elizabeth L Malone, Pacific Northwest National Laboratory)	We will make a new version of figure 2.2.3
2-95	A	8	25			Section 2.2.3. reiterates the dual relationship between CC and SD two or three times with different words. A less opaque format would be to state the relationship once, and then list the mediators between CC and SD in both directions. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	To be shortened
2-96	A	8	25			Consider moving section 2.2.3 after 2.2.1 (because the statements on the dual relation explain the concerns and the reasons for giving SD attention in this report); (Peter Bosch, IPCC TSU WGIII)	2.2.2 includes the key figures, so it should come before 2.2.3
2-97	A	8	48			This presumes that climate change has only negative impacts. This is out of line with the impacts literature. (Richard Tol, Hamburg University)	Delete negative and change “more difficult to meet” to “will influence”.
2-98	A	8	48		50	This could also be a positive relationship. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Delete negative and change “will make it more difficult to meet” to “will influence”.
2-99	A	9	5			Please refer to Fankhauser and Tol (REE, 2005), who show that the effect of climate change on economic growth is small. Tol (forthcoming, Climatic Change) finds little evidence that climate change would hinder poverty alleviation. Babiker and others find the effect of emission reduction on poverty alleviation is large. (Richard Tol, Hamburg University)	It is not our task to report empirical results

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2-100	A	9	18	10	37	the structure of this section on CCand SD is confusing, leading to overlapping sections and an unnecessarily lengthy text. (continued from previous comment) 2.2.4 seems to be on the definition question, but does not really discuss that, other than saying that the perspective chosen is that of "making development more sustainable" . That is too weak. A clearer description of what this report means with "sustainable" is required. The notion of "soft" vs "hard" SD should at least be mentionedThe dynamic perspective ("moving in the direction of more sustainability") can be emphasised more, making the point that a more absolute definition ("this development is sustainable") does not work. The section discusses how to measure sustainability (indicators), but in rather haphazard way. Discussion of methods to evaluate the degree of sustainability (action-impact matices, social cost-benefit analysis, sustainability impact assessment) are missing. The section should also discuss the scale issue: at what geographical scale can sustainability be analysed/ implemented? The title of 2.2.4 is confusing. (Bert Metz, IPCC)	Two short paragraphs will mention these major issues The title will be changed to SD goals
2-101	A	9	19			I follow the author's statement that it is not possible to give an overview over the hundreds of definitions of SD in the literature. But would it not be possible to outline the various broad lines of thinking about SD (and related controversies and their implications for climate change)? Relevant pieces of discussion can be found later on in Section 2.2.5. I propose to streamline this discussion, and present it following the 2nd paragraph of section 2.2.4. The text on indicators of SD (starting on line 35) should be presented in an extra subsection. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	See the comments to 2-100
2-102	A	9	20		41	To make the report more to the point, consider shortening the intro to 2.2.4 (p9, lines 20-41). Take out lines 49 on p9.to line 24 on p10 and instead insert the relevant parts of 2.2.7 (because we do not need the detailed lists of indicators here, and we can do with table 2.2.8 only); (Peter Bosch, IPCC TSU WGIII)	We will expand to faciliutate 2-100 and 2-101. Indicators will be kept because they emphasize that SD is also an OECD issue. We will make a table with the indicators.
2-103	A	9	49	9	50	obscure sentence (Marco Mazzotti, Institute of Process Engineering)	Includes social, environmental, economic, and institutional dimensions
2-104	A	9	51	10	23	The listing of sub-themes is too vague. For real understanding, it is necessary to specify common definitions of indicators for these sub-themes (e.g., atmosphere or land). It is also important to discuss how conflicts between opposite trends in indicators are treated when judging the sustainability of a development. E.g. expensive renewable energy is good for "atmosphere", but bad for "equity". What approaches exist to assess its overall sustainability?	We do not have space for that. More discussion will be added in 2.2 about conflicts and tradoffs between different dimensions.

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						(Elmar Kriegler, Potsdam Institute for Climate Impact Research)	
2-105	A	10	37	13	40	the structure of this section on CCand SD is confusing, leading to overlapping sections and an unnecessarily lengthy text. (continued from previous comment) The function of 2.2.5 is not clear: it now gives a (hard to read) description of several ways to look at development. Why is that material here? What function does it have? 2.2.6 is also very confusing. What is the point here? Lines 46-50 on page 12 seem to suggest that this section is about understanding the conditions under which development can become sustainable. Immediately this challenge is dropped by saying this report cannot cover that literature, because it is too large. In fact this question (how can development become sustainable?) is a key issue for understanding the possibilities for development and dealing with climate change to become synergistic (that issue is even discussed separately in 2.2.8). So this literature needs to be covered (I think the preferred place is in ch 2, although ch 12 also covers it). (Bert Metz, IPCC)	Will be edited based on coordination with chapter 3
2-106	A	10	39			This section refers to alternative development paradigms and I'm wondering whether it would be possible remind the readers on the advantages and disadvantages of dirrerent development paradigms in the climate change context. Such a comparison, possibly available in the literature (however I have no reference to provide) might rank the sustainable development approach as of the most effective options. (Philippe Tulkens, TERI School of Advanced Studies)	Will be edited based on coordination with chapter 3
2-107	A	10	39			Development paradigms is defined in Ch. 2: section 2.2.5 (framing, ca.1.5 page). Ch3: does not mention the word development paradigm, although in the explanation of scenario storylines (3.1.1.2 and more specifically 3.1.4 to 3.1.6) the concept is used. Ch 12, p18,line 33 refers to chapter 3 for development paradigms. Hence the following proposal: In Ch2 clarify section 2.2.5 to make it fit with the use of the concepts in Chapter 3. In chapter 3 refer back to chapter 2 and use explicitly the notion of development paradigms. (Peter Bosch, IPCC TSU WGIII)	Will be edited based on coordination with chapter 3
2-108	A	11	7	11	8	Whether mitigation adds costs to the optimal state depends on the calculation of damage costs - in an economic framework mitigation only adds costs when the marginal cost of mitigation exceeds the marginal damage costs. (Paul Baer, Stanford University)	This is correct, we can add the argument
2-109	A	11	23	11	26	Is this really Oliver North? I thought the famous institutional economist was named Douglas North, and Oliver North ran the Iran-Contra scandal.	Douglas North

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						(Paul Baer, Stanford University)	
2-110	A	11	35			line 35 and further: include a reference to section 2.7 in which these issues are elaborated (Peter Bosch, IPCC TSU WGIII)	Ok
2-111	A	11	48	11	50	with reference to the relative 'cost' of energy technologies and systems, Awerbuch (2004, 2005) redefines the method of calculating 'costs', using finance portfolio theory, to incorporate the risks of fuel price volatility in an energy system - concluding, amongst other things, that renewable energy can reduce the overall risk and cost of energy provision, even if the up-front cost is higher. This is an element that may be relevant to other chapters. Patterson (2004, p16) also raises fundamental questions over the nature of cost-comparisons in electricity provision. (Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	Too specific in relation to the argument of these lines
2-112	A	11	0			The first part of this page is an excellent discussion. However, in the fourth paragraph (starting on line 28), the text slips from economics to politics within noting the rich literature in institutional politics (e.g., Peter Haas). (Elizabeth L Malone, Pacific Northwest National Laboratory)	Will be edited
2-113	A	12	12	12	13	The sentence "It is here proposed that conduct very detailed studies on the impacts on individuals as well as larger social groups." is unclear. What are the authors suggesting? (Lourdes Maurice, US Government)	Language will be changed to “to conduct”
2-114	A	12	16	12	19	This point has been strongly made in (MM 1992, MM 2002, and MMRS 2005) -- e.g., "The precise definition of sustainable development remains an elusive (and perhaps unreachable) goal. Therefore, a less ambitious strategy that merely seeks to make development more sustainable might offer greater promise. The step-by-step approach of “making development more sustainable” (MDMS) becomes the prime objective, while sustainable development is defined as a process rather than an end point" (MMRS 2005). (Mohan Munasinghe, Munasinghe Institute for Development (MIND))	This point is already made
2-115	A	12	28	12	29	This sentence "various specific policy recommendations that addresses different components have been discussed in the literature." should include references. (Lourdes Maurice, US Government)	References will be added
2-116	A	12	28	12	39	This paragraph, presenting policy recommendations identified as fostering SD, is too vague. What can be learned from a list of nearly everything you can think of in this context? If there is important information to convey, it might be advisable to include a table that specifies in which way, under which paradigm, and for which	This belongs to chapter 12 12

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						institutional and societal arrangement these policies have been identified as fostering SD (case studies?). You state that "sustainable development policies cannot be defined in a clear cut way". How does this reverberate with your earlier distinction between direct and indirect SD policies in your discussion on page 7, line 49 to page 8, line 23? (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	
2-117	A	12	30	12	33	Add "advanced technology" (H-Holger Rogner, IAEA)	Add. Renewable energy and other advanced technology options
2-118	A	12	0	13		p. 12/13 Arrow. A cornucopian vision? Is this the only article where discussion between ecologist and economist about “consumption” is “summarized”? Others economist and social scientist suggest that consumption patterns are excessive and distorted. Perhaps there is confusion between what are human needs and wants covered by the concept of “consumption”. For a discussion see Rayner and Malone, pp 220-225, Proceedings of the IPCC Meeting, Colombo, Sri Lanka 1999. See also Max- Neef et al. 1995 Desarrollo a Escala Humana. Barcelona Icaria, on satisfactors employed to satisfy needs, also Jackson, T and N. Marks, 1996, Consumption, sustainable welfare, and human needs: an examination of UK expenditures patterns 1954-1994, Conference of the European section of ISEE (Juan Llanes, Havana University)	Is related to 2-79. More explanations will be given
2-119	A	13	1	13	5	the idea of "optimized" welfare is really quite meaningless because we are comparing welfare impacts across generations. At the very least, it involves a moral judgement considering the correctness of trading off impacts on one generation against impacts on another generation, but the fact that the "optimization" involves a moral judgement is not acknowledged here or even in most of the literature. A pathway that involves large, discounted negative impacts in the future but greater consumption today might be regarded as "optimal" by those living today, but the people who suffer the negative impacts in the future most certainly will not regard it as "optimal"! (the counter argument might be that the impacts can be offset by growth of economic assests today, so the can be an "optimum", but this is invalid because the worst foreseeable impacts involves loss of ecosystems and ecosystem services that cannot be compensated by any amount of growth of economic investments because they are not substitutable). Thus, the sentence should be re-written to avoid use of the word "optimal". (Danny Harvey, University of Toronto)	This is addressed in the cost section related to discounting, which will be mentioned in a footnote. The language is taken from the paper, so we cannot take out “optimal”, but we will use an exact quote.
2-120	A	13	1	13	4	It would be worth bringing in uncertainty here and explaining why current consumption cannot be optimised: first because there are too many unknowns in	Add sentence on uncertainty

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						climate change over too long a future to have any idea of an optimum; and second because the science suggests that there may be low probability, but catastrophic outcomes. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	
2-121	A	13	10			what is a "contemporaneous" good? (Juan Llanes, Havana University)	Change to commodities
2-122	A	13	16		26	"Weak institutions" covers a lot of ground -- political, social, economic, cultural… As the paragraph goes on, it appears that economic institutions are meant; however, institutions able to implement laws and regulations effectively are necessary, also. And the seeming assumption that what is needed is markets, more markets, runs counter to analyses of situations in which the introduction of markets has been known to introduce unsustainable practices. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Add other dimensions
2-123	A	13	16		39	section 2.2.6, p13 line 16-39 can be inserted in 2.2.2 in the discussion on the framework for SD or even better in a new section on mitigative capacity of which I suggest to move it from ch 12. (Peter Bosch, IPCC TSU WGIII)	The structure will change and this will be taken into consideration
2-124	A	13	17			Erase: "in developing countries" between "institutions and have a lot……" Justification: it seems to strong statement for many developing countries where political institutions (for instance) are stronger than in many economies in transition. Instead the argument given in text could be acceptable for environmental institutions in most countries, even developed countries. (Ana Yábar Sterling, Institute of Environmental Studies)	DC's will be deleted from page 13, line 16 because we find weak institutions everywhere
2-125	A	13	17			Are weak institutions the problem in general, or developing countries weak institutions?. How do you consider institutions in economies in transition? (Juan Llanes, Havana University)	DC's will be deleted from page 13, line 16 because we find weak institutions everywhere
2-126	A	13	17		26	Several chapters mention institutional issues, sometimes in the context of mitigative or adaptive capacity. The most logical place to deal with the topic upfront is in Ch.2. The main question here is the role and importance of institutions for mitigation. Hence the following proposal: Ch 2, p.13 line 17-26 remove from here (see also under sustainable development proposals) and include at the bottom of p.50. Ch 2, p 50. merge with section 12.1.1.2, determinants of mitigative capacity. Ch 3, p11-13 (3.1.6 Institutional frameworks): Keep here page 12 up to line 19. Integrate p12, line 20-55 into chapter 2, p51. Keep page 13 line 5-27.	Considered as part of the restructuring. Institutionsal issues will be covered in chapter 2 and somehow expanded

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						Ch 12, on sustainable development is a second place for mentioning institutional issues, but here in the framework of a transition to SD. The main question is here: what are the institutional changes that go together with a more sustainable development. The focus is on changes. The extensive text in 12.2.2.2 can be shortened by incorporating general institutional parts in Ch 2. : e.g. Page 34, lines 15-26; and by incorporating texts on specific climate policy instruments in Ch. 13 (see below). There is scope for making the remaining text more concise. (Peter Bosch, IPCC TSU WGIII)	
2-127	A	13	18			Include: "sustainable" between "broader and development …."Justification: in coherence with the previous comment. (Ana Yábar Sterling, Institute of Environmental Studies)	We are here purposely refering to development policies, and we will delete broader
2-128	A	13	20	13	21	Include: "(specially in developing countries)" between "most cases and will….."Justification: to stress that those weaknesses appears in developing countries even more frequently (Ana Yábar Sterling, Institute of Environmental Studies)	Cannot be added since we have just noted that weak institutions are not only a problem in DC's
2-129	A	13	41			This section omits the effects of emission reduction on economic growth; and the fact that JI and CDM are often paid from development aid money. (Richard Tol, Hamburg University)	It can be adressed in Chapters 3-11 that are reporting study results 3-11
2-130	A	13	41	16	41	the structure of this section on CCand SD is confusing, leading to overlapping sections and an unnecessarily lengthy text. (continued from previous comment) 2.2.7 is supposed to cover the impacts of climate change policy on development. Most of this section is however dealing with the WEHAB framework and the MDGs, which do not belong here but in the SD > CC section. Not much is said about the issue of CC>SD and maybe that is right (there is not much of framing here). 2.2.8 is supposed to look at the synergy question (in general terms because in specific terms ch 12 is doing that). It only touches briefly on the importance of institutional conditions. This is critical and deserves more thorough treatment. ther critical conditions also need to be covered here. (Bert Metz, IPCC)	Synergies and tradeoffs should discussed together. MDG's and WEHAB will be moved to the SD – CC section
2-131	A	13	48			Footnote: (1) where does the quote end? (2) the idea of "compensation" is as meaningless as the idea of "optimization", for the same reasons (Danny Harvey, University of Toronto)	Add closing inverted commas"
2-132	A	14	9	14	14	This is incorrect. WEHAB is NOT a WSSD decision. It was a proposal triggered by UN-SG duiring the prep-coms and then developed by some UN Institutions but	We will check and update.

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						strictly rejected by a number of developing countries at the WSSD. (H-Holger Rogner, IAEA)	
2-133	A	14	13	14	14	The language ", and some examples that must be considered …" is clearly not consistent with the general rule that the IPCC shall not provide recommendations and shall not be policy prescriptive. It would be helpful to include a reference to literature to inform about the obvious gaps in the WEHAB framework. If such literature is not available it is proposed to identify the need for some scientific investigation on the issue whether or not the WEHAB framework covers all relevant environmental issues or not. (Radunsky Klaus, Umweltbundesamt)	We are just referring to WEHAB and are supposed to discuss the coverage of it. We will add selected before WEHAB in line 12 to show that it is not complete.
2-134	A	14	19	14	19	What are some examples of "advanced fossil fuels"? (Lourdes Maurice, US Government)	Check if examples are included in WEHAB
2-135	A	14	28	14	31	It is not transparent why only the sectors human settlements and tourism should be added to the WEHAB framework. Figure 2.2.3 does not provide such linkage. It would be helpful to provide some linkage to literature. If such literature is not available it is proposed to identify the need for some scientific investigation on the issue whether or not the WEHAB framework covers all relevant environmental issues or not. (Radunsky Klaus, Umweltbundesamt)	It is a coordination issue with WGII and these sectors are included since WGII has specific chapters on these sectors. To be discussed with the TSU TSU According to the text it could include more sectors.
2-136	A	14	32	14	32	Insert Figure 2.2.3 (FÉLIX HERNÁNDEZ, IEG-CSIC)	The figure is include earlier in the section
2-137	A	14	47	15	14	Table 2.2.7 is providing little information and many repetitions. In addition, most of the important information is absorbed already in Table 2.2.8. I propose to remove Table 2.2.7. In discussing the benefits of SD policies for mitigating and adapting to climate change, it is important to discuss the scale of these benefits in relation to what is needed for effective climate protection. It seems that the benefits for adaptation are high, while significant benefits for mitigation can be questioned. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	The two tables need to be separate since 2.2.8 is about India and 2.2.7 is more general. However the formulation of the MDG's should be harmonised and Table 2.2.7 will be shortened
2-138	A	15	31	15	31	Suggest addition of 'energy security' element in this section, meaning the matter of secure access to affordable energy at national level. There have been some reports in the last two years (IEA, 2004, World Bank (ESMAP), 2005) outlining the impact of the high and volatile oil prices on the economy, in particular the latter assesses the vulnerability of the economies of many of the poorest countries that are also oil importing countries. The G7 Finance Ministers, IMF (2004, 2005), also	Add energy security issue in one sentence on page 15 line 14

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						highlighted concern in this area and promoted greater energy efficiency and alternative energy as part of the solution. Awerbuch (2005) also raises the role of renewable energy as a response (see also comment above). This aspect of 'energy security' and the linkage between elements of reducing vulnerability to energy price and climate mitigation (ie energy efficiency, indigenous renewable energy sources) may also be relevant to consideration of climate mitigation and sustainable development in other chapters. (Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	
2-139	A	15	32		42	No comments about problems with external debt of developing countries and the burden it supposes for SD, poverty eradication, development and mitigation issues, also steps undertaken towards cancellation (Juan Llanes, Havana University)	This paragraph is referring OECD conclusions so we cannot add our own arguments here. We are not aware of published literature about the subject.
2-140	A	15	33	15	35	This sentence "It is recommended that environmental taxes and other economic instruments as well as international agreements should be used in order to ensure cost effectiveness in pollution control." is too broad. Not all texes and economic instruments are cost effective - each must be assessed on its own merit. Recommend deleting. (Lourdes Maurice, US Government)	We will make it clear that it is OECD that recommends The general assessment of the literature is done in Chap. 13 13
2-141	A	15	39	15	42	The issue of retirement income policies in OECD countries seems to be of little relevance for "climate change policy impacts on development policies". If the IPCC would follow such route it would have to discuss also all other policy areas. However, this would clearly beyond the scope of this report. Therefore it is proposed to delete that wording, starting with "Finally, ...". (Radunsky Klaus, Umweltbundesamt)	It is part of the OECD document and it is a text taken directly from there
2-142	A	15	44	16	41	Why not include JI and CDM in this discussion? (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	CDM is mentioned in page 16 line 40. We will expand here with a more general statement CDM and JI.
2-143	A	15	44			In section 2.2.8., I miss a discussion of ethical investment fonds - their current impact, and what prospects they might bring for implementing SD goals via the capital market. Also, the role of micro-finance in the least developed countries would be worth mentioning. A discussion of these issues in the context of climate change would be very interesting? Any studies on this subject? (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	Both issues can be addressed in chapter 12 as part of the SD policies 12
2-144	A	15	44	16	41	section 2.2.8 is about stakeholder involvement. This is not so much a framing topic	To be coordinated with Chapter 12. The issue

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						as well one of practical implementation. Hence it fits better in chapter 12, where the be same issues are dealt with extensively (p.38-44). Delete section here. Sections on "cc policy impacts on development policies" are included in Ch12. (Peter Bosch, IPCC TSU WGIII)	are very important to have the report.
2-145	A	16	8	16	8	Other corporate initiatives, outlining approaches to policy and the international regime include: Defra 'Business Insights' conference outcomes from Oct 2005 conference on business and climate change - this outlines some specific issues around long-term policy, include details of priorities for finance/investment and power sector for existing and pre-commercial technologies. There are other busines statments, such as the Cambridge Corporate Leaders Group, and the Canadian Climate Leaders Forum. (Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	We add the reference
2-146	A	16	14	16	21	This paragraph is a description of a single group's objective which seems inappropriate when many other groups have also objectives. (Nick Campbell (Batch 2), ARKEMA SA)	Page Line 14 should write: These different initiatives have similar objectives for example WBCSD…..
2-147	A	16	19	16	21	The authors refer to the need to achieve a suitable balance between short term and long term mitigation efforts. What are the implications to policy makers? How should this balance be determined? Can the authors offer some advice as to reasonable balances? (Lourdes Maurice, US Government)	This is only the objectives of a business group so we cannot comment on that
2-148	A	16	23	16	30	This paragraph is out of date and does not reflect the requirements of mandatory ghg reporting for installations included with the EU Emissions Trading Scheme. (Nick Campbell (Batch 2), ARKEMA SA)	We are pointing out what business are doing which is another issue than requirements for regulation. The EU issues can be dealt with in chapter 13 13
2-149	A	16	43	25	15	this section is unnecessarily lengthy and ill-focused. I think there are 3 key issues to deal with in this section: 1) the need for step-wise decison making in the light of complexities, uncertainties and long-term nature of the problem, but aware of strong inertia (don't wait too long); 2) an overview of key decision analytical approaches that are found in the literature (and that are used in the literature that is reported in other chapters) (attention: there is not much new to TAR, so summarise briefly); 3) the valuation issue and the importance of realising that subjective elements are a key part of decison making (see also TS draft) (Bert Metz, IPCC)	Some sympathy with these comments but they are rather prescriptive and do not reflect the richness of the alternatives advanced in the literature.
2-150	A	16	45	25	15	Whilst this section is an excellent overview from a research perspective some	Brief references to the political science

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						atttention to the realities of political life would be appropriate. For example, in the UK, a current exhaustive rigorous review and assessment of existing and potential current policies is unlikely to determine next steps on major policy choices, for climate change policy-making, though it may well inform it. This is tricky for the FAR to handle, but unless you can point to how policy is actually formulated and implemented from this framework, the value of this analysis is reduced. (HEDGER MERYLYN, Environment Agency)	literature on the nature of decision making in relation to MEA's and at the national, subnational and firm level will be made (noting that we already are well over length). Important that chapter 13 then follows up in its review of Policies and Measures which includes options for effective coalition forming at all levels.
2-151	A	16	49	16	52	The sentence that begins "The literature offers no ideal …" is an important statement that should be retained in future drafts. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Agree
2-152	A	17	5	17	7	It is the understanding that the AR4 should inform about any findings based on assessment of literature that has not yet been covered by the previous assessment reports of the IPCC. However, the current language does not reflect this. Subchapter 2.3 might be shortened accordingly. (Radunsky Klaus, Umweltbundesamt)	But these are fundamental framing concepts that need to be repeated to remind the reader.
2-153	A	17	9	17	9	The number of published applications using the tolerable windows approach exceeds, by a considerable margin, the number using safe-landing analysis (note also that the Glossary -- where the term safe-landing simply refers to the TWA definition -- reflects this situation correctly). Thus the term "safe-landing approaches" should either be replaced by "tolerable windows/safe-landing approaches" or (linguistically preferably) by "guard-rail approaches (i.e., safe-landing analysis and tolerable windows approach)". This applies to lines 6 and 54. (Thomas Bruckner, Technical University of Berlin)	Agree
2-154	A	17	13	17	26	This text seems to repeat earlier assessments of the IPCC included in the SAR and the TAR. In order to be more concise and to keep the report within a reasonable length it is strongly recommended to simply include specific reference to the SAR and/or the TAR that refers to the subchapter and page within the subchapter. (Radunsky Klaus, Umweltbundesamt)	This would reduce the stand alone readibility of the report.
2-155	A	17	16	17	19	Optimization also depends on unique probability assignments which don't exist for most parameters of interest. (Paul Baer, Stanford University)	Include after "outomes" line 17 "and unique equilibria which are unlikely to exist."
2-156	A	17	19			While true, this can easily be interpreted as "anything goes". (Richard Tol, Hamburg University)	While this is a danger, it is not possible to always prevent misinterpretation.

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2-157	A	17	20	17	21	quotes should be around the word "optimal", not "global" (Danny Harvey, University of Toronto)	Extend quotes to include optimal.
2-158	A	17	22	17	23	Per the previous point, decision analysis does not depend on objective probability assignments, which not only "have not been established" but are theoretically impossible for many parameters of interest; it depends rather on unique subjective probability assignments, which also do not and arguably cannot exist (see Chapter 3 of Baer 2005, manuscript attached). (Paul Baer, Stanford University)	Agree – insert “and cannot be” after “have not been”
2-159	A	17	24		24	"May not be" implies "may be"; I think it's safe to say there can be no optimal global strategy (in fact, optimal strategies are undefined in any system in which there are at least two existing utility functions or two probability assignments). (Paul Baer, Stanford University)	While we do not disagree, this is firmer than the TAR and SAR formulation which is being referred to.
2-160	A	17	26	19	21	Sections 2.3.2 to 2.3.3 (up to start of 2.3.3.2) add little of value and contain some repetition. Suggest deletion. (Michael Jefferson, World Renewable Energy Network/Congresses)	See below.
2-161	A	17	30	18	8	It is proposed to delete this part because it does not include any references to literature and thus is clearly beyond the scope of AR4. The authors should consider that an assessment report of the IPCC is not a textbook. (Radunsky Klaus, Umweltbundesamt)	Agree that this section should be shortened significantly.
2-162	A	17	33	17	33	Suggest using "term" rather than "time". (Lourdes Maurice, US Government)	Prefer time.
2-163	A	17	33			insert "and co-benefits" after "costs" (Danny Harvey, University of Toronto)	Point noted – see reference above to shortening this section.
2-164	A	17	52	18	6	Paragraph repeated: lines 7-11 from page 17 (FÉLIX HERNÁNDEZ, IEG-CSIC)	Agree – one of the references will be removed.
2-165	A	17	54	17	54	The number of published applications using the tolerable windows approach exceeds, by a considerable margin, the number using safe-landing analysis (note also that the Glossary -- where the term safe-landing simply refers to the TWA definition -- reflects this situation correctly). Thus the term “safe-landing approaches” should either be replaced by “tolerable windows/safe-landing approaches” or (linguistically preferably) by “guard-rail approaches (i.e., safe-landing analysis and tolerable windows approach)”. This applies to lines 6 and 54. (Thomas Bruckner, Technical University of Berlin)	Agree
2-166	A	18	10	18	33	It is proposed to move text from lines 10 to 18 to line 40 on the same page 18 and	Will consider when rewriting section to

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						to delete text from lines 20 to 33 as again this text does not include references to literature and thus clearly is beyond the scope of AR4. (Radunsky Klaus, Umweltbundesamt)	shorten.
2-167	A	18	44			Section 2.3.3.1 fails to mention the safe-landing or tolerable windows approach (Petchel-Held et al., 1999, Climatic Change 41, 301-331; Bruckner et al., 1999, Environmental Modeling and Assessment 4, 217-234; Toth, 2004, Climatic Change 56, 7-36), In this approach, only constraints and policy targets are used to identify the set of admissible policies that observe these constraints and targets. The idea is to steer the system within the boundaries of the tolerable domain. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	Mentioned frequently elsewhere – these paragraphs are not intended to be all inclusive.
2-168	A	18	0			subchapter 2.3.3.1: Given that the references on which the text is based refers to 1993 and IPCC, 1995, page 63 it is proposed to shorten this text considerable and to highlight only findings since the TAR, if any. (Radunsky Klaus, Umweltbundesamt)	Will consider in redrafting to shorten this section.
2-169	A	19	10	19	21	The authors should augment Cost Benefit Analyses and Cost Effectiveness Analyses with some guidance as to the preferred approach for climate change. (Lourdes Maurice, US Government)	Not appropriate in this chapter and in any case this is neither the full set of alternatives, nor can an optimum tool be specified for all climate problems.
2-170	A	19	16	19	21	This paragraph is rather confusing, and seems to add little substantial information. In CBA like in cost-effectiveness analysis, the objective may also be to maximize a intertemporal welfare functional (Nordhaus, Warming the world, 2000). I propose to remove the paragraph (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	Will consider in redrafting to shorten this section.
2-171	A	19	17	19	17	Need to define CBA. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Will ensure it is in glossary.
2-172	A	19	24	19	24	Erratum:note in equity (FÉLIX HERNÁNDEZ, IEG-CSIC)	Agree note reference to be deleted.
2-173	A	19	25	19	34	There is a disconnect here between the statement "will often in at least one major policy case" and "the literature does not yet include any alternative approach." I believe the latter statement is true, and thus that the former should simply read "Conventional economic analysis discounts future benefits and costs, and assumes that tastes and preferences..." (Paul Baer, Stanford University)	Agree.
2-174	A	19	33	19	33	It is proposed to insert "play" after "current preferences". (Radunsky Klaus, Umweltbundesamt)	Agree
2-175	A	19	41	19	45	Question of whether the 'timing dimension' refers specifically to theoretical	This paragraph is unclear and will be clarified

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						approaches towards the overall timing of 'global' action, or whether this should refer to the important point in the introduction: 1.7.8 'Short-term versus long-term'. This states that policy responses must include near term fostering of Tech RDD&D to enable low levels of GHG emissions in longer term. This is a rather practical, but important element that also has a bearing on 'cost' issues - at firm, or investor level, many existing low carbon technologies will need incentivised, through policy and other mechanisms, to enable scale-up for the medium term, but may not provide the cheapest GHG emission reduction in the near term. Note also Tyndall briefing (2005) which states: 'To have the requisite impact in 2050 [on emissions], it is necessary to start directing investment towards low carbon technologies in the immediate and short term from now to 2010,and to persist with such low-carbon investments thereafter.' (Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	in the redrafting to shorten and clarify this section.
2-176	A	19	43	19	45	The following wording is proposed: "The institutions can provide information and general education programs, reserach and assessments, and frameworks to facilitate decision making, recognizing the global character of climate change." (Radunsky Klaus, Umweltbundesamt)	This paragraph is unclear and will be clarified in the redrafting to shorten and clarify this section.
2-177	A	19	47	20	49	I propose to put these paragraphs into an extra subsection 2.3.3.3 Issues related to the existence of multiple actors (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	See above
2-178	A	19	51			Somehow, the section on time has morphed into a section on games. The discussion on time has missed the advent of declining discount rates, the only new thing in 27 years. (Richard Tol, Hamburg University)	Clarify the whole section to relate more clearly to the existence of multiple actors, the problems of coalition formation, and the institutional arrangements that might support this. Reference to political science as well as game theory literature.
2-179	A	19	0	22		Issues of time and uncertainty are not clearly delineated and related to each other here. The sections should be carefully rewritten. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Agree.
2-180	A	20	5			Eyckmans and Finus has not been peer-reviewed. The title "new growth theory" is pretentious nonsense; do they really see themselves winning a Nobel Prize? Besides, most of the novelty is in Finus' head only. (Richard Tol, Hamburg University)	Clarify the whole section to relate more clearly to the existence of multiple actors, the problems of coalition formation, and the institutional arrangements that might support this. Reference to political science as well as game theory literature.

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2-181	A	20	21	20	29	It should be pointed out that these coalitional models typically imply that countries that will be harmed by climate change should pay high polluters to reduce their pollution to get them to participate. The prima facie inequity of this solution (and the fact that the UNFCCC specifically rejects this approach) should suggest that game theory does not adequately describe the international politics of climate change. (On the other hand, the fact that the US has refused to participate, because it would (presumably) not gain from mitigation, suggests that game theory does describe some aspects of the negotiations.) (Paul Baer, Stanford University)	Clarify the whole section to relate more clearly to the existence of multiple actors, the problems of coalition formation, and the institutional arrangements that might support this. Reference to political science as well as game theory literature. But note that this comment does acknowledge that game theory while incomplete, does describe some aspects of international negotiating behaviour.
2-182	A	20	23			Chander and Tulkens is restricted to transferable utility, and then their result is only a restatement of Kaldor-Hicks. (Richard Tol, Hamburg University)	Clarify the whole section to relate more clearly to the existence of multiple actors, the problems of coalition formation, and the institutional arrangements that might support this. Reference to political science as well as game theory literature.
2-183	A	20	31			Finus' new stuff is just good-old coalition theory. (Richard Tol, Hamburg University)	Clarify the whole section to relate more clearly to the existence of multiple actors, the problems of coalition formation, and the institutional arrangements that might support this. Reference to political science as well as game theory literature.
2-184	A	20	43			Give an example of how a security concern competes with fulfilling Kyoto requirements, but also give a counter example for balance (surely reduced dependence on energy supplies from politically unstable regions, allowing military disengagement, would enhance security!) (Danny Harvey, University of Toronto)	Agree delete the reference to security. Clarify the whole section to relate more clearly to the existence of multiple actors, the problems of coalition formation, and the institutional arrangements that might support this. Reference to political science as well as game theory literature.
2-185	A	20	43	20	49	It would be helpful to include some reference to literature on the assessment included in that paragraph. (Radunsky Klaus, Umweltbundesamt)	Clarify the whole section to relate more clearly to the existence of multiple actors, the problems of coalition formation, and the institutional arrangements that might support this. Reference to political science as well as game theory literature.
2-186	A	20	43	20	49	This section on other political science insights seems very underdeveloped relative to the game-theory section; There isn't a single citation.	Clarify the whole section to relate more clearly to the existence of multiple actors, the

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						(Paul Baer, Stanford University)	problems of coalition formation, and the institutional arrangements that might support this. Reference to political science as well as game theory literature.
2-187	A	20	46	20	46	"processesii" ?? (H-Holger Rogner, IAEA)	Typo.
2-188	A	20	49			Subchapter 2.3.4: There seems to be significant overlap with subchapter 3.6.2. It is proposed to revise both texts with a focus on the conceptual framework in chapter 2 and a focus on the results using those concepts in subchapter 3.6.2. Some cross-reference between both subchapters should be included as well. This should help to make the text in both subchapters more focused and overall shorter. (Radunsky Klaus, Umweltbundesamt)	Will coordinate with chapter 3 3
2-189	A	20	51			Section 2.3.4: This section would benefit from a discussion of the implications on decision-making from the different types of uncertainties or at least a cross-reference to Section 2.4 (Hans-Martin Fuessel, Stanford University)	Accepted
2-190	A	20	51			Section 2.3.4. fails to mention a list of quantitative approaches to DM under uncertainty that have been used in the context of climate policy analysis. In the following I provide such a list of approaches that I feel should be mentioned and contrasted with each other. The uncertainty space may be sampled on the basis of a probability measure, of a set of probability measures (imprecise probability) or no available measure. Decision criteria depend on what is known about the uncertainty. The classical case of expected utility theory relies on probabilistic information. It has been criticized for both the requirement of probabilities and the use of the expectation operation which allows for compensation across all outcomes, and thus, may underestimate catastrophic consequences (Chichilnisky, 2000, Resource and Energy Economics 22: 221-231; Lempert and Schlesinger, 2000, Climatic Change 45: 387-401; Cheve and Congar, 2000, Risk, Decision and Policy 5: 151-164; E. Kriegler, H. Held, and T.Bruckner, 2006, Climate Protection Strategies under Ambiguity about Catastrophic Consequences, Accepted for publication in: J. Kropp and J. Scheffran (eds.), Decision Making and Risk Management in Sustainability Science (tentative title), Nova Science Publ. Inc., New York; I have made a copy of this paper available to the Technical Support Unit. The book should be published in 2006). The convential expected utility paradigm is used in most studies of act-Iearn-act policies (e.g. Valverde et al., 1999, Environmental Modelling and Assessment 4: 87-101) and underlies also the	Some but not all of these techniques are explored in section 2.3.5. Consideration will be given to shortening and linking these sections, while broadening the range of issues (lightly) covered.

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						concept of a value of information (Kann and Weyant, 1999, Environmental Modelling and Assessment 5: 29-46). Non-conventional decision criteria have been proposed for the sake of identifying "robust" decisions under uncertainty. An example is exploratory modelling (Lempert and Schlesinger, 2000, Climatic Change 45: 387-401; Robalino and Lempert, 2000, Integrated Assessment 1, 1-19), which assumes no measure at all on the uncertainty spaces, and uses a minimax-regret criterion to identify optimal policies. In case of imprecise probabilities (sets of probabilities) a variety of decision criteria exist which are discussed in Kriegler et al., 2006 (see reference above). One of these criteria have been applied by Cheve and Congar, 2000 (see reference above) to a consumption-pollution problem, in which a type of precautionary behaviour could be identified. The precautionary principle (in many respects on the opposite end of expected utility) is another approach that should be discussed in the context of DM under uncertainty. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	
2-191	A	21	11	21	16	Moreover, it is possible to conceive short term objectives that would adjust to actual costs at any time thanks to some price-capping mechanism. Such "instantenous" adjustments would not be detrimental to climate mitigation precisely as the ultimate stabilisation levels cannot be decided upon. On the contrary, they could help countries adopt more ambitious objectives in reducing expected costs (IEA, 2002, Beyond Kyoto, Energy Dynamics and Climate Stabilisation, OECD/IEA, Paris; Philibert, Cédric, 2005a, Lessons from the Kyoto Protocol: Implications for the Future, International Review for Environmental Strategies, Tokyo, vol.5 n 1:.319-320); ---, 2005b, New commitment options: Compatibility with emissions trading, OECD/IEA Information Paper, Paris. (Cédric Philibert, International Energy Agency)	These issues are partly addressed in chapter 13 on policies and measures but consideration will be given to making this point in the process of shortening and linking these sections, while broadening the range of issues (lightly) covered. 13
2-192	A	21	14			"Several studies"? Provide references. (Danny Harvey, University of Toronto)	
2-193	A	21	16	21	30	This discussion ignores that in climate change, decision-making under uncertainty raises ethical questions because governments can not avoid deciding about acceptable levels of risk that will be imposed upon others. Nash, James, Moral Values In Risk Decisions, in Handbook for Environmental Risk Decision Making, C. Richard Cothern, ed , Lewis Publishing Co. Boca Raton, Florida, 1996 Therefore this section should include the following. "Decision-making in the face of uncertainty in the case of climate change often raises ethical questions because even if science can accurately describe levels of risk, ethical questions about the acceptability of this risk arise. That is from a scientific conclusion that a climate	The revised text will make it clear that all climate decisions involve value (ethical) judgments.

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						change creates a particular threat or risk, one cannot, deduce whether that threat is acceptable without first deciding on certain criteria for acceptability. The criteria of acceptability must be understood as an ethical rather than a scientificor economic question. (See Brown, The Imporrtance of Examining Global Warming Policy Issues Through an Ethical Prism, Global Environmental Change, 13, (2003), 229, 234) For instance, although science may conclude that a certain levels of GHGS in the atmosphere creates a risk that the West Antarctic Ice sheet may melt increasing sea levels by many meters, science cannot say whether this additional risk is acceptable because science describes facts and cannot generate prescriptive guidance by itself. The scientific understanding of the nature of the threat, of course, is not irrelevant to the ethical question of whether the risk is ethically acceptable, but science alone cannot tell society what it should do about various threats. In environmental controversies such as climate change where there is legitimate concern about certain consequences, important ethical questions arise when scientific uncertainty prevents unambiguous predictions of human health and environmental impacts. This is so because decision-makers cannot duck ethical questions such as how conservative "should" scientific assumptions be in the face of uncertainty or who "should" bear the burden of proof about harm. In the case of climate change this may be particularly important because decision makers must make decisions about acceptability of risk which will affect others around the world. (Gardiner, Stephen, Ethics and Climate Change, Ethics, April 2004, pages 255-592; Brown, Donald. A., Ethical Dimensions of Global Environmental Issues, Deadelus, Journal of American Academy of Artis and Sciences, Vol. 130, No 4, Fall, 2001, pg 59-75) For a good text on how scientific uncertainty and ethics interacts see Lemons, John. 1996. Scientific Uncertainty and Environmental Problem Solving. Cambridge, Mass.: Blackwell Science (Donald Brown, Commonwealth of Pennsylvania)	
2-194	A	21	32			Figure 2.3.1: This diagram is not an accurate representation of the temporal relationships that will occur in reality. IN particular, development path and demographic change are shown as occurring at the same time as climatic change and impact, whereas some or most of the eventual climatic change will occur after the development path has occurred, and many of the impacts (such as sea level rise and some ecosystem impacts) will not occur until quite some time after the climatic changes that trigger them have occurred. The figure should either be completely modified to reflect this, or deleted. (Danny Harvey, University of Toronto)	Agree that this is a poor description of the complexity of overlapping actions by groups of actors and we will discuss with chapter 3 in redrafting. 3

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2-195	A	21	32			Figure 2.3.1 and figure 3.34 are redundant. Suggest that these figures be combined, and that the caption include the text given in Ch3, p63, lines 5-7. (Haroon Kheshgi, ExoonMobil Research and Engineering Company)	Agree that this is a poor description of the complexity of overlapping actions by groups of actors and we will discuss with chapter 3 in redrafting 3
2-196	A	21	34	21	43	Make better schema (FÉLIX HERNÁNDEZ, IEG-CSIC)	Agree that this is a poor description of the complexity of overlapping actions by groups of actors and we will discuss with chapter 3 in redrafting 3
2-197	A	21	34	22	34	The discussion of act-learn-act strategies in these paragraphs is very general, and does not add much information beyond common sense (including Figure 2.3.1). I suggest to shorten it, and use the space to cover the suite of quantitative approaches to DM under uncertainty, some of which I have mentioned above. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	Some but not all of these techniques are explored in section 2.3.5. Consideration will be given to shortening and linking these sections, while broadening the range of issues (lightly) covered.
2-198	A	21	49	21	50	delete "the" before some ?? (H-Holger Rogner, IAEA)	Agree
2-199	A	21	0			Figure 2.3.1: Essentially the same figure (though with a less sensible design in the middle section) appears in the Chapter 3 FOD (as Figure 3.34). Even the text in the two chapters is almost identical (including the same punctuation errors). (Hans-Martin Fuessel, Stanford University)	Agree that this is a poor description of the complexity of overlapping actions by groups of actors and we will discuss with chapter 3 in redrafting 3
2-200	A	22	6	22	6	It is proposed to substitute the term "caricature" by "schematic figure". This is to avoid any confusion. The reader does not expect that the IPCC AR4 includes any caricature. I do hope that the authors have the same view. This means that the term "caricature" should be avoided in the whole report. (Radunsky Klaus, Umweltbundesamt)	Agree that this is a poor description of the complexity of overlapping actions by groups of actors and we will discuss with chapter 3 in redrafting 3
2-201	A	22	35			This section has only a few references, most of them old. The whole section needs to be updated to 2005. (Richard Tol, Hamburg University)	Consideration will be given to shortening and linking these sections, while broadening the range of references (lightly) covered.
2-202	A	22	35	25	15	Section 2.3.5 (mainly on CBA) adds little that is new, and could be briefly summarised to advantage. (Michael Jefferson, World Renewable Energy Network/Congresses)	Consideration will be given to shortening and linking these sections, while broadening the range of issues (lightly) covered.
2-203	A	22	35			Figure 2.3.2 (Not referred in the main text, however): In the column "ETC related to carbon intensity", clarification is needed of the distinction between "Learning-by-Doing" and "Learning curves". Probably the former endogenouly takes cost	Accepted

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						reduction by learning into account and the latter not. (Takanobu Kosugi, Ritsumeikan University)	
2-204	A	22	35			Figure 2.3.2 - Presented twice. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Acceptedrr
2-205	A	22	35			Assessment tools like CBA are popular and well accepted within economists and other specialists, but CBA focus more upon technical refinement while neglecting the restriction implied by the methodology. Criticism related to CBA argues that it loses a considerable amount of information in trying to reduce the environmental complexity to a one-dimensional monetary value. There is a certain degree of comfort associated with precise numbers despite the fact that such kind of value can be precise but wrong. There is a long tradition related to the assumption that the accuracy of quantitative results are more relevant and neutral than qualitative ones, but it not holds within uncertainty and complexity (Munda 2000)… "From a theoretical perspective, the optimizing principle is elegant since it provides an unambiguous tool for evaluating alternative strategies on the basis of their contribution to community welfare. From an operational point of view, the value of the optimizing approach can be rather limited, because the specification of a community welfare function requires complete information about all possible combinations of actions, and the relative trade-offs between all actions and constraints. Such information is generally unavailable. (Spash 1998) …… Multi attribute. Multi-objective or better Multi- criteria analysis, differs from CBA in three areas, a) while CBA focuses mainly on efficiency in monetary terms MCA dose not impose limits on the form of criteria, allowing for other considerations, b) CBA requires that effects be measured in quantitative terms, but MCA can be divided into three groups, one with quantitative data, a second that uses only qualitative one, and a third that handle both simultaneously (Munda, 2000) ……MCA do not need the use of prices but they can be used to arrive to a score. MCA has been developed expressly for situations where decisions must be made taking into consideration more than one objective which can not be reduced to a single dimension, its central focus is the quantification, display and resolution of trade-offs when objectives in conflict. (Van pelt, 1991, Munasinghe, 1993) for a discussion about the shortcomings of CBA under complexity and introducing "weak comparability", see Funtowicz et. al 1999, Information Tools for Environmental Policy under Conditions of Complexity, European Environment Agency, Environmental Issues Series No. 9 34 pp. For " weak comparability" see "Weak comparability of values as a foundation of ecological economics", J.	There was an attempt to make this point – will be clearer in next draft.

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						Martinez Alier, G. Munda, and J. O'Neill in Ecological Economics Vol. 26 No. 3 September 1998. (Juan Llanes, Havana University)	
2-206	A	22	38	22	38	The term "safe-landing approaches" should either be replaced by "tolerable windows/safe-landing approaches" or (linguistically preferably) by "guard-rail approaches (i.e., safe-landing analysis and tolerable windows approach)". (see previous comments above) (Thomas Bruckner, Technical University of Berlin)	Agreed – see comments above
2-207	A	22	42			Rewrite "The policy goal … represents '" as "Achieving or contrinbuting to achieving the policy goal is the benefit …" (Danny Harvey, University of Toronto)	Agree
2-208	A	22	49			Sathaye and Markandya have not contributed much to this literature. Nordhaus wrote the first paper, Tol the latest. (Richard Tol, Hamburg University)	Noted
2-209	A	22	0			subchapter 2.3.5: Assessing the year of the literature cited and taking into account several paragraphs without including any reference to literature it is proposed to shorten this subchapter considerable and to limit it to those findings that are additional to the information already provided in the TAR. (Radunsky Klaus, Umweltbundesamt)	Consideration will be given to shortening and linking these sections, while broadening the range of issues and references (lightly) covered.
2-210	A	23	19	23	28	attribute analyses is very useful; Citing the same feature as a strenth and weakness is confusing, though, The discussion should include cleare advice on appropriate use of this technique and its drawbacks and benefits versus other approaches.. (Lourdes Maurice, US Government)	The text aims to be explanatory – it is not the place of the framing chapter to provide advice that one form of analysis is better than another.
2-211	A	23	36	23	37	There are more than the two "broad classes" of IAMs. For instance, the WG III TAR devoted the whole Section 10.4.3. to the tolerable windows approach, which is not even mentioned here (for a summary of the decision-analytical frameworks discussed in the WG III TAR, see Table 10.1). (Hans-Martin Fuessel, Stanford University)	Tolerable windows/guard rails/safe landing are discussed in following paras but consideration will be given to shortening and linking these sections, while broadening the range of issues (lightly) covered.
2-212	A	23	36	23	41	I don't think it is a good idea to state that there is a dichotomy of CBA and target-based approaches on one hand and uncertainty-based approaches on the other. The deterministic versions of the former two approaches can and have been modified to include various kinds of uncertainties. There are many applications of probabilistic CBA (maximizing expected utility or minimizing expected costs) and risk assessments (minimizing costs of meeting a probabilistic target). For a review, see e.g. S. Peterson, 2005: "Uncertainty and economic analysis of climate change: A survey of approaches and findings", Enviromental Modelling and Assessment.	This point is basically right – will be addressed in redrafting.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Hans-Martin Fuessel, Stanford University)	
2-213	A	23	50			Rotmans and Dowlatabadi is now 7 years old. Much has happened since. (Richard Tol, Hamburg University)	Noted and reflected in lit. review in text
2-214	A	24	17			Why is Toth / tolerable windows singled out? There are many alternatives. (Richard Tol, Hamburg University)	Other references will be cited
2-215	A	24	18	24	27	The tolerable windows approach is also known as the "guardrail" (not "guide rail" approach). It was not proposed by Toth (2004) -- the first publication was in 1996. For early references, see Section 10.4.3 "Tolerable windows approach" in the WG III TAR; the key publications since the TAR are: (a) F.L. Toth (guest editor), 2003: Integrated Assessment of Climate Protection Strategies (ICLIPS). Climatic Change 56(1-2), special issue -- and (b) F.L. Toth, T. Bruckner, H.-M. Füssel, M. Leimbach, G. Petschel-Held, H.-J. Schellnhuber, 2002: "Exploring Options for Global Climate Policy: A New Analytical Framework". Environment 44(5):22-34 (Hans-Martin Fuessel, Stanford University)	Noted will be redrafted and other references cited.
2-216	A	25	18			Section 2.4 comment:I think that here some concepts should be defined, e. g., what is objective probability and what is subjective probability? For this, it should be considered that for an entire school of probability theory (de Finetti), objective probabilities do not exist. (As to myself, I have not yet seen a definition of objective probability that is not circular.) Also, 'risk' should be defined: Is it the 'probability of an unwanted event' (as in the Oxford dictionary http://ptcl.chem.ox.ac.uk/MSDS/glossary/GLOSSARY.html) or is it 'probability times damage'. The latter would be contrary to the normal everyday usage of the word (eg the risk to contact a given disease in a given time period). In the example of the previous sentence, it is clearly a probability, and multiplying it with the 'unwanted event' would not mean much. (Moreover, 'expected damage' describes 'probability times damage' precisely.) (Leo Schrattenholzer, IIASA)	Objective probabilities are defined p 27 l. 16-20. Subjective and bayesian: refer to 2.4.3. On defining “Risk': Comment accepted. Action taken: move 27:46-55 upfront and simplify according to the proposed definition for the IPCC glossary.
2-217	A	25	18			Subchapter 2.4: Again this subchapter seems to be too broad in relation to the scope of the AR4. It is suggested to summarise the concept of addressing uncertainties in the AR4 in general (the paper by Manning and Petit is referenced and need not be repeated in any greater detail) and in WG3 report in particular and to inform the reader about those items for which the authors could not follow the general concept and what the problems have been. All other information should be removed. (Radunsky Klaus, Umweltbundesamt)	The subchapter addresses the topics agreed in plenary. Text will be shortened.
2-218	A	25	18	36	46	Very strong section which does not seem to be well reflected in the Executive Summary.	Accepted. Thank you. Comment transferred to the executive summary writing team.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Nick Campbell (Batch 2), ARKEMA SA)	
2-219	A	25	18	36	46	this section 2.4 is way too long and has a strong textbook character. That is not what is needed. This section should describe how this report is dealing with uncertainty and risk (definition, measurement, communication, factoring it into decisions). A concise treatment of these issues would do. It is not necessary (and even unwaned) to start from scratch. Key is to provide the reader with the necessary information on rsk and uncertainty concepts and definitions, so that the material in other chapters can be understood (these chapters need to be in conformity then) (Bert Metz, IPCC)	Too long and too textbooky: Accepted. The revision will keep this comment in view.
2-220	A	25	19	25	20	what does it mean to "manage" risks? Why not just say "to reduce risks [to acceptable levels". (Danny Harvey, University of Toronto)	Risk management covers risk reduction. In a business and policy context, risk managers have to balance the opportunities (upside risk) with the downside risks. Refer to "Risk versus Risk" (1995) by Graham and Wiener, = Harvard University Press.
2-221	A	25	20	38	35	This section reads like a textbook, filled with various definitions. The section is missing its application of these definitions into the AR4 IPCC work. (Rutu Dave, IPCC WGIII TSU)	Refer to response to comment #2-219. We will make stronger links on uncertainty and risks with technology and decision making.
2-222	A	25	41	25	41	When referring to the "pedigree approach", credits should be given to the work of Funtowicz and Ravetz, who developed the NUSAP approach. (Hans-Martin Fuessel, Stanford University)	Accepted. Will include the citation.
2-223	A	25	46	25	49	Geologic storage projects such as Sleiper (saline aquifer, Norway) and Weyburn (CO2-EOR) are good examples of large scale implementation. Careful CO2 monitoring studies have been carried out at some pilot-scale projects as Nagaoka (saline aquifer, Japan) and FRIO (saline aquifer, USA) and valuable information on behaviors of injected CO2 within reservoirs will be published soon in scientific journals. (Ziqiu Xue, Research Institute of Innovative Technology for the Earth)	Accepted. Sentence will more specific.
2-224	A	25	47	25	47	Typo error (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Noted. Will change "geologic" to "geological".
2-225	A	25	48	25	49	The statement: For example, geologic carbon storage has only been studied through experiments, so there is little information about large scale implementation." is no longer true. The recently released IPCC Special Report on Carbon Dioxide Capture and Storage documents the wealth of information available on this technology. Change the statement to: For example, ocean storage of carbon dioxide has only	Sentence will be modified to be more specific.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						been studied ..." for a more valid example. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
2-226	A	25	48	25	49	Modify the sentence by: "For example, geologic carbon storage has only been implemented in three industrial-scale storage projects, so there is limited information …". (see IPCC SRCCS 2005 - summary for policymakers p6) (CZERNICHOWSKI-LAURIOL Isabelle, BRGM)	Accepted. Will modify the sentence as suggested.
2-227	A	26	10	26	10	for most of the class of events we care about, it is impossible to use statistics to estimate probability, not merely difficult. (Paul Baer, Stanford University)	Accepted. Will insert “or impossible”.
2-228	A	26	13	26	15	To change letter (FÉLIX HERNÁNDEZ, IEG-CSIC)	Accepted. Font size will be made consistent.
2-229	A	26	13	26	13	It is unclear why one may want to "separate probability and outcomes". There should be no need for doing this because they are very different conceptually anyway. This maybe a consequence of the (in my opinion misguided) idea to combine them to begin with in a (bad) definition of risk. (Leo Schrattenholzer, IIASA)	Accepted. Sentence will be apropriately modified and reference to the separation between probability and outcome will be dropped.
2-230	A	26	16	26	17	How does one 'set a constraint on the most unfavorable percentile'? (Leo Schrattenholzer, IIASA)	Word “constraint” is substituted by “norm”.
2-231	A	26	16	26	18	A citation to the "value at risk" literature would be very helpful. Also, it's important to note that any "distribution of outcomes at a future date" is necessarily a subjective distribution and thus "model dependent" in a very broad sense, and there will be no unique value of 5% thresholds (which are completely arbitrary in any case). (Paul Baer, Stanford University)	Accepted. Citations will be made. Noted. This is covered at p 27 l 16-20.
2-232	A	26	20			give an example of an "irreversible" option that one might end up committing too early to. This should also be balanced with a statement that you could forego future options (such as stabilizing at certain low CO2 levels) by delaying action too long. (Danny Harvey, University of Toronto)	Noted. The sentence about “irreversible options” has been dropped in this revision.
2-233	A	26	30			This section has textbook material only, and not even a textbook I would use in class. (Richard Tol, Hamburg University)	Noted. Refer to comment #2-219.
2-234	A	26	30			Section 2.4.3: This section contains only one reference, despite a large body of literature that is available on this topic. The same problem applies to many other sections as well. (Hans-Martin Fuessel, Stanford University)	Accepted. Will add citations appropriately.
2-235	A	26	34	26	35	Is this really in Chapter 3? I didn't see anything that looked like this.	Noted. The sentence is deleted in this revision.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Paul Baer, Stanford University)	
2-236	A	26	35	26	35	Make this reference to Chapter 3 more precise. Otherwise, the references text it is difficult to find. (Leo Schrattenholzer, IIASA)	Noted. The sentence is deleted in this revision.
2-237	A	26	37	26	38	Sorry, but this is nonsense. According to probability theory, probability is simply an additive and normalized measure (function) (, defined on a sigma algebra). (Leo Schrattenholzer, IIASA)	Noted. Text will be clarified.
2-238	A	26	39	26	41	This is highly questionable: First, it appears to confuse 'probability' and 'levels of uncertainty'. Why not ask any WGIII Lead Author who participated in the Maynooth Workshop to get this formulation right. In Maynooth, this distinction was clearly made and, as far as I could make out, clearly understood. Second, the idea to measure either one appears highly doubtful to me. (Leo Schrattenholzer, IIASA)	Noted. This section will be restructured to put forward the distinction between objective and bayesian (subjective) probabilities.
2-239	A	26	43	27	14	According to de Finetti, these three "procedures" are not distinct enough to differentiate between them. For the "Personal" approaches, this should be readily clear, but if you come to think about it, no-one can observe frequencies high enough to warrant an unambiguous disctinction between the "frequentist approach" and the other two. Of course, there is a difference between a large number of observations and a simple personal belief, but this is exactly the place where the distinction between uncertainty and probability comes to bear. (Leo Schrattenholzer, IIASA)	Noted. This section will be restructured to put forward the distinction between objective and bayesian (subjective) probabilities.
2-240	A	26	43		47	Most importanty, it only works when at least some historical observations are available! Crucially, it does not justify the statistical analysis of the output of multiple model runs. (Paul Baer, Stanford University)	Accepted. No changes needed in the text.
2-241	A	26	49	27	14	This is the first time I see a distinction between "personal" and "subjective" approaches, and I don't find it helpful.Both approaches are "subjective" in that they involve the strength of belief of individuals. This strength of belief can be elicited in several ways, by observing their behaviour in real or virtual markets, by structured interviews, by measuring their neural activity, etc. I strongly suggest to combine these two categories into one, which relates to "subjective" probabilities than can be processed by Bayesian analysis. (Hans-Martin Fuessel, Stanford University)	Noted. The personal and subjective approaches are integrated.
2-242	A	26	49	27	14	This discussion of "personal" vs. "subjective" probability is, in my opinion, very misleading. In my taxonomy, "subjective" probability subsumes "personal" probabilities elicited directly, behavioral probabilities inferred from collective	Noted. See previous comment.

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						behavior, and, most importantly, Bayesian computational methods that use models to compare evaluate the likelihood that observed data are the consequence of particular parameters. The absence of a discussion of the latter is a a crucial oversight, since that is the kind of probability that is used in discussing uncertainty in the climate sensitivity, which is a key input into all decision analysis models. (Paul Baer, Stanford University)	
2-243	A	26	53	26	55	I'm kind of skeptical about this; I'd at least like to see a citation, rather than have it reported as if it were a robust scientific fact. (Paul Baer, Stanford University)	Reference to the neuroeconomics litterature will be dropped. The seminal paper is Sutton et al. (1965) Evoked potential correlates of stimulus uncertainty. Science 150, 1187—1188.
2-244	A	27	17	27	17	Erratum: exists between (FÉLIX HERNÁNDEZ, IEG-CSIC)	Noted. Will insert space.
2-245	A	27	22	27	23	If you read this with the conviction that precise (objective) probabilities do not exist, this must sound very strange. In general, I think that there is no point in trying to pretend that probabilities do not always reflect some sort of 'degree of belief', in particular here (AR4)! It would appear much more fruitful to focus on the confidence in probabilities, which should be used to distinguish between what is called precise (objective) and personal (subjective). Doing so would leave enough room for the distinction between 'subjective' and 'arbitrary'. The feared lack of this distinction to me explains the wide-spread reluctance to follow de Finetti in understanding all probabilities as subjective (and as degree of belief). (Leo Schrattenholzer, IIASA)	Noted. It will be explained that in this WG, bayesian (subjective) probabilities are the norm.
2-246	A	27	40			Why is the IPCC talking about itself? Is vanity the latest addition to the list of IPCC vices? You're supposed to assess literature. (Richard Tol, Hamburg University)	Taken into account, p. 28, 10-18 deleted.
2-247	A	27	40	29	9	People are really sensitive to the words of 'risk' and 'uncertainty' in geologic CO2 sequestration. If possible please give some examples of risk and uncertainty in section 2.4.4. (Ziqiu Xue, Research Institute of Innovative Technology for the Earth)	Noted
2-248	A	27	42	27	54	I think that all these difficulties are self-made. Adopting a consistent conceptualization of probabilities and agreeing on useful definitions would have avoided these difficulties and considerably reduced the potential of confusion on the side of the readers of AR4. Would there still be time to 'fix' this? (Leo Schrattenholzer, IIASA)	Taken into account. This paragraph is moving upfront and will be rewritten.
2-249	A	28	11	28	18	The references to the WG I TAR do not "discuss uncertainties related to climate	Noted. This paragraph is removed from next

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						impacts" but uncertainties related to the (regional) manifestation of anthropogenic climate change. (Hans-Martin Fuessel, Stanford University)	version.
2-250	A	28	14			Check the number of the figure quoted at the end of the line (Michel Petit, CGTI)	Noted. This paragraph is removed from next version.
2-251	A	28	28	28	43	This is difficult to review because of the unreadability of Line 33 and the apparent accidents in the numbering of the tables. (Leo Schrattenholzer, IIASA)	Accepted. This printing problem will be fixed up in the next version.
2-252	A	28	45			Reading 2.4.5, I expect 2.4.5.1/2/3 to follow, not 2.4.6/7/8; most of this is textbook stuff, does not need to be repeated here. If you do decide to talk about this, please provide references. (Richard Tol, Hamburg University)	Taken into account. The section numbering is to be modified apropriately. Will consider additional references where needed.
2-253	A	29	10	29		(Paul Baer, Stanford University)	COMMENT MISSING ?TSU
2-254	A	29	16	29	28	The example here is inconsistent with the larger framing of the section, which is supposedly addressing "situations of uncertainty which do not involve the will of other agents"; yet the example is global society's response to mitigation measures. This response certainly involves the will of other agents, and while it is certainly an example of indeterminsim, it's not an example of randomness. (Paul Baer, Stanford University)	Accepted. Example removed.
2-255	A	29	21	29	21	Change "cause be" to "because" ?? (H-Holger Rogner, IAEA)	Accepted, corrected.
2-256	A	29	21	29	28	The examples in this paragraph don't go well with the point, which is that predictions aren't always deterministic. First, it uses chaos as an example, even though chaotic systems are in fact "deterministic", Second it uses human society as an example, even though this section is supposed to be about systems that don't involve human will. (Paul Baer, Stanford University)	Accepted. Example removed.
2-257	A	29	30		37	This discussion of Possibility theory is problematic. It confuses a certain class of very artificial problems (the "how many balls in the urn" problem) which arguably doesn't represent any significant class of real world problems, with a formal mechanism for manipulating imprecise probabilities (one of several, note the following paragraphs). Furthermore, the system depends on the meaning of the term "admissible probability", which isn't defined here. (Paul Baer, Stanford University)	Accepted. Will rewrite the paragraph for clarity.
2-258	A	29	30	29	36	Although I think it's an advance to discuss possibility theory, this doesn't do a very good job of it. In particular, the example of the possibility of a single future	Accepted. Will rewrite the paragraph for clarity.

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						scenario as having a bounded upper possibillity but an infinitesimal lower possibility is contradictory (Paul Baer, Stanford University)	
2-259	A	29	34	29	34	What is a 'possibility level'? The whole paragraph appears unclear to those unfamiliar with the theory. (Leo Schrattenholzer, IIASA)	Accepted. Will rewrite the paragraph for clarity.
2-260	A	29	38			Comment on Box 2.4.1: This is another example demonstrating that lack of precise concepts can lead to unnecessary controversy. How could one, for instance, prevent a scientist from adhering to a degree of belief? (Leo Schrattenholzer, IIASA)	Noted. Box is deleted. Material covered in WGII, 2.2.3.3 fod numbering.
2-261	A	29	0			Box 2.4.1: the WG I FOD includes an in depth discussion of the uncertainties on climate sensitivity and the ways of estimating a probability distribution function. The present discussion should concentrate on the emissions scenarios uncertainties , after a reminder explaining that the climate projections undergo uncertainties originating on one hand in the climate sensitivity (discussed in WG I report) and on the other hand on future emissions (discussed in the present WG III report). The last paragraph is rather trivial and deals actually with the necessity of replacing probability values by a probability distribution function, when moving from discrete events to continuously varying parameters. (Michel Petit, CGTI)	Noted. Box is deleted. Material covered in WGII, 2.2.3.3 fod numbering
2-262	A	29	0			Box 2.4.1.: It is proposed to delete that box because the cobtroversy about the IPCC SRES scenarios is well covered in chapter 3 (e.g. chapter 3.2.1.2.2). There is no need to address this issue in two different chapters. Chapter 3 seems to be much more appropriate. (Radunsky Klaus, Umweltbundesamt)	Noted. Box is deleted. Material covered in WGII, 2.2.3.3 fod numbering
2-263	A	29	0			Box 2.4.1 - it should be pointed out that both the Reilly et al estimate (which is actually based on results subsequently published in Webster et al. 2003) and the Wigley and Raper estimate are subjective probabilities, and no more credible than the subjective parameter estimates that went into them. (Paul Baer, Stanford University)	Noted. Box is deleted. Material covered in WGII, 2.2.3.3 fod numbering
2-264	A	30	1	30	6	Last sentence of Box is incomplete (H-Holger Rogner, IAEA)	Accepted. Sentence completed.
2-265	A	30	23			Why is this "insight" ascribed to Kriegler and his imprecise probabilities? This results has been known for at least 15 years. (Richard Tol, Hamburg University)	Accepted. Sentence modified.
2-266	A	30	23	30	27	I quite agree with the sentence “the warming in the 21st century would remain	Noted. We believe the comment refers to the

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						below 2 C in the absence of policy intervention," because it is evaluated accurately from the viewpoint of current scientific knowledge. (Masatake Uezono, Citizens' Alliance for saving the Atmosphere and the Earth)	entire sentence, in which case we agree with it.
2-267	A	30	24	30	24	Despite the quite lengthy current text on uncertainty the meaning of "very unlikely" remains unclear for the reader. It is strongly recommended to include a clear interpretation of such key terms in this chapter and any deviation from the use of such terms in WG3 report to the TAR, if any. (Radunsky Klaus, Umweltbundesamt)	Noted. Refer to table on "Qualitatively defined likelihood scale" which quantifies the terms.
2-268	A	31	10	32	10	This discussion of the nature of scientific knowledge is quite poor and should entirely revised. A clear distinction should be made between the basic laws of physics which, by definition can be disproved by experiments and the attempt to model complex phenomena by using these laws. When an experiment provides consistently results which are contrary to a basic law, the law has to be replaced by a new one which will remain valid until a further experiment provides incompatible results. Such events are exceptional and correspond to major progresses of science. This is pure rationalism and has nothing to do with empiricism, although an experiment can kill a theoretical law. On the contrary, theoretical approach of a complex phenomenon is based on theoretical well established laws but usually requires some simplifying assumptions. These assumptions are arbitrary and if the projection of the model is not in agreement with the observations, the assumptions should be modified in further researches on the subject. The observed disagreement between theory and experiment will not induce any major progress in science. This should not be described as a scientific approach, it is closer to an engineer approach. (Michel Petit, CGTI)	Noted; subsection is deleted.
2-269	A	31	11	31	12	Epistemology is not just the study of scientific knowledge, but of knowledge in general. (Paul Baer, Stanford University)	Noted; subsection is deleted.
2-270	A	31	29	31	43	there are a number of problems with these paragraphs. First, a theory that "explains most of the available observations" is not necessarily the theory that "maximally simplifies problem solving." Secondly, there is in many cases no obvious way to determine when one theory explains "more" of the observations than another -- the importance of particular predictions/observations to the explanatory value of theory is necessarily a matter of judgment. Third, there is no definition given of "closure,"	Noted; subsection is deleted.

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						which is a necessarily contextual concept. Finally, while it's good to note that there is a "qualitative human dimension," I would specify that there is an irreducible component of individual and collective judgment. (Paul Baer, Stanford University)	
2-271	A	31	38	31	43	This paragraph appears to assume the existence of objective probabilities of scientific theories, which are waiting somewhere to be discovered. I think that it would be much more useful to not think of certainty (in terms of probability disctributions) in this case (the AR4). The very notion of waiting until "normal scientific controversies are over" is highly questionable for me, not least because even considering the possibility of such waiting in the climate case could all too easily be used as a pretext for non-action. (Leo Schrattenholzer, IIASA)	Noted; subsection is deleted.
2-272	A	31	45	31	50	Here you seem to be very close to making yourself the case for regarding probabilities as (continuously refined) judgement. From my perspective, from here it is only one more small step to understanding all probabilities as subjective. To come back to an earlier comment of mine: Even the determination of probabilities of the six results of rolling a dice has this aspect of induction. One would have to roll a dice many times times to determine whether it is a "fair dice". And no matter how many times it would be rolled, the judgement whether equiprobability is a good model for a given real-world dice will be subjective! (Leo Schrattenholzer, IIASA)	Noted; subsection is deleted.
2-273	A	31	0			2.3 and 2.4 p.31 should one of these sections include a reflection on complexity, as “announced” in chapter 1? (See 1.5.6) (Juan Llanes, Havana University)	Noted. Will be coordinated with chapter 1’s restructuring.
2-274	A	32	7			Comment on Box 2.4.2: I propose to not think of the given example (on the demand curve) as an illustration of an alleged weakness of deductive inference. In a sense, you are saying here that a concept is weak because it cannot be correctly applied to each and every situation. This is like saying that the arithmetic concept of addition is weak because two moles of hydrogen plus one mole of oxygen do not add up to three moles of water (vapor). (Leo Schrattenholzer, IIASA)	Noted; box is deleted.
2-275	A	32	11	33	45	Excellent discussion on a very new issue for IPCC. Congratulations. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Noted, thanks.
2-276	A	32	26	32	30	I think I can guess what the metaphysical aspect of uncertainty is, but I propose to also say it in the text. (Leo Schrattenholzer, IIASA)	Accepted

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2-277	A	32	26	32	30	delete any reference to metaphysics which is irrelevant to climate change. (Michel Petit, CGTI)	Rejected. Metaphysics matter to perceptions of uncertainties in different contexts of climate change policymaking.
2-278	A	33	5	33	11	Same comment (mutatis mutandis) as previous. (Leo Schrattenholzer, IIASA)	Accepted
2-279	A	33	9	33	11	This is a provocative claim - I'd love to see an example! (Paul Baer, Stanford University)	Accepted. Will add an example in the next revision.
2-280	A	33	14	33	45	the relevance of those concerns to climate change , if any, should be demonstrated by examples taken in this field. (Michel Petit, CGTI)	Accepted. Examples will be given.
2-281	A	33	16	33	17	This sentence "promises" a list of several asepcts of strategic uncertainties but this list is missing. (If the two following paragraphs are intended to be examples of structural uncertainty, they should be indented or listed as bullet points.) (Hans-Martin Fuessel, Stanford University)	Accepted. We read “strategic” instead of “structural” in the comment. The words being defined will be set in italics.
2-282	A	33	18	33	18	Note that policy and other uncertainty from a commercial or investment perspective increases the risk and therefore the cost of capital ie it will attract capital that requires a higher return for taking that risk. The impact, for example, of uncertainty in the post-2012 debate means that investors take a risk on carbon market development (EU ETS and CDM) from 2013 onwards. [check Finance of Climate Change, Tang 2005, for specific chapter reference]. This comment may be relevant to other chapters or sections, including for example consideration of market efficiency, and cost. (Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	Noted.
2-283	A	33	19	33	16	Here it should be possible to add as na example the commercialization of CDM credits. Without the participation of USA in the Kyoto Protocol price of Carbon Credits may be too low to induce non-Annex I to host projects. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Rejected. The suggested example does not fit the concept of adverse selection.
2-284	A	34	0	35		The financial sector needs to screen, monitor and select on the basis of climate-criteria, to be able invest scarce resources in a sustainable way and to help mitigate climate change. (Tineke van der Schoor, Sustainability Centre Lauwersoog/ RUG-Bedrijfskunde)	Noted. The comment does not call for changes in the text.
2-285	A	34	0	35		Banks play a role in mitigation, e.g. through financing 'green projects'. In the Netherlands, 586.000 ton CO2 was prevented by green-label greenhouses and renewable energyprojects financed with 'green money'. The banking sector could play a much larger role in mitigation, when they would have more legal instruments	Noted. The comment does not call for changes in the text.

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						to control their clients not only on financial criteria, but also on sustainable development-criteria. (ref. oratie L.J.R. Scholtens, january 2006, see link on www.rug.nl. See below for references from this publication. (Tineke van der Schoor, Sustainability Centre Lauwersoog/ RUG-Bedrijfskunde)	
2-286	A	34	0	35		Also financial markets can mitigate the consequences of climate change, by Catastrophe bonds, - swaps, CEPs and CSN. They are quite large enough to provide the money needed for investments and policies directed at mitigation of climate change. (Tineke van der Schoor, Sustainability Centre Lauwersoog/ RUG-Bedrijfskunde)	Noted. The comment does not call for changes in the text.
2-287	A	34	5	34	36	This section does not give enough emphasis to the fact that governments are bound by the precautionary principle in Title 3 of the UNFCCC even though. granted, there is some ambiguity in its meeaning. In fact, it leaves the distinct impression that because there is ambiguity, deciion makers are free to justify non-action on climate change on the basis of scientific uncertainty. More specifically, although on lines 40 to 44 mentions that precaution is contained in the UNFCCC, it then stresses that there is no formal definition in the scientific literature on precaution and iin so doing leaves the impression that precaution may not be applicable to governments obligations under the UNFCCC. Moreover, precaution is an ethical principle, not a scientific principle. As an ethical principle it is not reducable to an algorithim, and therefore there is never likely to be reduced to a scientifically rigorous definition, but like most ethical principles requires that its application consider a host of issues including what is at stake, whether the harms are reversible, whehter the uncertainties can be resolved before the damage is done, etc.. In the case of climate change this analysis of climate change has led to the conclusion that the precautionary principle should apply. The precautionary prinnciple is understood ethically, depending on the aswers to these questions, to be a burden shifing principle that puts the burden on those who wish to continue risky behavior to demonstrate that the harm will not occurr. For a discussion of why the burden of proof should be as a matter of ethics on emitters, not vitims, see Brown, Donald A. American Heat: Ethical Problems With the United States Response to Global Warming, Rowman and Littlefield, Lantham Maryland, 2002.at 137-149 At minimum, therefore this section should state: Parties to the UNCCC are bound by the precautionary principle under the Title 3 of the UNFCCC which expressley states: The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific	Noted. Emphasis will be given by moving this aspect (lines 40-41) in the beginning of the subsection.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost (UNFCCC, Art 3) Although this provision is subject to interpretation, it is clear from it that there are limits to any nation's ability to justify non-action on uncertainty. The ethics literature makes a distinction between risks imposed upon oneself and risks imposed upon others without thier consent. See generally Nash, James, Moral Values In Risk Decisions, in Handbook for Environmental Risk Decision Making, C. Richard Cothern, ed , Lewis Publishing Co. Boca Raton, Florida, 1996, Also see, Brown, Donald. 2003. "The Precautionary Principle as a Guide to Environmental Impact Analysis: Lessons Learned from Global Warming," in Tickner, ed., Environmental Science and Preventive Public Policy. Washington, DC: Island Press, 2003 (Donald Brown, Commonwealth of Pennsylvania)	
2-288	A	34	5	34	44	the precaution principle is a political slogan which has no scientific value (see e.g. Dupuy and Grinbaum / C.R. Geoscoence 337 (2005) 457-474. The last sentence only “there is no consistent formal definition of precautionary decision-making in the scientific literature” should be kept. I would prefer to see here a presentation of the inertia of the CO2 concentration, of the climate response and of the socio-economic systems, that induce the necessity of an early action. (Michel Petit, CGTI)	Noted. Last sentence will be kept. This chapter is only about framing and can not discuss results.
2-289	A	34	7	34	9	This doesn't make any sense - why should "prevention" be based on known probabilities? Where are some of the places this distinction is made? (Paul Baer, Stanford University)	Accepted. Sentence will be appropriately modified.
2-290	A	34	23		25	Umm, it's not even clear that, outside the field of economics, it would be accepted that people have something called "risk aversion" which can be quantified on a real-numbered scale, no less what its value is. Is this supposed to apply to all risks, or only to financial risks? (Paul Baer, Stanford University)	We will add a contextual definition of risk aversion and it will be covered also in the glossary.
2-291	A	34	24	34	24	The reference should read "Jonas (1979)". (Hans-Martin Fuessel, Stanford University)	Accepted. Text will be corrected.
2-292	A	34	27			The statement "objective probabilities are difficult to estimate by experts" is incoherent. For most of the types of things we care about there are no objective probabilities. The real problem is that there is no agreement about subjective probability!	Accepted. Oxymoron will be dealt with. Subsection to be folded in the “decision making” section, taking into account the problem of disagreement.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Paul Baer, Stanford University)	
2-293	A	34	40	34	43	The precautionary principle is indeed mutiple interpretable.That is why Stephen Gardiner has formulated a Core Precautionary Principle. He suggests conditions for its application and denotes that it is especially applicable to the problem of climate change. See Stephen Gardiner, A Core Precautionary Principle, smgard@u.washington.edu (Gert de Gans, Kerkinactie)	Noted.
2-294	A	34	40	34	44	The authors note that the "Precautionary Principle" is a component of contemporary international law's doctrine. There is no formal defintion of it in for decision-making in scientific literature. That said, why has it been used to facilitate the assessment of climate change in both a scientific and economic context? What is the rationale for applying a concept of international law to deciplines based, at least large part, on empirical data? While the "Precautionary Principle" may have value in international law, it has little value (if any) in the context of economics and most certainly science. Please provide rationale for the use of this concept as it relates to the work contained in this report. (Lourdes Maurice, US Government)	Our sentence will be changed to mention that the precautionary principle appears in many international treaties
2-295	A	34	45	34	54	This paragraph could be updated to include the year 2005, in the next draft. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Noted. If 2005 data is available before SOD is submitted, then it will be included. Early estimates show 2005 to be in line with the increasing trend.
2-296	A	34	45			Sections 2.4.10 and 2.4.11: These two subsections do not seem to fit well into the overall context of Section 2.4. I suggest to drop them; if this is not an option, they should be better integrated with the other subsections. (Hans-Martin Fuessel, Stanford University)	These sections will be integrated in the decision making section
2-297	A	34	45			Presumably the 2005 experience will be covered and assessments by Swiss Re et al updated. (Michael Jefferson, World Renewable Energy Network/Congresses)	Noted. If 2005 data is available before SOD is submitted, then it will be included. Early estimates show 2005 to be in line with the increasing trend.
2-298	A	34	45	35	32	The insurance sector can play a significant role in the mitigation of climate change, in several ways. Weather derivatives could be also be added to the mentioned instruments. Insurance agencies can innovate to develop more and more specific instruments. It is however a dangerous route look at the national government as a backup, because this prevents the insurance sector and other economic sectors to take appropriate mitigating measures. (moral hazard) (Tineke van der Schoor, Sustainability Centre Lauwersoog/ RUG-Bedrijfskunde)	Accepted. Will add text to reflect the comment.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
2-299	A	34	46	34	54	Why are damages caused by the "11 September terrorist attacks" included in the list of "property losses due to extreme weather events"? When mentioning particular extreme events (such as Andrew, Lothar, and Martin), also specify their location. If possible, extend the time series to include 2005 data. (Hans-Martin Fuessel, Stanford University)	Noted. The reference provides the aggregate data including 9/11. We will look for disaggregated information and include if available in which case ref to 9/11 will be deleted.. If 2005 data is available before SOD is submitted, then it will be included. Early estimates show 2005 to be in line with the increasing trend.
2-300	A	34	50			I don't see where 11 september attack fall in the damages caused by extreme weather events? (Mohammed Alfehaid, Saudi Aramco)	Accepted
2-301	A	34	54			Add a sentence explaining that climate change makes obsolete the past statistics, on which insurance premium are based. (Michel Petit, CGTI)	Accepted. An explanatory sentence will be added.
2-302	A	35	0			references from L.J. R. Scholtens, on climate and financial intermediation, see above: LITERATUUR Association of British Insurers (ABI), 2005. Financial Risks of Climate Change, Climate Risk Management. Bello, Z.Y., 2004. Socially responsible investing and portfolio diversification, Journal of Financial Research 28,: 41-57. Berliner, B., 1982. Limits of Insurability of Risks, Prentice Hall. Corporation of London, 2002. Financing the Future: The London Principles: The role of UK financial services in sustainable development, Department for Environment, Food and Rural Affairs. Coulson, A., V. Monks, 1999. Corporate environmental performance considerations within bank lending decisions, Eco-Management and Auditing 6 (1), 1-10. Ericson, R.V., A. Doyle, 2004. Catastrophe risk, insurance, and terrorism, Economy and Society 33, 135-173. Freshfields Bruckhaus Deringer, 2005. Banking on Responsibility, London. Gurenko, E., R. Lester, 2004. Rapid Onset Natural Disasters: The Role of Financing in Effective Risk Management, World Bank Policy Research Working Paper 3278. Gylfason, T., 2001, Natural resources, education, and economic development, European Economic Review 45, 847-859.	Thanks. We will assess these references. *** TSU PLEASE LET US KNOW IF THEY HAVE BEEN PROVIDED TO YOU, THANKS. IN ANY CASE, WE WILL LOOK FOR THEM *** TSU

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						Heal, G., 2004. Economics of biodiversity: an introduction, Resource and Energy Economics 26, 105-114. ISIS, 2002. Environmental Credit Risk Factors in the Pan-European Banking Sector, ISIS, London. Jaffee, D.M., T. Russell, 1997. Catastrophe insurance, capital markets, and uninsurable risks, Journal of Risk and Insurance 64, 205-230. Kunreuther, H., P. Kleindorfer, P. Kovacs, 2001. Improving the Use of Insurance and other Financial Instruments for Risk Management, Paper presented at the international workshop "Disaster Reduction", Reston, VA, 19-21 August. Mills, E., R.J. Roth, E. Lecomte, 2005. Availability and Affordability of Insurance under Climate Change, CERES. Nell, M.. A. Richter, 2004. Catastrophic Events as Threats to Society: Private and Public Risk Management Strategies, Working Papers on Risk and Insurance 12, Hamburg University. Pollner, J.D., 2001. Managing Catastrophic Disaster Risks Using Alternative Risk Financing and Pooled Insurance Structures, World Bank Technical Paper 495. Rejda, G.E., 1998. Principles of Risk Management and Insurance, Addison-Wesley, Reading, Mass., 6th edition. Scholtens, B., 2001. Borrowing green: Economic and environmental effects of green fiscal policy in the Netherlands, Ecological Economics 39, 425-435. Scholtens, B., 2005. What drives socially responsible investment? The case of the Netherlands, Sustainable Development 13, 129-137. Scholtens, B., D.M.N. van Wensveen, 2003. The Theory of Financial Intermediation. An Essay on What it Does (Not) Explain, SUERF: Vienna. Skipper, H.D., 1998. International Risk and Insurance, McGraw-Hill Irwin, Boston, Mass. Swiss Re, 2002. Floods Are Insurable! Zürich. Swiss Re, 2005. Innovating to Insure the Uninsurable, Sigma 4/2005. Trieschmann, J.S., S.G. Gustavson, R.E. Hoyt, 2001. Risk Management and Insurance, Thomson Learning, Madison Road CT. Vellinga, P., E. Mills (eds.), 2001. Insurance and other financial services, in: IPCC, Climate Change 2001: Impacts, Adaptation, and Vulnerability, IPCC, 417-450. (Tineke van der Schoor, Sustainability Centre Lauwersoog/ RUG-Bedrijfskunde)	
2-303	A	35	6	35	6	Check English. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accepted. "is born by" will be replaced by "falls upon".

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2-304	A	35	13	35	13	Spell out PCS. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accepted. Modification made.
2-305	A	35	38	35	39	Can you provide a reference about CO2 sequestration off the shores of Hawaii? (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accepted. Reference will be provided.
2-306	A	35	38	35	39	Modify the sentence by: "…, such the CO2 ocean storage experiment off the shores of Hawaii…" (CZERNICHOWSKI-LAURIOL Isabelle, BRGM)	Accepted. “as” inserted after “such”.
2-307	A	35	39			The Hawaï example is confusing, as the local population opposition was based on an immediate concern of local sea pollution, not on the climate change concern which was not yet perceived as a serious problem. The absence of crisis (emergency, disaster or catastrophe) was indeed the source of the difficulty. (Michel Petit, CGTI)	Accepted. Sentence will be modified appropriately.
2-308	A	35	0			Section 2.3.5: There is some repetition with section 2.3.3.1. where already CBA, multi-criteria analysis and cost-effectiveness analysis are introduced. The inclusion of integrated assessment as an extra category in the typology of approaches is somewhat odd, as integrated assessment rather describes a (modelling) framework to which all of the other listed approaches can be and have been applied. (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	Will be coordinated with section 2.5
2-309	A	36	36			"IPCC guidance notes warn ..." Please provide a reference to the actual source of this, peer-reviewed and all.. (Richard Tol, Hamburg University)	Accepted. Reference to the guidelines deleted.
2-310	A	36	49	49	12	this section 2.5 is way too long and has a strong textbook character. That is not what is needed. This section should describe how this report is dealing with costs, benefits and potential. The most important point is to stress the sensitivity of cost calculations for assumptions. The key parameters should be dealt with briefly (there is not much new compared to TAR) and where relebvant conclusions given on how to deal with the choice of parameters in mitigation anlayses (eg for discount rates that a declining discount rate with increasing time horizon seems the way to go). Section 2.5.3 mostly is about Cost benefit analysis, which belongs in section 2.3 on decision making (option value theory should be discussed better). Table 2.5.6 is not very helpful: it raises more questions than it answers (Bert Metz, IPCC)	Noted • Section 2.5.3 will be coordinated with Section 2.3 further. • Table 2.5.6 can be deleted • Reduction of 2.5.4 and 2.5.6 accepted
2-311	A	36	49	49	15	I believe it is worth pointing out that this entire section on costs assumes that the methodological premises of economics - most crucially, that it is both meaningful and acceptable to aggregate harms and benefits in terms of a monetized "utility" - are uncontroversial, whereas in reality these premises are rejected by a wide variety	Noted

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						of social scientists and philosophers, at least for many contexts. The existence of this paradigmatic divergence deserves acknowledgement, and could conceievably be described within the "boxes" of uncertainty shown in table 2.4.5 as "low agreement much evidence." (Paul Baer, Stanford University)	
2-312	A	36	50			Maybe include this chapter: Azar (1998) identifies four crucial issues for cost-benefit analysis of climate change: the treatment of low-probability but catastrophic impacts, the valuation of non-market goods, the discount rate, and the choice of decision criterion. He shows that (i) ethically controversial assumptions have to be made about each of these aspects, (ii) the policy conclusions obtained from optimization models are very sensitive to these choices, and (iii) studies that find that minimal reductions are warranted have made choices that tend to reduce the importance of the most common arguments in favor of emission reductions. (Michel den Elzen, The Netherlands Environmental Agency)	Rejected given that CBA should be addressed in a very brief manner.
2-313	A	36	0			Chapter 2.5: This chapter includes very relevant information, especially with regard to the issue of discount rates in the long term. However, it is noted that also chapter 3 (subchapter 3.6.1.2) addresses this issue and some further alignment and consolidation would be very much appreciated. (Radunsky Klaus, Umweltbundesamt)	Taken into account in the latter corresponding chapters (coordinated to Chaper 3)
2-314	A	37	42			I think you mean neo-Keynesian. I'm not aware of post-Keynesianism, although chronologically post-Keynesianism would be modern economics (aka, wrongly, as neo-classical economics). (Richard Tol, Hamburg University)	Just use “Keynesian Model” without “Post-”
2-315	A	38	5	38	6	Include: "under some strict conditions" between "defined, and market…." Justification: to moderate the statement, in coherence with the next sentence. Also to mentioned tacitly the main conditions of property rights (perfect divisibility, transferability….) to ensure that exchanges in the market eliminates externalities. (Ana Yábar Sterling, Institute of Environmental Studies)	Updated according to the original formulation by Coase
2-316	A	38	7			external cost, property rights. Assumes that the problem can be solve when defining property rights, this is although not always possible and most environmental externalities are very difficult to assess from the economic point of view because complexity and values in conflict. (Juan Llanes, Havana University)	Updated according to the original formulation by Coase
2-317	A	38	8			Change: “a lack” between “of a, and of property…..” by: “an inadequate delineation”. Justification: in coherence with the previous comment and to mention the expression used in chapter 2, page 42, line 31.	Updated according to the original formulation by Coase

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Ana Yábar Sterling, Institute of Environmental Studies)	
2-318	A	38	22			Please refer to applications to climate change, of which there are plenty. Tol (2005) lists some 30 studies, and at least 5 papers have appeared since. (Richard Tol, Hamburg University)	Delete line 19-22 from "In practice, it can be difficult.."
2-319	A	38	22			On shadow pricing the most comprehensive treatment by far is Dreze and Stern in Handbook of Public Economics, North Holland, 1987. (Haakon Vennemo, ECON)	Delete line 19-22 from "In practice, it can be difficult.."
2-320	A	38	30	38	34	Erase: "Financial costs…….. into account"Justification: well known concepts which mention in text is misleading. (Ana Yábar Sterling, Institute of Environmental Studies)	Rejected, justification: many engineers used to the concept of financial costs
2-321	A	38	35			The content of this section contrasts somewhat with the sections on the same topic in WG II draft report. Could the assessment on the relevance of cost-benefit analysis be harmonized between the two WG's ? (Philippe Tulkens, TERI School of Advanced Studies)	We will review WGII draft report
2-322	A	38	35	39	45	The section of uncertianities and costs, does not indicate the findings made since TAR and particualrly the references used in this section seem rather outdated i.e. 1961, 1981 and 1989. It would be helpful if the authors could include recent material on this dimension. (Rutu Dave, IPCC WGIII TSU)	The section will be rewritten and integrated in section 2.3.4 on decision making and uncertainties. More recent material will be included, but the classical literature is still relevant
2-323	A	38	41	38	46	This conclusion refers only to crisis caused by the mitigation measures and ignore the crisis caused by the global climate change. The two facets of the problem are mixed in 2.4.11 and should be clearly distinct. A large climate change may induce major geopolitical troubles and create major crisis more important than local reluctance to mitigation actions (Michel Petit, CGTI)	Taken into account by adding "due to avoidance of climate change" after "uncertainties" in line 41, page 38
2-324	A	38	43			What is the "cost" of a risk? The idea does not make sense to me. There is a risk that certain costs my be incurred, but how can one assigne a "cost" to the risk itself? (Danny Harvey, University of Toronto)	Rejected, justification: it has been stated in line 47, page 38.
2-325	A	38	45	38	46	Global warming is a common issue to all people living this earth. It is not easy to say the risk is acceptable even its benifts to society exceed its costs,especially in low developed countries. (Ziqiu Xue, Research Institute of Innovative Technology for the Earth)	We will explain that decision making involves various countries and individuals that are affected differently
2-326	A	38	46	38	48	These sentences are taken word-for-word from Gollier 2001 - shouldn't they be quoted and cited? (Paul Baer, Stanford University)	ok
2-327	A	38	47	38	48	This explanation covers only part of the issue. It is necessary to warn the reader that	ok

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						sometime the uncertainty is small and the results of a cost benefit analysis can yield a conclusive output. Otherwise, the impression is that cost benefit analysis is useless. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	
2-328	A	39	5	39	9	These sentences are also taken word-for-word from Gollier 2001. (Paul Baer, Stanford University)	Ok
2-329	A	39	23	39	25	Can you define the concept of risk aversion? (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Ok
2-330	A	39	25			Again, please refer to the climate change literature. The IPCC is supposed to assess the literature on climate change, not write a textbook on decision analysis. (Richard Tol, Hamburg University)	More recent climate literature will be added
2-331	A	39	31			This can't be true. There are two precautionary principles. The Anglo-Saxon version (uncertainty is no excuse for inaction) is primarily political, but perfectly consistent with decision making under uncertainty; this goes back to von Neumann and Morgenstern. The Germanic version of the precautionary principle (better safe than sorry) is consistent with risk aversion, and goes back to Bernoilli. Gollier is a smart guy, but this is a bit overdone. (Richard Tol, Hamburg University)	The sentence will be integrated with the dicussion on the precautionary principle in section 2.3.4
2-332	A	39	0			Section 2.5.4 (Major Cost Determinants): the determinants discussed are all assumptions or methodological determinants; is that all there are? This is a pretty detailed section to be part of a "framing" discussion; did the authors include this level of detail deliberately? If so, a rationale should be provided. The examples and numbers are good, but the section doesn't explore the implications of using one schema or another. (Elizabeth L Malone, Pacific Northwest National Laboratory)	We will try to shorten, but all the concepts discussed are directly related to the cost results that will be reported in chapters 3-11
2-333	A	40	5	42	10	It is absolutely essential that somewhere in this section it be stated that (1) discounting, and the justification for discounting, applies only to impacts entail direct economic costs to people or that affect things that can be built through economic investments, but do not apply to non-economic impacts that cannot be subsituted for with economic capital (such as functioning ecosystems or biodiversity, which are recognized as worthy of protection under Article 2 of the UNFCCC), and (2) many of the most significant anticipated impacts of global warming apply to things where discounting is not applicable. (Danny Harvey, University of Toronto)	This issue about weak and strong sustainability will be addressed briefly in section 2.2
2-334	A	40	9			Maybe include here: Specification of the discount rate is partly a normative issue, with a variety of defended options (Arrow, 1996). Howarth (2003) suggests a rate	We will consider the references and add if there are new arguments

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						equal to the return on risk-free assets, 0.4% per year. Azar and Sterner (1996) argue that the rate should be zero on ethical grounds. Weitzman and other authors have suggested time-varying discount rates (Weitzman, 2001). REFERENCES: K. Arrow, in Climate Change 1995: Economic and Cross-cutting Issues – The Contribution of Working Group III to the IPCC Second Assessment Report, J.P. Bruce, H. Lee, E.F. Haites, Eds. (Cambridge Univ. Press, Cambridge, UK, 1996); R.B. Howarth, Land Econ. 79, 369 (2003).; C. Azar, T. Sterner, Ecol. Econ. 19, 169 (1996)). ; M. Weitzman, Am. Econ. Rev. 91, 261 (2001). (Michel den Elzen, The Netherlands Environmental Agency)	
2-335	A	40	11	40	14	The discount rate certainly has a strong influence on climate change cost analysis. However, it has been argued (Krutilla, 1967; Fisher and Krutilla, 1974, 1975; Boiteux, 1976) that environmental assets that are not substitutable nor reproducible should be given a value growing over time at a rate close to the discount rate. As a result, the future destruction of such assets would not be given only a trivial net present value in CBAs. In turn, this reinforces the arguments in favour of decreasing discount rates to account for uncertainty on future economic growth... (Philibert, 1999, previous comment). Neumayer 1999 has convincingly reframed this argument under the categories of sustainable development. For a recent review of this litterature and all the references mentioned here, see Philibert, Cédric, 2006, Discounting the Future. In David Pannel and Steven Schilizzi (eds), Economics and the Future: Time and Discounting in Private and Public Decision Making, Edward Elgar, forthcoming. (attached) (Cédric Philibert, International Energy Agency)	We will consider the references and add if there are new arguments Option values will also be discussed under decision making and uncertainty
2-336	A	40	11	42	14	Is well known the work of David Pearce about discount rate. To include in references? (FÉLIX HERNÁNDEZ, IEG-CSIC)	It is known, but covered by the literature that is referenced
2-337	A	40	14	40	24	This paragraph appears to imply that social discount rates are the only ones that need to be considered. This is not the case. The descriptive approach leads to discount rates that are often referred to as private discount rates. These rates require more discussion, since they are the rates private companies use when evaluating discretionary investments, the rates used to evaluate "no-regrets" actions. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	We will add conclusions about private companies
2-338	A	40	25	40	30	This paragraph misstates the "ethical" approach to discount rate in several ways. First, the ethical approach has no one prescription for how the discount rate should be calculated to protect future generations interests That is, there is no one	We consider the current text to be very much in line with the previous discussion in the SAR and the TAR about the ethical approach.

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						"ethical" approach as suggested by the paragraph. The ethical literature on the discount rates asserts that future generations interests are not be adequately considered if benefits to future generations are made worthless because of the discount rate while making other criticsms of the discounting. Because the UNFCCC expressly in Title 3 acknowledges that future generations interests should be protected, this section should simply state that there are a number of ethical problems that have been identified with discounting. These ethical problems are several. One, not mentioned in this section, is that unlike decisions made in normal investments where discounting reflects the time-value of money for the investor, climate change asks desicion makers to reflect on values to others who may not benefit by increases in GDP that would be caused by investments made now. Climate change, also raises new and troubling problems with discounting because costs and benefits are so enormously disaggregated in time and space.Therefore, this section should simply state that discounting raises numerous ethical questions or in the alternative discuss what some of those ethical problems are. They include: (a) investors interests don't always match future generations interests, (b) who represents future generations' interests in deciding discount rates particularly for societies that will not benefit from increased GDP or ecnomic stimulation in nations who want to apply discount rate:(3) dicount rates ultimately rely on dubious valuation techniques, such as" willingness-to-pay surrogates" that don't adequately deal with non-comensurable damages to things of special value, including loss of life. Atlthough economic values have been put on loss of life, ethical questions arise about whether life should be measured in this way, particularly in cases where the valuation is about future lives and not about lives that have been lamentably lost already. This disctintion is particularly important when victims of actions under consideration have not been consulted with about the value of their life and may not benefit from increased investments in the economy .For a discussion of the ethical limits of discounting in the climate change context, see Brown, Donald. 2002. American Heat: Ethical Problems with the United States' Response to Global Warming. Lanham, MD: Rowman & Littlefield, also Ott, Konrad, Gernot Klepper, Stephen Linger, Achim Schafer, Jergen Sheffran, Detlef Sprinz, Mienhard Schroder, Reasoning Goals of Climate Protection, Specification of Article 2 of the UNFCCC. Environmental Research of the Federal Ministry of the Environment, Research Report, 202 41 252, June 2004 (Donald Brown, Commonwealth of Pennsylvania)	The issues raised here are considered in section 2.7 on equity, and in section 2.5.4.6 on valuation techniques and in section 2.5.4.5 on valuation of non-market issues
2-339	A	40	25			Most readers will ignore the definition of the meaning of “a degree of risk aversion	It will be defined

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						between two and four" (Michel Petit, CGTI)	
2-340	A	40	26	40	40	One problem with the "prescriptive approach" is that if one fixes the pure preference rate to zero because it's about intergenerational comparisons, on the same grounds one should consider the income-elasticity of the marginal utility of income as infinite, as there is no reason to justify an impoverishment of the current, poorer generation for the profit of the future, richer generations (see, e.g. Philibert, C., 1999, The economics of climate change and the theory of discounting, Energy Policy 27: 913-929) (Cédric Philibert, International Energy Agency)	This is debatable and is a large issue in economic theory so we consider it as being to large an issue given our page limit
2-341	A	40	29	40	39	Missing simbols? (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accepted
2-342	A	40	30			The IPCC SAR did not derive the neoclassical equation of discounting. Frank Ramsey did. (Richard Tol, Hamburg University)	Accepted
2-343	A	40	30	40	33	It is true that this formula was "presented" in the SAR. However, this formula is commonly known as the "Ramsey rule" or "Ramsey growth discounting rule" as it builds on work by Ramsey (1928). (Hans-Martin Fuessel, Stanford University)	Accepted
2-344	A	40	31			I stopped reading here, as I am only allowed 200 comments. The chapter until here is not very good. There is a lot of textbook material, and very little literature assessment. I scanned through the rest of the chapter. There are ancillary costs as well as benefits, and the double dividend may be the wrong sign. You cannot just say that non-market valuation is difficult, and then ignore all the paper that do value things and have been published in peer-reviewed journals. On mitigation and adaptation, you have missed the literature that estimates the effect of climate change on emissions; and the literature that estimates the effects of emission reduction on vulnerability to climate change. On equity, you have lots of general stuff, but little specific climate change material; there's tonnes of paper apart from Gollier. On page 61, you start yet another discussion on time, and a page later you return to equity. This chapter needs thorough editing. Tol and Verheyen is not on equity, but on liability. How many papers do you refer to without having read them? The bits on technology are sound, but would be more convincing if more references to non-Edmonds papers are given (not that this would change the message much). (Richard Tol, Hamburg University)	Noted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
2-345	A	40	33	41		The level of discount rate to be used in the valuation of costs and benefits regarding climate change policies is a subject of controversy. The present writer does not find the treatment of the matter quite satisfactory. The discussion of the draft is essentially based on an equation on line 33 of page 40 (Chapter 2). It admits on the next page (page 41) that the "descriptive approach" based on this equation has drawbacks, mentioning two reasons. However, I think the draft misses the most important reason for the inadequacy of the equation. The assumptions behind the equation include the one that production does not involve any negative externalities including global warming itself. How can we utilize an equation derived on an assumption that global warming is absent to evaluate the policy to counteract global warming? When there exist production externalities, the equation in question must be rewritten, for example, as □(1 - □) - □ = □ + □g (1) [roo(1-eta)m - kappa = delta + ypsylon*g where roo = marginal productivity of capital, eta = the amount of expenditure required to abate pollutants (GHGs) emitted by adding one unit of output, kappa = the rate of capital depreciation, delta = the rate of pure time-preference (or, of impatience), ypsylon = the elasticity of marginal utility of consumption with respect to the level of consumption (in absolute value), and g = the rate of growth of consumption. The left-hand side of (1) is usually considered as a real market rate of interest, which is now modified by the existence of negative externalities like global warming. If □ is positive, the arbitrage argument must use a lower rate than the market real interest rate to estimate the socially efficient discount rate. Otherwise, if one saves today, he or she cannot expect to receive a full amount of social return in the future to compensate for the patience. AR4 should clearly state that the equation r = delta + ypsylon*g is quite misleading and should not be used as such to evaluate an appropriate rate of discount for global warming issues. Reference Akihiro Amano, "Climate change, response timing, and integrated assessment modeling," Environmental Economics and Policy Studies, Vol. 1, No. 1, 1998, pp. 3-18. (Akihiro Amano, University of Hyogo)	The space that has been allocated to cover this issue does not allow us to include a long discussion about alternative (and more refined) ways of deriving discount rates.
2-346	A	41	13	41	13	Unclear why future generations should be unable to trade (H-Holger Rogner, IAEA)	They do not participate in the market we will explain

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2-347	A	41	15	41	15	The use of discount rates higher than the growth rate for the long run raises another difficult problem: that it implies the possibility of investing at such compound rates for a long time. However, this may mean that a single investment, provided sufficient time is given, creates more wealth than the whole economy. See Rabl, Ari, 1996, Discounting of long term costs: What would future generations prefer us to do? Ecological Economics, 17, 137-145 (Cédric Philibert, International Energy Agency)	We feel that these issues are already covered by our extensive discussion about hyperbolic discounting
2-348	A	41	16		45	This discussion is confusing in several ways. First, the discussion needs to clearly explain that the recent literature on declining rates never implies that the future is not substantially discounted -- because the declining rates only refer to the period-to-period rate. That is, when you talk about the rate being, say, 5% for 50 years and then 0% for longer horizons, the literature means that everything after 50 years is still discounted but just not any more than the amount at 50 years -- which can still be substantial. That is why the declining rates in Newell and Pizer only serve to roughly double the expected mitigation benefit of GHGs. Second, empirical work on this issue emphasizes that whatever this decline looks like, it sits on top of uncertainty about what the appropriate near-term rate ought to be. That is, the decline might be from 4% to 0%, or from 7% to 3%, depending on choices about whether the "right" current rate is 4 or 7%. Third, the Weitzman (2004) paper is based on some very unusual growth assumptions leading to non-trivial probability of global economic collapse. In that case it would very important to consider the correlation of the discount rate (here, economic collapse) with the valuation of the good being examined (climate change mitigation). Fourth, generally this literature is NOT comparible with the term structure literature (Vasicek and CIR), that has focused not on the quadratic term in the no arbitrage condition, but the linear term (that can generate rising or falling term structures). Saying models in the two literatures are compatible without emphasizing these differences, while technically true, suggests a mutual support that does not really exist. Fifth, the discussion of recent govenment reforms ignores recent changes in the U.S. regulatory analysis guidance (see appendix D of http://www.whitehouse.gov/omb/inforeg/2003_cost-ben_final_rpt.pdf) that both recognizes the possibility of declining rates and balances it with the need for consistency across applications and with investments in the private sector. (William Pizer, Resources for the Future)	We will include the arguments in a short form
2-349	A	41	22	41	25	Weitzman (1998) (1999) are more relevant quotes here, as they are based on economic considerations close to those of Newell and Pizer - not a survey of	References to be included

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						opinions. (Weitzman, M.L., 1998, Why the Far-Distant Future should be Discounted at its Lowest Possible Rate, Journal of Environmental Economics and Management, 36, 201-208; Weitzman, M.L., 1999, Just Keep Discounting, But… in Portney P.R., Weyant J.P. (Eds), Discounting and intergenerational Equity, Resources for the Future, Washington D.C., April, 23-29. (Cédric Philibert, International Energy Agency)	
2-350	A	42	13	42	14	After the extensive and detailled discusison on IRR above this sentence presents the IRR including risks as 10 and 25%.Further literature should be mentioned to relate these figures with the IRRs previously discussed. As an example use the rate of return in the market share during the 20th Century to infer the real return on investments done. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accepted
2-351	A	42	32			"Proper mitigation cost analysis should take these imperfections into consideration" is surely true -- but how? The failure to do so is at the heart of our inability to estimate costs. (Elizabeth L Malone, Pacific Northwest National Laboratory)	This is briefly covered in section 2.5.2 in relation shadow pricing. The space do not allow a more detailed discussion 3.11
2-352	A	42	50	43	9	Replace ancillary benefits with co-benefits. The TAR (WG III, Pg. 708) defines ancillary benefits as "The ancillary, or side effects, of policies aimed exclusively at climate change mitigation. Co-benefits are defined (WG III, Pg. 711) as the benefits of policies that are implemented for various reasons at the same time -- including climate change mitigation ..." In the real world, policies are almost always implemented to achieve multiple benefits, so co-benefits is the more correct term. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	This is an issue that has be coordinated with chapters 3 and 11, so they will be consulted
2-353	A	42	55			On impacts on agriculture a useful case study is David O'Connor, Kristin Aunan, Terje Berntsen, Haakon Vennemo and Fan Zhai, 2003, Agricultural and human health impacts of climate policy in China: A general equilibrium analysis with special reference to Guangdong. OECD Technical Paper, 206, OECD, Paris (Haakon Vennemo, ECON)	Accepted
2-354	A	43	18	43	19	This is a very important issue. I suggest IPCC should start to handle this issue in a systematic way. If literature isn't available this issue should be mentioned as a knowledge gap. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Noted
2-355	A	43	21		23	Is the inability to include all external and implementation costs assumed to be why no-regrets actions are not taken? (Elizabeth L Malone, Pacific Northwest National Laboratory)	Yes, it this is understood as market imperfections
2-356	A	44	6	44	30	Replace ancillary benefits with co-benefits. The TAR (WG III, Pg. 708) defines	This is an issue that has be coordinated with

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						ancilliary benefits as "The ancillary, or side effects, of policies aimed exclusively at climate change mitigation. Co-benefits are defined (WG III, Pg. 711) as the benefits of policies that are implemented for various reasons at the same time -- including climate change mitigation ..." In the real world, policies are almost always implemented to achieve multiple benefits, so co-benefits is the more correct term. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	chapters 3 and 11, so they will be consulted 3, 11
2-357	A	44	30			The critical role of baseline policy is also illuminated in the OECD Technical Paper. (Haakon Vennemo, ECON)	Incomplet reference
2-358	A	44	34	45	36	This section on valuation as it relates to harm from climate change notes that there are a lot of "difficult evaluation issues." However it makes no effort either to evaluate the implications of these difficulties, or to even describe the conclusions that various authors have drawn. At a minimum, I think it is worth noting that these reasons have a great deal to do with why estimates of the "social cost of carbon" span at least two orders of magnitude (e.g., Clarkson and Deyes 2002, Pearce 2003), and why others reject cost-benefit analysis entirely ((Paul Baer, Stanford University)	The issue is very important but beyond our space limits
2-359	A	44	49	44	51	Umm, isn't this exactly backwards? (Paul Baer, Stanford University)	We will consider if the language is correct (min versus max)
2-360	A	44	50	44	52	The cited reference (Toth 2004) discusses the tolerable windows approach. The term "'safe landing'" analytical approach" should therefore be replaced by "tolerable windows approach". In recent studies (Zickfeld and Bruckner, 2003; Bruckner and Zickfeld, 2006), the tolerable windows approach has been applied directly to investigate the near-term implications of prescribed bounds on admissible THC weakening, duly imposed in order to avoid an irrevocable break-down. It might well be worthwhile adding the above sentence ("In recent studies ..") to the end of the last paragraph of page 44 (ending at line 52). The newly cited references are: K. Zickfeld, T. Bruckner: Reducing the Risk of Abrupt Climate Change: Emissions Corridors Preserving the Atlantic Thermohaline Circulation, Integrated Assessment 4, 106-115 (2003). T. Bruckner, K. Zickfeld: Low Risk Emissions Corridors for Safeguarding the Atlantic Thermohaline Circulation, Mitigation and Adaptation Strategies for Global Change (accepted).	Both tolerable window and safe landing approaches will be referenced

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						(Thomas Bruckner, Technical University of Berlin)	
2-361	A	45	10	45	20	This section appropriately notes that there are practical and ethical questions associated with using monetary values to human life and injuries. Yet it goes on to identify methods of measuring these values. These methods, however, do not solve all the ethical problems and this section should not imply this. For this reason, this section should say something after identifying these methods of valuation that "However, these techniques do not resolve all ethical controversies." (Donald Brown, Commonwealth of Pennsylvania)	Agreed
2-362	A	45	24	45	29	Comment n 16 also applies here. (Cédric Philibert, International Energy Agency)	? we do not know what no 16 is TSU
2-363	A	45	30	45	35	Section 2.5.4.5. This is an important debate and I don't think it adequate just to report the "recommendation" of a TAR chapter. There is literature on the issues in papers by Tol et al (1999?), the work of various philosophers (eg. Singer, 2002), and also in Grubb (2006b). I don't think this is covered anywhere else in the AR4. Refs: Singer P., "One atmosphere", in Peter Singer, "One World - the ethics of globalisation", Yale University Press, 2002; Grubb, Hourcade, Edenhofer & Nakicenovic, Submission to Stern review Dec 2005, edited in submission to Cambridge Journal of Economics. (Michael Grubb, Cambridge University)	The space does not allow us to discuss this in detail, but we will assess the literature suggested
2-364	A	45	37			Economic Valuation Techniques are not only linked to externalities, but also to valuation of environmental services and to assess development options. These techniques tend to reduce all goods to commodities, and this is only a legitimate point of view among others. The economic values of non-traded and traded environmental services and externalities also social externalities depend on the endowment of property rights, the distribution of income, and cultural issues. Some assume that economic valuation techniques are universally sound, but for instance, assessing environmental impacts trough CVM in developing countries will find that "expressed" economic values are not significant due to low income, limited monetary relationships and because consumer surplus can be also expressed in terms of time or food as a community wish to contribute to an environmental goal. It is not the same as using CVM to construct a demand curve to demonstrate WTP for water service in a rural community. Economic valuation is also legitimate in certain cases specially where values have a local or regional influence or for assessing compensation for damage inflicted but not for global issues. Differences observed between WTA and WTP have as D. Pearce stated four sources, 1) the intention to act as a free rider 2) the higher valuation by individuals of the status	This is a very detailed discussion, which is more of a textbook nature The first sentence of the section will be changed since it reads like a too strong statement

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						quo, 3) individuals have more experiences when buying as selling, 4) strategic behavior by individuals about how the "expressed preferences" are going to be used by other individuals. (Juan Llanes, Havana University)	
2-365	A	45	54	46	6	Definition of non- use value is valid but to abstract (NUV). The hypothesis that underlies NUV is that people place monetary values on natural resources that are independent of their present use of the resource, so "nonuse values are all of those component of total value that arise independent of use" (Freeman, 1993). NUV tend to be linked to more altruistic motives considering more ethical than utilitarian origin. The problem with different valuation techniques for assessing monetary impacts is that following theory, total economic value (also NUV) can only be determined using CVM (expressed preferences) with all the problems involved. (Munasinghe 1993, Azqueta, 1995). (Juan Llanes, Havana University)	We will note key limitations of the valuation approaches but cannot go into detail with all definitions
2-366	A	46	35	46	35	0$ per tonne CO2 is a poor example (H-Holger Rogner, IAEA)	Will be changed
2-367	A	47	23	47	23	Do you mean: no net "additional" costs? (H-Holger Rogner, IAEA)	Additional is not needed since we are measuring costs against a baseline
2-368	A	48	26	48	27	Technical potantial may well be dependent on R&D policy (H-Holger Rogner, IAEA)	Yes, that is consistent with the discussion in section 2.9
2-369	A	48	30			Mention the tradeoff of heat exchanger size and cost in all heat utilization equipment (boilers, heaters, air conditioners, heat pumps and freezers) as well as thicknes of insulation and the gas (higher molecular weight gases generally conduct less heat) enclosed in the insulation space. (Steven Freedman, Energy Consultant)	The example seems to be too specific to include here
2-370	A	49	16			Table 2.5.6 - 3rd row, 2nd column. Typo error. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Section 2.5.6 and the table will be deleted in order to shorten the chapter
2-371	A	49	19	56	39	This section 2.6 misses a short description of the similarities and differences between adaptation and mitigation (some of it is in section 2.6.2 but there it does not belong; see e.g. material from expert meeting on AM-SD). It also misses to clarify the relation ship with development (summarise key findings and use figure 18.3 from WG II chapter 18). section 2.6.2 on response capaity is too vague: identify the key factors influencing response capacity from the literature. Section 2.6.3 duplicates heavily with chapter 1 (on the relation with article 2). Drop here and leave to ch 1. The rest of the material in section 2.6.3 is confusing and ill-focused. I expect a general discussion on symergies and trade-offs between	We are sceptical about figure 18.3 because we do not think it explains very much. Furthermore the development path concept is not well explained in the literature. We will add more discussions about differences and similarities between mitigative and adaptive capacity, e.g. based on a paper by Michalowa. Section 2.6.3 will be coordinated with chapter 1 and shortend. The Special Climate Fund will

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						adpatation and mitigation (the specifics of that have to be in other chapters), but that is hard to find. What is the section on the Special Climate Change Fund doing here? 2.6.4 is mostly on specific cases of synergy or trade-off and that does not belong here but in other chapters. (Bert Metz, IPCC)	be taken out.
2-372	A	49	20	56	40	Refs list. Note that the reference to my paper should reflect that this is now published as Grubb, M. J. (2004). "Technology Innovation and Climate Change Policy: An Overview of Issue and Options." Keio Economic Studies 41(2): 103-132. (Michael Grubb, Cambridge University)	Accepted
2-373	A	52	8		17	Excellent discussion. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Thanks
2-374	A	52	20	56	40	This section would benefit from material from specific national policy making frameworks to understand the inter-relationships here and obtain insights. (HEDGER MERYLYN, Environment Agency)	This will be reflected in section 2.6.4
2-375	A	52	34	52	35	The IPCC position has always been that its duty is providing the policy makers with the scientific relevant information and the responsibility of deciding what is a dangerous interference or a sufficient time-frame rests with the policy makers. This position should be recalled. (Michel Petit, CGTI)	We will make it clear that this is an issue that both includes science and policy making aspects.
2-376	A	53	29	53	29	NAPAS never spelled out before (H-Holger Rogner, IAEA)	We will spell NAPAS
2-377	A	53	51	54	18	This section should be rewritten in light of the decision at COP/MOP-1 to have the SCCF managed by COP/MOP and not to use the GEF guidelines. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Reference to GEF funds will be taken out
2-378	A	55	8			Sentence reads "Biomass use for energy offers opportunities as a carbon sink and a carbon offset". I dispute the "carbon sink" component for the following reasons: 1) Something is a carbon sink if and only if the stocks of carbon increase; 2) There is no evidence that energy-from-biomass would result in an increase in carbon stocks; 3) If the use of biomass for energy became widespread it could result in short-rotation crops, which normally contain less carbon than long-rotation crops designed for high-value wood products; and 4) The quantity of stocks in the inventory of felled biomass would not be great and would not add appreciably to the carbon stocks in the biosphere. (Piers Maclaren, Piers Maclaren & Associates)	Modifications will be added to explain that it depends on the whole system, the baseline, the management and so on.
2-379	A	55	13	55	13	Incomplete sentence.	“by” the source.

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						(Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	
2-380	A	55	13	55	15	..is determined "by" the source of… (H-Holger Rogner, IAEA)	"by" the source.
2-381	A	55	14	55	14	"… is determined BY the source of …" (Marco Mazzotti, Institute of Process Engineering)	"by" the source..
2-382	A	55	15	55	18	Regarding social impacts due biomass use see Renewable Energy Partnership for Poverty Eradication and Sustainable Development, June 2005, ISSN 1101-8267, SEI, Stocholm, Sweden. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Reference to be added
2-383	A	55	26	55	29	See other examples in Moreira, 2005, Global biomass energy potential. Mitigation and Adaptation Strategies for Global Change(Special Issue, forthcoming). (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Reference to be added
2-384	A	55	42	55	45	At the institutional end, EBRD (European Bank of Reconstruction and Development) is the only IFI to have institutionalised formal Energy Efficiency Audits in their industrial loans process (EBRD, online 2006). This is a good example of how to capture greater EE potential within existing agreed transactions, even where these have no direct climate mitigation role. (Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	Example can be included
2-385	A	55	47	55	50	check sentence (Marco Mazzotti, Institute of Process Engineering)	Sentence to be rewritten
2-386	A	56	16	56	19	It must be specified that with respect to space heating and cooling, no general conclusion can be drawn from local examples such as that of India. In cold areas, climate change is more likely to reduce energy needs on balance while in warm areas it is more likely to increase them, but the balance will be different in each country. However, global warming is likely to increase energy consumption in the transport sector, first by reducing the efficiency of combustion engines, second by increasing air-conditioning loads, while not reducing heating loads, as generally heating is derived from engines' heat losses. (Cédric Philibert, International Energy Agency)	Accepted
2-387	A	56	41	66	40	This section 2.7 should I think highlight 2 issues: 1) how is climate change and climate change mitigation affecting equity (and what forms of equity do we distinguish); 2) what are the equity principles that are relevant to decisions on mitigation action (without going into the specifics that ch 13 is treating). The current text is fragmented in that respect: bits and pieces of those two questions are	2.7.5 will be intgrated in the cost section, 2.7.8 to be coordinated with 13. The points of items 1) and 2) will be reflected.

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						discussed in different sections. There is a need to reorganise, streamline and shorten. It is now too theoretical and the reader doesn't find easily what is important to know for reading the rest of the report. Why is 2.7.5 here while discount rates are discussed extensively in the section on costs? Doesn't make sense. Why is 2.7.8 here? It belongs in Ch 13 on international arrangements as far as I can see. (Bert Metz, IPCC)	
2-388	A	56	43			Chapter 2.7.1: It would be welcome if the introduction would inform about the subchapters. However, the current text includes little linkage to subchapters 2.7.2 to 2.7.8. (Radunsky Klaus, Umweltbundesamt)	Accepted
2-389	A	56	0			Section 2.7 Distributional and Equity Aspects. This section (as already mentioned) is particularly good. (Pat Finnegan, Grian)	Thanks
2-390	A	56	0			Chapter 2.7: The authors might have interpreted the scope too broad because the understanding should be to provide information on the conceptual framework related to distributional and equity aspects in the context of understanding the scientific basis of mitigation of climate change. It is further noted that this chapter addresses to a significant extent the themes impacts and vulnerabilities to climate change, differentiated by regions. However, those themes are clearly linked to the report of WG2. Chapter 2.7 needs therefore some significant redrafting in order to shift the focus from impacts and vulnerabilities to mitigation. From that perspective chapter 2.7 is not yet aligned with chapter 1 as in the Executive Summary of Chapter 1 it is clearly stated that "The main framing issue of this report is mainstreaming climate change mitigation as an integral part of sustainable development". In this context it might be relevant to discuss some recent literature that has been published by WRI. Unfortunately nothing about that very relevant document can be found in chapter 2.7. It should also be stressed that the IPCC should provide policy neutral assessments but avoid to be policy prescriptive and thus avoid any recommendations. (Radunsky Klaus, Umweltbundesamt)	When considering equity aspects mitigation a nd vulnerabilities are closely related, so we cannot ignore some of these WGII issues. However, we will do an attempt to simplify the arguments
2-391	A	57	14	57	14	It is proposed to inform the reader where the various equity approaches are discussed. This would also clarify that AR4 avoids to provide recommendations at all but that the report informs about the various approaches and their implications. (Radunsky Klaus, Umweltbundesamt)	Accepted
2-392	A	58	13			Table 2.7.2 on page 139 seems to have an error; the coefficient of variation for GNI per capita is reported as several thousand $US, where it should be a decimal	They are taken from the WG WDI. Table will be corrected

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						fraction. Perhaps this is actually the variance that is reported? Were these taken from a table in the WDI, or calculated by one of the authors based on raw data from the WDI? (Paul Baer, Stanford University)	
2-393	A	58	13			Table 2.7.2; last row (%change in co.var) needs explanation, as the figures deviate from what is expected (108%, 17% and -15% resp.). Consider also to combine the last two rows in one with title: % change, and to repeat the first column before Literacy rate to be able to give the exact year without possible confusion. (Peter Bosch, IPCC TSU WGIII)	Table will be corrected
2-394	A	58	15		32	section 2.7: p.58 line 15-32 doubles with section 2.2, can be shortened. (Peter Bosch, IPCC TSU WGIII)	Will be shortned.
2-395	A	58	17	58	19	This statement needs some qualification. It may depend significantly on the indicator which regions show the strongest impacts of climate change/extreme weather events by now and in the future. In terms of damage probably North America is hit most, in terms of casualities some Asian countries might be hit most. (Radunsky Klaus, Umweltbundesamt)	Will be shortned and a few other examples will be added
2-396	A	58	22	58	38	It is proposed to delete this part because it does not address distributional and equity aspects related to mitigation of climate change. The relevant uncertainty linked to mitigation seems to be the uncertainty about mitigation activities in other countries/groups of countries/regions. This is so fundamental because mitigation efforts in general are beneficial for all and only to a small extent beneficial for those who invest. (Radunsky Klaus, Umweltbundesamt)	Mitigation aspects and other regions will be added and the description of Africa will be shortend
2-397	A	58	23	58	32	It is noted that there are also other factors that are not related to climate change like HIV or civil war that are a major barrier for African countries with regard to sustainable development. As such a broader discussion clearly would be beyond the scope of this chapter it is recommended to keep the text within the scope as specified above. As the current text does not address equity and distributional issues in relation to mitigation it is proposed to delete this text. (Radunsky Klaus, Umweltbundesamt)	See comment to 2-396
2-398	A	58	34	58	40	As table 2.7.3 and this paragraph only focus on impacts and vulnerabilities that are not within the scope of this report of the AR4 it is proposed to delete it. (Radunsky Klaus, Umweltbundesamt)	Mitigation aspects will be added to the table
2-399	A	58	42			Table 2.7.3 Hardly seems like a "summary" of equity-related impacts of climate change - it seems like a (very) few examples (e.g., it discusses impacts on agriculture as the only economic impact within countries). This table desrves to be	Mitigation aspects will be added to the table

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						fleshed out. (Paul Baer, Stanford University)	
2-400	A	58	46	59	11	Again those 2 paragraphs focus on impacts, vulnerabilities and address adaptation. They should be streamlined and linked to mitigation in order to be consistent with the scope of this report. It might help to start with the next paragraph (lines 13 to 20). (Radunsky Klaus, Umweltbundesamt)	Mitigation aspects will be added
2-401	A	59	5	59	30	This section on equity leaves the empression that decision makers in thinking about how uncertainty effects equity may ignore rights of those who may be greatly harmed by climate change to fully consent to harms and risks placed upon other, Ethical literature on risky behavior acknowledge rights of victems to fully consent to risks imposed upon them by others. Therefore this section should include a few lines such as. Because climate change is beleived to threaten basic rights to life, liberty, and personal security, those who may shoulder the burden of harm from risks imposed upon them by others have rights to informed consent to bear that risk according to certain ethical theories. (Donald Brown, Commonwealth of Pennsylvania)	These arguments are included in the literature referenced about rights based approaches
2-402	A	59	27	59	27	Shouldn't this read "inappropriate"?? (H-Holger Rogner, IAEA)	Accepted
2-403	A	59	27			"..met by an appropriate response from society to ...". Unclear, do you mean: although met by… or: has led to the collapse of whole cultures through an (otherwise appropriate) response?. (Peter Bosch, IPCC TSU WGIII)	Inappropriate
2-404	A	59	40	61	36	Congratulation for treating so well this issue for the first time in IPCC. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Thanks
2-405	A	59	40	61	35	This entire section fails to deal with a number of important ethical issues adequately. First, as has been the case in previous work of the IPCC, this section conflates utility with equity by asserting that utility is one form of equity apparently because certain countries have asserted that utlility is one form of equity when asked about thier preferred definition of equity in Title 3 of the UNFCCC. Yet, although utility is a well respected meta-ethical theory about ethics, its major weakness is usually understood to be its failure to deal with equity and distributive issues. It is simply disengenous to assert that utilty is a form of equity. That is, although It is generally understood that utility is an alternative to equity and distributive justice, it is not a form of equity in the philosophical literature That is utility is not usually regarded as a principle of equity, rather it is a metathical	We will add that some literature find it problematic to combine utility and equity in relation to climate change policies.

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						approach to ethical questions. Therefore in the absence of rules that apply such concepts as Pareto Optimality that limit decisions' adverse impacts on those who might be harmed by welfare maximization pokicies alone, utility is not usually understood to be at all concerned with equity. A large exception to this generalization, however, is that many utilitarians support rules that acknowledge rights in some to not be harmed by others without thier consent, although they support these rules, not ultimately on inherent rights theories, as deontolgogists would, but on consequences. These philosophers, including, including Peter Singer and Shraeder-Frachette, although strong untilitarians, believe that persons have rights to life, liberty and personal security. although they conclude this based upon consequences of not recognizing these rights. They remain utilitarians. If persons have a right to life, liberty, and personal security, then there are major problems with CBA that make no distinctions about how harms and benefits are distributed. Equity is genarlly understood to be about how burdens and benefits of decisions should be farily distributed.not about weffare maximization. Because most literatue on CBAs, as the section correctly points out, conclude that decisions should be followed that maximize preferences withbout regard to how the harms and benefits should be fairly distributed, CBAs, without limiting rules, are not usually concerned with equity. Moreover, this section also may mislead readers about the ability to combine equity and utliity by pointing out that societies often combine equitable approaches with utility. This is misleading because it suggests that there is no philosphical problem with using welfare maximization cosiderations to limit what would be otherwise a fair distribution of costs and benefits that are morally grounded because some societies do this. Is does not apply ought. However, it is one thing for a sovereign government to mix utility and rights in cases where all their citizens are represented by their governme, in the case of climate change, where costs of reducing emissions are largely borne by one party and benefits of preventing climate change fall to others separated in time and space. this blending of utility and equity could be very ethically problematic because those who will be harmed by such policy choices are not represented in the decision making. For this reason, this section should acknowledge that there could be serious ethical problems with combining utility and equity when costs and benefits are as hugely disagregated as is the case in climate change. (See Gardiner and Brown above) For an example of a utlitiarain that recognizes rights see Singer, Peter. 2002. "One Atmosphere." In One World: The Ethics of Globalization, by Peter Singer, chap. 2. New Haven, CT: Yale University Press. For a good	

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						discussion of utility versus rights see, Jones, Charles, Global Justice, Defending Cosmolotism, Oxford University Press, New York, 1999 at 27 to 49. For a discussion of ethical problems with CBAs see Brown, Donald. 2002. American Heat: Ethical Problems with the United States' Response to Global Warming. Lanham, MD: Rowman & Littlefield. (Donald Brown, Commonwealth of Pennsylvania)	
2-406	A	59	40	61	36	The alternative apporaches in this paragrah are mainly interpreted from an individual point of view. This is understandable. However, climate change very much exceeds this level and should also be approached from an aggregate, (inter)national level. And then a right based view or capability set of alternatives is getting an other meaning. From a collectivist level the right to use an equal part of the atmosphere has strong papers. With respect to this discussion and with reference to Ralws' justice as fairness and the right based appproach Sen argues for the need to distinguish between global and international equity. Amartya Sen, Global Justice, Beyond International Equity, in: Inge Paul, Isabelle Grunberg, Marc A. Stern, Global Public Goods, International Cooperation in the 21st Century, UNEP, Oxford University Press, 1999. (Gert de Gans, Kerkinactie)	This argument will be added
2-407	A	59	40			Subchapter 2.7.4: In order to keep the text concise it is proposed to include specific reference to the TAR and to address only any new literature with regard to the various concepts that has been published since the TAR. (Radunsky Klaus, Umweltbundesamt)	Reference to TAR, but some of the "calssical" literature is needed
2-408	A	59	41	66	41	A lot has been written on the topic of equity, fairness, distributive justice in relation to climate change over the last couple of years. This section is giving a limited overview of the state of art on these issues. References can be supplied. (Gert de Gans, Kerkinactie)	Accepted
2-409	A	59	47	59	49	Utilitarianism is not a theory of justice, It is a theory of the good, which has nothing to say about whether something is "just". (Paul Baer, Stanford University)	Agreed
2-410	A	59	0	61		Ringius et al. (2002) could be referred to. (Asbjørn Torvanger, CICERO)	Check the relevance
2-411	A	60	26			Hence no action, even if it increased utility, could NOT? be tolerated if it violated this right. (Stephan Halloy, Universidad Mayor de San Andrés)	Reformulate to read "violate rights and duties of individuals"
2-412	A	60	28	61	36	The fallacy of some the libertarian argument has been exposed on both philosophical and modeling grounds: The full development of liberties and property	Reference will be added

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						rights is self contradictory and leads inevitably to further seggregation between rich and poor, hence the increase of poverty, as described in previous sections, e.g. Halloy, S.R.P. and Lockwood, J.A., 2005. Ethical implications of the laws of pattern abundance distribution. E:CO (Emergence: Complexity and Organization), 7, 41-53. (Stephan Halloy, Universidad Mayor de San Andrés)	
2-413	A	61	8	61	11	This is not really a right based approach. It would be better to entitle every world inhabitant (with e.g. 2000 as reference year with regard to population size) an equal per capita share in the intrinsic capacity of the earth to absorbe carbondioxide. This certainly would serve sustainability. Passing this value could result in economic compensation to countries with CO2-footprints p.p. lower than this treshhold. Compensation could be used for mitigation and adaptation. (Gert de Gans, Kerkinactie)	Add example of per capita emissions
2-414	A	61	0	61	0	Section 2.7.5 Wasn't time discounting etc discussed ealrier in this chapter (2.5.4.1)? (Michael Grubb, Cambridge University)	Integrated with cost section
2-415	A	62	5	60	12	This section says that the economic discount rate is justified partly on the grounds of growth making future generations better off and hence also more able to cope with the impacts of climate change. This would only be true if the investments made in the economy of one country as an alternative to investments in climate change will increase economic growth of people who will be harmed by climate change, wherever they are situated. . Yet it is not clear that investments made in one country will do this.Many poor countries could be both harmed by climate change and not experience economic growth from alternative investment made in other countries. For this reason, the claim that everyone will benefit from increases in GDP from investments that are alternatives to investment in climate change policy implementation should be accompanied by an acknowledgement that, however, this is only true in cases where increases in GDP will flow to those that are harmed by climate change. (Donald Brown, Commonwealth of Pennsylvania)	Covered in cost section
2-416	A	62	9	62	11	It is not obvious that a "Zero growth" scenario is really conservative in the long term. This is because of the lack of sustainability of our socio-economic system. If we choose the correct indicators for sustainability and if the assessments of those indicators show that the sustainability is not achieved than it will be only a matter of time that there will be a negative growth or reduction of welfare. In practice this means e.g. that under the assumption of doubling of damage induced by climate	To be covered in the cost section

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						change related extreme weather events (that are for the time being maybe in the order of 25 billion $ per year) every 10 years than it is a simple calculation to estimate by when the damage will be compensating any gain in GDP. Beyond that point in time we will experience negative growth. (Radunsky Klaus, Umweltbundesamt)	
2-417	A	62	10	62	10	It is very difficult to identify studies that propose zero growth for the world economy. Almost all studies assume positive annual growth. Can you quote literature where "zero growth" is considered. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	To be covered in the cost section
2-418	A	62	13	62	19	In this context it seems very relevant to introduce the concept that mitigation of climate change - starting immediately - is the best approach to reduce the risks of climate change in the far future. (Radunsky Klaus, Umweltbundesamt)	We will base this discussion on the literature
2-419	A	62	15	62	19	There seems to be a confusion here. The possibility of long term slow or no growth does indeed justify a declining discount rate, as argued on page 41. What justifies raising the values of many environmental assets (or the cost of their destruction) in the future is their non reproduceable and non substitutable nature (see comment n 16 and attached paper). (Cédric Philibert, International Energy Agency)	To be covered in cost section
2-420	A	62	27			If help is needed, you can contact me for suggested text about the linkage and post-2012 regimes (Multi-Stage, Brazilian proposal and C&C) here (michel.den.elzen@mnp.nl). (Michel den Elzen, The Netherlands Environmental Agency)	This is also covered by chapter 13 and we will like to keep it short 13
2-421	A	62	27			I think the text in this section needs to be revised. I miss some literature about equity principles and the link with a future regimen of future commitments. Suggested text: Many different categorizations of equity principles can be found in the literature and, when not contradictory, cannot in general be easily reconciled (e.g., Banuri et al. (1996); Rose (1998); Ringius et al. (1998; 2002)). Ringius et al. (2002) in search for the politically most salient equity principles for distributive fairness, conclude that three principles stand out as the most relevant elements for a widely accepted regime to target differentiation in future international climate negotiations: • Need: Mitigation efforts or emission ceilings should leave room to eradicate poverty and attain a reasonable standard of living or, in other words, should respect the equal rights of humans to develop. • Capability: mitigation efforts should be distributed in proportion to each country's ability to pay and to its mitigation opportunities. • Responsibility: mitigation efforts should be distributed	These climate policy regime discussion are more an issue for chapter 13

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						in proportion to a country's share of responsibility for causing the problem. Den Elzen et al. (2003) have extended this set, with the basic needs principle as a special expression of the capability principle: i.e. the least capable Parties should be exempted from the obligation to share in the emission reduction effort so as to secure their basic needs. The issue of equity principles is also described in Chapter 13 (2 places) REFERENCES: Ringius, L., Torvanger, A. and Holtsmark, B. (1998), 'Can multi-criteria rules fairly distribute climate burdens? - OECD results from three burden sharing rules', Energy Policy 26 (10), 777-793. Ringius, L., Torvanger, A. and Underdal, A. (2002), 'Burden sharing in international climate policy: principles of fairness in theory and practice', International Environmental Agreements: Politics, Law and Economics 2, 1-22. Rose, A., Stevens, B., Edmonds, J. and Wise, M. (1998), 'International Equity and differentiation in Global Warming policy', Environmental and Resource Economics 12 (1), 25-51. Den Elzen, M.G.J., Berk, M.M., Lucas, P., Eickhout, B. and Vuuren, D.P. van, 2003. Exploring climate regimes for differentiation of commitments to achieve the EU climate target. MNP-report 728001023, Netherlands Environmental Assessment Agency (MNP), Bilthoven, the Netherlands (Michel den Elzen, The Netherlands Environmental Agency)	
2-422	A	62	30	65	28	This section could be construed to conclude that decision makers have a valid choice to make under the equity prinicple in Article 3 of the UNFCCC to decide between a rights based approach and a utilitarian approach. It also leaves the impression that utility is repected interpretation of equity. As stated in the comment above, equity is generally understood to be a correction to utility and that utility is not a valid subset of equity. Utility is a respected ethical principle but it is not a form of equity, generally understood. The fact that some nations have asserted that utility is a form of equity when they were asked to provide interpretations of Article 3 UNFCCC should not be the basis for concluding that such interpretations are entiled to respect as a matter of ethics. Not all interpretations of what equity means under Article 3 of the UNFCCC are entilteld to respect as a matter of ethics. In addition, if rights exixt to not be harmed by others without thier consent, these rights are not simply a matter of policy choice, they need to be respected as a matter of international law. In fact, a strong case can be made that international law already requires that no country can undertake activities that greatly harm others	Chapter 13 issue 13

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						without their consent. There is a line of cases about pollution that recognize this right including the Trail Smelter Case.. If this is the case, a polluting country can not justify non-action on the fact that they did a CBA that cocluded that welfare would be maximized if they invested thier money in something other than climate change. International law recognizes basic rights to life, liberty, and personal security. for .example, the International Declaration of Human Rights expressly provides that: "Everyone has a right to life, liberty, and personal security. Even some utiliatrains recognize these basic human rightt altough the basis for these rights for them are consequences of not honoring these rights, not on deontological principles. For an example of a utilitarian that support rights, see Singer, Peter. 2002. "One Atmosphere." In One World: The Ethics of Globalization, by Peter Singer, chap. 2. New Haven, CT: Yale University Press For other examples of utilitarians that support rights, see Jones, Charles, Global Justice, Defending Cosmolotism, Oxford University Press, New York, 1999 at 27 to 49 " For this reason, this section should acknowledge that policy makers may not have under law choices to choose an option between a rights based approach and the most efficient solution that has no regard to how costs and benefits will by distributed. . (Donald Brown, Commonwealth of Pennsylvania)	
2-423	A	62	34	62	48	There seems to be a confusion here between the formal "Brazilian proposal" put forth in the UNFCCC context, and the "Contraction and Convergence" literature issued by Aubry Meyers. Moreover, why selectively quote this (these) proposals, which have been studied and challenged by others, and not some of the many others that have been made available, some focusing on "numbers", others on "types" of commitments. (Cédric Philibert, International Energy Agency)	Brazilian proposal will be deleted from the text
2-424	A	62	39	62	48	This section confuses two approaches. The Brazilian approach is not a contraction and conversion approach, but rather a method of assigning emissions reduction targets based on historic contributions to temperature increase. It was formally proposed by Brazil in the negotiations that led to the Kyoto Protocol and has been the subject of on-going study by SBSTA since then (See FCCC/SBSTA/2001/INF.2). The major barrier to implementation of this approach is the lack of a methodology for determining historic contribution to temperature increase. Contraction and convergence is an approach proposed by the Global Commons Institute (see www.gci.org.uk), a UK-based ENGO. It has been mentioned favourably by a number of African countries, notably Zimbabwe, but never formally proposed in the UNFCCC/Kyoto Protocol process.	Brazilian proposal will be deleted from the text

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						(Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
2-425	A	62	40	62	40	Refer to Meyer, A., 2000. Contraction & Convergence. The global solution to climate change. Schumacher Briefings, 5. Green Books, Bristol, UK. (Michel den Elzen, The Netherlands Environmental Agency)	It will be to biased to have only one view on this controversial issue, so we will prefer to keep it short
2-426	A	62	43		44	(and in other places of the text): +global market in tradeable emissions entitlements would promote efficiency, transfer of resources to poor countries+" To my opinion, any trade by GHG emissions entitlements is useless and immoral. It doesn't lead to any decrease of GHG concentration, and is simply self-cheating from the viewpoint of global climate, allowing rich countries to continue increasing emissions. Worse than that, it promotes not efficiency, but corruption among the poor countries governments, allowing them to get money for nothing. Moreover, if now the developing countries would sell their shares for GHG emissions, they will be likely inclined to develop their industries anyway several decades later, trying to get exclusions from the common rules. This, in turn, would eventually result in double corruption for the countries seeking special conditions for development in future, and unlimited emissions. If the developed countries really want to limit the GHG emissions and transfer some resources to poor countries, they should regard the technologies transfer to the developing world as the main point. This would result in conservation of natural landscapes, cleaner air and real (not virtual) limitation of GHG in the global atmosphere. Of great value would be also secondary by-products for the poor countries like technical education, higher employment, etc. And the trade by GHG emission entitlements should be prohibited in any form. Off course, I know that a huge economy already exists around this entitlements trade, and it is unlikely that it will be stopped. However, I would like my opinion to be heard by the community - probably, there are other people thinking in the same way. (Andrey Shmakin, Institute of Geography, Russian Academy of Sciences.)	
2-427	A	62	46	62	48	The sentence "The Brazilian proposal refers not to GHG emissions per se, but to contributions to temperature increases, noting that different levels of GHG emissions should result in differentiated responsibilities for future GHG emission reductions." There seems to be a disconnect between the first part, which refers to temperature increases rather than GHG emissions, and the second, which seems to suggest a distributed responsibility for GHG emissions. (Lourdes Maurice, US Government)	The Brazilian proposal will be deleted from the text
2-428	A	62	49	62	49	Brazilian proposal literature (See: www.match-info.net): Filch, M.L.G. and	The Brazilian proposal will be deleted from

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						Miguez, M., 1998. Time dependent relationship between emissions of greenhouse gases and climate change, Ministry of Science and Technology, Brasilia, Brazil.; den Elzen, M.G.J., Berk, M.M., Schaeffer, M., Olivier, O.J., Hendriks, C. and Metz, B., 1999. The Brazilian proposal and other options for international burden sharing: an evaluation of methodological and policy aspects using the FAIR model. RIVM-report 728001011, Bilthoven, the Netherlands (www.rivm.nl/ieweb); den Elzen, M.G.J. and Schaeffer, M., 2002. Responsibility for past and future global warming: uncertainties in attributing anthropogenic climate change. Climatic change, 54: 29-73.; Höhne, N. and Harnisch, J., 2002. Evaluating indicators for the relative responsibility for climate change – alternatives to the Brazilian proposal and global warming potentials. Proceedings from the Third International Symposium on non-CO2 greenhouse gases. Millpress, Rotterdam. pp. 371-376; den Elzen, M.G.J., Fuglestvedt, J. S., Höhne, N., Trudinger, C.M., Lowe, J., Matthews, B.J.H., Romstadt, B., Pires de Campos, C. and Andranova, N., 2005. Analyzing countries' contribution to climate change: Scientific uncertainties and methodological choices. Environmental Science Policy, 8: 614-636. (Michel den Elzen, The Netherlands Environmental Agency)	the text
2-429	A	62	54	63	6	This is demonstrated in a quantitative model in Baer and Templet (2001) (manuscript attached) (Paul Baer, Stanford University)	Reference will be assessed
2-430	A	63	6	63	10	Yes, but why would one ever assume constant marginal utility for any reason other than convenience? Declining marginal utility is cited without any reservations as a justification for time discounting, for example in the prior section. (Paul Baer, Stanford University)	Add remark about decrasing marginal utility
2-431	A	63	13	63	15	This should preferably be phrased in terms of ‘user rights’ with regard to the atmosphere instead of property rights to GHG emissions. (Gert de Gans, Kerkinactie)	Rewritten to: Emission or user rights
2-432	A	63	14	63	14	Where does this "sense of natural justice" come in? It makes sense in the context but the entire discussion of equity principles and ethical theories that come prior to it make no allusion to it. My conclusion, frankly, is that the theoretical discussion is underdeveloped. (Paul Baer, Stanford University)	The “natural justice” terms will be deleted. We will revisit the theoretical discussion, however we are limited by the pages allocated
2-433	A	63	20	63	21	This statement needs some qualification. It may depend significantly on the indicator who has to adapt most and where are actual such limits to adaptation that adaptation is not practical at all. As this might be quite complex and as adaptation	Add reference to IPCC Synthesis Report, 2001

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						is not the focus of this report it is proposed to delete that first sentence. (Radunsky Klaus, Umweltbundesamt)	
2-434	A	63	20	63	25	A longer justification for transfers for adaptation funds is in Baer (in press), manuscript attached. (Paul Baer, Stanford University)	Reference will be assessed
2-435	A	63	40	63	44	There are some problematic hidden assumptions here. Either countries are prepared to do what's fair, even if it's not in their interest, in which case most of game theory is out the window, or countries unhypocritically see what is in their interest as being fair. Which is it? (Paul Baer, Stanford University)	We will clarify that this can be a pragmatic approach
2-436	A	64	25	64	28	I could not understand this (FÉLIX HERNÁNDEZ, IEG-CSIC)	"That" will be deleted in line 26
2-437	A	64	25	64	27	I think this is false; I think that there is considerable consensus which rules are superior with regard to at least some specific criteria. Part of the problem is that the analysis to here has limited the principles to "utilitarianism" and "rights based." "Rights-based" is unhelpfully vague since it includes both libertarian and egalitarian conceptions of rights. If one took egalitarianism and Rawlsianism as specific variants of rights based approaches it wouldn't be hard to rank allocation rules with regard to them (indeed, most of the classic equity analyses, like Rose et al. 1998) pretty much say what allocation principles follow from what equity principles. Or is there no consensus about which equity principles should apply? (Paul Baer, Stanford University)	Agreed, but it is very specific in our mind in relation to some criteria. We will adress the concern raised.
2-438	A	64	29	64	32	This is true with repect to uncertainty of climate change impacts. However, from a point of view of equal sharing of the use of the atmosphere and of financing the MDGs, the transfer of large amounts of money is an important option for further exploration. (Gert de Gans, Kerkinactie)	This is a personal political point
2-439	A	64	37	64	44	Do the authors foresee a set of circumstances which would enable successful enforcement of the :no harm rule."? The concept seems to lack practicality. (Lourdes Maurice, US Government)	Check article to see authors have arguments about this issue
2-440	A	64	37	64	44	Baer (in press) makes a similar argument. (Paul Baer, Stanford University)	Check reference
2-441	A	64	43			What about the polluter pays principle in the Rio Declaration? (Gert de Gans, Kerkinactie)	Add reference to this principle
2-442	A	64	46	65	8	It might be worth to consider deleting this part as it refers to one country only and as examples referring to international law are already presented in the paragraph	We will look for other examples

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						above and as the next paragraph again addresses international climate change negotiations. (Radunsky Klaus, Umweltbundesamt)	
2-443	A	64	47	65	8	Erase: Examples of, ……. road transportation "Justification: To mention the case of India, even as an example, introduces a bias against many other countries . (Ana Yábar Sterling, Institute of Environmental Studies)	We will look for other examples
2-444	A	65	27			Other missing literature on equity principles and link post-2012 regimes, see: Ringius, L., Torvanger, A. and Holtsmark, B. (1998), 'Can multi-criteria rules fairly distribute climate burdens? - OECD results from three burden sharing rules', Energy Policy 26 (10), 777-793.; Ringius, L., Torvanger, A. and Underdal, A. (2002), 'Burden sharing in international climate policy: principles of fairness in theory and practice', International Environmental Agreements: Politics, Law and Economics 2, 1-22.; den Elzen, M.G.J. and Berk, M.M., 2003. How can the Parties fairly and effectively establish future obligations under long-term objectives? In: D. Michel (Editor), Climate policy for the 21st century: meeting the long-term challenge of global warming. Center for Transatlantic Relations, Washington, D.C., pp. 79-112.; Höhne, N., Phylipsen, D., Ullrich, S. and Blok, K., 2005. Options for the second commitment period of the Kyoto Protocol, research report for the German Federal Environmental Agency. Climate Change 02/05, ISSN 1611-8855, available at www.umweltbundesamt.de, ECOFYS Gmbh, Berlin; Ringius, Lasse, Torvanger, Asbjorn and Holtsmark, Bjart, 1998. Can multi-criteria rules fairly distribute climate burdens? OECD results from three burden sharing rules. Energy Policy, 26(10): 777-793.; Torvanger, A. and Godal, O., 2004. An evaluation of pre-Kyoto differentiation proposals for national greenhouse gas abatement targets. International Environmental Agreements: Politics, Law and Economics, 4(65-91); Torvanger, Asbjorn and Ringius, Lasse, 2002. Criteria for Evaluation of Burden-sharing Rules in International Climate Policy. International Environmental Agreements: Politics, Law and Economics, 2(3): 221-235.; den Elzen, M.G.J. and Lucas, P., 2005. The FAIR model: a tool to analyze environmental and costs implications of climate regimes. Environmental Modeling and Assessment, 10(2): 115-134; (Michel den Elzen, The Netherlands Environmental Agency)	This is more relevant for Chapter 13
2-445	A	65	51	66	6	This citation is missing from the references. Also, it's not clear from the description whether this is a political analysis or a modeling study. Conceptually, a modeling study is not likely to catch the fact that the allocation of emissions permits implies an actual right, whose value would increase relative as permits become more	To be added

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						scarce, and that countries might care about this. (Paul Baer, Stanford University)	
2-446	A	66	10	66	40	I think it would be helpful when talking about legal liability that since nations' responsibility for climate change may be determined by liabiliity rules, these liability rules may limit policy options that seek to make trade-offs between utility and rights. The section leaves the impression that choices between utility and rights are simply a matter of policy choice. If rights exist to be free from seveer harm caused by others is a recognized right, these rights cannot be annuled by policy choices. (Donald Brown, Commonwealth of Pennsylvania)	Liability issues are also related to political issues. Arguments about liability will be added.
2-447	A	66	10	66	15	It's not clear that the reason that liability proposals have been made has to do with the lack of mitigation resources in developing countries; prima facie, the disproportionate emissions and disproportional vulnerability implies that the direction of net harm is from rich to poor countries. (see Baer in press). (Paul Baer, Stanford University)	Reference will be assessed
2-448	A	66	12	66	16	It would be helpful to include some reference to literature on the assessment included in that paragraph. In such general terms this statement, even if it could be based on literature, does not seem to reflect all aspects of mitigation. E.g. there might even be cost-efficient mitigation options for developing countries (as demonstrated by a large variaty of CDM-projects). (Radunsky Klaus, Umweltbundesamt)	Argument will be added
2-449	A	66	18	66	23	The estimates attributed to UNEP and to "Development groups" need references. The statement about the insurance industry facing very hard times does not appear to be borne out by experience since 2001. The industry seems to be successfully adjusting to higher claims. Either support the sentence about the industry with more up-to-date information or delete it. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Qualifications will be added. References will be updated
2-450	A	66	20	66	20	Climate change has a very asymmetric character. Nonetheless, maybe for the first time in history, industrialized and developing countries have a real common interest in solving a problem. There is no other environmental issue which might have such dramatic consequences in due time for people and regions all over the world. Countries like China, India, Brazil are developing rapidly; on the basis of fossil energy use and they rightly point to industrialized countries as examples. If climate change is getting out of hand, also the North will be confronted, from the point of view of finances, with very substantial damage and with hugh investments in adaptation measures (see e.g. chapter 2, page 66, line 20 about the economic costs	The problem is overemphasized in this formulation. The issues have been addressed in section 2.2

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						of disasters attributed to climate change). North and South are sitting in a situation of mutual vulnerability. My suggestion is to stress this point of interdependency. (Gert de Gans, Kerkinactie)	
2-451	A	66	20	66	21	The insurance industry will not go bankrupt. They are already designing alternative financial mechanisms in order to cope with the risks. (Gert de Gans, Kerkinactie)	This is right, we will modify
2-452	A	66	21	66	23	Please, provide reference. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Ok
2-453	A	66	21	66	23	It seems unlikely that such high damage costs are so high in the next 20 years. Building on the figure of $300 billion for 1991 to 2000 and assuming a linear growth (doubling every 10 years) the global damage would be in the range of 2 $ trillion. However this figure neglects that most of the damage is in developed vountries but not in developing countries. As the focus of this report is not on impacts, vulnerabilities it is proposed to delete this paragraph at all. (Radunsky Klaus, Umweltbundesamt)	We will keep the argument but qualify the discussion
2-454	A	66	21	66	23	I would prefer to cite insurance industry sources rather than Simms on this, and the development groups' estimates should have citations as well. (Paul Baer, Stanford University)	Qualifications will be added. References will be updated
2-455	A	66	25	66	29	This is personal opinion and inappropriate for an IPCC Assessment. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Will be deleted
2-456	A	66	25	66	26	“share of development aid nearly halved during the 1990s”: in recent years the volume of aid has increased substantially. But in no way it is or will be enough to reach the MDGs. (Gert de Gans, Kerkinactie)	This is too political
2-457	A	66	25	66	29	It is strongly proposed to delete this paragraph because it is prescriptive with regard to political decisions to be made by governments in all of its parts. (Radunsky Klaus, Umweltbundesamt)	Will be deleted
2-458	A	66	25	66	29	This has an editorializing tone that seems out of character for the chapter ("seems impossible.") (Paul Baer, Stanford University)	Will be deleted
2-459	A	66	27	66	29	Very good conclusion and well supported on good arguments. Congratulations. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Will be deleted based on suggestions from other reviewers
2-460	A	66	27			“getting resources to tackle climate change seems impossible”: this is way a search is going on for new sources for financing international development. A CO2-tax could serve the dual purpose of bringing down emissions and at the same time generate substantial funds for development purposes. See remark nr. 2.	Will be deleted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Gert de Gans, Kerkinactie)	
2-461	A	66	28	66	29	See: Myles R. Allen and Richard Lord, The Blame Game (Who will pay for the damaging consequences of climate change ?), Nature, Vol. 432, 2 December 2004, pages 551-552 (commentary) and P.A Scott, D.A. Stone, M.R. Allen, in the same number of Nature (pages 610-614). (Gert de Gans, Kerkinactie)	Will be deleted
2-462	A	66	42	68	7	Although the section makes the point that there are numerous ways to categorise countries (which is an important point), it leaves the reader with the feeling that anything goes. Table 2.8.1 does not help, but further confuses. It would be good to highlight those categorisations that are used heavily in climate change mitigation literature (i.e Annex-I, non-Annex-I, Annex II (be specific what that is in UNFCCC), Least developed Countries, EITs, OECD) and for that purpose use figure from ...(ADD INFO). Another important point to make is that for mitigation other categorisations (socio-economic) are needed than for climate chnage, impacts or adaptation (geographical). Some tables with GDP (PPP) and HDI ranking might then be useful to add. Other stuff is not relevant. (Bert Metz, IPCC)	All UNFCCC relevant categories are or will be covered. The missing reference in this comment to a figure that could be adopted would be helpful if we are to consider it. It is not clear whether it is the role of chapter 2 to provide extensive listings of countries on indexes such as GDP(PPP), HDI etc. We will drop references in table not directly relevant to non-climate
2-463	A	66	42	68	7	Section 2.8 does not much sense here. Either replace by a discussion on the implications of the choice of a regional unit of analysis in assessment reports and the link to decision making, or take out. The sentences on light pollution (p.67, line 40) illustrate this point clearly: they are currently descriptive without telling why we should be interested in such a classification. Anyway the text after p.67 line 22 repeats what is already in table 2.8.1 and can be taken out. (Peter Bosch, IPCC TSU WGIII)	Accepted – the section will be re-written and more specifically focused on the various dimensions of climate change – impacts/adaptation, mitigation, , UNFCCC/KP groups, negotiating groupings, others eg AP6
2-464	A	66	0			Section 2.8 Regional Dimensions. However (as also already mentioned) this section is seriously inadequate, for the reasons already mentioned above. (Pat Finnegan, Grian)	The section will be re-written and more specifically focused on the various dimensions of climate change – impacts/adaptation, mitigation, , UNFCCC/KP groups, negotiating groupings, others eg AP6
2-465	A	67	6	67	6	It is proposed to substitute "two, to" by "others". (Radunsky Klaus, Umweltbundesamt)	Accept
2-466	A	67	18	67	18	Erratum: repeat while (FÉLIX HERNÁNDEZ, IEG-CSIC)	Accept
2-467	A	67	23	67	38	Table 2.8.1 is referenced here, without it being specified that it is inserted here. This, presumably, is an oversight (?---My assumption is that it is designed to be inserted here. However, see below)	Accepted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Pat Finnegan, Grian)	
2-468	A	67	23			Table 2.8.1 (No page number given in my version) Possibly, this is merely a very early draft of something that will eventually prove to be much more substantial (?) In my view----given comments already made above regarding the huge importance of this issue---it is earnestly to be hoped that this table will be developed into something much more substantial. (Pat Finnegan, Grian)	See responses to comments 2-462 and 2-463
2-469	A	67	27	67	27	It is proposed to delete the example of Turkey because no issue with regard to the status of Turkey is pending under the UNFCCC for the time being. (Radunsky Klaus, Umweltbundesamt)	Text will changed to “the classification of some countries has been a matter of dispute”
2-470	A	67	31	67	31	Insert Table 2.8.1 (FÉLIX HERNÁNDEZ, IEG-CSIC)	See above
2-471	A	67	33	67	36	This in a contradiction - either you're classifying countries, in which case the reference to "parts of brazil or china" makes no sense, or you're classifying countries or regions, in which case almost all countries would need to be subdivided. Furthermore, the category "economies in transition" is a historical and instituional classification that bears very little relationship to per capita income. (Paul Baer, Stanford University)	The text will be revised to “any national classification will hide regional differences”
2-472	A	67	40	67	42	Using population density alone as a proxy for night time light pollution seems very inaccurate. Many areas of the developing world have high population density but low access to electricity, which would mean low levels of night time light usage. Conversely, some thinly populated areas of the developed world, particularly the U.S., use large amounts of night time lighting for commercial activities. The point about use of proxies is valid, but you need a better example. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	This example will be dropped.

2-473	A	68	9			Section 2.9 It is appropriate to mention that all technologies are not equally efficient in delivering energy service. The use of, and R & D to develop improved technology enables thw world to use energy to provide what people need in a more efficient manner. (Steven Freedman, Energy Consultant)	Accepted. Introductory text to section 2.9 modified to emphasize end-use and demand technologies.
2-474	A	68	9	85	43	This section 2.9 contains a lot of material that belongs in chapters 3 (or 11), because it is on the specific findings on technologies for mitigation and not about the general concepts and background. At the same time these other chapters (particularly 11) contain material that actually should be in ch 12 (or is already there). Consolidation required. (Bert Metz, IPCC)	Comment from writing team: This problem was addressed at the November 10th 2005 meeting held in Washington DC at the Cosmos Club of Lead Authors from Chapters 2, 3 and 11 to coordinate an integrated treatment of technology across these three chapters. The conclusion of that meeting was that Chapter 2 would address the general literature on technological change. Chapter 3 would address specific results from scenario comparisons. And, Chapter 11 would summarize sectoral results and model induced technological change (ITC) intercomparisons. We therefore agree that continued coordination among Lead Authors of these three chapters is essential to implementing the November 10th plan. A special coordinating meeting is scheduled to be held in Beijing at 5:30 PM February 15th 2006.
2-475	A	68	10			Section 2.9 This section on technology is in general very well written. Note that quantitative results from the IMCP project are now available, reported in Edenhofer et al, (Ottmar Edenhofer, Kai Lessmann, Claudia Kemfert, Michael Grubb and Jonathan Koehler 2006, Induced Technological Change: Exploring its Implications for the Economics of Atmospheric Stabilization Energy Journal Special Issue on the IMCP, forthcoming). (Jonathan Köhler, Tyndall Centre, University of Cambridge)	Accepted. Refrence corrected.
2-476	A	68	11			this section should give a definition of the stages of technology development that then will be used in chapters 4-11 to decribe the maturity. The text now (in footnote 16 on page 68) gives some general reference but not a clear definition. I strongly suggest to adopt the definitions that were used in the Special report on CO2 capture and storage (research, demonstration, economically feasible under specific conditions and mature market), because they have shown to work well to characterise the maturity of technologies and they were well received by governments at the approval stage.	Accpeted. The difinition provided in a separate paragraph. This definition reflects widely accepted concepts / terminologies of technological change literature. Reference to IPCC speciral report added as a footnote.

						(Bert Metz, IPCC)	
2-477	A	68	14	68	14	While technology development and diffusion is a lengthy process,a century seems excessive. What are some examples of technology development and diffusion that take a century? (Lourdes Maurice, US Government)	Comment noted. The statement is summrizign findings from two previous IPCC report IPCC 2000 and IPCC 2001. Examples in the literature include railways diffusion, automobiles disfffusion, compulsory school laws in the US and so forth.
2-478	A	68	18	68	18	On Footnote 16: The idea of separating the technology process into discrete phases may be convenient for analytical purposes, but it is not an accurate portrait of the real world. In practice, technology development involves feedbacks between all stages, so that each is occurring continually. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Excellent comment. Accepted. Text has been changed emphasizing the feedback.
2-479	A	68	27	68	28	Financial/investment elements could also be included here. O'Brien and Usher (2004), provide clearly explained outline of the 'finance continuum' of financing required through the technology deployment process - in this case renewable energy (off and on-grid, developed and developing countries). This demonstrates the importance of this factor, and describes the decision-making process relating to risk and return considerations, as well as sources of finance and public-private financing arrangements. This may be relevant for other parts of WGIII. IEA (2003) World Energy Investment Outlook, also highlights that: "The difficulties that many countries will face in monilising financial resources for energy investment in the future will be exacerbated by poor and unpredictable energy policies. Governments still have an important role to play in creating and maintaining an enabling environment for investment. By minimising policy-induced risk and clarifying economic risk, reforms [policy environment] can reassure equity investors that energy companies will be able to generate a reasonable rate of return. Bankers have to be sure that debts will be serviced." (p97) (Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	We agree with the commnett. We added a line in the first para of 2.9.2.1 emphasizing the issues including policy environemnt.
2-480	A	68	31	68	46	The full spectrum of viewpoints is expressed in this paragraph, and the truth almost certainly lies somewhere in between. The second viewpoint, that existing technologies can successfully stabilize CO2 emissions, is somewhat naïve. While this may be technically true, the cost to society would be forbidding. In this sense, the third viewpoint is more realistic. The first viewpoint is probably the most practical - major increases in research funding are vital if innovative technology based emissions cuts are to be achieved. Such funding will result in both new and better technologies and reductions in costs asssociated with existing technologies. (Tom Denniss, Energetech Australia Pty Ltd)	We agree. The text in this chapter 2 frames the scientific debate and we believe that following sector -specific chapters make the point raised by the comments clear.
2-481	A	68	32	68	47	this belongs in ch 3 (Bert Metz, IPCC)	We believe that we should keep the paragraph here in ch 2 since it is important framing issue.

							This text establishs concepts to understand the quantitative discussions of future technology scenarios in chapter 3.
2-482	A	68	34	68	41	Maybe here it could be considered the biomass analysis carried out in Moreira, , 2005, Global biomass energy potential. Mitigation and Adaptation Strategies for Global Change(Special Issue, forthcoming). Or include this reference in page 69, line 20 to 31. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	This specfici example should be discussed in sectorial chapters. It is a bit out of concept of this framing chapter.
2-483	A	68	46			Add to end of sentence ", and to achieve things otherwise not achievable, eg. Efficiences." (Stan Bull, National Renewable Energy Laboratory)	Accepted. Text modified taking the comment into account.
2-484	A	69	5	0	0	Section 9 reads rather differently from the earlier sections of chapter 2 by covering many topics which I would expect to be treated in later chapters, especially quantitative estimates of the baseline and stabilisation scenarios. There is a good case for moving much of this useful text to chpaters 3 and 11. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Noted. We willl contine tah coordination with ch 3 and 11. We think some quantitative illustration is required to frame the issue of technology in climate change.
2-485	A	69	7	69	8	Treatment of uncertainty. I find this too vague and unhelpful. Of course it is true that the direction of technological change (TC) is uncertain, but what has changed since the TAR? Is TC not very likely to continue with indefinite reductions in IT and communications costs? The post-TAR modelling of induced technological change (ITC) in low-carbon technologies has changed our views of the uncertainty in the costs of mitigation, compared with a treatment where most TC is exogenous. The range may be wider, but there may be more estimates of negative costs. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Not responded. Information technology not addressed here. Issue of uncertenty sand chnsgges since TAR discussed in sections below.
2-486	A	69	7	69	9	It is worth mentioning that adaptation and mitigation require largely different technologies, with not much spillover between them. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Accepted. Text changes to including adaptation technologies.
2-487	A	69	7	69	31	this belongs in ch 3 (Bert Metz, IPCC)	Respectfully disagree. Esssential para for framing and for highlighting msjor litereeaature reveiew thast appeard since TAR.
2-488	A	69	8	69	10	Can we be more precise about the response of technical innovation and deployment to climate policy signals being highly uncertain? Chapters 4 to 10 are about such responses and strongly suggest that higher carbon prices will justify more mitigation options on a net present value basis. AR4 should be making judgements about the uncertainty surrounding the effects of technological change on costs of mitigation and scales of mitigation, based on the literature. This indicates that TC can reduce costs to a small fraction of what they may be without change; are we not fairly sure about this?	Rejected. Litureture does not support higher level of precision at this level of generalization.

						(Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	
2-489	A	69	13	69	15	There must be some chance of a silver bullet, i.e. say "very likely to be" instead of "exists". (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Good points. Text changed accordingly.
2-490	A	69	20	69	31	The coverage of the literature here does not seem focussed enough on the concepts and general treatment of technological change and innovation. It would be helpful to the reader to identify references which clarify concepts, e.g. Jaffe, A. B., R. G. Newell and R. N. Stavins 2003: Technological change and the environment. pp. 461-516 in K.-G. Mäler and J. R. Vincent (eds), Handbook of Environmental Economics, Elsevier Science B.V. The list provided is partial and covers both concepts and estimates. A road map should be given somewhere which tells the reader where each strand of the technological literature is covered in the Report. This chapter should cover concepts, definitions and how TC has been treated in models. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Good points. Text changed accordingly.
2-491	A	69	26	69	26	Use the proper name, "Innovation modeling comparison project (IMCP)" - a comparison of methodologies and approaches, not models for their own sake. Also Edenhofer reference should be 2006, not 2005 (Michael Grubb, Cambridge University)	Accepted. Precision added. Reference corrected.
2-492	A	69	33	69	46	Why no subsection early on, covering the definitions and concepts? (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Rejectd. Difinitions and concepts are provided later on in context.
2-493	A	69	39	69	39	Does TC include information technology (IT)? If so, the uncertainty of the pace and direction is not so great - IT is reducing costs of computing, telecoms, expert systems so fast that we can reasonably argue that they will become free except for the costs of information and the time costs of use. This has a profound effect on costs of mitigation (i.e. a spillover effect) not mentioned here. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Rejected. Specfic techologires should be discussed in individual sectoral chapters
2-494	A	69	47	71	11	Baseline issues are also discussed extensively in Chapter 3. It would seem better to consolidate the discussion in chapter 3. However the point (p. 70 lines 51-53) made that low emissions futures may be no more costly than high ones, is a very important one, and should not be lost. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	See the consideration by the writing team for comment 2-474 above.
2-495	A	69	49	70	14	Gerlagh R., and B.C.C. van der Zwaan (2004) (“A sensitivity analysis on timing and costs of greenhouse gas abatement, calculations with DEMETER”, Climatic Change 65:39-71) also report on the sensitivity of baseline emisisons on a whole	Good point. We added the refrence.

						range of parameters. For example, they compare a basic technology assumptions such as the learning rate for non-carbon energy sources with assumptions on economic growth. (Reyer Gerlagh, Centre for Advanced Study)	
2-496	A	69	49	71	8	this belongs in ch 3 (Bert Metz, IPCC)	See the consideration by the writing team for comment 2-474 above.
2-497	A	69	0	82		I read section 2.9 closely given my personal interest in the field. Whilst the whole field continues to move rapidly, I think it is a superb section and the material is not covered elsewhere in the AR4 - despite its length therefore it should only be pruned with care. I am less qualified to comment on the technology transfer subsection (2.9.3) (Michael Grubb, Cambridge University)	Noted. Thank you.
2-498	A	70	10	70	10	If possible use a different term or abbreviation. GWP will be used in this report to mean global warming potential. The simplest approach would be to use the term, unabbreviated. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted. GWP is spelled out.
2-499	A	70	40	71	10	This paragraph is obscure, also because the figure 2.9.1 is unclear and misses the coordinates on the axes. (Marco Mazzotti, Institute of Process Engineering)	Good comment, have rewritten paragraph for increased clarity.
2-500	A	70	0			Old stuff, discussion in IPCC 2001 -- why recycled here? (Elizabeth L Malone, Pacific Northwest National Laboratory)	A framing chapter must refer all relevant classical material.
2-501	A	71	7	71	7	Please translate cereris paribus for those of us who never learned Latin. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted
2-502	A	71	10			Figure 2.9.1 - what is on the x-axis? Not totally clear what's being depicted here. (Geoffrey Blanford, Stanford University)	Accept, authors will supply corrected figure
2-503	A	71	12	71	36	This material is now extensively covered in Ch 11 (but should actually be in the cost section of ch 2). Delete here (Bert Metz, IPCC)	See comment 2-474
2-504	A	71	20	71	20	"cased" should be "cases" (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Accept.
2-505	A	71	30	71	35	The authors are wrong when they say that costs are less an issue of methodology rather than assumptions. Terry Barker, Jonathan Köhler and Marcelo Villena (2002), The Costs of Greenhouse Gas Abatement: A Meta-Analysis of Post-SRES Mitigation Scenarios, Environmental Economics and Policy Studies, 5(2), pp135-166. show that modle structure is as important as assumptions - both are critical. (Jonathan Köhler, Tyndall Centre, University of Cambridge)	Agreed, changed text, added reference.
2-506	A	71	30	71	30	I would like to see references to the mixed models, e.g. the DEMETER model which has been used to analyze the bottom-up top-down dichotomy (van der Zwaan B.C.C., R. Gerlagh, G. Klaassen, and L. Schrattenholzer (2002) Endogenous technological change in climate change modelling, Energy Economics 24:1-19.),	The DEMETER model already referred previously in ch2 and no need to repeat it here.

						(Reyer Gerlagh, Centre for Advanced Study)	
2-507	A	71	37			The point that endogenous technological change modeling is in its infancy, and that salient uncertainties are best described through explorative model exercises under a range of (exogenous) technology assumptions is extremely perceptive. I applaud the point, and wish it could be amplified in other places where ETC is used to loosely to draw conclusions. (William Pizer, Resources for the Future)	Noted and much appreciated.
2-508	A	71	38	73	45	this belongs in ch 3 (Bert Metz, IPCC)	See comment 2-474
2-509	A	71	51			Figure 2.9.2 - See the description of the figure. The last 4b lines of text aren't compatible with the figure. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Will bechanged
2-510	A	72	14	72	14	Modify the sentence by: "…and finally, carbon capture and storage technologies." (CZERNICHOWSKI-LAURIOL Isabelle, BRGM)	Accepted. The text changed accordingly
2-511	A	72	18	72	22	This main point of this sentence is echoed elsewhere in the chapter - diversification of technologies results in the highest probability of a successful outcome. A portfolio of technologies will offset the risks of "putting all the eggs in one basket". The same point has been made in a slightly different way on page 74, where there is a reference to "hedging strategies". (Tom Denniss, Energetech Australia Pty Ltd)	Noted. We thank the comment.
2-512	A	72	24	73	45	This is very important material for the AR4, but it should be in Chapters 3 and 11, since it is reporting cost estimates of stabilisation. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	The coordination should be discussed with ch 3 and ch 11. Still, the issue of costs estimates of stabilisation should be included in this framing chaper. 3, 11
2-513	A	72	25	73	11	Not only technological change should be addressed in this Chapter. There is already enough evidence that wind power and biofuels technologies are already commercially available and could significantly help to mitigate climate change (for biofuels and bioenergy see Moreira, 2005, Global biomass energy potential. Mitigation and Adaptation Strategies for Global Change(Special Issue, forthcoming)) . For these examples, all that is required is political decision for their widespread use. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	This is general text on framing. Specific reference to wind energy should be dealt with in individual sectoral chapter.
2-514	A	72	32	72	32	I would like to see references to the 'many replications' of the Edmonds et al. (1997) study, e.g. Gerlagh R., and B.C.C. van der Zwaan (2003), "Gross World Product and Consumption in a Global Warming Model with Endogenous Technological Change", Resource and Energy Economics, 25:35-57 (Reyer Gerlagh, Centre for Advanced Study)	Accpted. REference added.
2-515	A	72	46			Fig. 2.9.3, These figures all use a standard discount rate. A recent NAS report has questioned the discount rate for environmental goods and services. While appropriate for a refrigerator or a car (a commodity), ecosystem goods and services	Discount rate issues are dealt with in the cost section of chapter 2.

						might more appropriately have an appreciation rate.This comment has, of course, multiple implications for all calculations of climate change impacts. (Paul Epstein, Harvard Medical School)	
2-516	A	72	0	73		Advanced technology scenarios have been completed for the US Climate Change Technology Program. Reference is Pacet, M., K.K. Humphreys, and N. Mahasenan, 2004, Climate change Technology Scenarios: Energy, Emissions, and Economic Implications, PNNL-14800, Richaldn, WA, Pacific Northwest National Laboratory. http://www.pnl.gov/energy/climate_change_technology_scenarios.pdf. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Accept, add reference
2-517	A	73	2	73	2	..a few tenths of a percent.. of what?? GDP?? (H-Holger Rogner, IAEA)	Of GDP, added to text
2-518	A	73	38	73	40	It would be more straightforward to quote directly the IEA (2004) World Energy Outlook, than Philibert and Podkanski (2005) which review collaborative efforts towards clean coal technologies… (Cédric Philibert, International Energy Agency)	Accept, reference deleted
2-519	A	74	10	74	10	Figure 2.9.5 bottom panel: the meanings of the different categories in the caption are not clear. Does "soil carbon sequestration" means only biological carbon sequestration in soils, or includes also forest, land… If yes should be replaced by "Biological carbon sequestration". "All types of carbon capture and sequestration" should be replaced by "All types of options for carbon capture and storage (CCS) and biological carbon sequestration". The two other items "Central power plant..." are not clear as well and should be rephrased. (CZERNICHOWSKI-LAURIOL Isabelle, BRGM)	Accept, precision added to figure caption
2-520	A	74	16			such material should not be in ch 11 but in ch 2 (Bert Metz, IPCC)	Accepted
2-521	A	74	22	74	26	this belongs in ch 3 (Bert Metz, IPCC)	Belongs here
2-522	A	74	25	74	25	The terminology "carbon capture and sequestration" should not be used. Use instead " carbon capture and storage" and "biological carbon sequestration". See my last comment at the bottom of this file. (CZERNICHOWSKI-LAURIOL Isabelle, BRGM)	Will use the new IPCC phraseology
2-523	A	74	28	74	35	Literature (generally not peer-reviewed academic literature) is starting to emerge that sheds light in this area, in particular concerning some of the elements that prompt investment, or hold it back; and which parts of the investment community respond and to which signals. Note for example: Tang, ed. 2005, The Finance of Climate Change, which brings forward a number of views and initiatives from within financing community. Also, technology specific - IEA (2001) looking at the role of market 'economies of scale', relative to design/R&D in bringing wind turbine costs down (R&D approximately 40% of the cost reduction). [The latter is also relevant to the discussion under 2.9.2.2.]	Specfic technologies should be addressed in indivisual chapter. Referece(IEA 2001) is not provoded.

						(Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	
2-524	A	74	29	74	35	Newell et al (1999) (QJE 114(3) pp. 941-975) do consider the evidence on effects of energy prices and energy-efficiency policies on innovation. They conclude "post-1973 energy price increases account for one-quarter to one-half of the observed improvement in the mean energy-efficiency of models offered for sale over the last two decades." (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Reference added.
2-525	A	74	36			Generally, an excellent overview of technological change. What I did find either missing, or not very apparent, is the role of the advance of science, which is the primary long-term driver of technology. The traditional public role of education and fundamental research to advance science has enabled technology innovation by the private sector. Current advances in biotech and materials (including nano) are often predicted in scenarios to be a prerequisite leading to new technologies. This could be seen as a primary spillover, a cause of the improvements seen in experience curves, or an outcome of R&D. It may be appropriate to add a category in section 2.9.2.1 covering education and fundamental research, since it enables rather than competes with R&D aimed at technology innovation in the ways discussed in the draft. (Haroon Kheshgi, ExoonMobil Research and Engineering Company)	Accepted. Science and engineering education added in the text
2-526	A	74	36	82	21	Despite making reference to a dynamic innovation model, the wording in this section quite often still reflects the outdated linear innovation model. It should be pointed out consistently, that the diffusion of technology - and therefore mitigation policies - also influence technology development. Thus using the same technological assumptions in a baseline scenario without mitigation policies and in a policy scenario with climate policies is inconsistent. The same holds for achieving different stabilisation levels, as portrayed in Figure 2.9.3. (Rainer Walz, Fraunhofer Institute Systems and Innovation Research)	Agreed. However, reporting of the modelling literature has to make this distincution between baseline and policy scenario.
2-527	A	74	36	82	34	Ch 11 has an extensive treatment of Induced Technological Change; that belongs here and should be integrated with section 2.9.2 (Bert Metz, IPCC)	Agree. Cordination is underway. See comment 2-474.
2-528	A	75	11	75	13	Some additional explanation is needed for the statement "... the understanding by potential innovators that any new knowledge might eventually spill over limits expected profits and therefore dampens private-sector innovative activity." One can reasonably argue that the secrecy and protection of intellectual property rights that accompanies private sector innovation inhibits the widespread use of some knowledge and thus dampens innovation. However, the ability to profit from new knowledge has been a strong driver of innovation since the dawn of the industrial age. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted the text changed.

2-529	A	75	15	75	31	This concept of technological change is actually almost the same as that represented in figure 2.9.7. That is no coincidence, because, as the IPCC Special Report on Technology Transfer (2000) concludes, there is no fundamental difference between diffusion of technology within a country and between countries. It would therefore be helpful to generalise figure 2.9.7, use it here to illustrate the concept of technological change and use it again when discussing technology transfer in section 2.9.3. The key points of this important sections need to be brought out more clearly (see draft TS). (Bert Metz, IPCC)	Agreed. the Figure has been modified.
2-530	A	75	28	75	28	Delete "U.S." The statement is true globally. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted. Text modified.
2-531	A	75	43	75	44	Subsection 2.9.2.1: The following R&D analysis (Hayashi, A., T. Kosugi, and H. Yoshida, 2005: Evaluation of polymer electrolyte fuel cell application technology R&Ds by GERT analysis, International Journal of Hydrogen Energy 30(9), pp.931-941.) may be a good example of the evaluation of applied R&D in fuel cells, which analysis suggests better concentration of R&D resources in certein elemental technologies. (Takanobu Kosugi, Ritsumeikan University)	Accepted. Reference added.
2-532	A	75	0			The source of technological change. Suggest to include Induced Technological Change (ITC), Goulder, Lawrence H. Induced technological Change and Climate Policy, October 2004, Pew Center on Global Climate Change, there are other references, this one is already included in the references of the chapter Please look to chapter 11, p. 3 and 11.3.4. That involves ITC too. (Juan Llanes, Havana University)	Good comments. We will coordinate with chapter 11 11
2-533	A	76	31	77	7	The definition of spillovers is narrow. There are different channels of influence by which innovativions may spillover to other agents in the economy. The Chapter only refers to technological (or knowledge) spillovers. The productivity achieved by a firm of an industry depends not only on its own R&D effort, but also on the pool of general knowledge which is accessible to it and upon which new innovations can be based. There are also rent spillovers (pecuniary externality of downstream industries): R&D leads to quality changes embodied in new and improved outputs that are sold to firms and consumers (Griliches, 1979; Griliches and Lichtenberg, 1984; Hall and Mairesse, 1995). Finally, R&D leads to a product market rivalry effect (Business stealing). For firms that compete in similar product markets, an increase in the knowledge stock of competing firms leads to business stealing and induces a change in the optimal R&D levels. If the price deflators are good, product market effects should not have direct effects on productivity (they might effect the optimal levels of inputs) (Bloom et al., 2004). Most studies try not to distinguish between the different spillover categories. It is, e.g., difficult to distinguish rent spillovers from knowledge spillovers if both are linked to some economic transaction.	Accepted and the text amended.

						(Andreas Löschel, European Commission, DG Joint Research Centre, Institute for Pospective Technological Studies)	
2-534	A	76	32	76	53	Spillovers are of particular relevance to my field of interest - ocean wave energy. The difficulty in the past with the wave energy industry has been the ability of designers to cope with the hostile environment of large storms and the extreme loadings that ensue. This problem has, to a very large extent, been overcome in the past decade or two by two main "enabling technologies". One is the enormously greater computer capacity that is available for running simulations for the purpose of the design of structures in the ocean. The other is the way the wave energy industry has been able to leverage off the lessons learned (via the billions of dollars spent) by the off-shore oil and gas industry as that industry developed the capacity to install large structures in the ocean to withstand extreme events. The wave industry could not have hoped to have learned these lessons via its own chequebook. (Tom Denniss, Energetech Australia Pty Ltd)	Accepted. The example added.
2-535	A	77	8	0	0	It would be helpful to have estimated rates in the experience curves quoted in surveys presented in a table here. Table 11.2.3 is such a table and maybe it should move to chapter 2. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Rejected. Our understanding is that ch 2 frames and ch 11 reviews the quantitative literature. 11
2-536	A	77	8			title "empirical evidence" suggest that the previous was not based on emperical evidence. Better to continue text of 2.9.2.1 or rename into something like: Learning curves. (Peter Bosch, IPCC TSU WGIII)	Accepted. Title 2.9.2.2 deleted.
2-537	A	77	32	78	40	I am pleased to see reference to the IEA study on experience curves (referred to as IEA, 2000 - the actual document can be viewed on http://www.iea.org/textbase/nppdf/free/2000/curve2000.pdf). This study of the cost reductions as a function of installed capacity for 108 different energy technologies (of all forms) is an excellent illustration of how uniform this process is across virtually all energy technologies. With a relative tight log-normal distribution centred around a 20% cost reduction per doubling of installed capacity, it augurs very well for wave energy. In fact, if wave energy can replicate the experience described in the IEA study, the initial unit costs (currently sitting at 10-15 cents per kWh) should reduce to under 3 cents per kWh by the time 1000 MW is installed. (Tom Denniss, Energetech Australia Pty Ltd)	Comment noted. Approval appreciated.
2-538	A	78	26	78	41	The two-factor learning approach is correctly described as experimental at the moment, but the empirical limitations should be further stressed. Especially, when private and public R&D expenses are - since they play a distinctive role in the different phases of innovation and diffusion - distinguished. The (potential) data sources and the empirical treatment of the two factor learning curve concept are unclear to me.	Rejected. We think the current text is cautious enough.

						(Andreas Löschel, European Commission, DG Joint Research Centre, Institute for Pospective Technological Studies)	
2-539	A	78	26	78	41	I do not share the view that the two factor learning curve concept is a valuable methodological step forward. It steps one step back from opening the black box. Given the complex processes of technological change and the differentiated insights of the general literature on innovation and technological change I think the way forward should be to capture more of the realism of innovation and diffusion modeling in simulation analysis. A first step in this direction is done e.g. in Otto, Löschel, Dellink (2005). (Andreas Löschel, European Commission, DG Joint Research Centre, Institute for Pospective Technological Studies)	Accepted. Refernce added conditioned that it has appeared on peer-reviewed literature. FEEM working paper available on WEB.
2-540	A	79	16	80	21	This section is only making reference to the IPCC Special report on Technology Transfer (SRTT)in a footnote (footnote 22), suggesting that it is no longer the key reference for this section. However, there is only one reference given to newer literature (Flannery and Kheshgi, 2005). This is not credible. The SRTT assessed a vast amount of literature and came to useful findings on the critical drivers, barriers and opportunities of technology diffusion. So the logical thing to do is to summarise those findings of SRTT in this section and to add any new and different thing emerging from te newer literature (that has to be seriously researched then!) (Bert Metz, IPCC)	Accepted. Reference to SRTT added.Also we note for the need for adtional references to be incoporated. That will be done in coordination with chapter 3 and 11. 11
2-541	A	79	16			In several other places in the FOD the term RD3 is used (e.g.ch4 p81). Should be explained here. (Peter Bosch, IPCC TSU WGIII)	Accepted. Difinition added in the bieinning of chapter.
2-542	A	79	27	79	27	Typo error. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accepted. Corrected.
2-543	A	79	35	79	41	I suggest to add one more technological market hurdle, which is the interest on corporation to introduce technolgies that can yield significant return since they incorporate new information which may be protected by copyrights. This explain why a very successful technology, ethanol production from sugarcane has not yet gained a much larger market worldwide. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accepted. Bullet on firm incentive structures added.
2-544	A	79	44	79	45	garbled sentence (Danny Harvey, University of Toronto)	Acccpeted. Sentence changed.
2-545	A	80	16	80	18	open markets and protection of intellectual property are debatable in this context and should be stated as such (Stephan Halloy, Universidad Mayor de San Andrés)	Rejectted. The text is not the endodrsement of the oepn market and IPR but citing the discussion in the literature.
2-546	A	80	23	82	19	This section 2.9.2.4 discusses the drivers of technology change, inclusing (policy) induced change, and overlaps therefore strongly with section 2.9.2.1. This needs to be consolidated. (see also comment on integrating Ch 11 material here). (Bert Metz, IPCC)	It is not the overlap since 2.9.2.1. defines the terminology and 2.9.2.4. is discussing the role of public and private for diffent stages of technology development
2-547	A	80	25		37	Given the discussion on the previous page, this may be a pointless debate.	WE agreed. We reached the same conclusion

						(Elizabeth L Malone, Pacific Northwest National Laboratory)	in the next paragraph of the context.
2-548	A	80	25	80	37	For the policy conditions that stimulate investment in renewable energy, see Hamilton (2005). However, its not clear whether this comment really pertains to the preceding section 2.9.2.3 on Development and Commercialization, or if policy belongs in 'public-sector' role. The latter could involve the role of public sector investment (including through international financial institutions, also raised in comment to Chapter 13 below) to reduce the risk associated with going in to new technologies (for the non-VC community). p81, lines 5-11 also touch on uncertainties around the scale of policy response to climate change (and what that would mean specifically for energy policy or carbon cap levels), which is an important issue at present, and not just related to R&D but also deployment/commercialisation. (Kirsty Hamilton, retainer to UK Business Council for Sustainable Energy; Associate Fellow, Chatham House.)	Accepted. Text regarding demand-pull changed accordingly.
2-549	A	80	39			fig 2.9.6 needs to be improved, current version is unreadable (Bert Metz, IPCC)	Acepted. Figure improved.
2-550	A	80	46	80	47	Here it would be useful to add the lack of interest of private sector to invest in technolgies, which are on the public domain, as is the case of ethanol from sugarcane. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accpeted. See comment 2-543.
2-551	A	80	47	80	47	The best reference on two market failures here is Jaffe et al (2005) Ecological Economics, vol. 54, issue 2-3, pages 164-174 (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Accepted. Reference added.
2-552	A	81	13		41	Excellent discussion. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Thank you.
2-553	A	81	15	81	31	Is (Montgomery and Smith, 2005) peer-reviewed literature? This paragraph is strong on beliefs and opinions expressed in the paper - does it merit such prominence? (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	Accepted. However, authors can not determine in Beijing if the literuater is peer-reviewed. However, we also note that the EPRI paper is generally peer-reviewed and cited also in IPCC 2001 report.
2-554	A	81	19			insert "that" after "argue" (Danny Harvey, University of Toronto)	Accepted.
2-555	A	81	21	81	23	Good examples of this kind of technologies are wind power and biofuels. It would be nice to to try to explain why penetration of such technologies are still growing at modest pace. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	We agree.However, this discussion belongs in sectoral chapter.
2-556	A	81	43	81	53	The conclusions in this paragraph are valid and important. They should be retained and strengthened in future drafts. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Thank you for the comment.

2-557	A	81	55			The discussion on the innovation model and the importance of demand-pull and technology push lack the insights of the systems of innovation literature. Thus it is suggested to add a paragraph on that approach, which could be inserted starting in line 55 on page 81. In the 1990s, the heuristic approach of systems of innovation gained wide acceptance (for an overview, see Lundvall et al. 2002, Nelson 2002, and Edquist 2005). In addition to the demand and technology factors, this approach underlines the manifold aspects of the intra-firm determinants of innovation, the characteristics of innovation as an in-teractive approach, the role of institutions in shaping activities, the importance of the home (lead) market as a base for competitiveness on the international markets, and the regulatory framework. The key notion of the systems of innovation approach is that these factors influence each other, highlighting the importance of feedback mecha-nisms. The framework of systems of innovation has been applied traditionally to na-tional innovation systems. More recently, however, it has been also applied to analyze technological or sectoral systems (e.g. Carlsson/Stankiewicz 1995; Carlsson et al. 2002, Malerba 2002 and 2005). It has been suggested that a technological innovation system can be best analyzed by looking at how the different functions an innovation system has to meet are fulfilled (Johnson/Jacobsson 2000, Bergek/Jacobsson 2003, Smits/Kuhlmann, 2004; Walz 2006). In the tradition of empirical studies on systems of innovation, the analysis is always context specific and the effects of the various factors depend on the systems' conditions. Most case studies undertaken in this research tra-dition dealt with "normal" innovations in manufacturing. However, most recently, vari-ous case studies in the energy sector (Bergek and Jacobsson 2003; Agterbosch 2004; Walz 2004; Foxon et al. 2005; Walz 2006; Jacobsson and Lauber 2006; Astrand and Neij 2006) have been performed which underline the importance of the various factors of the innovation system. Literature Agterbosch, S. et al. (2004): Implementation of wind energy in the Netherlands: the importance of the social and institutional setting, in: Energy Policy Vol. 32, pp. 2049-2066. Astrand, K.; Neij, L. (2006): An assessment of governmental wind power programmes in Sweden - using a systems approach, Energy Policy 34 (3). Bergek, A.; Jacobsson, S. (2003): The Emergence of a Growth Industry: A Comparative Analysis of the German, Dutch and Swedish Wind Turbine Industries, in: Metcalf, S; Cantner, U. (eds): Change, Transformation and Development. Physica-Verlag: Heidelberg, pp. 197-227. Carlsson, B. et al. (2002): Innovation systems: analy-tical and methodological issues, in: Research Policy, Vol. 31.2002, S. 233-245. Carls-son, B.; Stankiewicz, R. (1995): On the Nature, Function and Composition of Techno-logical Systems, in: B. Carlsson (ed): Technological Systems and Economic Perform-ance: The Case of Factory Automation. Dordrecht: Kluwer Academic Publishers. Ed-quist, C. (2005): Systems of innovation: Perspectives and challenges, in: Fagerberg, J. et al. (eds.): The Oxford Handbook of Innovation, Oxford University Press, Oxford, pp. 181-208. Foxon, T.J. et al. (2005): UK	Accepted. Difinition and refrecne provided. However, technology specific national exapmles mentioned in comment are not included since they belong to sectoral chapters.

						innovation systems for new and renewable en-ergy systems: drivers, barriers and system failures, in: Energy Policy, Vol. 33, pp. 2123-2137. Jacobsson, S.; Johnson, A. (2000): The diffusion of renewable energy technology: an analytical framework and key issues for research, in: Energy Policy Vol. 28, No. 9, pp. 625-640. Jacobsson, S.; Lauber, V. (2006): The politics and policy of energy systems transformation - explaining the German diffusion of renewable energy technology, Energy Policy 34 (3). Lundvall, B.-A. et al. (2002): National systems of pro-duction, innovation, and competence building, in: Research Policy 32, 2002, pp. 213-231. Malerba, F. (2002): Sectoral Systems of innovation and innovation and produc-tion, in: Research Policy, 32, 2002, pp. 247-264. Malerba, F. (2005): Sectoral Systems: How and why innovation differ across sectors, in: Fagerberg, J. et al. (Eds.): The Ox-ford Handbook of Innovation, Oxford University Press, Oxford, pp. 308-406, Nelson, R. R. (2002): Technology, Institutions, and Innovation Systems. In: Research Policy 31: 265-272., Smits, R.; Kuhlmann, S. (2004): The rise of systemic instruments in innova-tion policy, in: International Journal of Foresight and Innovation Policy, Vol. 1, No.1, pp. 1-26., Walz, R. (2004): Innovation Effects of Energy Policy Instruments in Germany. In: Energy & Environment 15 (2): 249-260., Walz, R. (2006): The role of regulation for sustainable infrastructure innovations: the case of wind energy in Germany and the U.S., International Journal of Public Policy, Vol. 2 (1). (Rainer Walz, Fraunhofer Institute Systems and Innovation Research)	
2-558	A	82	21	82	34	This paragraph is very similar to one in chapter 11. The discussion of different treatments of technology in the models should come earlier in the section. Clarke and Weyant (2002), p. 332) make the important point that in the presence of market failure to innovate suffici+K35ently (because private firms cannot capture all the benefits of their R&D and innovation) means that solutions of optimising models with ITC are no longer optimal. (Terry Barker, 4CMR Centre for Climate Change Mitigation Research, University of Cambridge)	We agree. We delete the section and we will cordinate with chapter 3 and 11.
2-559	A	82	21	82	34	this belongs in ch 3 and/or 11 (Bert Metz, IPCC)	Agreed. See 2-558
2-560	A	82	21			Section 2.9.2.5 is a bit lost here, it fits better in section 2.9.1 on page 69. (Peter Bosch, IPCC TSU WGIII)	Accepted. See 2-558.
2-561	A	82	36			Section 2.9.3 there is an important recent survey of the economics of international technological diffusion, which should be reviewed in this section: Keller W. (2004) “International technology diffusion .” Journal of Economic Literature, 42(3): 752-782. (Jonathan Köhler, Tyndall Centre, University of Cambridge)	Accepted. Refernce added.
2-562	A	82	36			Section 2.9.3. The treatment of relevant issues in international technology transfer should also consider the "imperfect" nature of technology markets: a) while some of the components of technology are of a public-good nature, some other have an	Accepted. Refernce added Suggestions incorporated in the text.

						important tacit nature; to the extent that these components are dominant in a technology, its value can be only aproximately specified, as with other intangible goods; b) technology markets are normally very concentrated on the supply side, and bargaining power unevenly biased against the buyers; c) the strategic nature of technologies normally includes limiting clauses is use and other restrictions in transfer contracts; technology transfer, therefore, can have a huge impact on the shape of industrial organization. Cfr., per example, Arora, Ashish, Andrea Fosfuri, and Alfonso Gambardella, 2001: Markets for Technology, Cambridge, Mass., The MIT Press; Kumar, Nagesh, 1998: Globalization, Foreign direct Investment and Technology Transfer, Routledge, London. This last author also highlights the shifting trend between licensing and FDI as alternative channels for technology transfer, with the first dominating the 1960's and 1970's, and the latter dominating since the 1990's. (Francisco Aguayo, El Colegio de México)	
2-563	A	82	36	85	43	This 2.9.3 section, starting with its title, tends to narrow the international dimension of technology development and diffusion to technology transfers to developing countries despite the much broader definition given in the IPCC 1992 Special Report "Methodological and Technological Issues in Technology Transfer". All kinds of technology collaboration should be considered here. For a review of the literature, see Philibert, 2005, Energy demand, energy technologies and climate stabilisation, Proceedings of the IPCC Expert Meeting on Industrial Technology Development, Transfer and Diffusion, September 21-23, 2004, Tokyo, as well as Philibert (2004) International Energy Technology Collaboration and Climate Change Mitigation, OECD/IEA. For lessons from actual experiences see the case studies that followed (Philibert, 2004, Concentrating Solar Power Technologies; Gagnon-Lebrun, 2004, High-Yielding crop varieties; Gueret, 2005, Appliances Energy Efficiency; Philibert and Podkanski, 2005, Clean Coal Technologies; Justus, 2005, Wind Power Integration into Electricity Systems) and finally Justus and Philibert, 2005, Synthesis Report. The advantage of integrating developing countries in the development of new technologies has been studied by Lefevre (2005): Lefèvre, Nicolas, 2005, Deploying Climate-friendly Technologies through Collaboration with Developing Countries, IEA Information Paper, IEA, Paris (Cédric Philibert, International Energy Agency)	Accepted. Refernce suggestions incorporated in the text. Refernce regarding specific technologies rejected as apporpirate as the scope of ch 2.
2-564	A	82	36	85	43	This section moves beyond the IPCC Special Report on Technology Transfer by formulating a conceptual framework (apparently THE framework to be used in this report) , but it is not clear on what literature that framework is based. The section refers to the SRTT frequently, but lacks summaries of the main findings of that IPCC assessment, in as far as these are still valid. It does not clearly state what new insights the newer literature provides. It is my impression that that is not that much in terms of new and different findings compared to SRTT. If that is true, say so. (Bert Metz, IPCC)	Agreed. SRTT framework still valid. New refrences had been added. Figure repreresents the outcome of SRTT and added literature.

2-565	A	82	36			"Support for..." is a direct policy recommendation. (Peter Bosch, IPCC TSU WGIII)	Accepted. Text changed.
2-566	A	83	5	83	6	It is proposed to substitute the first sentence by the following wording: Technology transfer is particularly relevant because of the great interest of developing countries on this issue. Progress on this matter has been usually linked to progress on other matters of specific interest to developed countries. (Radunsky Klaus, Umweltbundesamt)	Accepted. The alternative formulation incorporated
2-567	A	83	49	83	49	Difficult to understand this sentence. Please, review it. (Jose Moreira, Institute of Electrotechnology and Energy - University of Sao Paulo)	Accepted. Text modified. Exact quatation provided.
2-568	A	83	0	85		the issue of ODA and technology transfer is fraught with difficulties. Many are highlighted in this section. It would seem useful to note as well that ODA and technology transfer is also most often designed in such a way as to create dependence: increase in debt load, patents and property rights at very high costs to the recipient country. As such, the aid may not be seen as net benefit to the recipient as many Latin American countries and African countries now claim (Stephan Halloy, Universidad Mayor de San Andrés)	Agreement noted. However, no change in the text is necesssary since no specific literatrue suggested.
2-569	A	84	26	84	26	The authors may consider to include the nature of the technology in the list of relevant characteristics of the technology transfer process. Original deployment environments influence the inborn design of technologies, generating a set of system requirements (minimum income and scale levels, specialized inputs and infrastructures, ancillary services, energy, skill requirements); this set of characteristics can be absent in the application environment of the recipients, increasing the adaptation costs and efforts. This issue was dealt with in the old "appropriate technology" literature (see for example Stewart, Frances 1977, Technology and underdevelopment, The MacMillan Press, London). (Francisco Aguayo, El Colegio de México)	Accepted. Bullet added and the Figure modified.
2-570	A	85	9			fig 2.9.7 is meant here (Bert Metz, IPCC)	Accepted. Text corrrected.
2-571	A	85	24		30	This sounds a lot like blaming the victim. (Elizabeth L Malone, Pacific Northwest National Laboratory)	Accepted. Text modified.
2-572	A	85	26			fig 2.9.7 is meant here (Bert Metz, IPCC)	Accepted. Text corrrected.
2-573	A	86	1	98	17	This chapter seems to be a bit skewed with a limited list of references to applied macro-economic model analyses with endogenous technological change. There is e.g. no reference to the work on this topic by Fischer, C. and R. Newell (2004), "Environmental and Technology Policies for Climate Change and Renewable Energy", Discussion Paper 04-05 (Rev), Resources for the Future, Washington D.C. Fischer, C. and R.D. Morgenstern. 2003. Carbon Abatement Costs: Why the Wide Range of Estimates? Discussion Paper 03–42. Resources for the future. Washington D.C.,	Comment noted. Chpater reorganization has moved the discussion of ITC models to chpater 11. 11

						Buonanno P., C.Carraro, and M.Galeotti (2003) "Endogenous induced technical change and the costs of Kyoto" in Resource and Energy Economics 25: 11-34, and the many papers by Gerlagh and van der Zwaan with the DEMETER model. (Reyer Gerlagh, Centre for Advanced Study)	
2-574	A	86	1	98	17	The DEMETER model has been used to analyze various subjects discussed in this chapter, e.g. the bottom-up top-down dichotomy (van der Zwaan B.C.C., R. Gerlagh, G. Klaassen, and L. Schrattenholzer (2002) Endogenous technological change in climate change modelling, Energy Economics 24:1-19.), the effects of ITC on short and long-term costs of stabilization (Gerlagh R., and B.C.C. van der Zwaan (2003), "Gross World Product and Consumption in a Global Warming Model with Endogenous Technological Change", Resource and Energy Economics, 25:35-57), the effects of ITC on the elasticity of emissions to carbon taxes (Gerlagh R., B.C.C. van der Zwaan, M.W. Hofkes, and G. Klaassen (2004), "Impacts of CO2 taxes when there are niche markets and learning by doing", Environmental and Resource Economics 28:367-394), and the relative importance of ITC compared to other uncertainties in model parameters (Gerlagh R., and B.C.C. van der Zwaan (2004), "A sensitivity analysis on timing and costs of greenhouse gas abatement, calculations with DEMETER", Climatic Change 65:39-71). (Reyer Gerlagh, Centre for Advanced Study)	See response to 2-573
2-575	A	92	27	92	28	The reference should include "Ph.D. thesis" after the title. The work is publicly available from the electronic library of the university of Potsdam under the permanent URN http://nbn-resolving.de/urn/resolver.pl?urn=urn:nbn:de:kobv:517-opus-5611 (Elmar Kriegler, Potsdam Institute for Climate Impact Research)	Accepted. Text modified.
2-576	A	93	17	93	17	The full citation for "The Economics of Climate Change" (Ownen and Hanley, Eds., 2004) is missing both in this citation and from the references list. (Paul Baer, Stanford University)	Accepted. Reference corrected.
2-577	A	95	23	95	24	Then there is a reference in the list to Nordhaus (2002) and Popp (2002), but I could not find the reference in the main text of Ch. 2. In general, the reason for making references in this chapter is somewhat unclear to me. It is sometimes suggested that the reader should read the overview articles mentioned, but then some specific papers are included in the list of references. What choice is made? When it comes to R&D and climate change policy, I think that [Gerlagh R., and W. Lise (2005), "Carbon taxes: a drop in the ocean, or a drop that erodes the stone? The effect of carbon taxes on technological change", Ecological Economics 54: 241-260] is one of the view papers with the two mentioned above that explicitly include R&D in an economic Integrated Climate Change Assessment model. (Reyer Gerlagh, Centre for Advanced Study)	Additional refrence rejected as ITC literature is compehensievely reviewed in the Ch11. 11
2-578	A	95	23	95	24	I could not find the reference to Nordhaus (2002) or Popp (2002) in the main text of Ch. 2, though I am sure it is a valid reference. In general, the reason for making references in this chapter is somewhat unclear to me. It is sometimes suggested that	Accepted. Reference corrected.

						the reader should read the overview articles mentioned, but then some specific papers are included in the list of references. What choice is made? When it comes to R&D and climate change policy, I think that [Gerlagh R., and W. Lise (2005), "Carbon taxes: a drop in the ocean, or a drop that erodes the stone? The effect of carbon taxes on technological change", Ecological Economics 54: 241-260] is one of the view papers with the two mentioned above that explicitly include R&D in an economic Integrated Climate Change Assessment model. (Reyer Gerlagh, Centre for Advanced Study)	