WMO

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

UNEP

IPCC Fourth Assessment Report

Expert/Government Review of the Second-Order Draft

Chapter 11

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-1	A	0	0	0	0	In general, Chapter 11 is well written, policy relevant and providing a good coverage of the recent literature and a summary of the preceding chapters. Overall, the second draft is a significant improvenment compared to the previous drafts (including the structure of the different sections). The next draft, however, should pay more adequate attention to the literature references, including (i) sevreal references are mentioned in the text but not in the list of references (or vice versa), (ii) references in the text do not always correspond to those in the list of references, e.g. due to using different reference years, (iii) names of authors are not always spelled correctly, and (iv) several references are mentioned twice (or duplicated) in the list of references and, hence, one of them should be removed (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC. References (in SOD) have been re-checked and the omissions and duplications will be removed and author names spelt correctly.
11-2	A	0	0	0	0	General comment: To make it easier for the reader to compare figures, the same unit for costs should be used throughout the chapter. Now the unit is USD per ton CO2 is some parts of the chapter and USD per ton C in others (in some parts both units are given). Consider also, for the same reason, to convert Euro to USD (for instance table 11.9) (Kristin Aunan, Center for International Climate and Environmental Research - Oslo (CICERO))	ACC. US$/tCO2 will be used, if consistent with rest of Report.
11-3	A	0	0	0	0	Please see my Commentary titled "Addressing Potential Abrupt Climate Change" which does not fit into this Excel spreadsheet box. I have accordingly asked Dave Rutu to circulate it to lead authors. It draws attention to a body of peer reviewed and gray literature which appears to have been overlooked in the SOD, although it was brought to attention previously in my comments on the FOD. The main point is that the rest of the literature mostly treats atmospheric CO2 as a flow pollution problem, to be addressed through a reduction in emissions. However CO2 is not a noxious gas, and therefore atmospheric CO2 is an excess stock problem with several possible answers. It is technologically much easier to extract CO2 from the atmosphere by land use improvements that increase biotic absorption and yield biomass fuels (de-fossilization) than it is do without any fuel other than hydrogen (decarbonisation). In this Chapter I suggest the matter can be dealt with by a footnote on page 7. In general, the medium term focus of this Chapter is more in harmony with the need to address the threat of Abrupt Climate Change than is much of the rest of this Assessment Report. I believe that comments in the text regarding costs are likely to be substantially outdated by current oil prices and futures and provide a comment at p8 line 20. Otherwise, pressure of time has prevented me from providing detailed comments on the text as I had hoped to do and my few specific suggestions are mainly to draw attention to the holistic strategy	ACC. This is an important issue, and the general point should be made somewhere in the Report, but Chapter 11 is not the place to raise the issue for the first time. This literature will be considered if it includes integrated quantification of the sectoral options. Use of bio-energy is considered in Chapter 7 and estimates of its potential are included in Table 11.3. Sentence in 11.2 to be added.

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						(which I have asked to be described briefly in an addition to Chapter 2 Section 2.3.4) where it most relevant in this Chapter (Peter Read, Massey University)	
11-4	A	0	0	0	0	The costs and potentials estimated both top-down and bottom-up as reported in this chapter could be the key policy messages of the report. However, to be trustworthy, more qualification is needed to be added to the numbers. The assumptions behind the potentials calculations and the top-down/bottom-up comparisons would need to be spelled out. Also more explanation is needed on the interpretation of the results. (Expert Review Meeting Paris, IPCC)	This will be considered by the cross-cutting group on Table 11.3
11-5	A	0	0	0	0	table 11.3 is sensitive to energy price development. Mention the sensitivity of various elements to changes in energy prices (and other assumptions).What if the baseline would be different with higher energy prices? Also top-down/bottom up comparison would need to be clearer. (Expert Review Meeting Paris, IPCC)	Table 11.3 provides alternative estimates of potentials for different carbon prices, but for specific baselines. Clearly the baselines are affected by the assumed energy prices, but it was not possible in the time available to undertake the comparison exercise using different baselines.
11-6	A	0	0	0	0	Reviewers noted the large difference in style between Ch 3 (very wide ranges) and Ch 11 (in the extreme case one number). Also the conclusions on induced technological change should be coordinated with ch 3 (Expert Review Meeting Paris, IPCC)	We shall look again to see if a range can be given.
11-7	A	0	0	0	0	This Chapter is making a "brave" attempt to provide aggregated data across a broad range of sectors. There does not appear to be any reference within the text to an analysis of the limitations of the approaches taken. Such an analysis must be iincluded within the Executive Summary and, more importantly, reflected within the SPM and TS. In a report that is focused upon a timeline through to 2030, where pathways towards stabilisation targets are mentioned, these, and the mitigation potentials will not differ significantly through to 2030. I am very unclear on how the mitigation potentials from the different chapters have been aggregated. Aggregation will be methodology specific (just as mitigation potential is greater if a higher reference scenario is selected). It is very unclear how the differences between the baselines, reference scenarios etc. have been taken into account (or presumably input into a model). This requires clarification. The uncertainties must be clearly stated (for instance, that the outcomesof technology R&D are not known but these will affect the costs and availabilities of the currently non-commercial technologies, interactions between mitigation options may alter the deployment pathways. .Mitigation cost estimates will not necessarily land somewhere between	TIA. The chapter has 4 pages on the problems of aggregation and a detailed spreadsheet making the methods of aggregation transparent is provided. The qualifications on the table and methods will be revised to include more on the technological uncertainties. The assumptions required in the models (as noted in the comment) should come earlier in the Report, but will be considered when the BU and TD estimates are compared in the discussion of Table 11.8.

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						results determined from top-down models and bottom-up engineering models. Two major considerations: IA and CGE models that are used in "top-down" assessments assume that economies can optimise to a new equilibrium without significant transition costs. For example displaced coal-workers must be retrained or placed on welfare. Also one must consider how capital costs are treated because policies can lead to loss of sunk investments in obsolete capital stock that may need to be replaced with new more costly alternatives. IA and CGE models also assume highly idealized policies to implement mitigation approaches. Policies such as uniform global carbon taxes, or emissions trading with low transaction costs and universal project eligibility are unlikely to portray the true impacts of real policies where transaction costs, and limitations on projects will add to costs. (Nick Campbell, ARKEMA SA)	
11-8	A	0	0	0	0	Overall, this is an excellent chapter. Most of my comments are rather minor, with one very significant exception. (Danny Harvey, University of Toronto)	ACC
11-9	A	0	0	0	0	I strongly recommend that all emissions be converted from Gt CO2 to Gt C, for consistency with WG1, WG2, and Chapter 3 of WG3. (Danny Harvey, University of Toronto)	To be decided by TSU. Done.
11-10	A	0	0	0	0	Missing from this chapter is a discussion of which technologies provide the largest mitigation potential in 2030. A careful reading of Chapters 4-10 indicates that energy efficiency will be the most important technology, but policymakers and other readers whould not have to dig for this information. Chapter 11 should provide a roll-up of mitigation potential by technology analogous to the rollup of mitigation by sector and cost contained in Table 11.3. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC. This would be helpful and would complement the sectoral detail. However there may not be the time to do the work.
11-11	A	0	0	0	0	Topics on which there is no basis for stating conclusions should be identified explicitly. Chapter 11 should contain an explicit discussion of gaps in current understanding, and be specific about topics and issues on which too little is known to support firm conclusions. From my reading of the draft report and the underlying literature, I believe these include: The relevance of LBD to estimates of mitigation costs and design of climate policy The value of including ITC in models that address the cost of mitigation Long term costs of stabilization	ACC in part. There is an extensive literature on LBD, both theoretical and empirical, and there is new literature since the TAR including LBD in many models exploring the effects of climate policies. The Chapter is reporting this literature and its conclusions. The discussion of LBD in 11.5 concludes by listing the problems in the modeling (p. 54). We will take into account problems in using LBD (see

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						Upper bounds on near term mitigation costs In addressing these topics, the conclusions stated in the chapter go far beyond what can be supported by the current state of research. The conclusions should be deleted and replaced with a discussion of the research required before conclusions can be reached. (David Montgomery, CRA International)	Koehler et al 2006, Energy Journal). Moreover, we emphasize that ITC goes beyond LBD to include R&D and induced substitution of technologies. The chapter will be rewritten according these lines.
11-12	A	0	0	0	0	Top down model results do not place an upper bound on costs of mitigation. Even given a set of technology assumptions, it is incorrect to state that costs will be bounded by the results of top-down and bottom-up models. Estimates from top-down models assume perfect or near-perfect policy measures that lead to universal adoption of cost-effective mitigation measures, such as carbon taxes or universal cap and trade programs. Studies of even relatively well-designed regulatory programs suggest that regulatory programs that fail to equate marginal costs across sectors or create distortions and inefficient behavior can raise costs by a factor of 10. (See Paul Bernstein W. D. Montgomery and Thomas Rutherford. "Effects of Restrictions on International Permit Trading: The MS-MRT Model." The Energy Journal, Kyoto Special Issue, June 1999, pp. 221-256.P. Bernstein, W. D. Montgomery, and T. Rutherford, Economic Implications of the Adoption of Limits on Carbon Emissions from Industrialized Countries. Charles River Associates, November 11, 1997. Anne E. Smith, W. D. Montgomery, E. J. Balistreri, P. M. Bernstein, "Analysis of the Reduction of Carbon Emissions Through Tradable Permits or Technology Standards in a CGE Framework," AERE/Harvard Workshop on Market-Based Instruments for Environmental Protection, Cambridge, MA, July 18-20, 1999 (submitted to Journal of Environmental Economics and Management for publication).) Even if rewritten to include an appropriate time periond, the discussion of mitigation costs and GDP impacts associated with stabilization targets must clearly explain the underlying assumptions in the modeling used to derive the figures. For example, Section 11.3 on "Comparisons between Bottom-up and Top-down modeling" needs to clearly state that the estimates are based on an assumption that marginal costs across all regions and countries. This is only possible if there is a global policy in place under which all all countries are mitigating across all sectors and all gases starting before 2010 and continuing through the remainder of the century. Without such an assumption, costs would be much higher than the numbers cited for top-down models in Table 11.8. Using a different assumption about where mitigation occurs, e.g., only in Annex I, which would appreciably increase the carbon price in the top-down model results.	ACC in part. There are important points made in this comment that will be addressed in the responses. The upper bounds from the modeling results are not upper bounds on the costs, which could be much higher depending on how the climate policies are designed, introduced and whether they use regulation or market instruments. The cost estimations of top-down models are a potential for cost reduction. Whether these potentials can be realized depends on policy instruments and market barriers. We have referred to the literature showing that these policy failures can affect the mitigation costs. To some extent these points are more appropriately addressed in Chapter 13. The estimates of costs of mitigation from top-down models are conditional on the assumptions of the models, the baseline, the extent of GHG reduction, and the form and detail of the policies adopted. These factors are acknowledged in the report. The peer-review literature cited was covered in the TAR. 11.3 is comparing estimates provided earlier in the report, particularly for the top-down estimates, the data comes from Chapter 3, where the assumptions are explained. The global models do assume that marginal costs of abatement are equalized across regions, and literature is cited showing that costs rise if abatement is done only in Annex 1 countries

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						It is also unreasonable to assume that policies will achieve the cost minimization assumed in top down models in countries having inadequate governance or institutions to sustain efficient market outcomes. (See P. Bernstein W. D. Montgomery and S. D. Tuladhar "Potential for Reducing Carbon Emissions from Non-Annex B Countries through Changes in Technology," accepted for publication, Energy Economics. 2005. W. D. Montgomery and S. D. Tuladhar. The Asia Pacific Partnership: Its Role in Promoting a Positive Climate for Investment, Economic Growth and Greenhouse Gas Reductions. International Council for Capital Formation. June 2006.) Without institutional reform, China and India will remain unable to exploit the latest western technology broadly throughout their economies. Distortions that prevent adoption of technologies that are already economic even in countries that do not put a price on carbon, such as the United States, will also be obstacles to any efficient response to the incentives that international emission trading is supposed to provide. The various economic models that appear to show abundant cheap abatement opportunities in Asia do not take account of this reality. The IPCC's own report on technology transfer makes exactly this point. (See Intergovernmental Panel on Climate Change (IPCC), Methodological and Technological issues in Technology Transfer, IPCC Special Report, 1999.) Another reason why cited estimates from top-down models are not upper bounds on costs is found in recently published research also demonstrates that technology innovation will not be forthcoming if climate policies only put caps or prices on emissions and fail to provide up front incentives for R&D that is sufficient to deal with the climate externality as well as the R&D externality. Chapter 11 recognizes that a policy instrument that only deals with the climate externality is insufficient, but fails to cite this finding which demonstrates that standard cap and trade or pricing policies are insufficient to stimulate long term R&D and innovation. (See W. D. Montgomery and Anne E. Smith. "Price, Quantity and Technology Strategies for Climate Change Policy," Chapter 27 in Human-Induced Climate Change: An Interdisciplinary Assessment, Cambridge University Press, forthcoming 2006.) How such policies can be designed effectively remains an open question, and without policies that effectively stimulate R&D costs of stabilization will far exceed the levels projected in top down models that assume continued technical progress. Uncertainty about future climate policies will also lead to delays in investment, because of the option value of waiting until uncertainties are resolved, that will cause costs to be higher than estimated in top down models that assume all future	e.g. Table 11.9. This chapter is about potentials and technologies and not mainly about policy failures. There is no doubt that policy failures increases mitigation costs. Nevertheless, we will refer to the problem of time inconsistent policies which may have an important impact on the market penetration of technologies (see Montgomery and Smith 2006). Most top-down models reported in Chapter 11 implicitly assume that there are time-consistent policies. This is an important underlying assumption which is discussed on p. 59 of the SOD. Again, this comment emphazises that time-consistent policy instruments are crucial for realizing the potential of ITC.

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						regulations are known with certainty and responded to optimally. (See P. Bernstein R. B. Earle and W. D. Montgomery "The Role of Expectations in Modeling Costs of Climate Change Policies," in Human-Induced Climate Change: An Interdisciplinary Assessment, Cambridge University Press, forthcoming 2006.) (David Montgomery, CRA International)	
11-13	A	0	0	0	0	The entire discussion of costs of stabilization is based on a fundamental error, which must be corrected. Since the literature clearly demonstrates that stabilization of concentrations and temperatures may require mitigation actions over a century or more, the chapter grossly misrepresents the magnitude of the stabilization task by reporting only costs through 2030. Moreover, it is well established in the literature that how much cost to incur before 2030 and how much to incur after is a decision, not a fixed parameter. Stabilization requires a period of transition to a condition in which uptake equals net emissions, and this period will extend far beyond 2030. Thus the presentation ignores a large share of the costs of stabilization by illogically cutting off the estimates long before stabilization is achieved. Picking some level of mitigation in 2030 as being consistent with a particular stabilization target is entirely arbitrary and misrepresents the entire relevant literature on this subject, beginning with the "when flexibility" analysis initiated by the Wigley, Richels, and Edmonds paper and work of Manne and Richels. Even if the time horizon were extended, reporting any consensus on the costs of stabilization – even the statement that bottom up and top down models provide upper and lower bounds – is a shocking exercise in treating model results as reality. Any estimate of costs over the time scales required for stabilization is critically dependent on assumptions about the cost of technologies that do not exist today, that may or may not be successfully developed, as partially demonstrated by the cited modeling experiments by Nakicencovič. Stating that anything is known about what those costs will be, except that it depends on technology assumptions, is completely inappropriate. Indeed, we have clear evidence that cost reductions did not always accompany the deployment of major energy technologies, for example the case of civilian nuclear power. (See, W. D. Montgomery and J. P. Quirk. "Cost Escalation in Nuclear Power." In Perspectives on Energy: Issues, Ideas and Environmental Dilemmas (2nd Edition). Oxford University Press, 1978.) If there was any learning curve for nuclear, it was clearly negative. Nor do fixed targets always make assumptions technology come true, as demonstrated by the assumptions about battery technology that were the basis for the California ZEV mandate. Studies of demonstration and pilot projects also suggest a great deal less optimism about the	Noted. Chapter 11 is concerned mainly with mitigation to 2030, but reports costs from top-down models that address the long-term problem of climate stabilization and provide estimates of the implications for costs to 2030. Much of the literature reviewed in Chapter 11 is concerned with the cost-effectiveness of policies to achieve given stabilization targets. The costs of stabilization depend mainly on the price of backstop technology, the availability of other mitigation options like CCS or energy efficiency. The concept of ETC which can be induced further by climate policy tries to understand the investment process in these different mitigation options compare to other options in the economy. Clearly, ITC has its own opportunity costs. These opportunity costs increase when institutional frictions has to be taken into account like uncertainty, time consistency, market barriers.

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						inevitability of cost reductions assumed in initial engineering estimates. The key study, not mentioned in chapter 11, is comprehensive review of experience with first of a kind chemical process plants built entirely in the private sector by the RAND Corporation, which found that initial engineering estimates of cost were exceeded by factors of 100 – 200%. (See Edward W. Merrow, Kenneth Phillips, Christopher W. Myers Understanding Cost Growth and Performance Shortfalls in Pioneer Process Plants RAND Corporation, prepared for the Department of Energy R2569-DOE September 1981) (David Montgomery, CRA International)	
11-14	A	0	0	0	0	Selection bias is apparent in the choice to cite certain studies not found in peer-reviewed publications Several decisions to cite studies that did not appear in peer-reviewed publications are surprising, and will be seen as suggesting a clear bias in favor of including materials that minimize mitigation costs. I am appalled at some of the papers cited and discussed in the chapter. In particular, the so-called econometric analysis of mitigation costs by Repetto and Austin (cited on pp. 38 and 44) never appeared in a peer-reviewed publication and was subjected to devastating criticism by virtually all the modelers cited and by independent reviewers. Including such a paper will be seen as either a clear evidence of bias or inability of the IPCC to discriminate between appropriate and worthless methodologies. I am also surprised to see just one unpublished paper by Holtz-Eakin (cited on p. 38) in the discussion of costs of regional greenhouse gas limits in the U.S. This paper is not peer reviewed, and is part of a project that has been heavily criticized for the lack of documentation of any of the bottom up studies on which its assumptions about net cost savings from listed policies are derived. At minimum, citations to other studies of regional caps on greenhouse gas emissions should be included, such as the study by Bernstein et. al. of the New England Governor's proposal and the Regional Greenhouse Gas Initiative. (P. Bernstein S. D. Tuladhar and W. D. Montgomery Economic Consequences Of Northeastern State Proposals To Limit Greenhouse Gas Emissions From The Electricity Sector (RGGI) Charles River Associates Incorporated July 20, 2004. P. Bernstein S. D. Tuladhar and W. D. Montgomery Unintended Consequences: Northeastern State Proposals to Limit Greenhouse Gas Emissions. American Legislative Exchange Council. July 2004.) These are studies based on peer-reviewed models are no different in form of release from the University of California study. (In particular, the MRN model is described in P. Bernstein R. B. Earle and W. D. Montgomery "The Role of	Noted. The Repetto and Austin (1997) finding of lower costs from CGE models has been replicated in a later peer-reviewed publication (Barker et al. 2002), so the original reference has been retained.. The Holtz-Eakin reference is perhaps referring to Roland-Holst, 2006, a study commissioned by the State Government of California. The new references cited will be considered.

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						Expectations in Modeling Costs of Climate Change Policies," in Human-Induced Climate Change: An Interdisciplinary Assessment, Cambridge University Press, forthcoming 2006.) These studies reach exactly the opposite conclusion about the costs of regional greenhouse gas limits, one which is much more consistent with both economic theory and the conclusions of accepted top-down models. (David Montgomery, CRA International)	
11-15	A	0	0	0	0	Discussion of LBD as an established basis for projecting falling technology costs ignores a fatal lack of empirical support for assumptions about learning rates. All conclusions regarding the superiority of models that include LBD and about the implications of LBD for estimates of mitigation costs and design of climate policy should be stricken. The chapter glosses over a fatal flaw in the entire LBD literature (p 54, lines 19-23) which is an econometric identification problem. This fatal problem is mentioned as if it were just one of a number of positive and negative points of view that balance each other out. It is not – the fact that it is impossible statistically to determine whether cost reduction is due to cumulative production, returns to scale, or R&D happening simultaneously – since all are correlated with time – is fatal. It implies that there is no empirical basis for estimating learning rates, so that LBD must be put into the category of hypotheses for which there is no basis for reaching a conclusion. Other quite clear discussions of this identification problem exist in the literature, and make it clear that it is a fatal flaw in the empirical basis for LBD. This is discussed clearly in David Popp's presentation to the US EPA in which he states the following: Learning curves plot a correlation between cost and experience. However, they do not document the cause of improvements. No controls [are] included for other relevant variables. When controls for the effects of other variables are included, the influence of LBD is found to be very small compared to the effect of R&D. Wing and Popp (Ian Sue Wing and David Popp Chapter 7: Representing Endogenous Technological Change in Models for Climate Policy Analysis: Theoretical and Empirical Considerations in Managing Greenhouse Gas Emissions in California. The California Climate Change Center at UC Berkeley) make the same point: Because the social costs of technological change are lower in the LBD framework, models relying on LBD will provide a more optimistic estimate of the potential of technological change. Thus, an important empirical question is the relevant importance of each type of learning. Unfortunately, few empirical studies address	Noted. The problem of separating out the effects of changes over time and economic causality is fundamental in the econometrics of time series analysis, and affects all time-series analysis of economic relationships, not just estimates of LBD effects. There is however considerable engineering literature on cost reductions through LBD that is highly persuasive **Learning Curves in Manufacturing** Linda Argote; Dennis Epple *Science*, New Series, Vol. 247, No. 4945. (Feb. 23, 1990), pp. 920-924. Sue Wing and Popp, as quoted, do provide a basis for estimating effects of LBD by econometric methods, although they find it to be small. LBD has effects at the sectoral and macroeconomic level leading to increasing returns to scale, such as those in information technology sectors, and increasing returns to specialization at an industry and economy level. Recent literature on the econometric estimation of experience curves will be reviewed. It turns out that the existence of a backstop technology and R&D investments is more important than LBD, which may decrease the price of the backstop technology. (see Popp 2006 and Edenhofer et. al. 2006) Empirical estimations of the two-factor learning curve confirm this insight.

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						this question. Such research is limited both by data availability (as measures of costs, technology usage, and matching R&D data would be needed) and concerns over endogeneity of key variables. A typical learning curve model regresses costs as a function of cumulative capacity: (82) Cost = A CumCapt-α where Cost is the cost of investment of a new installation, and CumCap is the cumulative installed capacity of the technology prior to time t. Recently, papers by Klaasen et al. (2003), Söderholm and Sundqvist (2003), and Söderholm and Klaasen (2003) have extended this basic model to estimate "two-factor" learning curves for environmental technologies. These two-factor curves model cost reductions as a function of both cumulative capacity (learning-by-doing) and R&D (learning-by-searching, or LBS). To be comparable with the notion of cumulative capacity, in these models R&D is typically aggregated into a stock of R&D capital. Thus, endogeneity is a concern, as we would expect both investments in capacity to be a function of past R&D expenditures and R&D expenditures to be influenced by capacity, which helps determine demand for R&D. Söderholm and Sundqvist address this endogeneity in their paper, which estimates a two-factor learning curve for wind power. They find learning by doing rates around 5 percent, and learning by searching rates around 15 percent, suggesting that R&D, rather than learning-by-doing, contributes more to cost reductions. (See Soderholm, P., Sundqvist, T., 2003. Learning Curve Analysis for Energy Technologies: Theoretical and Econometric Issues. Paper presented at the Annual Meeting of the International Energy Workshop (IEW), June 2003 in Laxenburg, Austria. Klaassen, G., Miketa, A., Larsen, K., Sundqvist, T., 2003. Public R&D and Innovation: The Case of Wind Energy in Denmark, Germany and the United Kingdom, Interim Report IR-03-011, International Institute for Applied Systems Analysis, Laxenburg, Austria. Söderholm Patrik and Ger Klaassen (2003), "Wind Power in Europe: A Simultaneous Innovation-Diffusion Model," paper presented at the 12th Annual Conference of the European Association of Environmental and Resource Economists, Bilbao, Spain, June 28-30, 2003.) As cited in Montgomery and Smith, Nordhaus has discussed the lack of empirical support for the assumption that LBD will be a substantial part of ITC. His discussion of examples of LBD in airframe production (which was the example that brought the phenomenon to the attention of economists), semiconductor production, surgery, and other examples lead him to several conclusions. To quote (emphasis in the original): There is clear structural evidence of learning. The mechanism by which learning occurs is complex, including worker	

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						experience, forgetting, investment, R&D, and perhaps but not clearly cumulative output. Spillovers differ greatly depending upon the technology and whether they apply to workers, firms, specific technologies, and countries. Given current structure, it would be folly to rely upon LBD to rationalize a costly or critical component of climate change policy. Nordhaus concludes that the historical evidence is that LBD is largely firm-specific, that it occurs largely within a single generation of technology, and that it is unclear that there is any association between LBD and cumulative output with a technology. In the case of climate change, the needed technologies simply do not exist today, so that LBD with existing technology will not contribute to development or reduction in the cost of the needed technologies. (W. D. Nordhaus, "Economic Modeling of Climate Change: Where Have We Gone? Where Should We Go?" CCI/IA Workshop, Snowmass, Colorado, August 2, 2004.) (David Montgomery, CRA International)	
11-16	A	0	0	0	0	By failing to include obviously relevant studies found in the economics literature outside the standard publications that carry work on climate policy, Chapter 11 grossly exaggerates the empirical relevance and support for LBD. The microeconomic evidence makes it clear that LBD is specific to firms, embodied in labor so that even turnover within a firm can cause LBD to decay, and specific to generations of technology. Thus the notion that LBD can produce continuous improvement in carbon intensity independent of R&D or investment is clearly contrary to the known facts. As in the case of ITC in general, the studies cited as dealing with LBD are pure thought experiments, that work out the theoretical consequences of assumptions about learning rates that have no basis in reality. Policy inferences drawn from modeling studies that take LBD as a given without empirical foundation are therefore highly misleading. The statements that because of LBD an optimal emission path can include tight near term carbon limits or a high then declining carbon price is thus highly misleading – although assuming continuous LBD that accumulates over generations of technology leads to the stated result, there is no empirical foundation for the assumption and clear evidence that it is not true. Thus the policy implications of LBD are also an area in which the report should state there is no basis for conclusions because of the lack of empirical support for the existence of LBD for the types of energy technology improvement required to meet stabilization targets at costs within the bounds cited in the report.	Noted. The chapter will focus more on the importance of ETC and ITC and less on LBD.

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						(David Montgomery, CRA International)	
11-17	A	0	0	0	0	All conclusions regarding the superiority of models that include ITC and about the implications of ITC for mitigation costs should be stricken. Mitigation costs have been bracketed by modeling done without ITC based on assumptions of greater exogenous technical progress in the policy scenarios, so that the range of mitigation costs is not changed by including ITC. Moreover, a number of critical issues raised by ITC have not been resolved, so that even the ultimate conclusions from ITC models about the cost associated with creating new technology are unclear. Most important, the entire literature on ITC modeling is without empirical support, and represents the elaboration of assumptions about various parameters governing technical progress in specific models. This critical point is now ignored completely in the chapter. ITC is a thought experiment, in the sense that the entire literature consists of models that investigate the implications of assumptions about parameter values that have no basis in empirical research. Results from models making arbitrary and empirically unfounded assumptions about ITC should not be presented as representing likely future developments. Counterexamples to the inevitable reduction in costs of energy technologies abound, and are never mentioned. Instead the chapter concentrates on modeling exercises that are nothing more than thought experiments about how assumed improvements in technology would reduce costs of targets and timetables. Experience in large scale technology development in response to policy is not uniformly good. Two relevant experiments in promoting a large scale energy technology based on expectations about technical progress are commercial nuclear power and the California ZEV, both of which clearly failed to produce the assumed ITC. In the case of nuclear, LBD was negative, and in the case of the California ZEV mandate assumed improvements in battery technology never materialized despite federal and private sector R&D and mandates – because the mandates chose the wrong target. (W. D. Montgomery and J. P. Quirk. "Cost Escalation in Nuclear Power." In Perspectives on Energy: Issues, Ideas and Environmental Dilemmas (2nd Edition). Oxford University Press, 1978. Howard Gruenspecht Zero Emission Vehicles: A Dirty Little Secret Resources Winter 2001 Resources for the Future. Lloyd Dixon and Steven Garber California's Ozone-Reduction Strategy for Light-Duty Vehicles Direct Costs, Direct Emission Effects, and Market Responses RAND Corporation.) (David Montgomery, CRA International)	Noted. It is a misunderstanding that ITC mainly focuses on LBD. Models incorporating ITC have shown that a) backstop technologies (with and without LBD), b) end-of-pipe technologies like CCS, c) the availability of other mitigation options decreasing energy- and carbon intensity like fuel switching, d) the investment behaviors all determine mitigation costs. These components provided more responsiveness in aggregated investment and therefore reduce crowding out. This is emphasized on p. 59 of the chapter.
11-18	A	0	0	0	0	The mitigation aspects of land use sectors are inadequately addressed, even the dominant biofuel or bioenergy is inadequately addressed. Land use sectors are	Noted. Taken into account in Chapters 8 and 9. Chapter 10 summarizes mitigation aspects

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						critical for developing countries. (Government of India)	of land use in order to compare sectoral contributions to overall mitigation. 11.9 addresses the interaction between adaptation and mitigation aspects of land use. Some text on land use mitigation will be included in the discussion of Table 11.8.
11-19	A	0	0	0	0	The chapter is too long. At various places the chapter can be reduced in size. If there is more work put in the integration of various paragraphs and tables, referring internally etc might already reduce the size and improve clearance (Government of European Community / European Commission)	ACC. 12 pages have been removed by consolidation of tables and internal referencing.
11-20	A	0	0	0	0	Please be consistent in using the same unit for carbon prices $/tCO2 ($/tC) (Government of European Community / European Commission)	Accepted. $/tCO2 will be used. Any required conversions will be noted.
11-21	A	0	0	0	0	Little attention is given to the level of confidence that the authors have in the figures. Especially for Table 11.3 that seems to be derived from chapters 4 - 10 it is important to understand the robustness of the numbers. (Government of European Community / European Commission)	Accepted.
11-22	A	0	0	0	0	Hydrogen is introduced as a cross-sectoral technology, but not entirely presented as such in this chapter. What are the implications for the implementation of hydrogen techmologies at a large scale in terms of carbon prices. Can lock in effects be encountered or have additional investment costs to be made? (Government of European Community / European Commission)	Accepted. Will be considered as a response to coverage of hydrogen technologies in 11.2.
11-23	A	0	0	0	0	Cross sectoral mitigation options and interactions are a large part of the chapter. A visualisation of the main characteristics of this both in terms of technologies and in terms of policies complemented with examples would be illustrative and could save text, e.g.. page 14 and 17 (Government of European Community / European Commission)	The interactions are also in Table 11.2, which is proposed to be removed to save space. Figure 11.1 also covers interactions and options. We shall consider expanding Figure 11.1 to cover all major options and interactions.
11-24	A	0	0	0	0	Chapter 11 is an important chapter with a high policy relevant potential. It combines all different types of studies on costs and potentials for GHG mitigation; top down, bottom up studies at both a global and regional scale. In addition cross-sectoral, induced technological learning, macro economic effects, co-benefits and geo-engineering technologies are included. It has therefore also the potential to become fragmented in the information and not a coherent chapter with clear policy relevant information. More time is required to link the different sections and improve the consistency and so distill more policy relevant messages especially on the carbon price and the GHG mitigation potential. (Government of European Community / European Commission)	ACC. The issues cut across many chapters in the WG3 report and the policy messages are brought out in the SPM.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-25	A	0	0	0	0	Notwithstanding the participation of distinguished specialists the chapter would benefit from restructuring. Even though there are no very serious omisions in the information provided, and while the presented patches of information are as such important indeed, somehow key themes and messages (re)emerge throughout the chapter. (Government of Finland)	REJ. The structuring of the chapter follows closely the outline agreed by governments for chapter 11 (sections headings and coverage in summary). The structure adopted has been reviewed by the chapter team and changed, but it is inevitably a compromise.
11-26	A	0	0	0	0	Issues that could get somewhat more attention are distributional (equity) issues and interaction between mitigation and adaptation policies and measures. Distributional impacts significantly influence abatement potentials in case of significant feedback effects on economic growth and structure and in case of differences in acceptance of options and hence actual feasibility of options. Apart from impacts on the judgements of the recommendable global mitigation effort over time in relation to information on urgency, adaptation studies may also provide insights in sectoral effects relevant for estimating mitigation potentials. Changes in precipitation may affect hydro power potentials and changes in the occurrence and ferocity of storms may affect the deployment of wind power, notably off-shore. (see e.g. Kirkinen J, Martikainen A., Holttinen H., Savolainen I., Auvinen O. and Syri S. (2006) Impacts on the energy sector and adaptation of the electricity network business under a changing climate in Finland, SYKE Mimeograph 340 FINADAPT Working paper 10). http://www.environment.fi/syke/finadapt (Government of Finland)	Accepted for 11.9. Reference to be assessed and issue covered.
11-27	A	0	0	0	0	Treatment of induced technological change. -The ITC literature may or may not represent a step forward in modeling. The results of modeling exercises that include ITC are interesting, but they are at their foundations gedanken experiments. Modeling results are a direct reflections of a series of assumptions about -Mechanisms by which technology innovation occurs, and -Explicit parameterizations of those mechanisms, which govern technology innovation for technology processes. -The literature that is cited cited employs an ITC modeling paradigm that represents a set of assumptions about the methods by which technology innovation occurs in an economy that is vastly simpler than the processes that are identified in the literature. (See Chapter 2.) Results hinge on specific assumptions about the ultimate performance of specific, low-emission or non-emitting technologies, many of which are at an early stage of development. Given that, as the literature shows, technology performance can either improve or degenerate, depending on circumstance, e.g. nuclear energy in the 20th century.	Noted. All modelling requires assumptions and explicit specification of functional forms and quantification of their parameters. The new literature since the TAR has explored in more detail the assumption that technological development might be influenced by different paths for energy prices and carbon prices. This new literature is no different in kind to the EMF19 and EMF21 literature in making assumptions and following different approaches. It is an improvement on earlier ITC literature in several respects: 1) further empirical evidence is available on the influence of energy prices on

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						Treatment of induced technological change. -The traditional approach to modeling technological change as exogenous is another limiting case in which ITC depends completely on the rate of technological change in the general economy. This model has developed cost estimates that exogenously change the rate of technological change in key energy technologies in policy cases. The resulting pattern of costs from the exogenous technological change literature therefore brackets the results from the more recent ITC literature. -The limitations of the present ITC literature need to be made clearer. -There is no basis for the statement that the present ITC literature is an improvement on the existing literature. -There is no basis for the statement that the resulting "lower" costs associated with the ITC literature are an improvement relative to the existing literature. U.S. Government. (Government of U.S. Department of State)	technological change (e.g. Popp, 2002 "Induced innovation and energy prices" ARE 92(1) 160-180; Popp, 2006 quoted in comment 11.40 below) and on experience curves. 2) A variety of approaches to the problem of modelling ITC have been developed and reported (e.g. in EMF21, IMPC and Energy Economics, Special Issue 2006 and other peer-reviewed journal papers) and common themes and messages can by derived from the new literature. 3) The traditional approach provides an extremely broad range on how technology might develop, with some estimates of the effects of advanced technologies suggesting that costs of deep mitigation my be reduced by over 90%. It is important for stabilization policy to know how energy prices and carbon prices affect this reduction and the ITC literature is an improvement in our understanding of this process.
11-28	A	0	0	0	0	Need for a candid assessment of strengths and limitations including gaps in knowledge. -Needs to be included in the chapter executive summary -Generalize to all chapters -Bring into the SPM. U.S. Government (Government of U.S. Department of State)	Noted. Lines 7 to 14, p6 of the Executive Summary Chapter 11 lists a series of criticism and limitations in the ITC modelling. The summary text also emphasizes that ITC may reduce costs and that the reduction is conditional on actions adopting a cost-effectiveness criterion and characterizing technological change as through a variety of ITC paths.
11-29	A	0	0	0	0	Modifying solar radiance may be an important strategy if mitigation of emissions fails for one reason or another. Doing the R&D to estimate the consequences of applying such a strategy is important insurance that should be taken out. This is a very important possibility that should be considered. This should also be included in Figure SPM.6. Add a indication of radiative offset. Needs to be also coordinated with WG1 on radiative offset U.S. Government	ACC. subject to peer-reviewed literature under the rules of WG3 being available for review in 11.2.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Government of U.S. Department of State)	
11-30	A	0	0	0	0	Mitigation potential and the reference case (Chapter 3) are intimately intertwined. Mitigation potential is greater the higher the reference scenario. No mitigation potential can be computed outside the context of the reference case against which it is set. There is no unambiguous way to aggregate mitigation potential, just as there is no unambiguous methodology for attributing emissions mitigation after the fact. -Any aggregation is methodology specific. Attribution depends completely on the methodology. Change the methodology and emissions mitigation potential changes as well. -The estimation of aggregate emissions mitigation potential and its composition requires the use of a model. Obviously some model was used—either explicitly or implicitly. What was that model? -What happens when alternative models are used? These models need to be cited so that its equation structure can be examined. Given that the literature assessed in the individual chapters draws on a wide variety of mitigation potentials undertaken for various future dates, against numerous alternative backgrounds, it is not even clear what meaning can be attributed to the individual chapter estimates of emissions mitigation potential to say nothing of their aggregation. U.S. Government. (Government of U.S. Department of State)	ACC. The dependence of the mitigation potentials on the baseline is emphasized in the chapter and the methodology and qualifications are explained and listed in 11.3.1. This is not a formal modelling exercise, rather a synthesis of estimates in the literature, following that done in the TAR. The main points of the exercise are to provide • an overall view of the potentials of each sector • their uncertainty ranges • their sensitivity to different levels of carbon prices, complementing the new literature of the effects of carbon prices on technological development • a comparison with TAR estimates • a comparison with top-down model estimates.
11-31	A	0	0	0	0	Footnote 9 says 1% loss of GDP in 2030 is equivalent to 0.05% per year. The meaning of this statement is unclear. U.S. Government (Government of U.S. Department of State)	Footnote 9 (p. 66) does not include this statement.
11-32	A	0	0	0	0	Discussion of stabilization of CO2 at alternative levels makes no sense in the context of a 2030 time frame. -It is only possible in the context of a century or more. Thus, reference to Chapter 3 is essential. U.S. Government. (Government of U.S. Department of State)	Noted. The studies of cost-effective options for stabilization at different levels of CO2 concentrations provide estimates of the costs and CO2 reductions at different years in the time path to 2100, and it is these costs that have been used.
11-33	A	0	0	0	0	Chapter11Table.xls - Waste tab: no data is listed for Wastewater treatment. Suggested source: U.S. EPA's Global Mitigation of Non-CO2 GHGs, 2006, http://www.epa.gov/nonco2/econinv/international.html. U.S. Government (Government of U.S. Department of State)	Ch 10 issue
11-34	A	0	0	0	0	Chapter11Table.xls - Waste tab: it is not clear where the upper end of the range of mitigation in cell H9 is coming from. If this is from the Monni et al study, it is not clear from Table 10.6 on page 27 of Chapter 10. U.S. Government	Ch 10 issue

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Government of U.S. Department of State)	
11-35	A	0	0	0	0	Chapter11Table.xls - Waste tab: it is not clear where the lower end of the ranges of mitigation in cells G10 & H10 is coming from. If this is from the Monni et al study, it is not clear from Table 10.6 on page 27 of Chapter 10. U.S. Government (Government of U.S. Department of State)	Ch 10 issue
11-36	A	0	0	0	0	Chapter11Table.xls - Waste tab: it is not clear where range of mitigation in cells I8 & J8 is coming from. If this is from the Monni et al study, it is not clear from Table 10.6 on page 27 of Chapter 10. U.S. Government (Government of U.S. Department of State)	Ch 10 issue
11-37	A	0	0	0	0	Chapter11Table.xls - Waste tab: cells I4 & J4 both indicate <$20 - are they mislabeled? U.S. Government (Government of U.S. Department of State)	Ch 10 issue
11-38	A	0	0	0	0	Chapter11Table.xls - Waste tab: cells C8 & D8 - looks like projections from Monni et al are the only ones considered for this table. Other sources should be included, such as U.S. EPA's Global Mitigation of Non-CO2 GHGs, 2006, http://www.epa.gov/nonco2/econinv/international.html. U.S. Government (Government of U.S. Department of State)	Ch 10 issue
11-39	A	0	0	0	0	Chapter 5 contains only a brief discussion of the costs of the GHG reduction in that sector (pps. 92-95). These costs may be used in Chapter 11. Chapter 11 needs to provide more specifics regarding the estimates of economic potential for GHG reduction in the transportation sector for the estimates to be credible. U.S. Government (Government of U.S. Department of State)	Table 11.3 is a summary of estimates from chapters 4 to 10. Table 11.8 provides estimates from the top-down models on transport mitigation potentials at different ranges of carbon prices.
11-40	A	0	0	0	0	A recent workshop on climate change and technological innovation should be included in the references and discussion if possible. Some but not all of the papers may be included in the chapter, but I'd recommend checking that this is the case. Here's the link to the agenda with embedded links to pdf files from each of the presenters: http://cepa.maxwell.syr.edu/pages/87/cd-contents.pdf#search=%22wilcoxen%20technological%20change%22 U.S. Government (Government of U.S. Department of State)	Noted. Thank you.
11-41	A	0	0	0	0	Sometimes underlying tone of the chapter sounds prescriptive. (Joyashree Roy, Jadavpur University)	Noted. This is not intended.
11-42	A	1	1	0	0	Most of the cost and potential estimates in this chapter have not been through expert review. Doesn't that violate IPCC procedures? (Richard Tol, Economic and Social Research Institute)	Noted. Many of the estimates are syntheses of estimates reported in earlier chapters, themselves base on the underlying literature. Each chapter estimates are based on expert

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
							judgments.
11-1	B	4	0	0	0	It should be made clear in the Executive Summary that the entire discussion of mitigation from a cross-sectoral perspective is premised upon the operation of a carbon price. (Government of Australia)	Noted. Some of the literature covered is not specific about the carbon prices that would make the option feasible (e.g. those in 11.2.3). However the point is taken and the insertion of "at different carbon prices" will be included in the first sentence of the Executive Summary.
11-43	A	4	5	7	0	The mitigation aspects of land use sectors are inadequately addressed, even the dominant biofuel or bioenergy is inadequately addressed. Land use sectors are critical for developing countries. (Government of India)	See response to comment 11.18
11-44	A	4	16	0	0	Negative cost options should be in the baseline. See also line 35. (Richard Tol, Economic and Social Research Institute)	REJ. This assumes that the baseline is one in which first-best conditions of general equilibrium theory apply. Since they do not, opportunities will exist for improvements, hence for negative cost options for mitigation policy.
11-45	A	4	16	4	17	It is not completely clear why some mitigation options are available with positive payoff at market costs, i.e., why the private sector is not acting to take advantage. Is this a timing issue, or one where information is incomplete? Or is it because private actors are not willing to accept the social cost of carbon? A comment about the reasons for the existence of these options should be made. (,)	Accepted. The issue was extensively covered in the TAR, but some explanation of the substantial scale of the negative cost options in Table 11.3 should be given, with references to chapter 2 and the TAR.
11-46	A	4	16	4	17	It is not completely clear why some mitigation options are available with positive payoff at market costs, i.e., why the private sector is not acting to take advantage. Is this a timing issue, or one where information is incomplete? Or is it because private actors are not willing to accept the social cost of carbon? A comment about the reasons for the existence of these options should be made. U.S. Government (Government of U.S. Department of State)	See 11.45
11-47	A	4	17	4	17	"…… especially those involving metahne capture".. Must also mention" energy efficiency " which is a already prefered pathway for many developing countries (chapter 7 referes those) and where enormous potential also exist. (Joyashree Roy, Jadavpur University)	Accepted. Replace "methane capture" by "energy efficiency" in line 17.
11-48	A	4	24	4	30	The chapter's focus is supposed to be on solutions across sectors and nationwide measures up to 2030 with some further viewing up to 2050. The as yet quite speculative and probably long term geo-engineering options (if ever) do not belong	Rejected. Chapter 11 is expected to cover geo-engineering options even although they may only become important after 2030.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						to the focal area of chapter 11 and consequently can be dropped from the executive summary. (Government of Finland)	
11-49	A	4	25	0	0	What is meant by the term 'uncosted'? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	TIA. Uncosted literally means that the option have been explored as technically possible, but without any estimates made of how much they might cost.
11-50	A	4	25	4	26	Deep ocean storage as a geo-engineering option has recieved more attention than either of the options identified and should be mentioned in this sentence (Cliff Law, National Institute for Water And Atmosphere (NIWA))	REJ. Deep ocean storage is discussed in 4.3.6 and so has not been treated as a cross-sectoral option
11-51	A	4	25	4	26	This sentence is somewhat negative in tone. A better approach would be "There are geo-engineering options to remove CO2 directly from the air, e.g., by ocean fertilization or by blocking sunlight through greater cloud formation. Little is known about the effectiveness or costs of these methods, however, nor their potential side effects." (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC. The suggested re-wording raises the word count from 27 to 40, but some rewording will be done.
11-52	A	4	25	4	26	This sentence is somewhat negative in tone. A better approach would be "There are geo-engineering options to remove CO2 directly from the air, e.g., by ocean fertilization or by blocking sunlight through greater cloud formation. Little is known about the effectiveness or costs of these methods, however, nor their potential side effects." U.S. Government (Government of U.S. Department of State)	See 11.52
11-53	A	4	33	0	0	What discount rate is used in calculating the costs? (add as footnote?) (Ann Gardiner, AEA Technology)	Noted. The discount rates used are discussed in the Appendix on the synthesis on costs and potentials.
11-2	B	4	33	4	33	The authors should explain what was meant in the TAR by "substantial" opportunities, if "substantial" can be quantified it should be. (Government of Australia)	The scale of the opportunities at costs less than 20 US$/tCO2 eq. is given in the next sentence at 10Gt CO2-eq. The total CO2 emissions in 2000 is about 30 GtCO2, so it is substantial in relation to current emissions.
11-54	A	4	34	0	0	It is not immediately clear what the 20-27 US$/tCO2 refers, is this the average cost of multi-year savings, capital cost, etc? (Chris Mottershead, BP)	Noted. The cost estimates are explained in detail later in the chapter.
11-55	A	4	43	4	48	When looking at the background information in chapter 11 the executive summary, on page 4, does not represent a fair summary of the carbon leakage issue. The attitude seems to be that carbon leakage is not significant. This is not true and by saying so the executive summary of chapter 11 represents a biased version of	Noted. Quantitative estimates of the leakage rate since the TAR are not covered in the Executive Summary. An additional summary will be considered. The UNICE rates quoted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						results mentioned on p. 73 in chapter 11. There are surveys referenced in chapter 11 of a carbon leakage up to 40 percent in the EU. Reference could also be made to a study made by COWI for UNICE (Competitiveness and EU Climate Change Policy, octobre 2004), which estimates an impact of about 20 % carbon leakage already by 2010 in the EU (Study included in the email). (Helle Juhler-Kristoffersen, Confederation of Danish Industries)	are similar to other findings using CGE models and do not especially add to the literature.
11-56	A	4	43	4	48	The background information in chapter 11 the executive summary, on page 4, does not represent a fair summary of the carbon leakage issue. The attitude seems to be that carbon leakage is not significant. This is not true and by saying so the executive summary of chapter 11 represents a biased version of results mentioned on p. 73 in chapter 11. There are surveys referenced in chapter 11 of a carbon leakage up to 40 percent in the EU. Reference could also be made to a study made by COWI for UNICE (Competitiveness and EU Climate Change Policy, October 2004), which estimates an impact of about 20 % carbon leakage already by 2010 in the EU. (,)	See 11.55
11-57	A	4	43	4	48	The background information in chapter 11 the executive summary, on page 4, does not represent a fair summary of the carbon leakage issue. The attitude seems to be that carbon leakage is not significant. This is not true and by saying so the executive summary of chapter 11 represents a biased version of results mentioned on p. 73 in chapter 11. There are surveys referenced in chapter 11 of a carbon leakage up to 40 percent in the EU. Reference could also be made to a study made by COWI for UNICE (Competitiveness and EU Climate Change Policy, October 2004), which estimates an impact of about 20 % carbon leakage already by 2010 in the EU. (Jean-Yves CANEILL, EDF)	See 11.55
11-58	A	4	43	4	48	"It is very likely that…..US$/tCO2 eq.". Bio-energy or biofuels which dominate the mitigation potential should be mentioned. (Government of India)	ACC. Bioenergy to be added on line 46.
11-59	A	4	50	0	0	"the gap has largely gone" this is wishful thinking -- the sheer fact that bottom-up models still produce negative cost nonsense shows that the gap is still there -- the fact that some top-down modellers without much of a track record have been busy massaging their results with incorrectly specified learning-by-doing is not proof of anything except that some people are willing publish bad science (Richard Tol, Economic and Social Research Institute)	REJ. The text is reporting on the fact that with these estimates the gap has gone.
11-60	A	4	50	0	0	There seems to be a word missing in this sentence (..has largely gone _down_?) (Kristin Aunan, Center for International Climate and Environmental Research -	ACC. Will be reworded.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						Oslo (CICERO))	
11-3	B	5	11	5	11	Delete "without the United States and Australia", as this specification is unnecessary. The sentence is not purporting to be a complete fully detailed storyline on international activities. (Government of Australia)	REJ. This is a statement of fact, which is relevant to the estimates of the costs of Kyoto.
11-61	A	5	17	5	17	Add "Effects on international competitiveness from policies to achieve targets similar to those of the Kyoto Protocol are very small". See 11.7.4 page 75, line 13 to 18. (Government of Germany)	ACC. A sentence will be added.
11-62	A	5	19	5	30	Add the word "global" to line 21 so that it reads: "of stable and predictable global carBn prices" The bulk of the relevant studies look at a global context, or at least multiple countries, so it is appropriate to add the word global to this sentence. This would also make this sentence consistent with the following sentences in this paragraph that look at gloval concentrations. (Russell Jones, API)	ACC.
11-63	A	5	21	0	0	This is not what top-down models conclude. $100/tC is sufficient for substantial action ONLY IF policy implementation is cost-effective, that is, full where, when and what flexibility. Absent that, carbon prices would be much higher. See e.g. Pearce (2006, Energy Economics) on a comparison between idealised and real climate policy. (Richard Tol, Economic and Social Research Institute)	ACC. The sentence will be changed to start "Top-down cost-effective assessments …"
11-64	A	5	36	0	0	The estimate of 0.8% of GDP is meaningless without a date. (Richard Tol, Economic and Social Research Institute)	Noted. The paragraph is about effects to 2030. However, "by 2030" will be added on line 36 to remove any ambiguity.
11-65	A	5	36	0	0	I assume this is cumulative loss of GDP? (Chris Mottershead, BP)	See 11.64
11-66	A	5	45	6	5	This characterisation is wrong, as I pointed out in my comments on a previous draft. I do not understand why that comment was ignored. Induced technological change only reduces costs if there are no opportunity costs to energy R&D. If there are, for instance because there is a finite number of engineers, induced technological change may well increase the costs of emission reduction compared to a situation without induced technological change. See the works of Goulder, Smulders, van Zon. (Richard Tol, Economic and Social Research Institute)	REJ. The text is describing the literature. ITC through LBD reduces the costs in the model applications reviewed. A shortage of engineering is a short-run problem, which is not relevant over a 20 year time horizon.
11-67	A	6	0	6	0	One aspect is missing here to cover the full cause effect chain: temperature <- concentrations <- global emissions <- regional emissions (missing). Chapter 13 has	Noted. It is not clear that these links should be explained here.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						some values on the regional emission levels necessary to meet the stabilization goals. This could be included here. (Government of European Community / European Commission)	
11-4	B	6	2	6	25	Again, final sentence unclear and not self-evident. (Government of Australia)	ACC. Sentence will be reworked.
11-68	A	6	5	0	0	There is no reason to assume that climate policy would increase energy security, e.g., domestic coal. (Richard Tol, Economic and Social Research Institute)	REJ. This is not assumed in the sentence.
11-69	A	6	5	6	6	Co-benefits are benefits; they do not reduce costs. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC. Sentence will be reworded to replace "reduce" by „offset".
11-70	A	6	7	6	13	The criticism towards top-down models is insufficiently specific, whereas the implications of the alleged weaknesses with respect to the assessment of technological development is kind of implied but not discussed. Presumably the text refers to global CGE models, which is only a subset of all CGE models used for climate policy assessment. Country models and even some multi-country models have often much more detail regarding energy use and sometimes have also dynamic features e.g. allowing for the (approximate) inclusion of learning effects (e.g. Dellink R. and Hofkes M., (2006) The Timing of National Greenhouse Gas Emission Reductions in the Presence of Other Environmental Policies, FEEM Working Papers with number 2006.17) (Government of Finland)	Noted. The text refers to those models used in the ITC literature. This could be made explicit by starting the paragraph: "However, many of these top-down models…". However, this text will be cut.
11-71	A	6	8	0	0	Why are top-down models singled out as stylised? Most bottom-up models have a very stylised representations of markets, if any. (Richard Tol, Economic and Social Research Institute)	See 11.70
11-72	A	6	8	6	13	Paragraph with statements on top down models sounds extremely biased especially for an executive summary. It may be rephrased as " Top down models need to be reworked to include uncertainties, muliplicities in policy instruments , market failure, spill over benefits from investment etc." (Joyashree Roy, Jadavpur University)	See 11.70
11-5	B	6	10	6	13	Final sentence is opaque. Explain the 'one policy instrument'. Two market failures are presumably additional to that. Are the two 'instruments' in line 13 about market failures or something else? (Government of Australia)	ACC. The one instrument included is usually carbon tax or auctioned emission permits. This instrument addresses the climate change externality. In theory the spillover benefits from private investment should be addressed by a policy instrument such as general incentives for innovation. However, the text is to be cut.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-73	A	6	18	6	20	The sentence ("However some….may crowd out other R&D.") is unclear. Yes, there is an issue of crowding out, but what R&D is being crowded out by government promoted "low-carbon R&D"? If the R&D being crowded out has nothing to do with energy use and GHG emissions, then why would the government promoted low-carbon R&D have a "negligible" impact. If "low-carbon" R&D is crowding out other GHG related R&D, then that would have an impact, but it is not clear here and should be clarified. (Russell Jones, API)	ACC. The chapter text makes it clear that the assumptions about which R&D is crowded out and to what extent are crucial in the effects reported by the models. The text will be clarified.
11-6	B	6	18	6	20	Second sentence does not seem self-evident. (Government of Australia)	See 11-73
11-74	A	6	23	6	25	needs the addition of "if well designed" ie "…through carbon taxes or cap and trade schemes are introduced, if well designed, the markets will reward cost-effective…." Things like the longevity and perceived political stability of the scheme are key to whether the 'market' will invest against it for the medium term. A reference from the market on this is Standard & Poors, the rating agency, in its report "Climate Change Credit Survey: A Study of Emissions Trading, Nuclear Power, and Renewable Energy", [November 2005, online] contains a subheading 'Uncertainty delays investment' in a commentary on EU Climate Change Policy looking at the electricity generation sector (page 7) and the impact of EU ETS post-2012 uncertainties . (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	ACC.
11-75	A	6	24	6	25	Please clarify the sentence "Even so….longer term". I do not understand what is means in the context of the whole section. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC. The sentence is referring to lock-in, and this will be made explicit.
11-76	A	6	24	6	25	Delete from "Even so..." to "longer term" since there is no evidence for this statement in the chapter. (Government of Germany)	REJ. Lock-in is discussed in 11.6 .
11-77	A	6	44	0	46	How can you conclude that something is substantial but has yet to be quantified? (Richard Tol, Economic and Social Research Institute)	ACC. Replace “is” by “may be”.
11-78	A	7	5	7	9	as per comments to other chapters (e.g. Chapter 4, page 94, and with references Ch1, line 17), WGIII needs to take a consistent approach on energy security and high [current] oil prices, as well as impact on oil prices from mitigation policy. High oil prices at present, for example, are impacting oil importing developing countries [references provided above, IEA, ESMAP for example]. Therefore if prices remain high [e.g. check revised price assumptions in IEA's 2006 World Energy Outlook, it would be important to state the impact on importing countries as well. This is also relevant to page 74, lines 35 to 41), and section 11.7.5.1 starting	TIA. This is a statement about modeling studies.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						on page 76. (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	
11-79	A	7	7	0	0	A well-known effect of falling energy prices is increasing energy intensity, counteracting what you just concluded about positive spillovers. (Richard Tol, Economic and Social Research Institute)	Noted. The spill-over effect being discussed reduces the effect of the original mitigation action.
11-80	A	7	7	7	9	The analysis of the impact on oil; producers doe s not refer to "peak oil"- a serious omission, because that factor will maintain oil prices at high levels. (Andrew Dlugolecki, University of East Anglia)	Noted. The effects of oil prices on mitigation is an important topic to be addressed in chapter 1 and chapter 11. However, the report will not be assessing the literature on oil prices per se.
11-81	A	7	7	7	9	Please explain the reasoning. Is it because oil revenue is often a large source of income (large share of GDP) for oil-exporting countries? U.S. Government (Government of U.S. Department of State)	ACC. Yes, oil output is often a very large share of total output in oil exporting countries.
11-82	A	7	15	0	0	Policies are at least as important as technologies and sectors. (Richard Tol, Economic and Social Research Institute)	ACC. Policies will be included in the sentence.
11-83	A	7	18	0	0	Again, you confuse policy and baseline. If these things were profitable, they would happen in the absence of climate policy. If climate policy is used to bring about other environmental improvements, it is bound to do so in an ineffective and expensive way. See for instance the work of Tinbergen. (Richard Tol, Economic and Social Research Institute)	REJ. Opportunities exist for secondary benefits from mitigation policies because not all environmental damages are addressed by other policies in the baseline.
11-84	A	7	23	7	24	Insert “for cost estimates” after implications” and delete “on their estimates of costs” (Danny Harvey, University of Toronto)	Unclear. This text is not here.
11-85	A	7	26	7	27	It is not clear why piecemeal regulatory treatment of individual pollutants would lead to stranded investments in equipment. It could lead to less regulation of climate than would be socially desirable, however. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Noted.
11-86	A	7	26	7	27	This would hold only if synergy between local and global pollution control were present, but that need not be the case according to the earlier sentences in this paragraph. Need to qualify this sentence. U.S. Government (Government of U.S. Department of State)	Noted. However the sentence does not assert that this need be the case.
11-87	A	7	26	7	27	It is not clear why piecemeal regulatory treatment of individual pollutants would lead to stranded investments in equipment. It could lead to less regulation of climate than would be socially desirable, however. U.S. Government (Government of U.S. Department of State)	See 11-85
11-88	A	7	27	0	0	Comma after “3” (Danny Harvey, University of Toronto)	Unclear – no “3” in line 27

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-89	A	7	30	7	36	A weak paragraph which accurately reflects the inadequate treatment of A&M overlap in the chapter. See Chapter 18, WGII, and Winkler et al. 2006 reference on A&M capacity from Chapter 12. U.S. Government (Government of U.S. Department of State)	Noted.
11-7	B	7	31	7	31	Replace comma with a fullstop. (Government of Australia)	ACC.
11-90	A	7	40	9	10	This introductory chapter fails to clearly introduce and define cross-sectoral, as distinct from and complementary to sectoral. In fact several viewpoints are introduced throughout section 11.1. Similarly a reader who is not a specialist in distinguishing and understanding the conceptual difference between a measure in the sense of a policy instrument and a measure in the sense of an actual improvement in machinery or operational procedures may be easily mislead by parallel uses of both notions. The following text suggestion could be placed somewhere in the beginning of section 11.1, while editing preceding and following patches of text and linking it to the discussion in sections 11.2.2 and 11.3.1. "The previous chapters 4-10 dealt with options for greenhouse gas abatement in selected sectors. This chapter aims to synthesize that information into overall abatement potentials. However sectoral potential estimates cannot straightaway be aggregated into overall potential estimates. Therefore we take in this chapter a so-called cross-sectoral perspective. Cross-sectoral can refer to two types of effects. First, the measures in one sector can affect the feasible potential of other sectors. For example, wide applications of fundamental innovations in building construction regarding energy use, materials, location & orientation and neighbourhood & urban structure have significant implications for the volume and structure of energy supply for heating, power & light, and transportation. A second kind of cross-sectoral effect is the application of particular technologies in various sectors, such lighting. For example, learning curve effects may be underestimated in a single sector setting in comparison to a market analysis that takes application in all sectors into account. Apart from these cross-sectoral effects the synthesis of the sectoral potentials into an overall potential could be taken one step further by assessing induced effects across all sectors as well as labour and capital markets by means of macro-economic models. The latter kind of assessments may affect overall abatement potential estimates relatively mildly, but it can have significant impact on the overall ordering of measures in terms of cost-effectiveness and welfare effects of alternative packages." (Government of Finland)	ACC. The suggested text will be edited and included in the Introduction to describe better the purpose of the chapter.
11-91	A	7	48	7	48	From "mitigation" hang a footnote to read "In this Chapter 'mitigation' or 'emissions	REJ. This is a definition that should be in

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						reductions' should be understood as net reductions in emissions, i.e. emissions reductions plus absorption increases that are the total outcome of mitigating activities" (Peter Read, Massey University)	Chapters 1 and/or 2.
11-92	A	7	48	7	48	Report does not emphasize sectoral approach only. It is broader than that. Delete sentence, or reword. U.S. Government (Government of U.S. Department of State)	See 11.90
11-93	A	7	48	7	48	Policies need not only be formulated by government. Reword to include industry, and interactive (partnership) activities. U.S. Government (Government of U.S. Department of State)	ACC. Will be reworked.
11-94	A	8	5	0	0	Can delete “below” (Danny Harvey, University of Toronto)	ACC
11-95	A	8	12	8	12	If "barriers" are important enough to be highlighted in the Executive Summary, then they are important enough to identify. Either specify the barriers or delete the reference to "barriers." (Russell Jones, API)	REJ. The text is emphasizing the policies to reduce barriers are in the portfolio available.
11-96	A	8	20	8	20	Add "References to costs in this older literature, and to much of the subsequent literature summarised below relate to oil prices that predate the increases of 2005 and 2006, and related increases in the prices of othe fossil fuels. This means that, in the short and medium term, the cost of measures that provide alternative fuels, particularly transportation fuels, is generally over-estimated in the literature (Peter Read, Massey University)	ACC. This is a general point about the effects of oil prices on the mitigation potentials that will be addressed in chapter 1.
11-97	A	8	21	8	32	I think the paper by Montgomery and Smith (referenced in Chapter 2 of SOD) is highly relevant to the discussion of induced technical change (ITC). The Montgomery and Smith (M&S) paper demonstrates an important “dynamic” (or time) inconsistency in the ITC theory. The failure of Ch 11 to cite the M&S paper and include in its References is a major oversight. (Christopher Green, McGill University)	ACC. Reference will be reviewed and included.
11-98	A	8	21	8	32	The paper by Montgomery and Smith (referenced in Chapter 2 of SOD) is highly relevant to the discussion of induced technical change (ITC). The Montgomery and Smith (M&S) paper demonstrates an important “dynamic” (or time) inconsistency in the ITC theory. The M&S paper should be cited in Ch 11 and also should be added to its the References. U.S. Government (Government of U.S. Department of State)	See 11.97
11-99	A	8	26	0	0	Please add: At the same time, theortical work that includes the opportunities costs of research suggest that these models are misspecified, overestimate the benefits of R&D and may even have the sign of the estimated cost change wrong.	REJ. The literature reviewed covers the opportunity costs of R&D, and the suggested conclusions hold.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Richard Tol, Economic and Social Research Institute)	
11-100	A	8	26	0	0	ETC may or may not lower costs. The IMCP studies are but a few in many. Note that some of the IMCP results suffer from miscalibration. In the Hedenus/Azar paper, for instance, the baseline is the same, regardless of whether technology is endogenous or exogenous -- changing the representation of technology requires recalibration of the model -- if not, the comparison is meaningless. The Sano et al. study suffers from the same problem, and also the Edenhofer study speaks of "the" baseline scenario. Popp's paper is silent on this matter, but ITC is not very important anyway in this model. Crassous is peculiar: The ETC and no-ETC versions of the baseline are forced to be identical, which can only imply that there are so many degrees of freedom in the model that there are no results, only assumptions. (Richard Tol, Economic and Social Research Institute)	ACC. If models include ETC, they may or may not show reductions in costs, depending on the parameters and functional forms. However, the studies reviewed all show reductions in costs for higher carbon prices, so the text as written is correct.
11-101	A	8	31	8	31	Recommend adding "waste tips" as a synomym to "landfills" [in definition in glossary]. (Jean Bogner, Landfills +, Inc)	ACC. However, this is a matter for the Glossary.
11-102	A	8	32	8	32	add "(4) The issue of precautionary measures to address potential abrupt climate change has received attention and led to the development of a strategy that treats greenhouse gases as an excess stock problem rather than a flow pollution problem". (Peter Read, Massey University)	REJ. We need to have reviewed some literature on this topic to include this statement.
11-103	A	9	2	9	2	How/Why were stabilizations of 450 to 550 ppmv chosen? U.S. Government (Government of U.S. Department of State)	Noted. These were the stabilization levels in the literature reviewed.
11-104	A	9	4	9	4	What does “limited” mean here? Is it accurate to state that it can “only” be achieved with additional government policies? U.S. Government (Government of U.S. Department of State)	UNCLEAR – no line 4.
11-105	A	9	20	10	7	Section 11.2.1. This is an island section with no landing in other parts. Further it seems not to fit in the paragraph that supposed to deal with technologies and not with policies. The section that deals with cross-sectoral policies is in need of a description of what is cross-sectoral and what is purely sectoral so maybe this part can be moved to that section in slightly revised form, otherwise, please delete. (Government of European Community / European Commission)	1) The discussion on “policies” has been deleted—in large measure this is addressed in CH 13
11-106	A	9	20	22	10	Merge sections 11.2.1-11.2.2 with 11.3, while skipping 11.2.3 or moving that (in reduced size) to the end of 11.6. (Government of Finland)	3) The opening sections have been shortened and refocused
11-107	A	9	20	9	0	Much if not all of section 11.2.1.1 and Table 11.1 should be moved to Chapter 13. U.S. Government (Government of U.S. Department of State)	1) The table has been deleted, policies are discussed in CH 13

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-108	A	9	30	10	5	It may be useful to draw a distinction between government funds that are used for R&D at "national labs" and government funds that are used to promote R&D but through the private sector. That distinction is missing from Table 11.1. (Russell Jones, API)	3) The table has been deleted, policies are covered in CH 13
11-8	B	9	30	10	5	The authors should explain why they have not listed domestic taxes on emissions or on energy as examples of market based instruments. (Government of Australia)	3) The table has been deleted, policies are covered in CH 13
11-109	A	9	31	0	0	The meaning of the expression: “Exceptions possible” in Table 11.1 is not clear. (Mikiko Kainuma, National Institute for Environmental Studies)	3) The table has been deleted, policies are covered in CH 13
11-110	A	9	31	0	0	Policy and measures listed in Table 11.1 are related to those addressed in Chapter 13. Instruments listed in Chapter 13 are regulations and standards, emission taxes and charges, tradable permits, voluntary agreements, phasing out subsidies and providing financial incentives, research and development and information instruments. Table 11.1 could be rearranged based on the information in Chapter 13. Not only measures but also feasibilities could be assessed in Table 11 from the view points of environmental effectiveness, cost effectiveness, distributional effects (including equity) and political feasibility. (Mikiko Kainuma, National Institute for Environmental Studies)	3) The table has been deleted, policies are covered in CH 13
11-111	A	9	36	0	0	Table 11.1: What's the difference between 'Tradable permits/quotas' and 'Domestic emissions trading'? (what's the difference between these instruments, justifying separate recording/) (Jos Sijm, Energy research Centre of the Netherlands (ECN))	3) The table has been deleted, policies are covered in CH 13
11-112	A	10	3	0	0	Table 11.1: What does DSM stand for: Demand Side Management? (please use full expression rather than abbreviation). Is DSM an information instrument or does it stand for a variety of (other) instruments? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	3) The table has been deleted, policies are covered in CH 13
11-113	A	10	16	11	0	Section 11.2.2. "Cross-sectoral Technological Options". The technique of comment 1, CCOS, possibly should be mentioned in this section also. It has many of the same cross-sectoral characteristics as CCS, which is referred to on line 6 of page 11. (Martin Lawrence, Earth & Ocean Carbon Ltd)	1) See 11-120: Text will reference IPCC Special Report on Carbon Capture and Storage (Chapter 6) in which these and other options are discussed
11-114	A	10	31	10	42	There are other technological developments outside the energy sector besides IT that may affect the technological development in the energy sector, such as nano-technology. So, a more generic consideration of these intersectoral technology development interactions (via products and processes) would be appropriate. Furthermore, note that e.g. developments for IT not necessarily imply an enhancement of energy productivity. Progress in IT can in any sector: (1) improve	3) add at end of paragraph: Of course, the net impact of IT on greenhouse gas emissions could result either in net reductions or gains depending, for example on whether or not efficiency gains were offset by compensating increases in production.

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						input efficiency (thanks to increased precision); (2) improve output efficiency (e.g. more processes can run simultaneously). No.1 will mostly be positive for mitigation policy, but no.2 might enable higher throughput and therefore work against mitigation. (Government of Finland)	
11-115	A	11	11	0	0	Or hydrogen fueled internal combustion engines. See comments on chapter 5. U.S. Government (Government of U.S. Department of State)	1) add: at end of sentence: or directly in combustion engines
11-116	A	11	26	11	30	A reference without a date is used for temporarily information, are there other literature sources for the same information with a date? (Government of European Community / European Commission)	Reference Sources corrected.
11-117	A	11	33	11	35	"Comment. From my point of view, the phrase: -Implementation of the fuel cells in stationary applications could provide valuable learning for vehicle application and could also be the basis for the hydrogen production and CCS implementation that would be needed use by other sectors.- could be integrated in this way: Implementation of the fuel cells in stationary applications could provide valuable learning for vehicle application and could also be the basis for the hydrogen production and CCS implementation that would be needed use by other sectors and, in a longer perspective, it could be possible to use Fuel Cell Vehicles (FCV) as a new power-generation source, supplying electricity to homes and to the grid like a new different type of Distributed Generation, especially at peak times (Vehicle-to-Grid – V2G). This innovative use of FCV could be able to reduce the costs related to the introduction of the new products, and will represent a huge amount of new installed peak power generation capacity. References: 1) EPRI – S. Gehl: Generation Technology Choices: Near and Long Term. U.S. DoE EIA Annual Energy Outlook Conference. Washington DC, 2004. Available on the Web at <http://www.eia.doe.gov/oiaf/archive/aeo04/conf/pdf/gehl.pdf >, Page 15. 2) California Air Resources Board: Vehicle-to-Grid Power: Battery, Hybrid, and Fuel Cell Vehicles as Resources for Distributed Electric Power in California. California Environmental Protection Agency 2001. Available on the Web at <http://www.udel.edu/V2G/V2G-Cal-2001.pdf >. 3) W. Kempton, J. Tomi: Vehicle-to-grid power fundamentals: Calculating capacity and net revenue. Journal of Power Sources 144 (2005) 268–279. Available on the Web at <http://www.udel.edu/V2G/KempTom-V2G-Fundamentals05.PDF >. 4) V. Romeri: Hydrogen: a new possible bridge between mobility and distributed	3) Add: If broadly implemented the utilization of electric power from H2 fuel cells in vehicles could become a factor in consideration of delivering distributed electric power in non-transport applications. (Romeri reference included)

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						generation (CHP). 19th World Energy Congress. Sydney 2004. Available on the Web at <http://www.worldenergy.org/wec-geis/congress/papers/romeriv0904.pdf >." (Mario Valentino Romeri, none - private Italian citizen)	
11-118	A	11	36	11	41	Your statement is negatively formulated. Since when do energy supply options to be capable of covering full global energy demand? The reason is mainly restricted by investment costs to the year 2030. On the longer term it MIGHT be possible under certain conditions. If you look at Chapter 8 where a figure of 400 EJ is mentioned in the year 2050 biomass energy might at least contribute to a large share. (Government of European Community / European Commission)	1) proposed re-write of paragraph to account for several comments: Biomass is an example of a cross-sectoral technology in which there is the potential for competition for resources. Any assessment of the use of biomass, e.g., as a source of transportation fuels, needs to consider competing demands from other sectors for the creation and utilization of biomass resources. In particular, Section 4.5.3 indicates that the technical capability and land availability today for biomass fuels falls far short of meeting projected global demand for energy. With technical breakthroughs biomass could make a larger future contribution to world energy needs. Such breakthroughs could also stimulate the investments required to improve biomass productivity for fuel, food and fiber. Re-wording reduced in length and forward reference made to new biomass text in 11.3.1.
11-119	A	11	41	11	41	Add "although there is also potential for synergy rather than conflict, with energy consumers being the ultimate source of capital inputs that raise soil productivity to co-produce both fuel and food or fibre" (Peter Read, Massey University)	1) see 11-118, as revised above.
11-120	A	11	50	12	0	Section 11.2.3 "Ocean Fertilization and Other Geo-engineering Options". The current discussion should (and currently does not) describe the technique of carbon capture and ocean storage (CCOS) using enhanced carbonate dissolution. A description of this promising technique is available on-line at www.netl.doe.gov/publications/proceedings/01/carbon_seq/p24.pdf. A refereed paper dealing with this technique is Caldeira, K., and GH Rau, 2000: Accelerating carbonate dissolution to sequester carbon dioxide in the ocean: Geochemical implications. Geophysical Research Letters 27(2) pp. 225-228. I suggest that you	1) Add at end of P12 line 9: The IPCC Special Report on Carbon Capture and Storage (Chapter 6) discusses a variety of approaches to sequester CO2 in oceans. Some of these options have many elements in common with ocean geoengineering.

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						add the following text to from a new paragraph at the end of Section 11.2.3.2, i.e. immediately following line 50 of page 12. "Another technique of carbon capture and ocean storage (CCOS) that is being explored is to utilize enhanced carbonate dissolution (Caldeira and Rau, 2000). The essence of the technique is to take power plant flue gases and pass them through sea water and react the resulting carbonic acid with a carbonate mineral such as limestone. This technique speeds up a natural process that would otherwise take many centuries to capture the carbon. For this reason the ecological impacts might be expected to be less than for other ocean storage techniques." (Martin Lawrence, Earth & Ocean Carbon Ltd)	
11-121	A	11	50	11	35	Geo-engineering options can be included in AR4 report, but I don't see well why it is talked about in this chapter. They do not seem to be cross-sectral issues but one of the technological options like carbon sequestration. This part should be moved to Chapter 3 or Chapter 4. Agriculture sector is another possibility like forestation. If this topic remains, the authors should clarify to what extent geo-engineering technologies relate to other sectors. (Shunsuke Mori, Tokyo University of Science)	2) It was explicitly part of our assignment based on the agreed organization of WG3 Report
11-122	A	11	50	13	35	This section is very descriptive as a textbook. What could these technologies contribute on the longer term? Are they a real option? When can they be expected? How big is their potential? How do you define geo-engineering options? Can you distill consistent messages from the literature on the potential interest? If literature is weak, also please mention (Government of European Community / European Commission)	1) TIA: The text and the Executive summary make it clear that these are speculative and largely uncosted options.
11-123	A	11	50	13	35	skip this part or present it at the end of 11.6 but in condensed form as a kind of side remark about extra sectoral activities, that might be relevant in the very long run but are still speculative (Government of Finland)	2) It was explicitly part of our assignment based on the agreed organization of WG3 Report
11-9	B	11	50	13	35	Section 11.2.3 Ocean Fertilisation and Geoengineering Options. This section seems inadequate to describe the storage of carbon in the ocean, as it focuses only on iron fertilisation. Ocean storage was given more prominence in TAR and since and in the period 2001-2005 there has been considerable published work. The authors should note the relevant treatment of this subject in the IPCC Special Report on Carbon Capture and Storage (2005), including on non-technological aspects like the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter. (See for example, Google Scholar search <ocean storage> and carbon). (Government of Australia)	2) see 11-120

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11-124	A	12	5	12	6	Suggest that this first sentence be removed. There appears no connection to geo-engineering as written. (Haroon Kheshgi, ExxonMobil Research and Engineering Company)	1) will be deleted
11-125	A	12	6	12	7	This statement gives the impression that there was not a literature prior to the TAR. The TAR gives a more extensive review of the literature than is given here. Suggest replacing "a literature has developed on alternative," with "there have been further contributions to the literature on". Also suggest considering the recent issue of Climatic Change and the paper by Crutzen (2006, vol. 77, issue 3-4, pages 211-220). (Haroon Kheshgi, ExxonMobil Research and Engineering Company)	1) Since the TAR, there have been further contributions to the literature on geo-engineering techniques for mitigating climate change.
11-126	A	12	6	0	0	Insert "at sufficiently low levels" after "stabilization" (Danny Harvey, University of Toronto)	2) Entire sentence has been deleted
11-127	A	12	13	12	36	My comments are relatively minor, as my previous comments were added to the original text in this section. This section perhaps requires further formatting though, as there is some repetition. To address this I suggest removal of the two sentences starting on Line 15 with " Several pilot experiments....." and ending with ".....viability of this strategy" on Line 18. The word "pilot" is misleading, as this implies that these experiments were tests for artificially stimulating ocean carbon sequestration, when in fact they were undertaken to understand controls of biological production in certain water masses. The Buessler & Boyd (2003) reference should be retained by inserting it after ".....two experiments to date." on Line 25. (Cliff Law, National Institute for Water And Atmosphere (NIWA))	1) ACC
11-128	A	12	13	12	14	This sentence seems to optimistic corresponding with the rest of the section. (Government of European Community / European Commission)	1) Section needs a summary statement regarding potential, barriers, issues. Will be reworded
11-129	A	12	15	12	15	Include this point: 'A matter of concern is the lack of legal framework to require an international assessment of the responsabilities, risks and benefits of such fertilization projects (Schiermeier, 2003, Nature 421: 109-110.)' (Government of Spain)	3) Situation needs to be clarified as to whether or not there are existing legal frameworks (local, national, international) to authorize practice of fertilization projects. Sentence included at start of 11.2.2
11-10	B	12	21	12	22	Delete 'deliberate carbon sequestration as not being the driver behind these studies'. This statement is neither necessary nor true. Boyd et al (2004) in their abstract say '… also for proposed geoengineering schemes to increase oceanic carbon sequestration'. (Government of Australia)	1) deleted
11-130	A	12	25	0	0	Should be "depleted"	1)ACC

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Danny Harvey, University of Toronto)	
11-131	A	12	27	12	28	Following on from "….largely recycled back to CO2" add "in the upper water column" (Cliff Law, National Institute for Water And Atmosphere (NIWA))	1)ACC
11-132	A	12	27	12	29	If efficiencies are to be quoted, then the term should be defined, and the magnitude stated. I suspect that this is export efficiency, and not energy efficiency as is commonly used in this document. Is 30% high or low, and can it be improved? Otherwise the reader will have no idea what such an efficiency means. (Haroon Kheshgi, ExxonMobil Research and Engineering Company)	1) REJ: use of terms is clear to a non-engineer.
11-133	A	12	29	12	29	Add "the actual" in this sentence to read "This suggests that current estimates of THE ACTUAL carbon sequestered per unit iron……" (Cliff Law, National Institute for Water And Atmosphere (NIWA))	3) ACC
11-134	A	12	29	12	30	If a judgement is to be given about "current estimates", then a reference should be given to those estimates, and perhaps the estimates should be quoted. I suspect that there is more than one estimate of cost and this judgement may not be applicable to all cost estimates. (Haroon Kheshgi, ExxonMobil Research and Engineering Company)	1)ACC text clarified
11-135	A	12	35	12	36	"None of these impacts have been directly identified in experiments to date, PARTLY due to time and space constraints" (Cliff Law, National Institute for Water And Atmosphere (NIWA))	1)ACC
11-11	B	12	37	12	37	The authors should consider addressing: "Macronutrient enrichment of the ocean". While iron fertilisation will only stimulate phytoplankton in 30% of the ocean, the remaining portions of the ocean can be stimulated by providing an additional suite of nutrients. Nitrogen is the nutrient required in the largest amount and a number of experiments have shown that natural assemblages of phytoplankton can respond to additions of macronutrients alone. The issues are discussed in Jones (2004) and modelling by Matear and Elliott (2001) show Maximum sequestration efficiencies of 90%. Shoji and Jones (2001) suggested the cost of sequestration might be in the range $5-15 of tonne of carbon sequestered. Like iron fertilising, the extra marine protein produced by macronutrient enrichment might make Ocean Nourishment a no regrets option. [Matear and Elliott (2001) Enhancement of oceanic uptake of anthropogenic CO2 by macro-nutrient fertilisation, In ed D Williams et al., Greenhouse Gas Control Technologies CSIRO, Melbourne.451-456, 2001, ISBN 0643066721] [Jones, I S F (2004) 78. The Enhancement of Marine Productivity for Climate Stabilization and Food Security Chapter, Handbook of Microalgal Culture, ed A. Richmond, Blackwell, Oxford.[[Shoji, K and I S F Jones (2001) The costing of carbon credits from ocean nourishment plants. The Science of the Total	ACC: Unfortunately we have no space for an extended treatment, but the main reference given here is included.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						Environment, 277, 27-31.] (Government of Australia)	
11-136	A	12	38	12	50	Please add 11.2.3.2 following sentence. In Japan, the artificial marine structures are constructed to generate the up welling for increasing nutrient supply to the shallow layer. This system simulates the growth of phytoplankton and thereby sequestering the CO2 in the form of organic carbon. Magi et al. (2005) estimated net organic production over the year to be 470gC m-2 yr-1 using 1300 mgC m-2 day-1. Reference: Greenhouse Gas Control Technology, Vol.1, 791-799 (2005) (Government of Japan)	No space for extended treatment.
11-137	A	12	38	0	0	In Section 11.2.3.2, studies that evaluate the potential benefits and costs of these mitigation options should be reported, e.g., Crutzen, P. 2006 Climatic Change. U.S. Government (Government of U.S. Department of State)	1) Crutzen has been taken into account.
11-138	A	13	10	13	16	This is a totally absurd idea and does not merit serious consideration, and certainly not in an IPCC report. To illustrate, Teller is proposing to place a 1 million km2 deflector IN ORBIT, while an elementary back-of-the-envelope calculation indicates that a mere 66,000 km2 of solar collectors (which could be a mix of PV and solar thermal power generation) on the Earth's surface (0.55% of the world's desert area) would be sufficient to generate on amount of power equal to the present total world electricity production of about 15 TWh/yr. Even allowing that some of the energy would have to be converted to hydrogen and back, with losses, due to time/space mismatches between supply and demand, we are talking about 1/10 the area of collector to largely solve the problem (in conjunction with end-use efficiency measures in all sectors, appropriate urban panning, and use of other readily-available renewable energy resources) compared to the deflector area needed to merely treat one of the symptoms of the broader set of problems associated with fossil fuel use. However, the other ideas are equally absurd (and I do not mean to imply that you are endorsing them), so I guess they all stay – but at least put the first idea in perspective by making the comparison given above. (Danny Harvey, University of Toronto)	2) part of our mandate
11-139	A	13	21	13	21	This approach has been discussed in more detail in two recent papers:- 1. Cicerone, R.J. (2006). Geoengineering: encouraging research and overseeing implementation. Climatic Change 77: 221-226. 2. Crutzen, P.J. (2006). Albedo enhancement by stratospheric sulfur injections: a	1) ACC and incorporated

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						contribution to resolve a policy dilemma? Climatic Change 77: 211-219. (Cliff Law, National Institute for Water And Atmosphere (NIWA))	
11-140	A	13	35	0	0	Another impact that needs to be considered is the reduction in the amount of photosynthetically active radiation (PAR) at the Earth's surface due to schemes that involve reflecting some portion of the sun's energy. Inasmuch as about a 2% reduction in solar energy (4.8 W/m2 forcing) is required to offset a CO2 doubling (and so even more as CO2 and other GHG concentrations increase), and that global net photosynthesis on land is about 60 Gt C/yr, there could be a reduction in C uptake of about 1.2 Gt C/yr (compared to the current fossil fuel emission of 6.5 Gt C/yr)– a rather substantial offset. Please mention this as well. (Danny Harvey, University of Toronto)	3) add after p 13, line 30. These approaches require assessments of a range of potential environmental impacts that could occur as side effects.
11-141	A	13	35	0	0	Acidification of the oceans is not a risk, it is a geochemical certainty if any significant fraction of the recoverable fossil fuel resource is used. An even more serious certain effect is the reduction in the degree of supersaturation of surface waters with respect to calcium carbonate – the structural component of coral reeds and of much of the plankton at the base of the marine food chain. Freezing emissions at 17 Gt C/yr (about 2.5 times present emissions), for example, would decrease the supersaturation from 4.8 times saturation to 2.6 times saturation in non-polar regions, and from about 2.8 times saturation to 1.28 times saturation in polar regions according to calculations by Harvey (2006a). This is almost certain to have severe ecological impacts (Orr et al., 2005), and possibly also significantly impact the carbon and sulphur cycles with all sorts of long term (10s to 100s of thousands of years) ramifications for the entire Earth System. Thus – it is should be more forcefully pointed out – a change in global climate is only ONE of the impacts of increasing CO2. The other major impact is a change in ocean chemistry (pH and saturation state), which none of the proposed engineering "fixes" address at all. REFERENCES: Harvey, L.D.D.: 2006a, 'Plausible resolution of uncertainties in global-warming science has no near-term practical implications for climate policy', Climate Policy (submitted) Orr, J.C. et al. 2005. Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. Nature 437, 681-686. (Danny Harvey, University of Toronto)	1) add: … agriculture and forestry. However, they do not mitigate or address other impacts such as increasing ocean acidification.
11-142	A	14	0	28	0	None of the discussion of mitigation potential (pp. 14 - 28) belongs in an IPCC	

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						Assessment Report. What is included in the draft does not assess, summarize, or even refer to studies that derive quantitative estimates of mitigation potential as defined in the chapter. Instead, it presents original research performed by some of the authors, that combines data developed in disparate studies into one overall estimate of the amount of mitigation that is possible at a stated cost. It is not appropriate to include original research in a report that is designed to be an assessment of research already peer-reviewed and published. Calculations of mitigation potential are only possible through application of a model that specifies relationships between mitigation actions in different sectors, develops an explicit baseline, accounts for scarce resources required by mitigation actions, and makes consistent assumptions about costs and performance of present and future technologies. There is an implicit model behind the original calculations presented in the chapter, but it is so simplistic and leaves out so many critical factors in estimating a marginal abatement cost curve that the results would not be accepted for publication in any reputable journal. I would be embarrassed as a chapter author to take responsibility for such flawed and naïve analysis in a report designed to be an assessment of the best research available. To be more specific, the derivation of mitigation potentials amounts to use of a very primitive model of the interactions between actions to reduce emissions in different sectors. This model consists of the set of mitigation estimates from the other chapters, a methodology, and set of assumptions which get all wrapped up in a spreadsheet (Chapter11table.xls). Analyzing these interactions explicitly is the purview of both energy systems models and computable general equilibrium models – which, for example, account for the resources and energy supplies required to carry out specific mitigation actions. The section simply assumes that there are no interactions. It likewise appears to assume that the same amount of mitigation be achieved at a given cost no matter what baseline emissions pathway is chosen – which clearly cannot be the case because the technologies assumed as mitigation measures may already be adopted in the baseline. Moreover, there is no demonstration that the estimated mitigation potentials have been evaluated properly with respect to either of the two baselines used for this analysis. The mitigation estimates in the draft apparently do not take account of the technological changes already embedded in the SRES B2 and WEO 2004 reference scenarios against which the mitigation estimates were made. Creating a marginal abatement cost curve taking even these obvious factors into account requires a model, so that derivation of marginal abatement costs or mitigation potentials cannot be a conclusion of a meta-analysis such as AR4.	REJ: The summaries of various studies is within IPCC scope; methodological frameworks to do so are in the literature. All issues are explicitly discussed in the cross-cutting group on costs and potential, and possible subsequent process to further elaborate on the still existing shortcomings . The section is intended to draw together and summarise the assessment of chapters 4 to 10. The main interactions between sectors have been identified and gaps and overlaps considered. The text acknowledges the difficulties and qualifications, but the exercise is merely synthesising and providing uncertainty ranges for results in studies in the literature, which are covering detail, either not represented at all in the models, or done so in a very aggregated manner. The methodology can be compared with that of top-down modelling. The interactions represented in many CGE studies reported in AR4, for example through average input-output coefficients for 1997 from GTAP, are rigid and stylized and do not allow for long-term technological changes over time or interactions between different technologies applying across sectors. The dependence of the estimates on the baseline is recognized and allowed for.

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						Marginal abatement costs or mitigation potential must therefore be derived from studies with specific models. The chapter could legitimately discuss mitigation potential if it provided a survey of published estimates of marginal abatement costs and mitigation potential, and tried to reconcile the assumptions and conclusions of those studies. No citation is given to any published study that does what this section attempts. As it stands, this discussion either elevates one model to that status of pronouncing on all others, or it is using some implicit model that is clearly deficient in that it ignores all interactions and includes unstated assumptions about first set of issues. (David Montgomery, CRA International)	
11-143	A	14	25	14	27	Define "ocean fertilization". Also, the sentence seems too speculative to be meaningful. U.S. Government (Government of U.S. Department of State)	TIA. Ocean fertilization is defined in 11.2.2.1.
11-144	A	14	26	14	42	In this section it would be good to explain that economic potential estimates of one sector are quite different from those of multi-sector estimates. Single sector estimates can refrain from interaction effects and purely focus of technical-economic feasiblity of various technical (and non-technical) measures. In a multi-sector approach induced effects via markets have to be taken into account and hence often other kind of models are rquired. In ideal circumstances the sector specific simulations and the wider multi-sector simulations are considered together (recursively). (Government of Finland)	For dealing with the aggregation issue, see 142.
11-145	A	14	26	14	26	The statement in the headline statement is either incorrect or misleading. It should be deleted. A number of options exist to provide policy incentives equivalent to carbon pricing. The second sentence, which is clear, factually correct and policy-neutral, should be substituted as the bold 'headline' sentence. U.S. Government (Government of U.S. Department of State)	Comment on wrong place. It appears to relate to the SPM. In any case section 11.3.1 have been extensively re-written.
11-146	A	14	46	14	50	Footnote 4: this is a duplicate with footnote 6 and where can I find the "guidance document on Costs and Potentials? Is that literature? (Government of European Community / European Commission)	ACC. Source for IPCC internal use: delete footnote.
11-147	A	15	5	15	6	Change "incentive regimes" to "economic potential for GHG mitigation expressed in $/tCO2-eq." and delete the phrase in the parentheses. The term "incentive regimes" implies that implementing a policy to create this cost of carbon would result in the indicated amount of mitigation. However, private actors would have to make most of the necessary investments. They do not include non-market costs or benefits in their calculations, nor in most cases are they willing to accept the low discount rates used to calculate economic potential. As a result it is highly unlikely	REJ. Sentence clearly indicates that economic potentials are derived, and is also clear about the various $/tCO2-eq. range for which it has been done.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						that the mitigation potentials indicated by this analysis would be achieved. Since the assumption used in calculating "economic potential" have been carefully defined, there is no problem presenting the results. However, these results should always be labeled "economic potential." Use of different terminology is an invitation to misinterpretation. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
11-148	A	15	5	15	6	Change "incentive regimes" to "economic potential for GHG mitigation expressed in $/tCO2-eq." and delete the phrase in the parentheses. The term "incentive regimes" implies that implementing a policy to create this cost of carbon would result in the indicated amount of mitigation. However, private actors would have to make most of the necessary investments. They do not include non-market costs or benefits in their calculations, nor in most cases are they willing to accept the low discount rates used to calculate economic potential. As a result it is highly unlikely that the mitigation potentials indicated by this analysis would be achieved. Since the assumption used in calculating "economic potential" have been carefully defined, there is no problem presenting the results. However, these results should always be labeled "economic potential." Use of different terminology is an invitation to misinterpretation. U.S. Government (Government of U.S. Department of State)	See 147.
11-149	A	15	8	15	32	Whether all chapters make use of the same baseline is not mentioned. The baseline is of higher importance for the assessment of the potentials (Government of European Community / European Commission)	ACC. See also response to 142.
11-150	A	15	25	15	26	Do you mean double counting between potentials? (Government of European Community / European Commission)	Yes. The word 'double counting' is not mentioned in line 25-26. The issue is now explained in 11.3.1
11-151	A	15	35	16	15	Rephrase. "The impact of the Kyoto Protocol on global emissions in its first commitment period is likely to be limited and…" Setting the institutions and the process in motion may have a bigger effect on emissions after 2012. (Government of European Community / European Commission)	Comment on wrong place. Text appears to be re-written.
11-152	A	15	46	15	46	Be specific on which sectors. U.S. Government (Government of U.S. Department of State)	ACC. See also response to 142.
11-153	A	15	49	15	50	Footnote 5: please include in main text instead of footnote (Government of European Community / European Commission)	ACC. text has been re-written and regional BU estimates provided.
11-154	A	16	16	16	44	Another coverage issue is the estimation of mitigation potential for non-CO2 gases. This is adequately covered in Chapter 7-9, but not in chapter 5, 6, and 10. Chapter 5 (Pg. 10, line 24 – Pg. 11, line 10) indicates that F-gases account for 4-12% of total CO2-eq emissions from the transport sector in the EU, Japan and the U.S., but the	See response to 142.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						chapter does not discuss mitigation potential or cost for these emissions. The text also discusses non-GHG impacts of aircraft, but mitigation potential and cost for these impacts may be beyond the scope of this report. Chapter 6 indicates F-gas emissions of 1.5 GtCO2-eq/yr. from the building sector, but does not estimate mitigation cost or potential. The chapter indicates that mitigation of these emissions is discussed in the IPCC Special Report on F-Gases. However, this report only considers mitigation to 2015. Finally, Chapter 10, Pg. 22, line 31-34, implies that technology is available to "reduce or eliminate" N2O emissions from wastewater systems, but does not indicate mitigation potential or cost. Finally, Chapter 10, Pg. 28, lines 1-45, discusses F-gas emissions from the waste management sectors, but does not discuss emission rates or mitigation potential or costs. In total, these emissions represent a significant fraction of total GHG emissions, and their mitigation could make a significant contribution on a stabilization pathway. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
11-155	A	16	16	16	44	The estimation of mitigation potential for non-CO2 gases is adequately covered in Chapter 7-9, but not in chapter 5, 6, and 10. Chapter 5 (Pg. 10, line 24 – Pg. 11, line 10) indicates that F-gases account for 4-12% of total CO2-eq emissions from the transport sector in the EU, Japan and the U.S., but the chapter does not discuss mitigation potential or cost for these emissions. The text also discusses non-GHG impacts of aircraft, but mitigation potential and cost for these impacts may be beyond the scope of this report. Chapter 6 indicates F-gas emissions of 1.5 GtCO2-eq/yr. from the building sector, but does not estimate mitigation cost or potential. The chapter indicates that mitigation of these emissions is discussed in the IPCC Special Report on F-Gases. However, this report only considers mitigation to 2015. Finally, Chapter 10, Pg. 22, line 31-34, implies that technology is available to "reduce or eliminate" N2O emissions from wastewater systems, but does not indicate mitigation potential or cost. Finally, Chapter 10, Pg. 28, lines 1-45, discusses F-gas emissions from the waste management sectors, but does not discuss emission rates or mitigation potential or costs. In total, these emissions represent a significant fraction of total GHG emissions, and their mitigation could make a significant contribution on a stabilization pathway. U.S. Government (Government of U.S. Department of State)	See 154.
11-156	A	16	25	16	28	What about the industrial and transport sector. Should these sectors not be mentioned under energy end-use sectors? (Government of European Community / European Commission)	REJ. These sectors still generate products/services for end use.
11-157	A	16	36	16	44	(The "coverage" issue) and Table 11.2 (Synthesis): How are non-road engines and equipment (e.g., forklifts, construction equipment, tractors, small generators, airport	See response to 142.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						equipment, lawn and garden equipment, chainsaws, marine pleasurecraft, mining equipment, etc.) treated? In the U.S. air pollution regulation arena, these are considered to be "mobile sources" and are treated as a single category with several subdivisions based on the similarity of engine types and uses. In principle, these sources could be distributed among several categories (energy supply – generators & mining equipment; transportation – marine vessels; agriculture – farm equipment; forestry – chainsaws; foklifts and construction equipment – industry), but from a policy perspective, there may be advantages to considering them as a group. It is also important to ensure that they aren't omitted from these sectors. U.S. Government (Government of U.S. Department of State)	
11-158	A	16	41	16	44	This sentence suggest that for the transport sector extrapolated data have been used, but that does not appear from Table 11.3. If data from transport sector are extrapolated this is important to note! (Government of European Community / European Commission)	ACC. This needs to be sorted out; see also response to 142.
11-159	A	16	41	16	44	Need to provide more specifics of the exact procedure that was used. U.S. Government (Government of U.S. Department of State)	See response to 158.
11-160	A	16	48	17	9	ICT options seem not to be described in sectoral chapters as a separate mitigation option. It seems from this part that that is a missed change. Are there sufficient concrete numbers to include options like this is the separate options and so also in Table 11.3?? (Government of European Community / European Commission)	REJ. Table 11.3 is organized according to sectors, not technologies. ICT affects sectors indirectly mainly in building, transport and industry.
11-12	B	16	52	16	52	The authors need to provide a definition of "ICT". (Government of Australia)	ACC.
11-161	A	17	22	17	31	This would hold true if sector growth were not to offset efficiency improvement. Except for the industrial sector in OECD countries, historically, sector growth appears to more than offset efficiency gains in other sectors. Need to separate discussion between historical observations, and future baseline and mitigation cases. U.S. Government (Government of U.S. Department of State)	ACC. Text will be replaced accordingly. New tables added to compare with TAR and baselines.
11-162	A	17	37	17	0	Need to explain why the SRES B2 and WEO 2004 were selected for this analysis. U.S. Government (Government of U.S. Department of State)	ACC. Some explanation will be provided in text.
11-13	B	17	39	17	39	The authors need to provide an explanation as to why the SRES B2 scenario was used instead of other baselines. (Government of Australia)	See 162.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-163	A	17	41	17	44	It is unclear whether the comment in the baseline assuming substantially lower energy prices than in later projections refers to B2 or WEO 2004. The text needs to be explicit about which scenario it is discussing. Also, since the comment refers to only one of the two scenarios used as baselines, what energy price assumption is made in the other baseline scenario? (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC. Refer to both B2 and WEO: will be clarified in text.
11-164	A	17	41	17	46	Sentence starts at " one important…." do you refer to WEO or also to B2 scenario? If it is the case for only one of the two scenarios, the comparability is probably not so good. (Government of European Community / European Commission)	See response to 163.
11-165	A	17	41	17	44	It is unclear whether the comment in the baseline assuming substantially lower energy prices than in later projections refers to B2 or WEO 2004. The text needs to be explicit about which scenario it is discussing. Also, since the comment refers to only one of the two scenarios used as baselines, what energy price assumption is made in the other baseline scenario? U.S. Government (Government of U.S. Department of State)	See response to 163.
11-166	A	18	0	18	0	Missing Price et al, 2006 in the references. U.S. Government (Government of U.S. Department of State)	ACC. Will be included.
11-167	A	18	10	21	15	The estimation procedure in the Section 11.3.1.5 is interesting and valuable. However, one question is whether this procedure has appeared in the peer-reviewed article according to the IPCC report rule. At least, there is no reference on the procedure and results. The reviewer strongly recommends this process and results should be published (or be included) as an academic paper if this is the original work of writing team. (Shunsuke Mori, Tokyo University of Science)	Noted. See response to 142. A similar procedure was followed in the TAR chapter 3. The AR4 team considered that the synthesis procedures are part of the literature assessment.
11-168	A	18	10	18	0	Table 11.2 - Explain how cogeneration is addressed. It is not obvious how it is addressed in this table. U.S. Government (Government of U.S. Department of State)	Table 11.2 removed
11-169	A	18	11	0	0	Table 11.2 could be an interesting table if more elements are added. For example, in transport, increase of electric vehicles could increase the need of electricity. Use of fuel-cell vehicles could change the electricity demands. Distributed electricity generation by solar PV in the buildings can change the centralized electricity demand. These could be in Table 11.2 (Mikiko Kainuma, National Institute for Environmental Studies)	Table 11.2 removed
11-170	A	18	12	0	0	Table 11.2, bottom line: what is meant by 'LFG recovery'? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Table 11.2 removed
11-171	A	18	12	18	0	Table 11.2 needs to be revised to include more detailed information or be deleted.	Table 11.2 removed

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						U.S. Government (Government of U.S. Department of State)	
11-172	A	18	19	18	20	Price et al, 2006 is not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	See response to 166.
11-173	A	18	20	21	14	This section attempts to construct a table that provides useful information by aggregating data across sectors. In order to make the estimates credible, it is important to ensure that the procedure used is transparent. For each sector, it would be useful if the chapter could provide the numbers and methodology that were used for the aggregation process. It does this for electricity but would be useful to have a section for each sector with a description of the calculations rather than the material provided in the footnote to Table 11.3. U.S. Government (Government of U.S. Department of State)	See response to 142.
11-174	A	19	1	0	0	Table 11-3 --- Many of my "General Comments" are related to information summarized in Table 11-3 (which is reproduced as SPM 2 and TS-19), based on information from chapters 4-10. Please see those comments. (Christopher Green, McGill University)	See response to general comments.
11-175	A	19	2	19	3	The meaning of the statement that "intermittent renewable electricity was assumed to reduce generation from fossil fuels" is not clear to me. Reduce relative to what? Also, if the intermittent energy is sent directly to the grid (not taken from storage) then beyond a negligible amount it will have to be backed up by spinning reserve. (Christopher Green, McGill University)	REJ. The sentence explains what assumptions have been used. Reduction is relative to a case in which no intermittent renewable power would have been sent to the grid.
11-176	A	19	2	19	0	Table 11.3. Estimates of Mitigation Costs and Potentials: We have serious reservations about the validity and comparability of the underlying estimates from Chapters 4 to 10, which are presented in Tables11.3, because there is no demonstration that the estimated mitigation potentials have been evaluated properly with respect to the two baselines used for this analysis. The mitigation estimates in the SOD apparently do not take account of the technological changes already embedded in the SRES B2 and WEO 2004 reference scenarios against which the mitigation estimates were made. The estimates of mitigation costs and potentials from Chapters 4 to 10 lack transparency and robustness. It is unclear whether these estimates come from the assessed literature or should be considered new research for each chapter. The aggregation of mitigation potentials in Table 11.3 is seriously flawed, and the authors should consider deleting the table unless these shortcomings can be solved. The aggregation appears to be new analysis, not an assessment. It attempts to aggregate completely different sectoral estimates, which is unsound. These cannot be simply added up for a global mitigation potential since they do not include	See response to 142.RE will need to review the response later; cannot give green light at this point. Suggestion taken into account. 11.3.1 has been extensively re-written and the concerns expressed in this comment have been addressed as far as practicable, with caveats inserted at many points in the explanation. The value of the exercise was considered at length by the cross-cutting group on costs and potentials, and it was decided to include a synthesis, with full detail to make the procedures transparent. The aggregation, allowing for all the problems of double counting and

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						regional and cross-market economic effects. A proper assessment of the mitigation potential from a cross-sectoral perspective requires a fully consistent modeling framework using a common baseline that takes into account economic interactions between sectors. Both bottom-up and top-down analyses are an important part of the literature and both should be reflected. Chapters 4-10 should, at the very least, present the sectoral estimates from top-down models. A more appropriate approach for Chapters 4-10 would be to present both the global and bottom up estimates at the regional level (leaving global estimates to global models) and then discuss the differences in estimates, the strengths and weaknesses of the alternative approaches, and key priorities for improving estimates. This same comparison between the top-down and bottom-up estimates should be made within each sectoral discussion. The following table provides an example. Sector TS-8 Range of Model Results TS-19 Estimate Comment Forestry 0-604 2,700 Why is TS-19 so much higher? Is this a limitation of IAMs? Energy Supply & 6,500-16,000 5,200-8,100 Why is the TS-19 estimate lower than most Transportation standard models? Agriculture 604-1,656 3,300 Why is the TS-19 estimate so much higher? Buildings 627-2,238 3,700-4,100 Why is the TS-19 estimate so much higher? Our specific comments on Chapters 4 to 11 detail these and other concerns and offer a recommendation on an appropriate comparison of the bottom-up estimates from Chapters 4 to 10 and the top-down estimates from integrated models in Chapters 3 and 11. U.S. Government (Government of U.S. Department of State)	consistency is only intended to be indicative and suggestive. It should also be recognized that top-down models also have their limitations see DeCanio, S.J., 2003: *Economic Models of Climate Change: A Critique.* Palgrave MacMillan, New York, 203pp. It was impossible for the chapter teams to include top-down literature at this stage in the process. They have focused on the detailed energy-engineering literature. However, the chapter 11 text comparing TD and BU results has been improved and some reconciliation between estimates made.
11-177	A	19	7	19	0	The meaning of the statement "intermittent renewable electricity was assumed to reduce generation from fossil fuels" is not clear. Reduce relative to what? Also, if the intermittent energy is sent directly to the grid (not taken from storage) then beyond a negligible amount it will have to be backed up by spinning reserve. U.S.	See response to 175.

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						Government (Government of U.S. Department of State)	
11-14	B	19	15	19	15	The authors should explain what "intermittent" technologies are. (Government of Australia)	ACC.
11-178	A	19	20	20	0	Table 11.3 Same as Table SPM.2 The baseline for the waste sector is not SRES B2. Need to add explantory note indicating that the baseline for the waste sector was a BAU projection using the 2006 UNFCCC inventory guidelines and the historical rate of increase in landfill gas recovery for energy use; also need to ref.Monni et al. (2006)--see full reference in Chapter 10. (Jean Bogner, Landfills +, Inc)	ACC. Will be included in text.
11-179	A	19	20	20	25	This table highlights uncertainty in reduction potential at different costs. The "Low" global total is 18.2 Gt while the sum of the "<0" and "0-20" categories is 10.7 Gt, a very large percentage difference. This should be noted in Table 11.3 by adding a row for each sector that cummulates the total of the different cost categories. The fact that the cumulative global total for all sectors for the Hi/Low category is 25 Gt and the total for the cumulative cost categories is 18.6 Bt should be noted in the text. (Russell Jones, API)	See response to 142.
11-180	A	19	20	19	21	It is unclear how the estimate of mitigation potential in Table 11.3 for the transport was developed. The notes (Pg. 20, line 17-18) indicate that they are the potentials for light duty vehicles, biofuels and aviation only, but a sum for these factors is not shown in either Chapter 5 or 11. Chapter 11, Pg. 16, lines 36-42, referring to the transport sector, states "… some crude extrapolation is required for overall coverage.", but does not explain the basis or process for extrapolation. Finally, Table 5.17, is a summary of CO2 mitigation potential in the transport sector from several studies, but none estimate the 28.3% reduction indicated in this table. Table 5.17 provides cost estimates for specific technologies, but not for the global total. There are cost estimates for an unspecified amount of mitigation in LDVs, which indicate that the cost will be below $100/tCO2 if oil price is somewhat above $40/Bbl. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC. Covered in adjustment of table 11.3.
11-181	A	19	20	0	0	If the potential is calculated compared to the emissions of the BaU cases (the SRES B2 and IEA baselines) in Table 11.3, it is not clear why there are no regrets potential. Does it mean that baseline cases are not market optimal? No-regret potential in building sector is large (also quoted in Page 60, Line 44). It is better to clarify the definition of reduction potential. The table also gives an impression that the precision differs sector by sector. Non-OECD total in buildings is 1350, not	REJ. Definition of no regrets potential discussed in chapter 3. Some explanation is given in the revised text.

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						1400 in Table 11.3? (Mikiko Kainuma, National Institute for Environmental Studies)	
11-182	A	19	20	20	26	Table 11.3. would it be possible to present the results also in bar charts? This is more visible as this table is very large. (Government of European Community / European Commission)	This is considered by TSU. Bars may, however, imply loss of the notion of uncertainty.
11-183	A	19	20	20	5	Table 11.3 This is a very useful Table that strongly increases the understanding of the magnitude of the emission reduction potentials and were these potentials can be found. It would be useful to also report the reference emission levels in quantitive terms. The origin of the data is difficult to find back and the methodology is only briefly described. Would a graph on the methodology be helpful? (incorporating Table 11.2) (Government of European Community / European Commission)	See response to 142.
11-15	B	19	20	20	25	Table 11.3: There needs to be a more explicit statement of where the significant mitigation potentials lie. For instance it should be explicitly noted that around 3 GtCO2-eq of the potential in the energy sector comes from the use of nuclear power and bioenergy. (Government of Australia)	REJ. Such detail is not available according to reporting format.
11-16	B	19	20	20	25	Table 11.3: The authors need to explain why the SRES B2 scenario was used as the baseline for the table. (Government of Australia)	See 162.
11-17	B	19	20	20	25	Table 11.3: The authors need to ensure that the methodology and the figures reflected in this table are robust, as the table will be a key focus of the WG3 report for policy makers. As such it is critical that the figures used in the table are internally consistent and can be traced to figures presented in the sectoral chapters of the report. It seems that the figures used for the Buildings; Forestry; and Waste sectors are derived outside of the figures presented in those sectoral chapters (for instance the Buildings chapter uses 2020 rather than 2030 to calculate mitigative potential; and the Waste chapter seems to only have a mitigation potential figure for CH4). The authors need to explain these discrepancies and provide information on where each of the figures used in the table can be found in the sectoral chapters (or alternatively detailed information on how the figures have been derived). (Government of Australia)	ACC. To be covered in the subsequent process.
11-18	B	19	20	20	25	Table 11.3: A more clear explanation needs to be included in the text that follows the table, setting out the limitations and high uncertainties inherent in the presented cost estimates. After all, the analysis is attempting to consider the costs of moving to a system with completely different characteristics, not simply an incremental change. Consequently, the costs of the mitigation actions presented in the sectoral	ACC. See response to 11-17.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						chapters could be significantly greater than presented here and the authors should be explicit that the cost figures are only indicative. (Government of Australia)	
11-19	B	19	20	19	25	In first column for 'Energy Supply' 2030 emissions scenario is shown as 'n.a'. Does 'n.a/ mean not applicable or not available? If not applicable, this assumes emissions have been fully attributed to other sectors - can we be sure this has happened in sectoral analysis? If it means not available, there is a major hole in 2030 emissions picture. Issue seems to at least need some explanation in text/footnotes. (Government of Australia)	ACC. Needs to be addressed.
11-184	A	19	21	19	0	It is unclear how the estimate of mitigation potential in Table 11.3 for the transport was developed. The notes (Pg. 20, line 17-18) indicate that they are the potentials for light duty vehicles, biofuels and aviation only, but a sum for these factors is not shown in either Chapter 5 or 11. Chapter 11, Pg. 16, lines 36-42, referring to the transport sector, states "… some crude extrapolation is required for overall coverage.", but does not explain the basis or process for extrapolation. Finally, Table 5.17, is a summary of CO2 mitigation potential in the transport sector from several studies, but none estimate the 28.3% reduction indicated in this table. Table 5.17 provides cost estimates for specific technologies, but not for the global total. There are cost estimates for an unspecified amount of mitigation in LDVs, which indicate that the cost will be below $100/tCO2 if oil price is somewhat above $40/Bbl. U.S. Government (Government of U.S. Department of State)	See response to 180.
11-185	A	20	18	20	18	Delete the sentence "Industry is exclusive of material efficiency improvements, other than through recycling." Table 7.4 (Chapter 7, Pg. 11) lists a number of materials efficiency techniques other than recycling, e.g. the use of blended cements and geopolymers to reduce clinker requirement in the cement industry. The approach used by Chapter 7 estimated mitigation potential by industry, rather than by technology, makes estimating the amount of mitigation potential due to materials efficiency improvements difficult. However, they are included. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC. Sentence to be deleted.
11-186	A	20	18	20	0	Table 11.3 - Forestry potentials were estimated in the IPCC LULUCF 2000 by region and major option. These could be included or at least described in the text if the cost ranges are not available. U.S. Government (Government of U.S. Department of State)	Noted. A range has now been provided by ch 9.
11-187	A	20	18	20	0	Delete the sentence "Industry is exclusive of material efficiency improvements, other than through recycling." Table 7.4 (Chapter 7, Pg. 11) lists a number of materials efficiency techniques other than recycling, e.g. the use of blended	See response to 185.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						cements and geopolymers to reduce clinker requirement in the cement industry. The approach used by Chapter 7 estimated mitigation potential by industry, rather than by technology, makes estimating the amount of mitigation potential due to materials efficiency improvements difficult. However, they are included. U.S. Government (Government of U.S. Department of State)	
11-188	A	21	13	21	14	These lines rely on assumptions that are not readily apparent. They would read better if they said something like: "Based on the cost assumptions, it can be concluded that if various barriers were removed, around 4 GtCO2 could be reduced by 2030 at negative costs, additional to the baseline." (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC. Suggested sentence is clearer.
11-189	A	21	13	21	14	At least in the US, there are significant reductions available for negative and low cost in the LDV market. This opportunity is magnified by the current high fuel prices. The text should note explicitly that the estimates presented here are likely to be conservative in that they don't include available reductions from the transportation sector. U.S. Government (Government of U.S. Department of State)	ACC. Notes added to tableand in text to cover these points.
11-190	A	21	14	21	14	Refer to Table 11.4 (Government of European Community / European Commission)	Point is unclear. Text relates to table 11.3.
11-191	A	21	20	21	23	The final bullet seems to be the most important one, please change order (Government of European Community / European Commission)	ACC.
11-192	A	21	25	21	31	There are some changes compared to the TAR. This leaves us with two main questions: 1. is the methodology comparable with the one used in the TAR? Did TAR also look at difference compared to the baseline? And if so what are the reasons for the main difference. (Government of European Community / European Commission)	REJ. Point covered in last sentence by referring to the text on this in Ch 4-10.
11-193	A	21	27	0	0	Yes, the estimates for industry have been revised downwards substantially. Why? Does it mean the technologies progress less in last 5 years than expected? The reason should be clarified. (Mikiko Kainuma, National Institute for Environmental Studies)	Noted. Explanation now given.
11-194	A	21	28	0	0	The industry potential is not reduced significantly (see Chapter 7) (Ann Gardiner, AEA Technology)	Noted. Explanation now given.
11-195	A	22	5	0	0	For Table 11.4, indicate what the baseline emission is, so that the size of the emission reductions in relative terms can be seen. (Danny Harvey, University of Toronto)	ACC.
11-196	A	22	5	22	10	Table. 11.4 currently has no entries for AR4 for the industrial sector. However, these number can easily be derived form Table 7.8, which specifically shows a	ACC. Discussed in chapter 7 team and text revised.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						mitigation potential of 560 MtCO2-eq. for non-CO2 gases at a price of <$20/tCO2-eq. The mitigation potential for non-CO2 gases was largely insensitive to cost above $20/tCO2-eq. As noted in a comment on Table 11.3, Chapter 7's estimates of mitigation potential in Table 7.8 include materials efficiency, so it is appropriate to compare them with the sum of energy efficiency and materials efficiency from the TAR. Also, there appear to be some anomalies in the table. For example, why is AR4 potential for Buildings at <$20/tCO2 the same as the low end of the range of AR4 at <$100/tCO2? And why is the low end of Waste at <$100/tCO2 below the estimate at <$20/tCO2? (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
11-197	A	22	5	22	10	There appear to be some anomalies in the table. For example, why is AR4 potential for Buildings at <$20/tCO2 the same as the low end of the range of AR4 at <$100/tCO2? And why is the low end of Waste at <$100/tCO2 below the estimate at <$20/tCO2? U.S. Government (Government of U.S. Department of State)	See 11-196
11-198	A	22	5	22	10	Table. 11.4 currently has no entries for AR4 for the industrial sector. T hese number can easily be derived form Table 7.8, which specifically shows a mitigation potential of 560 MtCO2-eq. for non-CO2 gases at a price of <$20/tCO2-eq. The mitigation potential for non-CO2 gases was largely insensitive to cost above $20/tCO2-eq. As noted in a comment on Table 11.3, Chapter 7's estimates of mitigation potential in Table 7.8 includes materials efficiency, so it is appropriate to compare them with the sum of energy efficiency and materials efficiency from the TAR. U.S. Government (Government of U.S. Department of State)	See 11-196
11-199	A	23	5	23	8	Figure 11.1 this figure is not very clear and needs to be reconsidered (Government of European Community / European Commission)	ACC. Some additional explanatory text to be added.
11-200	A	23	8	0	0	Iwafune et al 2001, abc is not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC. Needs to be covered.
11-20	B	23	14	23	16	The authors should provide an assessment as to whether the success of demand side measures in Tokyo can be extrapolated more widely or are unique to Tokyo due to local circumstances. (Government of Australia)	REJ. There is no base for speculation about the degree to which extrapolation of the results is justified.
11-201	A	23	25	0	0	Komiyana et al, 2003 is not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	
11-202	A	23	25	24	7	This is misleading in the way that it gives readers the impression that introducing cogeneration will increase the CO2 emission and the system is not efficient. Any efficient system, how efficient it may be, if compared with no CO2 emitting nuclear	ACC. Add ", albeit unlikely" before "case" in line 32.

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						power, it is obvious that the system in question is seen as increasing CO2 emission. Other means of power generation technologies including CHP substituting nuclear power occurs in peculiar circumstances when nuclear power plants dominates the power supply and introduction of other means of power generation substitutes nuclear. This situation is not the case for most of the countries, if not all, at present time. Even in France where 80% of power comes from nuclear, saving power is encouraged to reduce CO2 emission. (Satoshi Yoshida, The Japan Gas Association)	
11-203	A	23	25	24	7	Komiyama et al. (2003) The paper referred here is a study aimed at understanding the total system CO2 emission regarding introduction of cogeneration. The result of this paper suggests that cogeneration will substitute oil-fired power in the first half and LNG CC and IGCC in the later half of the study period. This paper suggests that the possibility that the diffusion of cogeneration will replace nuclear is slim. Most likely scenario is standard scenario where power generated from cogeneration will replace mostly oil-fired power in the first half of the study period. For the latter half study period, the paper concluded that LNG CC and IGCC would be replaced. Nuclear power will be displaced only in most extreme case scenario which is "unlimited construction of nuclear power plants scenario". Please refer to the original paper for accurate conclusion of this study. (Satoshi Yoshida, The Japan Gas Association)	ACC. Text to be adjusted in order to include the points made.
11-204	A	24	7	0	0	You're dead on when it comes to this issue. You can add: "For a further discussion of these issues and related issues pertaining to trigeneration (the simultaneous production of heat, electricity, and chilled water), see Harvey (2006b)". REFERENCE: Harvey, L.D.D. 2006b. Clean building: Contribution from cogeneration, trigeneration and district energy. Cogeneration and On-Site Power Production, September-October 2006, pp107-115. (Danny Harvey, University of Toronto)	REJ. Information goes beyond the description of the Komiyama et al. paper.
11-205	A	24	9	24	9	This title should read "The Effects of Rising Energy Prices on Mitigation," since that is what the paragraph is about. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC.
11-206	A	24	9	24	9	The title should read "The Effects of Rising Energy Prices on Mitigation," since that is what the paragraph is about. U.S. Government (Government of U.S. Department of State)	ACC.

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11-207	A	24	10	24	25	Clarify what the threshold might be? U.S. Government (Government of U.S. Department of State)	Noted. The thresholds appear to be institutional – related to habitual budget allocation for different energy services such as heat and light, transportation.. Re-written.
11-208	A	24	11	24	25	This part is very technical and the main message is not clear (Government of European Community / European Commission)	Noted. Paragraph adds important element of asymmetry of responses.
11-209	A	24	15	24	25	The reference seems unclear. Need to explain the reasons behind the existence of thresholds. U.S. Government (Government of U.S. Department of State)	REJ. Thresholds are presented as empirical facts.Re-written.
11-210	A	24	24	25	17	This study is currently only described in terms of what was done and a presentation of the results. The reason for mentioning this study is therefore unclear. For this part of the chapter it is important to mention that the main results of the study were that the costs for meeting the KP EU15 wide target would be 0.06% of GDP. These costs would be twice as high if each member state would reach its KP target separately. (Government of European Community / European Commission)	REJ. The reason of mentioning this study is its discussion of cross-sectoral effects. The GDP effects of the KP are discussed in 11.4.
11-211	A	24	26	24	26	Why the year 2025 where further the timeframe 2030 has been used? (Government of European Community / European Commission)	ACC. Delete “to 2025”.
11-212	A	24	26	28	10	Can you find common findings from these studies? Please compare the studies on meeting the KP for instance in one graph. Please compare carbon prices. And how do the carbon prices and mitigation potentials relate to Table 11.3? (Government of European Community / European Commission)	REJ. Such information can be derived from the source cited from which the table has been derived.
11-213	A	24	34	0	0	DG Environment studies are typically not peer-reviewed. In fact, DG Environment is notorious for publishing studies that are politically expedient rather that scientifically sound, and for manipulating results so as to support political positions. This study has no place in an IPCC report. (Richard Tol, Economic and Social Research Institute)	REJ. Official government reports are accepted sources in IPCC.
11-214	A	24	47	25	16	The source for Table 11.5 is given as EU DG Environment, 2001. Surely there is a more recent study than this, especially given all the work done relating to the EU-ETS. (Russell Jones, API)	Noted. Table 11.5 is the best example we could find to show the sectoral and multi-gas implications of KP-type mitigation.
11-215	A	26	17	0	0	Change “be” to “include some of” (Danny Harvey, University of Toronto)	ACC.
11-216	A	26	26	26	27	Move “on GDP, employment and sectoral output” to after “Impact” (,)	ACC. However, the discussion of GDP and employment effects has been moved to 11.4 and 11.8.
11-217	A	26	26	26	29	What do the values in the table represent? Are they 2010 values? Cumulative 10-	ACC. % difference from base added to top of

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						year averages? Also, the text identifies them as percentage reductions, but the table itself does not state any units. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	table.
11-218	A	26	26	26	29	Need to clarify what the values in the table represent. Are they 2010 values? Cumulative 10-year averages? Also, the text identifies them as percentage reductions, but the table itself does not state any units. U.S. Government (Government of U.S. Department of State)	See 217.
11-219	A	26	31	27	6	It appears that a subsidy rebate of a Japanese carbon tax vastly reduces the tax needed and the GDP effects. This raises question as to what the effects of the subsidy scheme alone would be. Is there any information on this? (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Unknown information.
11-220	A	26	31	27	6	It appears that a subsidy rebate of a Japanese carbon tax vastly reduces the tax needed and the GDP effects. Is there any information as to what the effects of the subsidy scheme alone would be. U.S. Government (Government of U.S. Department of State)	See 219.
11-221	A	26	34	26	38	Please indicate the value of 45,000/3,400 Japanes Yen in US$ of Euros. Otherwise, this section is rather meaningless to most readers. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC. To be adjusted.
11-222	A	27	11	27	11	Add: Schumacher and Sands (in press) model the response of greenhouse gas emissions in Germany to various technology and carbon policy assumptions over the next few decades using the SGM Germany model. Accounting for advanced technologies such as coal integrated gasification combined cycle (IGCC), natural gas combinecd cycle (NGCC), carbon dioxide capture and storage (CCS), and wind power they show that emissions reductions can be achieved at substantially lower marginal abatement costs in the long run with new advanced electricity generating technologies in place. In a scenario assuming a carbon price of 50 Euros per ton CO2 they show that with the new and advanced technologies the electricity sector would account for the largest share of emissions reductions (around 50% of total emissions reductions in Germany) by 2020, followed by other (non-energy-intensive industries) and households. Reference: Schumacher, K. and R. Sands (in press). Innovative energy technologies and climate policy in Germany. Energy Policy. (Government of Germany)	ACC. New text added.
11-223	A	27	23	27	24	To accurately reflect the EIA analysis of the NCEP study, add the following to the end of the sentence on lines 223-24: "the overall growth of the economy is "not materially alter" (p.42) although no costs were included for the implementation of the "CAFE" transportation sector portion of the NCEP program that produced most	ACC. However, the discussion of GDP effects is re-located to 11.4

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						of the emission reductions." The importance of the transportation sector reductions is clearly identified in Figure 11.2 (Russell Jones, API)	
11-224	A	28	10	28	15	The "NCEP" and "CAP-Trade" labels in Figure 11.2 should be expanded to read: "NCEP including technology mandates" and "Cap-Trade without technology mandates." (Russell Jones, API)	ACC.
11-225	A	28	24	28	25	EMF MACs look very low, see comments for Chapter 3 (Claudia Kemfert, German Institute for Economic Research)	REJ. Figures are correct
11-21	B	28	24	28	25	EMF MACs look very low, see comments for Chapter 3 (Government of Germany)	see 11-225
11-226	A	28	30	0	0	Note that, according to Grubb, Carraro and Schellnhuber (2006, Energy Journal), the IMCP models fall in three classes: "ITC makes little difference", "ITC impacts insufficient" and "big ITC with backstop" -- you here create a different impression, and should at least add the caveat "in the presence of backstops" with a footnote explaining that a backstop technology has an infinite supply at fixed costs, properties that no real life technology has ever displayed. (Richard Tol, Economic and Social Research Institute)	ACC.
11-227	A	29	6	0	0	Also give the change relative to 2000 emission. (Danny Harvey, University of Toronto)	REJ. Insufficiently relevant addition.
11-228	A	29	7	29	20	Future attempts to summarise and compare potential estimates would probably benefit from using meta-analysis (later mentioned on page 44) which allows for a more systemized comparison of the effects of core input variables and the resulting core output. (Government of Finland)	Issue of aggregation has been clarified.
11-229	A	29	12	0	0	Suppose what is meant is 'gross world product' (not grow...) (Kristin Aunan, Center for International Climate and Environmental Research - Oslo (CICERO))	ACC.
11-230	A	29	20	0	0	In Table 11.8, "top-down models" are equated with "models in the IMCP". Many of the best top-down models stayed out of the IMCP, walked away before the IMCP was finished, or were removed. The IMCP models are not representative of the top-down modelling community, and in fact show a systematic bias towards low emission reduction costs, as you show below. Table 11.8 should be removed or made representative. Note that Edenhofer et al. (2006) count 10 models in the IMCP; why was one removed? Perhaps it is the AIM model which does not seem to include endogenous technological change at all. (Richard Tol, Economic and Social Research Institute)	

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11-231	A	29	20	0	0	Table 11.8: I assume the figure '82000' in column 3, row 'chapter 11' should be 8200? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Yes, accepted.
11-232	A	29	20	29	25	Table 11.8: The table shows sectoral economic potentials for BU and TD models. As IMCP is not focusing on sectoral impacts and there are no results that can be shown, IMCP results should be shown in a separate figure/table. (Claudia Kemfert, German Institute for Economic Research)	IMCP results now replaced by top-down model results;. for results see also table 3.17.
11-233	A	29	20	0	0	I believe that the "82000" near the bottom of Table 11.8 should be "8200" (Danny Harvey, University of Toronto)	ACC.
11-234	A	29	20	29	20	There are no conclusions drawn based on Table 11.8. The figures for the BU buildings sectors seem to be very high compared to TD. WHY? The figures from the TD models on the industry seem high, is there a reason for that? Looking at the numbers for agricultural forestry sector gives the impression that the numbers of the TD models are so low because these sectors are barely included. Could that conclusion be made? (Government of European Community / European Commission)	ACC. The table has been re-drafted to take account this and other points made by reviewers. Anew set of conclusions has been included.
11-235	A	29	20	29	20	Table 11.8 why is there only one figure for TD < 100 $/tCO2? (Government of European Community / European Commission)	see 11-234
11-236	A	29	20	29	0	Where in the report is the detailed basis for each of the estimates for the transportation sector shown in Table 11.8? The details need to be presented to be credible. U.S. Government (Government of U.S. Department of State)	See the underlying chapters for such details on the transport sector.
11-237	A	29	20	29	0	Table 11.8 - What do negative values for agriculture and zero for forestry and waste mean? If there is a carbon price, does a negative value mean that there would be release of more carbon, and a zero value means there is no effect? Need to explain or correct this. U.S. Government (Government of U.S. Department of State)	see 11-234
11-238	A	29	20	29	0	Table 11.8 - It would be useful to separate the sectors into fuels (direct emissions) and electricity (indirect emissions). U.S. Government (Government of U.S. Department of State)	see 11-234
11-239	A	29	20	29	0	Table 11.8 needs to be re-developed as an assessment and comparison of the sectoral mitigation estimates from Chapters 4 through 10 and those in Chapters 3 and 11. This should only be done if and only if the sectoral chapter estimates are deemed to be acceptable by the other chapter committees. The table should be structed in the following way: The "top-Down"<US$20/CO2 column should be dissagregated to sepereate results from two different kinds of models. One for models that have detailed	see 11-234

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						representation of end-use technologies, e.g., AIM, MESSAGE, and MiniCAM, and other models that do not. The same dissagration should be done for the "Top-down" <US$100/CO2 column. This will allow for a comparison of bottom-up estimates with top-down estimates that include end-use mitigation technologies. The proper assessment is to evaluate the already published literature on mitigation estimates derived from consistent modeling approaches that take into account a specific baseline and the corresponding mitigation actions. For example, Chap 3, Sec 3.6 and Chapter 11, Sec 11.4. U.S. Government (Government of U.S. Department of State)	
11-22	B	29	20	29	25	Table 11.8: The table shows sectoral economic potentials for BU and TD models. As IMCP is not focusing on sectoral impacts and there are no results that can be shown, IMCP results should be shown in a separate figure/table. (Government of Germany)	see 11-232
11-240	A	30	9	30	10	Please include the emissions from the baseline in the table. (Government of European Community / European Commission)	ACC.
11-241	A	30	16	30	0	The agricultural sector also appears to offer an exception. U.S. Government (Government of U.S. Department of State)	see 11-234
11-242	A	30	28	0	0	If some numbers in Section 11.3.4.2 are taken from Table 11.3, there are inconsistency (e.g. 800 MtCO2/yr of power generation (Page 30, Line 28) and 1200 MtCO2 of industry (Page 30, Line 43)). (Mikiko Kainuma, National Institute for Environmental Studies)	ACC Revised tables check for consistency.
11-243	A	30	28	30	28	The numbers mentioned in the text e.g. 800 Mt do not always correspond with Table 11.3 (Government of European Community / European Commission)	See 242.
11-244	A	30	33	30	0	Or hydrogen fueled ICE's. Refer to comments on chapter 5. U.S. Government (Government of U.S. Department of State)	ACC.
11-245	A	30	40	30	49	Where do these numbers come from? (Government of European Community / European Commission)	see 11-234
11-246	A	30	40	30	48	Discuss fuels and electricity emissions separately. U.S. Government (Government of U.S. Department of State)	see 11-234
11-247	A	30	50	30	53	The order of the mitigations over time are not mentioned earlier. The IEA 2006 report is not properly referred to, but can this conclusion also be drawn based on the costs figures from table 11.3? Where do the lowest costs occur? This is not discussed earlier but might be discussed in combination to what TD models say about the implementation strategies of mitigation options. Important and policy relevant especially when related to Chapter 13. (Government of European Community / European Commission)	see 11-234

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11-248	A	30	53	0	0	How about hydrogen? Several sentences are found in Chapter 11 that describe about fuel-cell. The sentence 'economics in mitigation scenarios tend to become more electrified (Edmonds et al.) in Page 30 Line 53 appears again in Page 60 Line 37. It may be an important message, but other possibilities also could be reviewed. (Mikiko Kainuma, National Institute for Environmental Studies)	REJ. Duplication of sentence no serious issue because context differs.
11-249	A	31	7	0	0	Again, the IMCP backstop results require a caveat. (Richard Tol, Economic and Social Research Institute)	see 11-232
11-250	A	31	15	31	15	I could not find a discussion of the relative costs of a carbon tax v. a cap & trade carbon rationing approach (possibly with a safety valve). There is a literature on this topic which suggests that a tax approach generally is the more cost effective choice. See, e.g., Pizer, William, "Choosing Price or Quantity Controls for Greenhouse Gases," Climate Issues Brief No. 17, Resources for the Future, Washington DC, July 1999. This topic should be covered in this chapter, whether at this point or elsewhere. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC. Point needs to be included.
11-251	A	31	15	31	15	There is no discussion of the relative costs of a carbon tax v. a cap & trade carbon rationing approach (possibly with a safety valve). There is literature on this topic which suggests that a tax approach generally is the more cost effective choice. See, e.g., Pizer, William, "Choosing Price or Quantity Controls for Greenhouse Gases," Climate Issues Brief No. 17, Resources for the Future, Washington DC, July 1999. This topic should be covered in this chapter, whether at this point or elsewhere. U.S. Government (Government of U.S. Department of State)	See 250.
11-252	A	31	17	37	13	It is important to clarify that the so-called portfolio studies usually employ (top-dwon) models that assess alternative policy incentives, whereas typical cost-contours of abatement alternatives are given (but the movement along the contours depends on other factors in the simulation). In dynamic models which allow for learning also the contours themselves can move. This kind simulations differs essentially from the bottom-up ones discussed in preceding sections. It is worthwhile to elaborate table 11.10 such that also its suitability for particular issues is typified. Thatmtable could however be placed in an annex to chapter 11. (Government of Finland)	Noted. Difference between TD and BU results will be clarified in further process. Tbale 11.10 has been removed.
11-253	A	31	20	31	20	Change "appears" to "might seem" to make it clear that that allocation reductions equally across sections is not necessarily equitable. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC.
11-254	A	31	20	31	20	Change "appears" to and "might seem" to. Need to make it clear that allocation reductions equally across sections is not necessarily equitable. U.S. Government	ACC.

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						(Government of U.S. Department of State)	
11-255	A	32	15	32	25	See also Kemfert, Truong, Kohlhaas and Protsenco (2006):The environmental and economic effects of European emissions trading – with special references to germany in Climate Policy, forthcoming. This paper finds that Germany, Great Britain, and Czech Republic are the main sellers of emissions permits, while Belgium, Denmark, Finland, and Sweden are the main buyers. (Claudia Kemfert, German Institute for Economic Research)	ACC if source is provided.
11-23	B	32	15	32	25	See also Kemfert, Truong, Kohlhaas and Protsenco (2006):The environmental and economic effects of European emissions trading – with special references to germany in Climate Policy, forthcoming. This paper finds that Germany, Great Britain, and Czech Republic are the main sellers of emissions permits, while Belgium, Denmark, Finland, and Sweden are the main buyers. (Government of Germany)	See response to identical point in batch A.
11-256	A	33	5	33	6	I have the strong feeling that something is missing in the sentence "Correspondingly….C$(1995)28.47bn….. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC. Text corrected.
11-24	B	33	18	33	18	Delete "without the United States and Australia", as this specification is unnecessary. (Government of Australia)	Taken into account. The remark "without the United States and Australia" is meant to be relevant for the ensuing comment on modeling, which is now more explicit.
11-257	A	33	25	33	25	Include the model DART into Table 11.4.1 (see papers cited in last comment) (Sonja Peterson, Kiel Institute for the World Economy)	Taken into account. Table 11.10 is being revised to include only models discussed in section 11.4.
11-258	A	33	25	33	30	A further modle is missing in the list: the CGE-IAM model WIAGEM covers also ITC, see Kemfert (2005): Kemfert, C.: Induced Technological Change in a multi-regional, multi- sectoral trade model,- in Special Issue of Ecological Economics, ,2005, Vol 54/2-3 pp 293-305 (Claudia Kemfert, German Institute for Economic Research)	TIA: The table has been removed, although the paper was not discussed in the literature review.
11-25	B	33	25	33	30	A further modle is missing in the list: the CGE-IAM model WIAGEM covers also ITC, see Kemfert (2005): Kemfert, C.: Induced Technological Change in a multi-regional, multi- sectoral trade model,- in Special Issue of Ecological Economics, ,2005, Vol 54/2-3 pp 293-305 (Government of Germany)	See previous, A-258.
11-259	A	33	26	0	0	Heading of Table 11.10: I suppose 'section 11.5' should be 'section 11.4'? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted. Heading should be 11.4.
11-260	A	33	26	0	0	Table 11-10 --- Only two of the models listed indicate a "backstop technology". My guess is that several more assume a carbon-free "backstop". If so, that should be	Taken into account. The characterization of model types was confusing. Section 11.5 has

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						indicated. (Christopher Green, McGill University)	a list of models with more technology details; this section focuses on geographic coverage, which will be reported in the table.
11-261	A	33	26	33	0	Table 11-10 --- Only two of the models listed indicate a "backstop technology"? It appears that several more assume a carbon-free "backstop". If so, these should also be indicated. U.S. Government (Government of U.S. Department of State)	See previous, A-260.
11-262	A	33	26	33	26	Table 11.10: Row SGM Edmonds et al. (2004), add CGE in last column (Government of Germany)	See previous, A-11-260
11-263	A	34	6	0	0	I suppose 'table 11.4.1' should be 'table 11.10, and that 'this chapter' should be 'this section'? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted.
11-264	A	34	29	34	29	It would be more accurate to say "the non-participation by the United States," than "the withdrawal of the United States," since the U.S. never officially entered the Kyoto agreement (the actions of the Administration at the time did not bind the U.S. to participate). (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted.
11-265	A	34	29	34	29	It would be more accurate to say "the non-participation by the United States," than "the withdrawal of the United States," since the U.S. never officially entered the Kyoto agreement (the actions of the Administration at the time did not bind the U.S. to participate). U.S. Government (Government of U.S. Department of State)	See previous, A-264.
11-266	A	34	32	34	33	Please describe Figure 11.3. Difficult to understand what the bars mean. U.S. Government (Government of U.S. Department of State)	Accepted.
11-267	A	35	0	0	0	This table and accompanying text is unreadable. U.S. Government (Government of U.S. Department of State)	See previous, A-11-266
11-268	A	35	5	0	0	Figure 11.3: I was not able to read the text. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	See previous, A-11-266
11-269	A	35	5	35	5	Figure 11.3 is unreadable (Government of European Community / European Commission)	See previous, A-11-266
11-270	A	37	6	37	6	It would be more accurate to say "the non-participation by the United States," than "the withdrawal of the United States," since the U.S. never officially entered the Kyoto agreement (the actions of the Administration at the time did not bind the U.S. to participate). (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted.
11-271	A	37	6	37	6	It would be more accurate to say "the non-participation by the United States," than	See previous, A-11-270

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						"the withdrawal of the United States," since the U.S. never officially entered the Kyoto agreement (the actions of the Administration at the time did not bind the U.S. to participate). U.S. Government (Government of U.S. Department of State)	
11-272	A	37	8	37	12	It says "That is, excess allowances in Russian and Ukraine roughly equal the shortfall in Europe, Japan, Canada, and other countries. However, some of these same studies emphasize that strategic behavior by Russia and Ukraine, acting as a supply cartel and/or choosing to bank allowances until the next commitment period, leads to a positive emission price." Maeda (2003) works on the exactly same topic from a theoretical point of view and derived rationale of price formations. It should be cited. Maeda, Akira (2003). The Emergence of Market Power in Emission Rights Markets: The Role of Initial Permit Distribution. Journal of Regulatory Economics 24(3): 293-314. (Akira Maeda, Kyoto University)	Accepted.
11-273	A	37	15	0	0	Section 11.4.3 partly overlaps with Section 11.3.3, notably page 26-27 and pp37-41 (dealing both with US, Canada and Japan). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Taken into account. The discussion in section 11.3.3 now more clearly emphasizes the complementary sectoral policies.
11-274	A	37	15	43	13	Please refer the carbon prices here with the ones from TD models and from BU studies. A general comment has also been made on this, to integrate more cost figures of different studies in one or more graphs. (Government of European Community / European Commission)	Rejected. The prices and costs in this section are not comparable across studies (TD v. BD or otherwise) because they are examining different policies. However, a related analysis of potential at a given price takes this concern into account and is given in section 11.3.3.
11-275	A	37	26	38	52	The U.S. is surprised that, in the section on policy studies of the U.S., the authors spend nearly all their time analyzing two pieces of U.S. legislation that have not passed a single house of Congress much less passed into law while they avoid any discussion—nay, any mention—of the Energy Policy Act of 2005 (EPCAct2005), which was signed into law in August 2005 and which is going to have far-reaching impacts on the U.S. energy economy. In addition to research and development programs, EPAct2005 has a number of provisions designed to accelerate market penetration advanced, clean energy technologies. These include about $11.5 billion (net) in tax incentives over ten years to promote the use of clean energy technologies. These include tax incentives for: production from advanced nuclear power; clean coal facilities; integrated gasification-combined cycle; energy efficient commercial buildings; energy	Accepted. We have included several sentences about EPACT 2005 in the U.S. policy discussion.

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						efficient homes; energy efficient (i.e., Energy Star) appliances; residential energy efficient property; business installation of fuel cells and stationary microturbine power plants; business solar investment tax credit; alternative motor vehicle credit; nuclear power; and many others technologies. The Act grants the Department of Energy the authority to issue loan guarantees for a variety of commercial projects that use technologies that avoid, reduce, or sequester greenhouse gases. Eligible technologies include: renewables; carbon capture & storage; hydrogen fuel cells; advanced nuclear energy; coal gasification; energy efficiency; efficient generation and transmission and distribution; and production facilities for fuel efficient vehicles. The Act also provides standby support coverage to indemnify against certain regulatory and litigation delays for the first six new nuclear plants. Under this provision, DOE is authorized to indemnify certain covered costs up to $500 million for each of the first two and $250 million for each the next four new nuclear plants if full power operation is delayed because a regulatory scheduled is not kept or litigation occurs. In addition, the Act mandates an increase in the renewable content of gasoline from 4 billion in 2006 to 7.5 billion gallons in 2012 (about 15.1 billion to 28.4 billion liters). It also establishes 16 new appliance efficiency mandates covering a variety of appliances, and Federal agencies are required to improve the efficiency of their buildings. A discussion of its provisions would bring this section up to date. Throughout the G, EPAct2005 is mentioned only twice and perfunctorily in Chap 4 on pages 95 and 96. A more thorough overview of E PAct2005 is needed. U.S. Governmen (Government of U.S. Department of State)	
11-276	A	37	35	0	0	Table 11.11: what is meant by 'Kyoto (+9%)? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted. This has been clarified to explain an assumption that, through offsets, net reductions of U.S. emissions is 9% above the Kyoto target.
11-277	A	37	35	37	35	A row needs to be added to Table 11.11 showing the dollar equivalent of the Real GDP (% loss) to put the impact in perspective. (Russell Jones, API)	Taken into account. We have included a note to the table that allows conversion into dollars. Generally, all numbers in the table were given in percentage terms to emphasize relative impacts.
11-278	A	37	35	0	0	The units for CO2 emission reduction (pertaining to the entire US) are surely not tons of CO2 (whether C or CO2 is used, the result should be in metric units (tonnes, not tons)). (Danny Harvey, University of Toronto)	Accepted. Now reads million metric tons.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-279	A	38	24	38	26	It is important to explain that macroeconomic models include costs of transitioning from one energy price regime to another, whereas CGE models do not. The phrase "price impacts on GDP unrelated to marginal abatement costs" does not reveal this difference. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Taken into account. The econometric estimates reflect historic impacts of energy price shocks on economic activity – including transitional effects but also assuming the shocks were unforeseen. This has been slightly elaborated in the text.
11-280	A	38	24	38	26	It is important to explain that macroeconomic models include costs of transitioning from one energy price regime to another, whereas CGE models do not. The phrase "price impacts on GDP unrelated to marginal abatement costs" does not reveal this difference. U.S. Government (Government of U.S. Department of State)	See previous, A-11-279
11-281	A	38	31	38	33	Delete "energy-efficiency policies ….. sectors". Renewable energy standard is not an energy efficiency policy. U.S. Government (Government of U.S. Department of State)	Taken into account. The text now reads "alternate CO2-reducing policies".
11-282	A	38	49	38	52	It is unclear what the fuel economy debate has to do with this point; also the NHTSA source cited is not in the Reference list. U.S. Government (Government of U.S. Department of State)	Taken into account. The fuel economy debate centers on whether the cost savings from fuel economy improvements are real, or offset by losses in other amenities (power, size, etc.). This is relevant for the discussion of California, because it is these gains that offset other costs. The reference has been included and now parenthetically clarifies this point.
11-283	A	38	52	0	0	US NHTSA 2006 is not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted.
11-284	A	39	14	39	14	"intangible costs" should be defined here since this is not a familiar term in economics. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Taken into account. "intangible" deleted.
11-285	A	39	14	40	0	Table 12: The units in the tables are unclear. U.S. Government (Government of U.S. Department of State)	Taken into account. Column headings now read "reduction in consumption (%)" and "reduction in GDP (%)"
11-286	A	39	14	39	0	Define "intangible costs". U.S. Government (Government of U.S. Department of State)	See previous, A-11-284.
11-287	A	39	16	41	29	Many of the policy studies for Europe seem quite old now e.g. EC(1999) and not particularly policy relevant. It would seem sensible to include more recent studies by the European Commission (e.g. http://ec.europa.eu/dgs/energy_transport/figures/scenarios/doc/2006_scenarios_on_energy_efficiency.pdf) and by the European Environment Agency	Accepted. We now include the second reference in the discussion of post-Kyoto scenarios (the EU section is focused on analysis of near-term, EU policies). The first reference does not include any cost estimates.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(http://reports.eea.europa.eu/eea_report_2005_1/en/Climate_change-FINAL-web.pdf) (Peter Taylor, International Energy Agency)	
11-288	A	40	0	41	0	Quite some EU member states also carried out national modelling studies, which were often richer in technical detail and exemplified the difficulties of burden sharing by showing that modest sector effects for the entire EU may still entail significant effects for some Member States (e.g. Honkatukia J., Kemppi H., Perrels A (2003), How to dismember a potent instrument – the intractability of the emission trade proposal of the European Commission, ECEEE 2003 Summer Study Proceedings, pp. ...; Perrels A., Kemppi H., Lehtilä A. (2001), Assessment of the Macro-Economic Effects of Domestic Climate Policies for Finland, VATT Report No. 82, Helsinki. www.vatt.fi (Government of Finland)	Rejected. The current discussion notes that there is considerable variation by country; e.g. Table 11.12. While we would like to include more national studies, due to space constraints we have focused on modeling results that compared costs across European countries on a consistent basis.
11-289	A	40	5	0	0	Give the units for this part of the table (%GDP loss?) (Danny Harvey, University of Toronto)	Accepted. Units now specified in title.
11-290	A	40	6	0	0	Table 11.12(b) : I assume the indicated figures (I) express losses in welfare, GDP and terms of trade, and (ii) are expressed in % changes?? Please state these issues clearly (see also next comment). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted.
11-291	A	40	12	40	13	The text states; "Terms of trade generally improve for European countries, except for the United Kingdom and Denmark". However, if you look at Table 11.12(b), the figures for the terms of terms all have the same sign, suggesting that they all improve (or deteriorate, depending on whether the table indicates gains/losses in terms of trade, expressed in % changes). Please clarify these issues (see also previous comment) (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Taken into account. The column heading now reads “improvement” and the missing minus signs for the UK and Denmark have been fixed.
11-292	A	40	15	40	20	See also Kemfert, Truong, Kohlhaas and Protsenco (2006):The environmental and economic effects of European emissions trading – with special references to germany in Climate Policy, forthcoming. This paper finds that Germany, Great Britain, and Czech Repub (Claudia Kemfert, German Institute for Economic Research)	Not available in time for the TOD (Nov 06)
11-293	A	40	15	40	20	A link to chapter 13, pp 12 should be included (Claudia Kemfert, German Institute for Economic Research)	Accepted.
11-26	B	40	15	40	20	See also Kemfert, Truong, Kohlhaas and Protsenco (2006):The environmental and economic effects of European emissions trading – with special references to germany in Climate Policy, forthcoming. This paper finds that Germany, Great	See previous, A-11-292

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						Britain, and Czech Repub (Government of Germany)	
11-27	B	40	15	40	20	A link to chapter 13, pp 12 should be included (Government of Germany)	See previous, A-11-293
11-294	A	40	16	40	31	There are additional relevant studies: Klepper, G. & S. Peterson (2006). Emissions Trading, CDM, JI and More – The Climate Strategy of the EU. The Energy Journal 27(2), 1-26 and Klepper, G. & S. Peterson (2004). The EU Emissions Trading Scheme: Allowance Prices, trade Flows, Competitiveness Effects. European Environment 14(4):201-218. (Sonja Peterson, Kiel Institute for the World Economy)	Accepted.
11-295	A	40	0	0	0	Table 11.12 b) unit of measure ? (Stefano Caserini, Politecnico di Milano)	See previous, A-11-289
11-296	A	41	33	41	34	Please compare these findings with those of Kainuma et al., stated on pp. 26-27. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted
11-297	A	41	40	41	47	Incomplete literature review for China modeling of policy scenarios. See, e.g. Sinton, Jonathan E., Joanna I. Lewis, Mark D. Levine and Zhu Yuezhong, editors. China's Sustainable Energy Future: Scenarios of Energy and Carbon Emissions (Summary) LBNL-54067, October 2003. http://china.lbl.gov/publications/scenarios_summary_01apr04.pdf (Joanna Lewis, Pew Center on Global Climate Change)	ACC. The suggested reference considers alternative future scenarios rather than specific policies to mitigate climate change, the subject of this section. However policies are listed in the full report, which will be covered.
11-298	A	41	42	41	43	Based on Chen (2005), "Chinese experts' estimation on marginal abatement costs in China (IPAC, China MARKAL-MACRO) are much higher than foreign modelers (GTEM, EPPA, POLES)." should be added. (Government of China Meteorological Administration)	Noted. Extra text added using text from Chen which discusses the reasons for the differences in marginal abatement costs.
11-299	A	41	47	0	0	The following paragraph can be added: Aunan et al. (2006), using a CGE model for China, conclude that China can reduce its CO2 emissions with 15-20% without suffering a welfare loss owing to co-benefits that incorporates both avoided damage to human health from concurrent reductions in particulate air pollution and avoided agricultural crop loss from concurrent reductions in surface ozone precursors. The avoided crop loss and the avoided health damage are comparable in size. They also find that in general the distributional impact is not adverse (Reference:Aunan, K., T. Berntsen, D. O'Connor, T.H. Persson, H. Vennemo and F. Zhai, 2006. Benefits and Costs to China of a Climate Policy. Environmental Development Economics, (Accepted).) (Kristin Aunan, Center for International Climate and Environmental Research - Oslo (CICERO))	Taken into account in Section 11.8; a reference is now included in this section.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-300	A	42	5	0	0	Figure 11.4 is hard to read in black and white print. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted. Table retyped.
11-301	A	42	11	0	0	Table 11.13 is hard to read. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	See previous, A-11-300
11-302	A	43	14	44	15	This section can be reduced especially by summarising information in table (Government of European Community / European Commission)	Noted.
11-303	A	43	16	0	0	What is meant by 'their paper'? (do you mean the paper by Den Elzen, et al. , mentioned in the previous section?) (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted.
11-304	A	43	23	0	0	The scientific convention is to refer to gaseous concentrations as ppmv, not ppm. (Danny Harvey, University of Toronto)	Accepted
11-305	A	43	40	43	45	See also Kemfert, C.: International Climate Coalitions and trade - Assessment of cooperation incentives by issue linkage, In Energy Policy, 2004, Volume 32, Issue 4, pp. 455-465; and Kemfert, C., Lise, W., Tol, R.: Games of Climate Change with International Trade, in: Environmental and Resource Economics, 28, 2003, pp. 209-232 (Claudia Kemfert, German Institute for Economic Research)	TIA. the first paper is discussed in 11.7
11-306	A	43	40	43	45	A link to chapter 13.3 should be included (Claudia Kemfert, German Institute for Economic Research)	Accepted.
11-28	B	43	40	43	45	See also Kemfert, C.: International Climate Coalitions and trade - Assessment of cooperation incentives by issue linkage, In Energy Policy, 2004, Volume 32, Issue 4, pp. 455-465; and Kemfert, C., Lise, W., Tol, R.: Games of Climate Change with International Trade, in: Environmental and Resource Economics, 28, 2003, pp. 209-232 (Government of Germany)	See previous A-11-305
11-29	B	43	40	43	45	A link to chapter 13.3 should be included (Government of Germany)	See previous A-11-306
11-307	A	43	41	0	0	What do you mean by "..they find different coalitions favor different countries"? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	The passage has been removed.
11-308	A	44	6	44	7	Prior to the summary paragraph in line 8, or after section 11.4.5, it is useful to mention that there is emerging evidence-based research looking at the transmission between climate policy and investment, including how the existing Kyoto architecture is perceived by businesses and investors. More of this type of analysis is relevant in the consideration of post-2012 architecture by policymakers, in terms of understanding which factors in the current regime are stimulating which form of	TIA. This seems like an important point that best fits in Chapter 13. Unless there are quantitative cost studies, it does not fit well here. However, a new section on risks and investment has been added in 11.6 and another on energy security in 11.8, both of which

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						business activity; and what factors are holding back investment in emissions reductions or technology. Publications (grey literature) include: * Sullivan, R., and Blyth, W., August 2006 "Climate Change Policy Uncertainty and the Electricity Industry: Implications and Unintended Consequences", Briefing Paper, Chatham House, from URL www.chathamhouse.org.uk (Rory Sullivan is from Insight Investment Management, which is the asset management arm of HBOS Ltd). * Hamilton, K., and Kenber, M., April 2006, "Business Views on International Climate and Energy Policy", report commissioned by UK Government. * Standard & Poors the rating agency in its report Climate Change Credit Survey: A Study of Emissions Trading, Nuclear Power, and Renewable Energy, [online report, November 2005]. There are a range of other reports looking at issues around EU ETS specifically. (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	acknowledge several of the points made here.
11-309	A	44	11	44	12	The lines refer to assumptions that affect costs. Co-benefits are in the benefits category. Also, most of the models do not explicitly introduce transactions costs into their estimates. Were they to do so, the estimates would be increased. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Rejected. Generally, non-climate co-benefits are treated as negative costs in the AR4. Adjustment costs would typically be less important for these long-run scenarios, in contrast to short-run studies, as responded to in A-11-279.
11-310	A	44	11	44	12	The lines refer to assumptions that affect costs. Co-benefits are in the benefits category. Also, most of the models do not explicitly introduce transactions costs into their estimates. Were they to do so, the estimates would be increased. U.S. Government (Government of U.S. Department of State)	See previous A-11-309.
11-311	A	44	14	44	15	Please check the references to sections 11.5, 11.6, 3.3.5.4 and 11.8.2. They do not seem to be correct. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted. 11.5 refers to endogenous technological change, 3.3.5.4 refers to multi-gas scenarios, and 11.8.1 refers to co-benefits.
11-312	A	44	16	45	21	It would be helpful if this section is earlier in the chapter so it can berefer to this when discussing differences between BU and TD models for instance. In addition the term meta-analyses needs to be explained. (Government of European Community / European Commission)	Reject. We believe it is better to discuss differences across models after all the results have been presented. Meta-analysis has been parenthetically explained.
11-313	A	44	40	44	40	In the absence of a backstop technology, and with realistic limits on substitutability between energy and other factors, the Kaya identity can be used to assess the credibility of stabilization cost estimates. Doing so reveals that the low costs reported in chapter 11, and elsewhere, may not be credible. (See p.12 of my review of FOD.) (Christopher Green, McGill University)	Noted.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-314	A	44	40	44	40	In the absence of a backstop technology, and with realistic limits on substitutability between energy and other factors, the Kaya identity can be used to assess the credibility of stabilization cost estimates. Doing so reveals that the low costs reported in Chapter 11, and elsewhere, may not be credible. U.S. Government (Government of U.S. Department of State)	See previous A-11-313
11-315	A	44	48	44	52	What about differences in how C taxes are assumed to be recycled? Retto and Austin (which is cited later) show this to be important too, although maybe the latest studies don't differ in this respect. (Danny Harvey, University of Toronto)	Noted. As the commenter indicates, this is not relevant in the current studies.
11-316	A	45	8	45	9	What do you mean by 'treatment of trade' and 'leading to differences' (differences of what)? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted. Sentence has been clarified to include "emissions trading" and "differences in cost".
11-317	A	45	23	60	19	The section on the use of endogenous and exogenous technological change is interesting and is presumably written by an enthusiast of the latter "new" area. There appear to be a number of "subjective" statements which imply that the present literature is an improvement of that from the past (whereas it is primarily a change/simplification in assumptions). Further the suggestion that the resulting "lower" costs compared with existing literature are an improvement does not appear to have a basis in fact. (Nick Campbell, ARKEMA SA)	Taken into account. All the modelling studies are based on stylized assumptions. The notion of lowering costs is with respect to a particular exogenous baseline. This will be more carefully noted throughout the chapter
11-318	A	45	33	0	0	Ch 11: p.45, l.33 and some other places: cross referencing with ch 3, and clarification on the 2030-2050 versus 2100 divide between ch 11 and 3 is lacking. (Peter Bosch, IPCC TSU)	Accepted
11-319	A	46	5	46	5	Table 11.14 Nice overview (Government of European Community / European Commission)	Noted
11-320	A	46	22	0	0	There is also a forthcoming special issue of Energy Economics on the same topic. (Richard Tol, Economic and Social Research Institute)	Taken into account
11-321	A	46	25	0	0	Wing and Popp > Sue Wing and Popp (Richard Tol, Economic and Social Research Institute)	Accepted
11-322	A	47	17	47	18	LBD is not "costless". It requires less investment than R&D, but it still requires a staff that can collect and analyze data, and the costs associated with the trial-and-error testing that is usually involved in applying an LBD learning. While economists may treat this as "costless," that is a gross oversimplification. This point is acknowledged on Pg. 54, lines 15-17, when the investments that are required for technology diffusion and accompanying R&D are discussed. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted
11-323	A	47	17	47	18	LBD is not "costless". It requires less investment than R&D, but it still requires a	See the previous comment 11-322

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						staff that can collect and analyze data, and the costs associated with the trial-and-error testing that is usually involved in applying an LBD learning. While economists may treat this as "costless," that is a gross oversimplification. This point is acknowledged on Pg. 54, lines 15-17, when the investments that are required for technology diffusion and accompanying R&D are discussed. U.S. Government (Government of U.S. Department of State)	
11-324	A	47	36	47	36	The acronym ETC is ambiguous here since it could refer to either Endogenous Technical Change of Exogenous Technical Change. It should be defined. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted
11-325	A	47	36	47	36	The term "ETC" here firstly appears without eaplanation. Term "ITC (Induced Technological Change?)" is also used in this chapter. To avoid the confusion, ITC should be ed by ETC, or add a explation in the footnote like that "ITC (Induced Technological Change) in the Figure is alternative term of ETC.". (Shunsuke Mori, Tokyo University of Science)	Accepted
11-326	A	47	36	47	36	The acronym ETC is ambiguous here since it could refer to either Endogenous Technical Change of Exogenous Technical Change. It should also be defined. U.S. Government (Government of U.S. Department of State)	See previous comment, 11-325
11-327	A	47	37	47	37	After the end of the sentence ("… optimal emission levels."), insert the following sentence: "However, cost-benefit analysis results are heavily dependent on conjectural and controversial assumptions. A recent sensitivity analysis shows that the relatively low optimal tax and resulting modest emission reductions of the Nordhaus model depend on assumptions about the subjective value of moderate warming, the choice of the discount rate, and the model's representation of the physical processes of climate change; plausible changes to these assumptions lead to a markedly higher optimal tax and much greater mitigation (Ackerman and Finlayson 2006)." (Frank Ackerman, Global Development and Environment Institute, Tufts University)	Taken into account, we acknowledge that the level of marginal benefits could depend on the model.
11-328	A	47	41	48	9	It should be also pointed out that the distinction between "learning curve" and "scale of economy" effects is often difficult from the histrical data. However, the latter is usually foreseeable given the production conditions whie the former is not. (Drastic price reductions in the semiconductor and LSI are the case. The above two effects are interacted strongly and thus lower prices realized.) (Shunsuke Mori, Tokyo University of Science)	Accepted
11-329	A	48	11	48	13	According to the third column of this table, a key point in measuring costs is "the	Taken into account, clarify marginal returns

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						assumed rate of return to R&D, typically based on an assumption that substantial spillovers exist and that the rate of return to R&D is several times higher than conventional investment." Does this refer to average rate of return, or to return at the margin of R&D investment? The assumption of very high rates of return to R&D in the referenced studies seems weak without some justification how this could persist. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	are higher based on spillovers.
11-330	A	48	11	48	13	According to the third column of this table, a key point in measuring costs is "the assumed rate of return to R&D, typically based on an assumption that substantial spillovers exist and that the rate of return to R&D is several times higher than conventional investment." Does this refer to average rate of return, or to return at the margin of R&D investment? The assumption of very high rates of return to R&D in the referenced studies seems weak without some justification how this could persist. U.S. Government (Government of U.S. Department of State)	See 11-329
11-331	A	49	1	0	0	Figure 11.5: are the costs expressed in metric tons of C or CO2? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Taken into account, it is presumably C; we have changed the figure and text.
11-332	A	49	18	49	26	The discussion here is very important. It suggests that the crucial requirement for stabilization is energy technology, much of it "advanced", or altogether new. Thus, technological uncertainty should play a major role in, or dominate, mitigation cost estimates. As a result, stabilization costs could range from low to very high—but discussion of the latter possibility is virtually non-existent in the SOD—and is not even hinted at in the draft SPM. (Christopher Green, McGill University)	Taken into account, we acknowledge uncertainty about in the Executive summary..
11-333	A	49	18	49	26	The crucial requirement for stabilization is energy technology. Much of it "advanced", or is altogether new. Thus, technological uncertainty should play a major role in, or dominate, mitigation cost estimates. As a result, stabilization costs could range from low to very high—but discussion of the latter possibility is virtually non-existent in the SOD—and is not even hinted at in the draft SPM. U.S. Government (Government of U.S. Department of State)	See previous comment, 11-332
11-334	A	49	26	0	0	It should be added that the technologies needed for significant end use efficiency improvements already exist – we do not need to wait for technology to develop before getting started. This point is made in Chapter 6 and somewhere in Chapter 2 or 3. (Danny Harvey, University of Toronto)	Taken into account, energy efficiency is not a major technological shift. .
11-335	A	49	31	49	32	LBD is not "costless". It requires less investment than R&D, but it still requires a	Accepted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						staff that can collect and analyze data, and the costs associated with the trial-and-error testing that is usually involved in applying an LBD learning. While economists may treat this as "costless," that is a gross oversimplification. This point is acknowledged on Pg. 54, lines 15-17, when the investments that are required for technology diffusion and accompanying R&D are discussed. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
11-336	A	49	31	49	32	LBD is not "costless". It requires less investment than R&D, but it still requires a staff that can collect and analyze data, and the costs associated with the trial-and-error testing that is usually involved in applying an LBD learning. While economists may treat this as "costless," that is a gross oversimplification. This point is acknowledged on Pg. 54, lines 15-17, when the investments that are required for technology diffusion and accompanying R&D are discussed. U.S. Government (Government of U.S. Department of State)	See previous section 11-335
11-337	A	50	0	51	0	Table11.16: As I read the table, some of the studies summarized seem ambivalent about the contribution of induced technical change. Is this ambivalence reflected elsewhere in the report? (Christopher Green, McGill University)	Taken into account, we refer to Uncertainty in the Executive Summary. See also previous comment 11-332
11-338	A	50	0	51	0	Table11.16: Some of the studies summarized seem ambivalent about the contribution of induced technical change. Is this ambivalence reflected elsewhere in the report? U.S. Government (Government of U.S. Department of State)	See previous section 11-337
11-339	A	50	1	51	1	Table 11.16 has been splitted into Portrait and Landscape pages. (Muhammad Latif, Applied Systems Analysis Group)	Taken into account
11-340	A	50	5	50	5	The term "ITC" in the Table 11.16 seems to be "Induced Technological Change" which is similar to ETC in Table 11.18 and others. To avoid the confusion, ITC should be ed by ETC or add a explation in the footnote like that "ITC (Induced Technological Change) in the Figure is alternative term of ETC.". (Shunsuke Mori, Tokyo University of Science)	Taken into account, we clarify the meaning of ETC and ITC
11-341	A	51	5	51	5	A further modle is missing in the list: the CGE-IAM model WIAGEM covers also ITC, see Kemfert (2005): Kemfert, C.: Induced Technological Change in a multi-regional, multi- sectoral trade model,- in Special Issue of Ecological Economics, ,2005, Vol 54/2-3 pp 293-305 (Claudia Kemfert, German Institute for Economic Research)	REJ because it is part of the review of Sijm (2004). WIAGEM is discussed in section 11.7
11-30	B	51	5	51	5	A further modle is missing in the list: the CGE-IAM model WIAGEM covers also ITC, see Kemfert (2005): Kemfert, C.: Induced Technological Change in a multi-regional, multi- sectoral trade model,- in Special Issue of Ecological Economics,	See previous comment, 11-341

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						,2005, Vol 54/2-3 pp 293-305 (Government of Germany)	
11-342	A	52	46	52	46	The question is asked, what is the correct degree of crowding out? But it is not the right question. Any resources diverted into climate change R&D "crowd out" some other activity. The key is the assumption that R&D, whether climate-related or other, obtains 4X the rate of return, at the margin of investment, as conventional investment. This is difficult to accept. It suggests that governments in all of the countries modeled vastly under-invest in R&D. Yet there are powerful political incentives, in the U.S. and elsewhere, to so invest, but with not very high returns (earmarked public funds intended for specific locales are an especially egregious form of public R&D investment in the U.S.). This is not to say that high returns cannot be earned on some of this investment, but it suggests that at the margin, returns may be low or non-existent. The proper question at this juncture is, what are actual marginal returns to public investment in R&D activity? (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Noted. Both the cost (crowding out) and the benefit (rate of return, typically assumed to be higher than market rates because of inappropriable spillovers) are important parameters. The latter is discussed in the paragraph that follows the discussion of the former.
11-343	A	52	46	52	46	The question, "what is the correct degree of crowding out" it is not the right question. Any resources diverted into climate change R&D "crowd out" some other activity. The key is the assumption that R&D, whether climate-related or other, obtains 4X the rate of return, at the margin of investment, as conventional investment. This is difficult to accept. It suggests that governments in all of the countries modeled vastly under-invest in R&D. Yet there are powerful political incentives, in the U.S. and elsewhere, to so invest, but with not very high returns (earmarked public funds intended for specific locales are an especially egregious form of public R&D investment in the U.S.). This is not to say that high returns cannot be earned on some of this investment, but it suggests that at the margin, returns may be low or non-existent. The proper question at this juncture is, what are actual marginal returns to public investment in R&D activity? U.S. Government (Government of U.S. Department of State)	See 11-342
11-344	A	52	49	0	0	What do you mean by 'twice as much mitigation at a given price…? (price of what)? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Taken into account by re-writing.
11-345	A	53	8	0	0	Table 11.17: please explain what is meant by tow-factor learning, notably the terms LDR and LSR. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Taken into account.
11-346	A	53	23	0	0	The statistical procedures used to estimate learning rates are substandard and likely to have lead to substantial overestimates. Particularly, estimates and estimation	See 11-15

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						methods suffer from non-stationarity and missing variables -- either would imply both overestimates and overconfidence. Köhler et al. (2006, Energy Journal) have a nice critique. (Richard Tol, Economic and Social Research Institute)	
11-347	A	53	25	53	0	Table 11.17 - Spell out the model acronyms and/or provide one or two sentence descriptions of the model in the footnote, which at present only describes the MERGE-ETL model. U.S. Government (Government of U.S. Department of State)	Accepted. Will be included in a revised version of table 11.16 in as much as space allows.
11-348	A	53	35	53	35	The reference is missing in the "References" section. (Leo Schrattenholzer, IIASA)	Taken into account. The reference was incorrectly included.
11-349	A	54	0	59	0	Table 11.18: and accompanying text --- The summary of the Edenhofer study, indicates that many (6 of 11) models introduce a "backstop" technology. There are many objections to the "backstop" energy technology assumption, including that a backstop technology(ies) does not currently exist. This apparently has not deterred modelers, some of whom (if I read the Table correctly) assume that a backstop will be endogenously induced into existence (presumably justifying the use of "generic" to describe it). Here, I would again repeat that the Montgomery and Smith paper (see my comment re p.8) be given serious consideration. It may shatter illusions about the likelihood that a carbon-free backstop technolog(ies) can be induced into existence. (Christopher Green, McGill University)	Taken into account. We acknowledge that Montgomery and Smith refer to the problem that backstop technologies cannot be induced by time-inconsistent policies in 11.5.
11-350	A	54	16	0	0	Learning is not costless -- it requires time and effort, and often money too. Experience is costless for an individual, but not for large organisations (typical for energy and transport) which require expensive management information systems and need to pay experienced workers more than inexperienced ones. (Richard Tol, Economic and Social Research Institute)	Accepted. Text changed to make it clear that LBD is not costless but requires investment.
11-351	A	54	29	0	0	Technology is not fixed in the initial period in any model -- with or without ICT. This "innovation" cannot be ascribed to the IMCP, and it in fact misrepresents other models. (Richard Tol, Economic and Social Research Institute)	Taken into account by deleting "so that technology is not "static"…".
11-352	A	55	1	55	0	Table 11.18 and accompanying text --- The summary of the Edenhofer study, indicates that many (6 of 11) models introduce a "backstop" technology. There are many objections to the "backstop" energy technology assumption, including that a backstop technology(ies) does not currently exist. This apparently has not deterred modelers, some of whom assume that a backstop will be endogenously induced into existence (presumably justifying the use of "generic" to describe it). The Montgomery and Smith paper should be given serious consideration. It may shatter	See 11-349

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						illusions about the likelihood that a carbon-free backstop technolog(ies) can be induced into existence. U.S. Government (Government of U.S. Department of State)	
11-353	A	55	1	55	0	Table 11.18 - Has any backcasting been done to test the influence of ETC on current set of technologies? If not, this may be a gap where more research is needed. U.S. Government (Government of U.S. Department of State)	Taken into account, we acknowledge that the uncertainty about crucial parameters are important and suggest this as a research gap.
11-354	A	55	5	0	0	Why is Table 11.18 limited to IMCP models? There are other models with ICT, such as FUND, Goulder, MERGE, and Smulders -- note that these models lead to different conclusions. Note also that DEMETER is not a general equilibrium model -- it has one sector (Richard Tol, Economic and Social Research Institute)	Taken into account. We now summarize the IMCP and the study of Sijm in one table. We refer to the last version of Edenhofer et. al. 2006.
11-355	A	55	5	0	0	Note that DEMETER is not a general equilibrium model (see Edenhofer et al., 2006) -- DEMETER has one sector only -- if you want to be a purist, any growth model after Solow is a general equilibrium model, and you would have to relabel ENTICE, FRICE and MACRO. (Richard Tol, Economic and Social Research Institute)	Taken into account, we harmonize the table with the Table used in the Special Issue of the EJ
11-356	A	57	10	58	10	The term "ITC" in the Figure 11.6 seems to be "Induced Technological Change" which is similar to ETC in Table 11.18 and others. To avoid the confusion, ITC should be ed by ETC or add a explation in the footnote like that "ITC (Induced Technological Change) in the Figure is alternative term of ETC.". (Shunsuke Mori, Tokyo University of Science)	Accepted
11-357	A	58	5	0	0	Figure 11.6 is hard to read in black and white print. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted. It will be in colour.
11-358	A	59	28	0	0	Please add a discussion of the theoretical literature on induced technological change. As I wrote in previous but ignored comments, inclusion of the opportunity costs of R&D in a general equilibrium framework may well change the sign, and make emission reduction with induced technological change more expensive than without. It is inexcusable for the IPCC to ignore a part of the literature that suggests the opposite conclusion. (Richard Tol, Economic and Social Research Institute)	Taken into account. Technological change has its own opportunity costs. We will be more explicit about this.
11-359	A	59	41	60	11	Even assuming high social rates of return to R&D, whether investment in one particular area increases social welfare is not obvious. It's a little like whether a bilateral trade agreement is welfare enhancing relative to a general trade agreement. If the former is a substitute policy for the latter (in this case a policy that strengthened inducement to all R&D) then it is not necessarily welfare enhancing. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Taken into account. We acknowledge the opportunity costs of R&D investments.(see Ott, Löschel, Reilly 2006)

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-360	A	59	41	60	11	Even assuming high social rates of return to R&D, whether investment in one particular area increases social welfare is not obvious. It's a little like whether a bilateral trade agreement is welfare enhancing relative to a general trade agreement. If the former is a substitute policy for the latter (in this case a policy that strengthened inducement to all R&D) then it is not necessarily welfare enhancing. U.S. Government (Government of U.S. Department of State)	See previous comment, 11-359
11-361	A	59	42	59	45	This is a very important point, and needs drawn attention to in other chapters, alongside the streamlining of definitions (as per my comments to Chapter 1, page 20). There is a strong emphasis on 'technology' in WGIII, without ensuring that it is clear how this fits with consideration of infrastructure or energy policy, and where the balance is between R&D and deployment. This comment is therefore helpful in redressing a tendency towards emphasising the R&D end of the 'technology' discussion; I hope, as relevant, this is reflected in other chapters. (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	Noted
11-362	A	59	47	0	0	Vincent et al 2006 is not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted
11-363	A	60	8	0	0	Weber et al 2003 is not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	Accepted
11-364	A	60	8	60	8	Weber et al (2003): reference not included in the literature list (Government of Finland)	Accepted
11-365	A	60	13	60	19	This statement is complete nonsense, and is thoroughly contradicted by the history of major technological developments during the past 50 years, several of which would have never happened were it not for critical governments support in the early stage (or would have taken much longer). The statement is a reflection of an excessive belief in the outdated ideas of neoclassical economics – just get the prices right, and the magic of the marketplace will solve our problems. The statement can be challenged in two ways: 1. Based on other studies of the relationship between R &D funding and patents, which have come to different conclusions (Margolis and Kammen (1999), based on time series data; and Ragwitz and Miola, 2005, based on international comparisons). As the conclusions in these papers are intuitively reasonable, I conclude that there is something wrong in the work cited by the author. 2. Based on specific case studies of major technological developments. As stated in Hoffert et al. (1998): "This past century, accelerated technology development from wartime and postwar research produced commercial aviation, radar, computer chips, lasers and the Internet, among other things."	Taken into account. It is not necessarily a contradiction to Popp's insight. References will be checked. Text has been added to clarify the statement. In the case of CCS on power stations it does not seem rational that power companies would install the technologies on a large scale without a carbon price or regulation.

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						I asked the lead author (Marty Hoffert) for an elaboration of this statement, and here is his reply: "The Internet was supported for 20 years by DARPA -- the Defense Advanced Research Projects Agency set up by the US government to fund high-risk, high-payoff projects, and for another 10 years by the National Science Foundation. [Note: the Internet, as I think is well known, evolved from early efforts to improve communications between government research labs] Power plant gas turbines were certainly a spin off of aircraft gas turbines developed by government R & D [Note: this point has been confirmed somewhere by Robert Williams]. Indeed, it's difficult to find any innovative late 20th century technology that wasn't developed by government R & D. Large-scale integrated circuits certainly were in the space program. This led to personal computers and cell phones so ubiquitous that we never stop to ask why they're here. A real question politically is whether we are willing to commit comparable R & D resources for an objective, however much it impacts our survival, other than blowing each others brains out…. The Dakota Gasification Plant, which pipes CO2 to the Saskatchewan Weyburn fields for secondary oil recovery -- a poster child of the Bush Administration for how carbon capture and storage (CCS) might be cost-effective -- only exists because DoE during the Carter administration built a plant to demonstrate coal-to-natural gas alternate fuel synthesis; it was eventually sold for 6 cents on the dollar to Dakoto Gasification which is why it's cost effective today. It is a distortion of reality by market economists to imply industrial R & D by companies paved the way to CCS -- which is, incidentally, the front-running energy supply technology for reducing CO2 emissions." REFERENCES: Hoffert, M.I. et al. 1998. Energy implications of future stablilization of atmospheric CO2 content, Nature, 395, 881-884. Margolis, R.M. and D. Kammen, 1999. Underinvestment: The energy technology and R&D policy challenge. Science 285, 690-692. Ragwitz, M. and A. Miola. 2005. Evidence from RD&D spending for renewable energy sources in the EU. Renewable Energy 30, 1635-1647. (Danny Harvey, University of Toronto)	
11-366	A	60	14	60	15	Popp (2002) was not included in the reference section for Ch. 11 U.S. Government (Government of U.S. Department of State)	Accepted
11-367	A	60	18	60	19	Patents are not the only measure of returns to R&D, but this evidence tends to contradict the notion that the U.S. government substantially under-invests in energy	See previous reponse 11-365

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						R&D. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
11-368	A	60	18	60	19	Patents are not the only measure of returns to R&D, but this evidence tends to contradict the notion that the U.S. government substantially under-invests in energy R&D. U.S. Government (Government of U.S. Department of State)	Accepted The text has been re-written.
11-369	A	60	21	71	29	The entire section 11.6 needs to be coordinated and consolidated with Chapter 3. Chapter 11 should deal with mitigation up to 2030 as stated in the Introduction, page 7, line 45. Much of the material in section 11.6 is already covered in Chapter 3. U.S. Government (Government of U.S. Department of State)	TIA. The Chapter has a mandate to address the linkage between medium and long term (2030-2050). Coordinationg with Ch.3 undertaken.
11-370	A	60	32	0	0	What are the results for non-IMCP models? (Richard Tol, Economic and Social Research Institute)	TIA. The main other dataset of model results is the EMF studies. These were not made available to Ch.11 for the SOD, but have been and will be fully incorporated for the final draft. Sentence to reflect this.
11-371	A	60	41	60	45	The conclusion in this text is strongly support by the IEA's recent report Energy Technology Perspectives 2006. The results of this study are summarized on Pg. 64, lines 6-14, but a reference to it here would be useful. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC
11-372	A	60	41	60	45	The conclusion in this text is strongly supported by the IEA's recent report Energy Technology Perspectives 2006. The results of this study are summarized on Pg. 64, lines 6-14, but a refrence to it should also be included. U.S. Government (Government of U.S. Department of State)	See 11-371
11-373	A	60	41	60	51	Another factor that should be considered is that there are few energy efficiency curves that include technological change. In effect, the potential for energy efficiency does not change over time. If this were considered, the long-term potential would be considerably higher. U.S. Government (Government of U.S. Department of State)	ACC
11-374	A	61	13	0	0	After "barriers to energy efficiency;" add "information programs and training (especially in the buildings sector); infrastructure investments (rapid transit, district energy systems);" (Danny Harvey, University of Toronto)	TIA
11-375	A	62	1	62	21	Nice and strong picture, but again, can other earlier mentioned insights from literature also be included on the side or as a line or with colours or so? This all to integrate all the information in Chapter 11 and so improve the conclusions and insights	ACC. new text added.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Government of European Community / European Commission)	
11-376	A	62	5	0	0	Why is EMF21 excluded from Figure 11.7? These are the latest results! (Richard Tol, Economic and Social Research Institute)	EMF21 results are included to the extent data was available, and more data have now been made available; see 11-370
11-377	A	62	5	62	0	Figure 11.7. The data in Figure 11.7 needs to be checked against the references. It appears that some of the EMF21 data is not correct. The descriptions of the differences between the modeling studies need to be considerably improved, particularly with why there are positive GDP effects in the IMCP targets. Also, it is not clear what the value of the Figure 11.7 (c) is since it is not well described and appears inconclusive. U.S. Government (Government of U.S. Department of State)	TIA. See 11-370. Generic point taken into account. Fig 11.7c makes important point that the models are extremely varied in terms of the relationship between carbon prices and GDP impacts of those prices, and this has been clarified in the text, with a special footnote on model results in which GDP is above base.
11-378	A	62	6	0	0	Figure 11.7: Why does Figure 11.7(a) include 5 different stabilisation levels (including Cat. B) and Figures 11.7(b) and © only 4 levels? (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC. See 11-377. The labels now make it clear that there are only 2 stabilization levels considered. Also additional data received means the fifth category can be extended to (b) and (c)
11-379	A	62	6	0	0	Replace “gross-world-product costs” with “impact on gross world product” (Danny Harvey, University of Toronto)	ACC
11-380	A	62	8	62	9	The note to Figure 11.7 mentions that Figure 11.7(a) covers 4 stabilisation levels, but actually it covers 5 levels (including Cat.B). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	See 11-378
11-381	A	63	14	0	0	Please add standard deviation or range to $12/tC and $7/tC. Please add the rather higher carbon prices later in the scenario; just quoting the start is misleading. (Richard Tol, Economic and Social Research Institute)	(i) ACC, (ii) indication added but the main focus agreed for specific data is on 2030 data.
11-382	A	63	18	0	0	This may reflect ETC, but also that the IMCP models are miscalibrated -- this would be no surprise, as the IMCP models have, on average, a much lower pedigree than the EMF models. (Richard Tol, Economic and Social Research Institute)	REJ. In the IMCP models that do generate lower costs, the structural analysis in most papers suggest that ETC does play a role in lowering costs. There is no reason to think that other features of the models covered in IMCP would bias costs down. The EMF21 studies and data published in December 2006 reveal results that are similar in kind to those of the IMCP and in some ways less suitable for analysis of the trajectories 2010 to 2030 being analysed in Chapter 11. For example, the FUND results show a very high carbon

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							tax/permit price in 2010, with no effect on CO2 emissions or GDP.
11-383	A	63	30	63	31	My understanding is that only one model shows the results showing negative GDP loss for stabilizations of CO2 in IMCP studies. The description of "a couple of models in the IMCP project predict GDP gains" will be incorrect, and should be changed to, for example, "results from a model in the IMCP project predict GDP gains". (Keigo Akimoto, Research Institute of Innovative Technology for the Earth (RITE))	TIA. In fact, three of the models (E3MG, FEEM-RICE fast and ENTICE) show GDP/output gains, but for different reasons. The ENTICE results are apparent with high substitution elasticities on p. 173 of Popp's paper in IMCP special issue.
11-384	A	63	31	0	0	In Edenhofer et al. (2006), negative costs are explained, in E3MG, by its Keynesian nature -- presumably this means that the government budget is never closed or that emission reduction in financed by our friends from Mars -- and, in FRICE, by the second-best initial equilibrium, although there is no a priori reason to assume that government intervention would get us closer to the first-best. The underlying assumptions require critical discussion. FRICE, astonishingly, combines perfect-market and second-best features -- reading the Bosetti papers, it strikes me that the model is internally inconsistent. The same may well be true of the MIND model (Edenhofer et al., 2006), which combines learning externalities with perfect competition. (Richard Tol, Economic and Social Research Institute)	REJ. E3MG has a closed accounting system. Second best analysis is compatible with perfect foresight. FEEMRICE model is a second-best model, with perfect foresight, not perfect markets. MIND model is not a second-based model, it is a first-best model.
11-385	A	63	31	0	0	Again, the discussion is limited to the IMCP. You might add, for instance, that EMF models typically report positive costs, as negative costs are part of the baseline scenario. (Richard Tol, Economic and Social Research Institute)	ACC
11-386	A	64	33	64	33	Add industry to the list. Chapter 7 (Table 7.8) indicates that substantial reductions in GHG emissions are available in the industrial sector at <$20/tCO2-eq. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC
11-387	A	64	33	64	33	Add industry to the list. Chapter 7 (Table 7.8) indicates that substantial reductions in GHG emissions are available in the industrial sector at <$20/tCO2-eq. U.S. Government (Government of U.S. Department of State)	See 11-386
11-388	A	64	40	64	42	The reference here to the "wedges" approach appears to be a reference to Pacala and Socolow (2004). If so, that reference does not discuss price. Either delete this sentence or provide a reference to support it. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	TIA.
11-389	A	64	40	64	42	The reference here to the "wedges" approach appears to be a reference to Pacala and Socolow (2004). If so, that reference does not discuss price. Either delete this	See 11-388

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						sentence or provide a reference to support it. U.S. Government (Government of U.S. Department of State)	
11-390	A	64	42	65	9	It is far from clear what literature supports the conclusion in this text. Either delete this conclusion or provide the references that support it. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	TIA. This is built upon the data in the figures and discussed earlier and references in the footnote. To be made explicit
11-391	A	64	42	65	9	This is a very policy relevant statement!!! Is it in line with Table 11.8 and 11.3? Why not included in summary? This is also one of the first statements with level of confidence attached. (Government of European Community / European Commission)	ACC
11-392	A	64	42	65	9	It is far from clear what literature supports the conclusion in this text. Either delete this conclusion or provide the references that support it. U.S. Government (Government of U.S. Department of State)	See 11-390
11-393	A	64	43	0	0	Footnote 7: Hedenus, et al 2006 and Sano, et al 2006 are not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC
11-394	A	65	21	65	21	Change “developed” to “commercialized.” It would be fairer to characterize technologies in terms of their degree of commercialization, rather than their degree of development. As the IPCC Special Report on CCS documents, each component of CCS technology has been demonstrated, but the package has not been put together for post-combustion CO2 capture. It has been demonstrated for removal of CO2 from natural gas, a very similar application. The major barrier to application of CCS is its cost. However, there are many applications in the $20-50/tCO2 range discussed earlier in this section. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC
11-395	A	65	21	65	21	Change “developed” to “commercialized.” It would be fairer to characterize technologies in terms of their degree of commercialization, rather than their degree of development. As the IPCC Special Report on CCS documents, each component of CCS technology has been demonstrated, but the package has not been put together for post-combustion CO2 capture. It has been demonstrated for removal of CO2 from natural gas, a very similar application. The major barrier to application of CCS is its cost. However, there are many applications in the $20-50/tCO2 range discussed earlier in this section. U.S. Government (Government of U.S. Department of State)	See 11-395
11-396	A	65	34	65	35	This needs to say 'A rising carbon price, in a clear and stable policy environment, brings forward ….' The perception of the evolution of government commitment to 'climate' or 'low carbon' policy, and therefore future demand in new products also matters.	ACC

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	
11-397	A	65	35	65	36	Delete "like CCS." CCS can be competitive in special cases, such as its use for enhanced oil recovery (EOR). CCS projects for EOR are being planned in the U.S. in the absence of a carbon price. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC
11-398	A	65	35	65	36	Delete "like CCS." CCS can be competitive in special cases, such as its use for enhanced oil recovery (EOR). CCS projects for EOR are being planned in the U.S. in the absence of a carbon price. U.S. Government (Government of U.S. Department of State)	See 11-397
11-399	A	66	7	0	0	Figure 11.8 misses some information (for instance, what is expressed along the Z-axis, I.e. the third dimenseion) and even with the explanatory note, the figure is hard to understand. Please give further clarification. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC
11-400	A	67	17	67	17	Suggest adding in a sentence on the importance of taking into account finance and investment considerations in the design and analysis of technology push and pull approaches. As mentioned above 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 monitising 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, Chatham House; UK Business Council for Sustainable Energy)	ACC
11-401	A	68	3	68	3	There is an error in this table on the line for the cement industry. A 1.2% retirement rate is equivalent to an 83 year, not a 50 year, average lifetime. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC, but table compacted
11-402	A	68	3	68	3	There is an error in this table on the line for the cement industry. A 1.2% retirement rate is equivalent to an 83 year, not a 50 year, average lifetime. U.S. Government (Government of U.S. Department of State)	See 11-401

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-403	A	68	22	0	0	The HaDuong et al. study is now widely discredited. Indeed, even Minh's PhD thesis reaches the opposite conclusion. (Richard Tol, Economic and Social Research Institute)	REJ. Reviewer produces no evidence or citation to justify his remark, and his claim about HaDuong thesis is factually wrong and verified with HaDuong.
11-404	A	68	24	0	0	Van Vuuren is a numerical study, that by definition cannot lead to unambiguous conclusions. (Richard Tol, Economic and Social Research Institute)	ACC. In this context, delete “unambiguous”. (though some mathematical framings suggest that the conclusion is unambiguous).
11-405	A	69	39	69	51	linked to the preceding comment, note the importance of analysis of the main elements which are actually driving the switch in investment, 'on the ground'. (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	ACC
11-406	A	70	17	0	0	There are a whole bunch of studies following on Pindyck, all with more realistic models. (Richard Tol, Economic and Social Research Institute)	Section deleted for reasons of space
11-407	A	70	29	0	0	Ulph and Ulph, and Ulph and Maddison show that the above conclusions are reversed if there are multiple decision makers. (Richard Tol, Economic and Social Research Institute)	Section deleted for reasons of space
11-408	A	70	31	0	0	Mori 2006 is not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC
11-409	A	71	12	0	0	Shukla 2006 and Jiang 2006 are not included in the list of references (Section 11.10). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC
11-410	A	73	6	73	19	See also Kemfert, C.: International Climate Coalitions and trade - Assessment of cooperation incentives by issue linkage, In Energy Policy, 2004, Volume 32, Issue 4, pp. 455-465; and Kemfert, C., Lise, W., Tol, R.: Games of Climate Change with International Trade, in: Environmental and Resource Economics, 28, 2003, pp. 209-232 (Claudia Kemfert, German Institute for Economic Research)	TIA. Text and reference included in 11.7.6
11-31	B	73	6	73	19	See also Kemfert, C.: International Climate Coalitions and trade - Assessment of cooperation incentives by issue linkage, In Energy Policy, 2004, Volume 32, Issue 4, pp. 455-465; and Kemfert, C., Lise, W., Tol, R.: Games of Climate Change with International Trade, in: Environmental and Resource Economics, 28, 2003, pp. 209-232 (Government of Germany)	See 410
11-411	A	73	8	74	41	The GDP impact is very dependend upon assumptions made on especially capital mobility between countries and the application of JI and CDM. This can among	ACC. The IPTS reference will be included in 11.4.4 Post-Kyoto studies. However, it is not

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						other studies be seen from the study made by the EU Commissions research unit IPTS (Analysis of Post-2012 Climate Policy Scenarios with Limited Participation, June 2005. Study is included) and the study made by COWI for UNICE (Competitiveness and EU Climate Change Policy, october 2004. Study is included in the email). To be able to understand why there is such a difference in impact from survey to survey, it is recommended to present a table demonstrating some of the main assumptions made in each model estimate, especially assumptions made about capital mobility between countries, the access to JI/CDM credits and assumptions made about oil prices. It is also recommended to link the GDP - % to some illustrative measure, e.g. saying "this corresponds to the national product of a specific country or to the research budget of a specific region..." or likewise. (Helle Juhler-Kristoffersen, Confederation of Danish Industries)	possible in the time available to prepare a table as suggested.
11-412	A	73	8	74	41	The GDP impact is very dependent upon assumptions made on especially capital mobility between countries and the application of JI and CDM. This can among other studies be seen from the study made by the EU Commissions research unit IPTS (Analysis of Post-2012 Climate Policy Scenarios with Limited Participation, June 2005. Study is included) and the study made by COWI for UNICE (Competitiveness and EU Climate Change Policy, October 2004. To be able to understand why there is such a difference in impact from survey to survey, it is recommended to present a table demonstrating some of the main assumptions made in each model estimate, especially assumptions made about capital mobility between countries, the access to JI/CDM credits and assumptions made about oil prices. It is also recommended to link the GDP - % to some illustrative measure, e.g. saying "this corresponds to the national product of a specific country or to the research budget of a specific region..." or likewise. (Nick Campbell, ARKEMA SA)	See 11-411
11-413	A	73	8	74	41	The GDP impact is very dependent upon assumptions made on especially capital mobility between countries and the application of JI and CDM. This can among other studies be seen from the study made by the EU Commissions research unit IPTS (Analysis of Post-2012 Climate Policy Scenarios with Limited Participation, June 2005. Study is included) and the study made by COWI for UNICE (Competitiveness and EU Climate Change Policy, October 2004. To be able to understand why there is such a difference in impact from survey to survey, it is recommended to present a table demonstrating some of the main assumptions made in each model estimate, especially assumptions made about capital mobility between countries, the access to JI/CDM credits and assumptions made about oil prices. It is also recommended to link the GDP - % to some illustrative measure,	See 11-411

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						e.g. saying "this corresponds to the national product of a specific country or to the research budget of a specific region..." or likewise. (Jean-Yves CANEILL, EDF)	
11-414	A	73	16	73	16	The throwaway refernce to delining global energy prices needs to be explained- it seems counterintuitive-see next comment also (Andrew Dlugolecki, University of East Anglia)	REJ Issue is clearly presented
11-415	A	73	38	73	40	Please skip "…associated with the EU emissions trading scheme (ETS)…" and "….especially from a technological perspective, and…." (not correct). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC delete from text.
11-416	A	73	38	73	46	I don't see with all respect, in a an impartial report, the in-depthness in the mentioned paper. I read the paper and found that it relies more on personal judgements rather on solid scientific finding, which is reflected in the conclusion summarized in line 44. I would recommend staying away from favouring certain authors. (ALFEHAID MOHAMMED, MINISTRY OF PETROLEUM)	Noted, although the paper provides an useful review of trends in industrial competitiveness and what might affect these trends.
11-417	A	74	34	74	41	Bohringer and Rutherford use the term 'spillover effects' in a quite different ('trade/financial/economic') meaning than is usually the case (refering to technological or R&D spillovers). Hence, this different meaning should be stated clearly (or maybe even better: the section on Bohringer and Rutherford should be skipped). (Jos Sijm, Energy research Centre of the Netherlands (ECN))	REJ meaning is clear from text.
11-418	A	75	5	75	18	The argument could be accepted for the existing carbon/energy taxes, given the regime of subsidies for locally produced carbon intensive energies, but for next generation taxes that some of the OECD countries are planning to implement to comply with Kyoto Protocol has very significant effect on competitiveness. (ALFEHAID MOHAMMED, MINISTRY OF PETROLEUM)	Noted, It is not clear from the text what is being discussed. Is a $100/tC tax a policy similar to those of the Kyoto Protocol? Baron says in his findings section "These results [i.e., the empirical studies] do not provide a direct indication of the effects of carbon/energy taxation on trade patterns in energy-intensive industrial products. Indeed, taxation differs from more standard command-and-control policies applied for pollution control so far: while providing a signal to develop most economic options to reduce emissions, it also applies a permanent cost on the remaining emissions. It is therefore difficult to conclude from these past

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
							experiences. Text is re-worked. Page 12
11-419	A	75	45	75	46	Where does this conclusion come from? (ALFEHAID MOHAMMED, MINISTRY OF PETROLEUM)	ACC section deleted.
11-420	A	76	10	76	22	This seems to ignore recent experience with EU ETS- if the reason that demand declines is due to a "tax" of some kind, then in fact prices for less carbon-intensive energies will creep up, and even outside the rehgulated region, producers may be able to exact a "rent". Secondly,this analysis makes no reference to "peak oil" as a price driver. (Andrew Dlugolecki, University of East Anglia)	Partly ACC. The demand for alternative low-carbon fuels will increase, and text added to this effect. However, we are reluctant to get into the "peak oil" debate – it is not directly relevant.
11-421	A	76	46	78	15	Again this whole discussion is really not accep[table, as it ignores "peak oil" see "Half Gone" by Jeremy Leggett, 2006 for example and many other papers. (Andrew Dlugolecki, University of East Anglia)	REJ not relevant
11-422	A	76	0	77	0	This is a reiteration of my comments on the first order draft. In the SOD the problem accentuated, where still the authors of this chapter insist on using biased vocabulary when it comes to OPEC. It is more objective to address all oil producers rather than addressing only OPEC. OPEC produce around 40% which means that the majority of production does not come from OPEC, then why insisting on singling out OPEC as a bad cartel. (ALFEHAID MOHAMMED, MINISTRY OF PETROLEUM)	REJ. The text is reporting the literature discussing OPEC losses under Annex I mitigation policies and the uncertainty of these losses depending on international coalitions. There is no value judgment in the text as to whether market power is good or bad.
11-32	B	77	19	77	19	after "levels." add "" All model estimates reviewed by Barnett et al. show that OPEC countries will keep experiencing an increase of the demand for oil but that this increase will be slowed down by mitigation efforts following the Kyoto protocol." (Government of Netherlands/Ministry for the Environment)	REJ. The fact that demand for oil is increasing for OPEC, it is also true for many other commodities. This is a baseline assumption. Losses and gains are usually expressed in relation to baseline in all IPCC reports and as well as in the empirical literature. .
11-423	A	77	22	77	22	Add "Large scale expansion of global biofuels as a precautionary response to the threat of potential abrupt climate change would see their cost become the backstop at a price around $35/bbl (the switchover price for flexi-fuel cars in Brazil today)." (Peter Read, Massey University)	REJ speculative. We would need some evidence to support this conclusion, since ta very large increase in global demand for biofuels may well drive up the price.
11-33	B	78	15	78	15	after "benefit." add "Various natural resource-dependent economies (e.g. United Arab Emirates, Abu Dhabi, Dubai) have made strides to enhance non-oil industries and the creation of human capital, diversifying their economies away from oil-price fluctuations and oil-dependency. Studies find that a smaller dependence on natural resources might – next to a diminished vulnerability to demand and price shocks – also increase investment, institutional quality, a country's terms of trade, and an increase in human capital (e.g. Papyrakis and Gerlagh 2004, Gylfason 2001)."	REJ. Article is concerned with the impact on natural resource abundance on innovation, not on diversification.

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						(Government of Netherlands/Ministry for the Environment)	
11-424	A	78	27	0	0	Section 11.3 should be section 11.5. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC Change text
11-425	A	79	31	79	44	As noted in comments to other chapters, chapter 3, end of page 97 states "National policies driven by energy security concerns can, however, have strong alignment with climate goals." This is an important point to emphasise here; noting that ESMAP ("The Impact of Higher Oil Prices on Low Income Countries and on the Poor.", March 2005, ESM299) has an index to quantify the vulnerability of countries to high prices. (see also my comments to Ch1, line 17). (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	ACC; the paragraph on energy security is being developed in 11.8.
11-426	A	79	42	79	44	The wealth of new literature is on air pollution control not on employment and energy security. U.S. Government (Government of U.S. Department of State)	REJ; there is increasingly more literature on energy security and employment effects.
11-427	A	80	6	80	10	By speaking of "mismatches", you are putting a negative spin on the fact that pollution co-benefits occur NOW. The mismatch is a good thing (we get some immediate benefits from emission reduction), so I would re-orient this discussion in a positive way. (Danny Harvey, University of Toronto)	Accepted. Replace 'mismatches' for 'differences' However, there are important differences of the temporal and spatial scales between air pollution control and climate change mitigation.
11-428	A	80	35	0	46	I suggest a slight rearranging and rephrasing of the two first paragraph in 11.8.1.2 (for instance the mentioning of primary emissions versus precursor emissions is a bit confusing): Epidemiological studies have identified consistent associations between human health (mortality and morbidity) and the exposure to fine particulate matter and ground-level ozone, both in industrialized and developing countries (WHO, 2003; HEI, 2004). Because burning of fossil fuels is linked to both climate change and air pollution, lowering the amount of fuel combusted will lead to lower carbon emissions as well as lower health and environmental impacts from reduced emissions of air pollutants and their precursors. Since the TAR, an increasing number of studies have demonstrated significant benefits of carbon mitigation strategies not only from improved local air quality in cities, but also from reduced levels of regional air pollution – affecting a larger share of the populations and resulting from lower levels of secondary air pollutants'. Although the literature employs... (as before)	Accepted. The text suggested in clearer that the original. The word local should be erased from the proposed second paragraph change: "from improved <u>local</u> air quality in cities, but also from reduced levels of regional air pollution"

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						(Kristin Aunan, Center for International Climate and Environmental Research - Oslo (CICERO))	
11-429	A	81	14	0	0	Please add: However, basic principles also suggest that the same positive health and environmental effects can be acheived at a much lower costs by environmental and health policies, rather than by climate policy. (Richard Tol, Economic and Social Research Institute)	REJ: Irrelevant. This section is on co-benefits of mitigation policy. However new text added to cover explicitly the point that air pollution policies may be easily adjusted
11-430	A	83	1	0	0	Check table 11.20: The references given in first column are not precise all of them (e.g Canton- Caton and Constable, 2000, Burtaw et al, 2003, Aunan et al. 2004 (Kristin Aunan, Center for International Climate and Environmental Research - Oslo (CICERO))	Accepted
11-431	A	83	1	85	1	Table 11.20 has been splitted into Portrait and Landscape pages. (Muhammad Latif, Applied Systems Analysis Group)	Not in our copy! Accepted in any case
11-432	A	83	1	83	0	Table 11.20 - Add footnotes to explain why there are no reported carbon dioxide reductions when there is a carbon price reported by Burtraw (2003), Aunan (2004), and Kan et al. (2004). What is included in health benefits by each author? Also convert all currencies to US$ and report the exchange rate and year of conversion. U.S. Government (Government of U.S. Department of State)	Done as far as practical.
11-433	A	84	1	0	0	Table 11.20: Health benefits column for Vennemo et al 2006: Delete 34 so that the figure is 15-75 USD/tC (Kristin Aunan, Center for International Climate and Environmental Research - Oslo (CICERO))	Accepted
11-434	A	84	5	84	10	Why is for Germany only Baden Württemberg included (Fichtener et al)? It is not representative for Germany (Claudia Kemfert, German Institute for Economic Research)	REJ; The referred study refers to Baden-Wuerttemberg only. The chapter includes provincial studies also for other countries (China!), even if the findings might not be fully transferable to the national scale.
11-34	B	84	5	84	10	Why is for Germany only Baden Württemberg included (Fichtener et al)? It is not representative for Germany (Government of Germany)	Same comment as 11-434A
11-435	A	87	37	87	44	What does such a potential refer to here? Do the economic welfare benefits in this paragraph also account for health benefits? U.S. Government (Government of U.S. Department of State)	TIA; It refers to the potential for no-regret measures. Text changed to: "Such *potential for no regrets measures in* developing countries is consistently confirmed

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							by studies applying a general equilibrium modelling approach, which takes into account economic feedbacks within the economy."
11-436	A	88	44	0	0	Eickhout and colleagues show that climate policy would reduce biodiversity in Europe (through biomass and biofuels). (Richard Tol, Economic and Social Research Institute)	This depends on how biomass is grown. Negative impacts on biodiversity can be expected if natural ecosystems are converted for this purpose, but not if present agricultural land is used for biomass production (as it is mainly done in Europe today).
11-437	A	88	53	90	0	Section 11.8.1.5 needs to be written around Table 11.20. Is Syri (2001) same as Syri (2002)? EIA (1999) same as EIA (1998)? The material covered in this section also seems to be covered in Section 11.8.1.2 Co-benefits for Human Health. Consider combining the two because of the large overlap in cited literature. U.S. Government (Government of U.S. Department of State)	TIA; Considered in the rewriting process of the final draft
11-35	B	90	5	90	0	Section 11.8.1.7 - This section reports only the literature on tradeoffs without that on synergies. Need to include the latter. U.S. Government (Government of U.S. Department of State)	ACC; We need to cite references looking at synergies, not only at trade-offs. Introduce in the first sentence after mentioning the synergies the following references: (Canton 2000, Han, 2001; Van Vuuren 2006) – or some more from the table.
11-438	A	90	6	90	6	As per preceding comment, energy security issues given their current importance could usefully be highlighted in the introduction to this section 11.8.1.6, it appears to primarily emphasise air pollution, with energy security only using an example based around a statistics for Germany under 11.8.2 (page 92). (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	TIA; The paragraph on energy security has been considerably expanded. Given that, subsection 11.8.1.6, which is currently focused on of GHG and AP only., will include integrated approaches with energy security and other policies, such as employment. This subsection will be moved toward the end of the section, under 11.8.3. (To me that's a matter of taste. If you think that this is ok, its fine with me. However, we

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							should maintain the visibility and practical importance of an integration with air pollution control -- Yes, but we should include the other issues in there, especially energy security. The bulk however will be focused on AP and GHG)
11-36	B	90	34	90	30	Delete first and third paragraph. Much of it has already been said above. U.S. Government (Government of U.S. Department of State)	TIA; this comment refers to the Technical Summary, not Ch.11
11-37	B	90	36	90	36	This is a very important caveat to the model studies of induced technological change that needs to be retained in future drafts. U.S. Government (Government of U.S. Department of State)	TIA; this comment refers to the Technical Summary, not Ch.11
11-38	B	90	37	90	39	These two sentences may be deleted. They repeat the substance of the first sentence. U.S. Government (Government of U.S. Department of State)	REJ;. The two sentences add substance. The first makes the specific case for AP and GHG. The second sentence shows that co-control can also increase emissions… they both add to the first sentence.
11-39	B	91	30	91	31	The projection of the health effects of reduced air pollution is not as certain as implied by this sentence. Change the beginning of the sentence to "This is projected to result in the prevention …" to indicate that these are modeling results with all the uncertainty that such results imply. U.S. Government (Government of U.S. Department of State)	REJ; the comment is the same as TS-1380 – it corresponds to the TS.
11-439	A	91	35	91	35	Change "Bio-fuels are considered" to "Bio-fuels from sustainably-grown biomass are". Bio-fuels are carbon neutral only if the biomass they use is replaced and their growth does not involve the depletion of soil carbon. Meeting these two criteria is the definition of sustainably grown biomass. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	ACC;
11-40	B	91	35	91	35	Change "Bio-fuels are considered" to "Bio-fuels from sustainably-grown biomass are". Bio-fuels are carbon neutral only if the biomass they use is replaced and their growth does not involve the depletion of soil carbon. Meeting these two criteria is the definition of sustainably grown biomass. U.S. Government (Government of U.S. Department of State)	Same as 11-439A
11-440	A	91	36	91	36	replace "decarbonisation" with "defossilization" [sustainably produced biofuels are renewable carbonaceous fuels which is why their adoption involves a much reduced 'stranded assets' problem compared with other renewable sources of energy and makes moder bionergy an important bridging technology] and before "combustion"	REJ; Although "defossilization" is a more rigorous term than "decarbonisation", the latter is widely used and accepted in the scientific

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						insert "traditional" (Peter Read, Massey University)	community. Tech note: changing would require checking all the report…
11-441	A	91	43	91	43	before "biomass combustion" insert "traditional" (Peter Read, Massey University)	ACC;
11-442	A	91	46	0	0	I think the reference to Smith et al 2004 is wrong (climate impacts are not mentioned in the Burden of Disease report as far as I can see). Alternative references are Rufus D. Edwards, Kirk R. Smith, Junfeng Zhang, Yuqing Ma, 2004. Implications of changes in household stoves and fuel use in China Energy Policy 32 (2004) 395–411, and Kirk R. Smith, R. Uma, V.V.N. Kishore, Junfeng Zhang, V. Joshi, and M.A.K. Khalil, 2000. GREENHOUSE IMPLICATIONS OF HOUSEHOLD STOVES: An Analysis for India. Annu. Rev. Energy Environ. 2000. 25:741–63 (Kristin Aunan, Center for International Climate and Environmental Research - Oslo (CICERO))	ACC; the reference will be changed in the revised text, thanks for the observation
11-443	A	91	46	91	47	I suggest to add also for biomass, as later is done for ethanol abd biodiesel . "On he opposite, combustion of biomass in medium to large installaion with stringent air quality measures would avoid a substantial part of toxic emissions, sometimes also with increases in efficiency". (Stefano Caserini, Politecnico di Milano)	TIA; revised text of lines 48-50: "On the opposite, controlled combustion of biomass with stringent air quality measures would avoid a substantial part of toxic emissions, sometimes also with increases in efficiency, while ethanol and biodiesel can be produced from biomass in medium to large industrial installations with air quality control measures that prevent negative health impacts".
11-41	B	92	1	92	15	It is worth mentioning in this paragraph that some countries' (e.g. US') regulations will soon require both light- and heavy-duty diesel to meet stringent emission standards, significantly ameliorating concern about health effects of diesel engines. U.S. Government (Government of U.S. Department of State)	TIA; insert the following text at the end of line 15 "Although both the US and the EU are moving to very stringent emission standards for diesel engines, their adoption by the rest of the world is often delayed by years."
11-42	B	92	6	93	0	Section 11.8.2: California has also completed a recent study that shows employment gains from state greenhouse gas emission controls. See M. Hanneman	TIA; the study will be checked and a reference to it

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						and A. Farrell (eds.), Managing Greenhouse Gas Emissions in California, U.C. Berkeley California Climate Change Center Report U.S. Government (Government of U.S. Department of State)	inserted at the end of the first para. Of p93 (**LAC**)
11-444	A	92	16	92	16	Add "11.8.1.10a Potential abrupt climate change //New line// The holistic greenhouse gas management strategy mentioned in Chapter 2 section 2.3.4....." [[NB I believe that this section in Chapter 11 is the most appropriate location for that material if it is not accepted for inclusion in Chapter 2]] ".....constitutes an integrated strategy involving the agriculture, forestry and energy sectors in a concerted biosphere management programme that extracts CO2 from the atmosphere through increased biomass production, extracts commercial energy and stores part of the carbon out of the atmosphere. Shifting oil company investments 'from drilling to tilling' this strategy delivers sustainable rural development in the 'South' and additional farm income in the 'North', as well as increasing energy security and improved prospects of avoiding dangerous climate change. (Peter Read, Massey University)	REJ; this discussion is not appropriate for this section
11-43	B	92	17	92	0	Section 11.8.1.11 - The three examples cited in this section are not examples of practical applications. They are more studies not implemented discrete projects. Either explain their inclusion better, add other examples, or change the first sentence to note that this remains in the study phase. U.S. Government (Government of U.S. Department of State)	TIA While not fully implemented projects, they are examples of regulations that take into account the synergies between GHG mitigation and other policies. In this sense they are very different from the previous studies. Add the following text at the end of line 19 p92 “ The realization of co-benefits has moved beyond a notion or an analytical exercise “and is actually reflected increasingly in national regulations and international treaties”
11-44	B	93	15	93	19	What is the labor intensity per unit of capital investment? Is it also higher meaning that a unit of capital investment produces more employment opportunities? This would be a more relevant indicator of productivity otherwise renewable energy becomes a job creation program which should be compared on its own merits. U.S.	REJ; the sentence is clear as it is now. Labor intensity is not an indicator of productivity.

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						Government (Government of U.S. Department of State)	
11-445	A	93	20	93	21	The sentence on GHG mitigation and energy security is not fully correct as GHG mitigation may also have adverse effects on energy security. More generally, giving the importance and recent popularity oof the topic on the interaction between energy security and slimate policy, the attention addressed to this topic in section 11.8.2 is far too short (only one sentence of 16 words!). For additional information on this topic, see among other: (i) Dieter Helm (2005): The Assessment: The New Energy Paradigm, Oxford Review of Economic Policy, Vol 21, No.1, pp. 1-19, (ii) Hal Turton and Leonardo Barreto (2006) Long term security of energy supply and climate change, Energy Policy, Vol 34, pp. 2232-2250, and (iii) William Blyth and Nicolas Lefevre (2004), Energy Security and Climate Change Policy Interactions, IEA Information Paper, Paris. (Jos Sijm, Energy research Centre of the Netherlands (ECN))	ACC; there is a new paragraph on energy security. Thanks for the references.
11-446	A	93	20	93	21	"The comments on the effects of GHG mitigation on energy security can be extended. The linkage between security of energy supply and climate change mitigation is a very important issue. Specifically, the synergies and trade-offs between these two policy objectives are relevant to decision makers. These interactions will affect the technological paths that energy systems will follow in the future. Turton and Barreto (2006) have examined the trade-offs and synergies between supply security, climate change mitigation and technology-specific policies that promote the use of indigenous resources. Their analysis has shown that the nature of synergies and trade-offs between security of energy supply policies and climate change mitigation policies depend, in part, on the strength of the GHG abatement policy signal. If a stringent GHG mitigation policy is pursued, then it also achieves many of the objectives of a security of supply policy with respect to oil, indicating that some strong synergies exist between these two policies in some areas. However, these synergies appear directional in the sense that cheapest way to achieve security of supply does not improve GHG emissions, but the cheapest way of achieving deep cuts in emissions does improve security of oil supply. By contrast, although there are positive synergies between a less stringent abatement policy and a supply security policy, there is still a significant additional cost associated with achieving both policy goals compared to a single goal, indicating that these synergies are weak. This implies there is a threshold level of abatement above which greenhouse policies begin to promote oil security. In contrast, gas supply security was not improved significantly by either of the GHG abatement policies examined in their study, and appears to involve a greater trade-	TIA; The paragraph on energy security will be considerably expanded . Thanks for the discussion and the references.

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						off under the more stringent abatement policy, mainly because of the lower emissions intensity of this fuel. Huntington and Brown (2004) have conducted analyses that suggest that if individual countries or regions pursue policies to enhance their security of energy supply, this could lead to a so-called ”how” inefficiency in climate change mitigation. That is, a country or region could try to reduce the consumption of those primary energy resources for which its dependence on imports is larger, rather than those that are more carbon-intensive . References: 1. Turton, H., and L. Barreto, 2006: Long-term security of energy supply and climate change. Energy Policy 34, 2232-2250. 2. Huntington, H.G., and S.P.A. Brown, 2004, Energy Security and Global Climate Change Mitigation, Energy Policy 32, 715-718. (Leonardo Barreto, Paul Scherrer Institute)	
11-45	B	93	20	93	21	Energy security may be enhanced by mitigation options in many ways including reduced dependence on oil imports, diversified fuel mix, better utilization of indigenous sources, etc. Please cite additional sources here. U.S. Government (Government of U.S. Department of State)	TIA; The paragraph on energy security will be considerably expanded.
11-46	B	94	1	94	47	It is not clear as to what this paragraph has to do with mitigation. Roads get rougher and hence fuel efficiency declines in Alaska? Is opening of the northern passage a mitigation strategy? U.S. Government (Government of U.S. Department of State)	None of these are mitigation strategies, pre se, but the impacts of climate change on mitigation activities.
11-447	A	94	11	0	0	Please add: In a series of papers, Tol and co-authors show that emission reduction may well increase vulnerability to climate change. In another series of papers, Roson and colleagues estimate the impact of climate change on greenhouse gas emissions. (Richard Tol, Economic and Social Research Institute)	Actual reference requested...
11-448	A	94	15	0	36	This section is incomplete. There are also substantial positive impacts of climate change on energy supply, particularly wind and biomass. There are also substantial impacts on energy demand. (Richard Tol, Economic and Social Research Institute)	References requested and some included.
11-449	A	94	30	94	36	Nuclear energy is also exposed to climate change, with respect to water for cooling if the water source is vulnerable. (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	Reference made.
11-450	A	94	30	94	36	An issue which has been ignored is the vulnerability of nuclear power plant to shortages of cooling water, and high ambient temperatures during heatwaves- this has been witnessed in 2003 and 2006 in EU , and will rise. (Andrew Dlugolecki, University of East Anglia)	Accepted

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11-47	B	94	30	94	0	Section 11.9.1 - Weak section. Needs to focus on mitigation and adaptation overlap such as cool roofs technologies that reduce ozone formation, electricity use, and CO2 emissions, and tree planting. In each sector, there can be strategies that complement, and/or conflict and require tradeoffs. WG II has a whole chapter on this (Chapter 18). This section should dovetail with material in that chapter. U.S. Government (Government of U.S. Department of State)	ACC and TIA: text revised. The reference to WG2 is given at the head of the section.
11-451	A	94	40	94	47	In coastal areas both climate extremes and increasing means will create higher exposure for transport infrastructure in the future. (Government of Sweden)	Accepted
11-48	B	94	40	94	36	Chapeau material. Need to cite references. U.S. Government (Government of U.S. Department of State)	Accepted
11-452	A	95	13	95	14	an important penetration of low-cost air conditioning already happened in Europe, in particular during and after the heat waves of 1-14 august 2003 (Stefano Caserini, Politecnico di Milano)	OK
11-49	B	95	15	95	22	This text should reflect the point made in Section 7.8, that industry is vulnerable not only to the direct impacts of climate change, but to changes in government policy or consumer preference that will result from climate change. Industry can adapt to these vulnerabilities by changing its processes or product slate to reduce GHG emissions. U.S. Government (Government of U.S. Department of State)	see 11.454
11-453	A	95	17	95	18	I query that industry designs for extreme events, based on insurance industry experience of that sector, Rather, it is the case that until now extremes have been rare, and other factors are much mor edominant in business success (Andrew Dlugolecki, University of East Anglia)	Reworded.
11-454	A	95	25	95	22	This text should reflect the point made in Section 7.8, that industry is vulnerable not only to the direct impacts of climate change, but to changes in government policy or consumer preference that will result from climate change. Industry can adapt to these vulnerabilities by changing its processes or product slate to reduce GHG emissions. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Rejected. Irrelevant.
11-455	A	96	5	96	6	This, in particular the footnote, need checked. My understanding is that biomass renewable energy projects, using planted fuel wood/residues, are permitted under CDM, if substituting for thermal fuel sources ie against a fossil energy baseline. It may not be possible to count it against a non-renewable biomass baseline. (Kirsty Hamilton, Chatham House; UK Business Council for Sustainable Energy)	Rejected. Only quoting a decision of the CoP.
11-50	B	96	10	96	13	Please explain what "This mitigation strategy…" refers to here. U.S. Government	Accepted

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						(Government of U.S. Department of State)	
11-456	A	96	16	96	16	Please, correct the reference as "Moreira, 2006"; "Moreira, J.R., 2006; Global Biomass Energy Potential, Journal of Mitigation and Adaptation Strategies for Global Change, 11, 313-333" (Jose Roberto Moreira, Institute of Electrotechnology and Energy, University of Sao Paulo-IEE-USP)	Accepted
11-457	A	96	31	0	0	Perhaps the most important, and certainly the best quantified interaction between adaptation and mitigation is in the area of public health. See the papers by Tol, Tol and Dowlatabadi, and Tol and Yohe. (Richard Tol, Economic and Social Research Institute)	Accepted
11-458	A	97	20	97	20	reference cited in my comment on chapter 11, page 47, line 37: Ackerman, F., and I. Finlayson, 2006. "The Economics of Inaction on Climate Change: A Sensitivity Analysis," Climate Policy, in press. [note to editors: copy available on request from Frank.Ackerman@tufts.edu] (Frank Ackerman, Global Development and Environment Institute, Tufts University)	Accepted
11-459	A	97	23	97	26	The author names are wrong. "Tomodaa -> Tomoda" and "Fujiib" ->"Fujii" (Shunsuke Mori, Tokyo University of Science)	Accepted
11-460	A	97	23	97	23	"Tomodaa" and "Fujiib" should be changed to "Tomoda" and "Fujii", respectively. (Keigo Akimoto, Research Institute of Innovative Technology for the Earth (RITE))	Accepted
11-461	A	97	26	97	26	The same literature as the above, and therefore should be deleted. (Keigo Akimoto, Research Institute of Innovative Technology for the Earth (RITE))	Accepted
11-51	B	103	49	103	49	add "Gylfason, T. (2001), “Natural resources, education, and economic development”, European Economic Review, 45, 847-859" (Government of Netherlands/Ministry for the Environment)	Accepted
11-462	A	107	21	0	0	2005->2006 Masui, T., G. Hibino, J. Fujino, Y. Matsuoka and M. Kainuma, 2006: Carbon dioxide reduction potential and economic impacts in Japan: application of AIM, Environmental Economics and Policy Studies, 7(3), pp. 271-284. Table 3 of that paper is source. (Mikiko Kainuma, National Institute for Environmental Studies)	Accepted
11-463	A	107	44	107	49	References: Meyer and Lutz is doubled (Claudia Kemfert, German Institute for Economic Research)	Accepted
11-52	B	107	44	0	0	References: Meyer and Lutz is doubled (Government of Germany)	Accepted

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
11-464	A	108	5	108	5	Please, correct the reference as "Moreira, J., 2006; Global Biomass Energy Potential, Journal of Mitigation and Adaptation Strategies for Global Change, 11, 313-333. (Jose Roberto Moreira, Institute of Electrotechnology and Energy, University of Sao Paulo-IEE-USP)	Accepted
11-53	B	108	51	108	51	add "Papyrakis, E. and Gerlagh, R. (2004), "The Resource Curse Hypothesis and Its Transmission Channels", Journal of Comparative Economics 32, 181-193" (Government of Netherlands/Ministry for the Environment)	Accepted
11-465	A	109	38	109	43	One and the same reference appears twice. (Leo Schrattenholzer, IIASA)	Accepted
11-466	A	111	17	0	0	I notice that my work is not referred to at all -- although I did publish papers on the costs of emissions, technological change and emission reduction, policy instruments for emission reduction, and the interactions between adaptation and mitigation -- all since the TAR, and most in readily accessible journals. I guess this is a response to my earlier, critical remarks. Tol, R.S.J. (forthcoming), 'Multi-Gas Emission Reduction for Climate Change Policy: An Application of FUND', Energy Journal. Schwoon, M. and R.S.J. Tol (forthcoming), 'Optimal CO2-abatement with socio-economic inertia and induced technological change', Energy Journal, 27 (4), 25-60. (Q540) Tol, R.S.J. and G.W. Yohe (2006), 'Of Dangerous Climate Change and Dangerous Emission Reduction' in H.J. Schellnhuber, W. Cramer, N. Nakicenovic, T. Wigley and G. Yohe (eds.), Avoiding Dangerous Climate Change, Cambridge University Press, Cambridge, Chapter 30, pp. 291-298. Tol, R.S.J. (2005), 'An Emission Intensity Protocol for Climate Change: An Application of FUND', Climate Policy, 4, 269-287. Tol, R.S.J. (2005), 'Emission Abatement versus Development as Strategies to Reduce Vulnerability to Climate Change: An Application of FUND', Environment and Development Economics, 10, 615-629. Tol, R.S.J. (2005), 'Adaptation and Mitigation: Trade-Offs in Substance and Methods', Environmental Science and Policy, 8 (6), 572-578. Tol, R.S.J., R.J. Heintz and P.E.M. Lammers (2003), 'Methane Emission Reduction: An Application of FUND', Climatic Change, 57 (1-2), 71-98. Tol, R.S.J. and H. Dowlatabadi (2001), 'Vector-borne Diseases, Climate Change, and Economic Growth', Integrated Assessment, 2, 173-181. (Richard Tol, Economic and Social Research Institute)	References added where appropriate. Several of these references came too late to be included in the FOD and SOD.