WMO

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

UNEP

IPCC Fourth Assessment Report

Expert/Government Review of the Second-Order Draft

Chapter 10

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
10-1	A	0	0	0	0	It has been noted that the issue of uncertainty is not addressed in this chapter and that the figures provided in the text are not followed by uncertainty eventhough this is a scientific document. I would suggest that you reconsider the original documents/reports and see whether uncertainties are provided and if this is not the case, say something about that, since saying this is also a part of the "Assessment" of available information. In this context, I'm not sure whether you could use an expert judgment to provide a range of uncertainties. (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Accepted. We will add a paragraph explaining the issue of uncertainty, noting that many of our sources do not address this directly.
10-2	A	0	0	0	0	I find it useful to harmonize the use of the terminology "mitigation of GHG" or "mitigation of GHG emissions" used interchangeably throughout the text. Which one is more appropriate in the context of the AR4? It may also be useful to include the appropriate term in the glossary. Does "mitigation" include only "reduction in emissions" or also "reduction of number of gases that could potentially be emitted by a particular waste management practice?" I think both. (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Accepted. “Mitigation of GHG emissions” is the preferred phrase.
10-3	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). Although it obvious from the text that the authors are very well aware of it, I suggest that the need to assess GHG fluxes rather than simply focus on emissions reductions be brought to the attention of readers by a footnote on page 4. Unfortunately time constraints prevent me from providing the detailed comments on this Chapter that I had hoped for, so, beyond that footnote, the relevance of waste management to the holistic strategy discussed in my Commentary and briefly described in proposed Chapter 2 new section 2.3.4, is mentioned in proposed new material on page 33. (Peter Read, Massey University)	Noted. This does not appear to relate significantly to Chapter 10 issues. To be dealt with in Chapter 2 as per TSU direction.
10-4	A	0	0	0	0	Please see my Commentary titled "Addressing Potential Abrupt Climate Change"	Noted. This does not appear to relate

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						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). Although it obvious from the text that the authors are very well aware of it, I suggest that the need to assess GHG fluxes rather than simply focus on emissions reductions be brought to the attention of readers by a footnote on page 4. Unfortunately time constraints prevent me from providing the detailed comments on this Chapter that I had hoped for, so, beyond that footnote, the relevance of waste management to the holistic strategy discussed in my Commentary and briefly described in proposed Chapter 2 new section 2.3.4, is mentioned in proposed new material on page 33. (Peter Read, Massey University)	significantly to Chapter 10 issues. We will review this in the light of the Chapter 2 proposed section 2.3.4 when available. (Replicate comment to 10-3).
10-5	A	0	0	0	0	THE DESIGN OF "DRY TOMB" LANDFILLS ARE FUNDAMENTALLY FLAWED. The draft focuses on landfills, and gas collection and energy recovery from landfills, concluding with this sentence, repeated on p. 10 and elsewhere, asserting that "landfilling is expected to continue as the dominant method for large scale waste disposal" in N. America, Austrialia and New Zealand. No basis is provided for simply extrapolating the past into the future. In view of the fact that it is only landfilling of discarded organic matter that generates methane, and in further view of the fact that the only citation in the draft (P. 19/L. 25) to real world long term gas collection efficiency may be as low as 20%, it would seem that the IPCC would not want to ratify and encourage a continuation of a past practices that is responsible for approximately 10%, not 2-3%, of anthropogenic GHGs, without a providing a basis for doing so. Presumably, reliance is placed on the fact that landfilling will remain dominant -- separate from their appropriateness for managing decomposable discards -- becuase they cost less. But, in view of the fatal design flaw, the question must be answered with facts whether that price advantage only arises due to a market distortion from major externalities. Specifically, a serious review should address the fact that the entire basis for liner-based landfills	Taken into account. Chapter 10 cites published literature relating to landfill gas collection efficiencies. This level of detail is beyond the scope of this chapter. We will seek a reference for the sentence “landfilling is expected to continue as the dominant method for large scale waste disposal" in N. America, Austrialia and New Zealand”.

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						has been found to be fatally flawed. USEPA has repeatedly acknowledged that the liner and collection systems will "ultimately fail," which means pollution has only been postponed, not prevented, 46 Federal Register 11128-11129 (February 5, 1981).The Agency's Inspector General has interviewed the staff who wrote the regulations and found that they were not based on science but rather on the need to keep costs low. Office of the Inspector General, RCRA Financial Assurance for Closure and Post-Closure (2001-P-007) (March 30, 2001), at pp.33-34. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	
10-6	A	0	0	0	0	GAS COLLECTION SYSTEMS ARE INEFFECTIVE. On pages 3, 15 and 19, the conclusion is stated that landfill gas collection is effective. Although there is extensive reference to theoretical, best case constructs that, for example, by ignoring major times of gas emissions when there is no functioning gas collection system, postulate very high capture rates, the only citation in the draft to real-world long term conditions states on p. 19, line 25, that "'lifetime' recovery efficiencies may be as low as 20%" (Oonk and Boom, 1995). Moreover, only the Oonk and Boom analysis conforms with the UNFCC+K5 protocols that refer to long term impacts not the instantaneous rate of best case system while up and functioning. In additon, the fact that the conversion of CH4 to CO2 as 23 times is calculated over a 100 year time frame. Were a one year time frame used, the conversion might be more than 400 times. A decision needs to be made whether the only waste management approach that produces methane of concern, and for which real-world abatement is extremely poor leaving most of the methane to be released, should be given such prominance, and, indeed, whether they should be discouraged instead. Similar statements such as (P. 7/L. 35) "There is no single best option..." needs to be modified to reflect whether the landfill option is the worst option. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	Noted. Chapter 10 cites published literature relating to landfill gas collection efficiencies.
10-7	A	0	0	0	0	Other issues that possibly might be given attention in the text are: Flaring versus electricity generation from an economic perspective, end-of-pipe solutions on recycling projects, the impact of national waste management schemes, the acceptability and regulatory issues about transport of upgraded landfill gas in pipelines and purchasing of landfill gas or electricity generated by landfills by utilities, as well as issues related to export of waste. (Expert Review Meeting Paris, IPCC)	Accepted. This will be discussed in the text. Individual's comments pertaining to these issues will be separately discussed.
10-8	A	0	0	0	0	Overview: Much of this chapter is quite excellent and shows technical sophistication. It is clearly and well written and very informative. However, we have a few major disagreements with the overall presentation. Policies to avoid	Taken into account. The text will be expanded to address the reviewer's comments to the extent possible.

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						disposal of organics into landfill and support composting need to be promoted. Overview: The document is overly landfill oriented, which is disappointing because landfill gas recovery is slow and financial incentives are too delayed to motivate most political leaders (who have short term agendas for reelection). Economic instruments that support composting are urgently needed to enable national and international facilitation to farmers that can not otherwise afford to cover the cost difference between landfill and compost and to governments that wish to improve vast tracts of unproductive government land . These instruments should be designed to recognize the externalities of destroying pathogens from human fecal matter, manures, carcasses, etc., and returning good quality organic materials to the earth for soil amendment, as well as reducing green house gases. IPCC's lack of recognition for the role of compost in fully avoiding methane generation in the immediate term is a major policy flaw. Application of the decay model to compost is detrimental to progress in carbon finance and green house gas reduction in the waste management sector, unless the rules for fully accelerated (i.e., immediate) decay and full capture of gasses are addressed. It is disappointing that there is not greater support for the amount of greenhouse gas to be avoided through recycling and related energy offsets in product manufacturing and feedstock mining or production avoidance. Further, substantial important benefits in the waste management sector could come from fleet changes to renewable fuels and support for transfer systems, collection frequencies and route rationalization efforts that could dramatically reduce collection fleet fuel consumption with immediate results. Refuse collection fleets, like bus fleets, are uniquely viable for renewable energy fuels because they can be fueled at fleet-dedicated stations and refuse fleets can be fueled by CNG and LNG from landfill gas at the landfills. The work done does not think adequately outside the box for solutions that yield immediate methane avoidance, as opposed to landfill. Also, landfill needs quite good operation to yield high level methane capture and most developing countries will not be able to maintain good operation. Other measures, such as composting and recycling, are much easier for them to operate. Incineration is not technically viable for developing country waste, can not possibly be operated properly in most developing countries, and costs about 10 times more than landfill when proper air pollution control requirements are met. We disagree entirely with the document's emphasis that incineration is a viable alternative, and statements that thermal proceses can provide complementary short term mitigation. No fossil fuel reduction will occur from incineration in developing countries, because the waste calorific	

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						value is not self-sustaining. Numerous Bank studies have examined this in every region of the world. Only a few ECA and China cities are on the borderline of self-sustainability --- but NOT fossil fuel reduction. We ask the authors to show us ONE developing country city that is selling surplus energy from a municipal waste incinerator that meets EU standards for air pollution control. (Sandra Cointreau, World Bank)	
10-9	A	0	0	0	0	Throughout Chapter 10, landfill gas collection and utilization is described as an effective method to reduce GHG emissions. The Executive Summary presents it as proven and affordable technology, and Section 10.4.2 describes its effectiveness favorably. Only passing mention is made of the fact that significant fugitive (uncollected) emissions occur due to lifetime landfill gas recovery efficiencies as low as 20% (page 19, line 27). Yet these two deficiencies (low lifetime collection and fugitive emissions) in landfill design and operation are critical to understanding the long-term emission characteristics of landfills and their inability to avoid the release of GHGs. This inability to continuously collect and manage landfill gas, which is typically 45 to 55% CH4, can exacerbate worldwide CH4 emissions not only in developed countries like the U.S. that continue to rely predominately on landfills, but especially in developing countries that turn more and more to modern landfilling techniques. The inherent nature of modern landfill design and operation results in poor lifetime gas collection and control efficiency. The modern engineered landfill is an anaerobic biological process, which, unlike most other waste management processes, is difficult to control due to its sheer size and the nature of its operational phases. Fugitive CH4 and NMVOC emissions occur during each phase of landfill development. Initially, fugitive emissions emanate from active landfilling areas prior to installation of landfill gas collection systems and impermeable covers or bio-covers. Temporary horizontal collection systems and covers can only provide for the partial capture and control of the total landfill gas generated. Bioreactors may compress the time over which landfill gas is produced, but capture of landfill gas is more difficult due to the greater proportion of gas produced during the landfilling phase, and the fraction captured is speculative. During the active gas extraction phase when landfill gas is most efficiently collected, fugitive emissions can still escape through lateral migration, leachate collection systems, and inadequate seals. Even in landfills with energy recovery, not all collected gas is utilized because the energy generation system is sized for economical performance, leaving the remaining gas to be flared. After the active extraction phase ends,	Noted. Chapter 10 cites published literature relating to landfill gas collection efficiencies.

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						landfill gas that continues to be produced is flared or vented. Lastly, landfills leave legacy issues. As an example, many Superfund sites in the U.S. were landfills. In closed landfills, fissures inevitably occur in the impermeable cover, rainwater infiltrates into the waste mass and anaerobic activity resumes, letting the landfill gas escape unabated. Landfill gas collection and utilization techniques provide only partial control of CH4 and NMVOC emissions and are subject to numerous operational limitations. These limitations, as further described in the reference for this comment (Anderson et al, to be published), should be included in the appropriate sections in Chapter 10. Reference for this comment: Anderson, P, L. Bingham, and R. Stevenson, (publication forthcoming), From Beneath the Ground: Gas from Landfills Threatens to Overheat the Earth, Center for a Competitive Waste Industry. (Brian Bahor, Covanta Energy Corporation)	
10-10	A	0	0	0	0	Life Cycle Analysis of waste management methods should be emphasized and even required as a quantitative tool to help decision-makers and policymakers evaluate the energy and environmental impacts of waste management scenarios. Life Cycle Analysis (LCA) is mentioned briefly in Section 10.1 (page 4, line 44) but not discussed in any detail. LCA is an important tool because it enables a "big picture" assessment of waste management alternatives. Less thorough evaluations that only consider short-term or best-case scenarios can yield misleading conclusions that are not beneficial to the environment. The Municipal Solid Waste Decision Support Tool, or MSW-DST, developed by RTI International and its partners in collaboration with U.S. EPA is an example of one peer-reviewed LCA that has been used by waste management professionals. The MSW-DST quantifies life cycle GHG, energy, and other pollutant emissions for specific waste management scenarios. LCA results consistently demonstrate that GHG emissions and energy consumption are negative values (the negative value demonstrates that energy is saved and environmental impacts are avoided) for waste management systems that include material and energy recovery (Thorneloe et al, 2005). When waste-to-energy is included in a scenario, it provides the maximum "negative value" for greenhouse gases and other pollutants associated with public health (SO2, NOx, CO, particulate), largely because WTE avoids more fossil fuel associated emissions than any other waste management option, including landfill gas to energy. The Executive Summary should reference the MSW-DST as a useful LCA tool and it	Taken into account. We will include additional information related to a range of LCA studies.

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						should be described further in the body of Charter 10. Reference for this comment: Thorneloe, S., K. Weitz, and J. Jambeck, 2005: Moving from Solid Waste Disposal to Materials Management in the United States, presented at the Tenth Waste Management and Landfill Symposium, Cagliari, Italy, October 3-7, 2005. Accessible at http://siteresources.worldbank.org/INTUSWM/Resources/ThorneloeA209Final.pdf (Brian Bahor, Covanta Energy Corporation)	
10-11	A	0	0	0	0	There is no reference of Indian context. There are significant data available through Tata Energy Research Institute (TERI) and National Solid Waste Association of India (NSWAI) on GHG emissions. Recently NSWAI has estimated Methane Emission from Municipal Solid Waste (MSW) in the country. (Government of India)	Taken into account. References to be consulted.
10-12	A	0	0	0	0	Please refer our newsletter on “Climate Change- Methane emission in India” which is self explanatory for the above subject. Please see our website – www.nswai.com. (Government of India)	Taken into account. References to be consulted.
10-13	A	0	0	0	0	Methane generation is mainly from rice cultivation and MSW dumping yards. Also US Govt. has stated that India is the second largest country after China in rice cultivation which contributes to significant methane generation. (Government of India)	Noted, but relates mostly to the chapter on Agriculture.
10-14	A	0	0	0	0	If IPCC default is used for such countries, its inventory reliabily will again be questionable. (Government of India)	Taken into account. To be addressed when considering uncertainties.
10-15	A	0	0	0	0	Data used for developing countries is very old as compared to the developed ones. (Government of India)	Taken into account. To be addressed when considering uncertainties.
10-16	A	0	0	0	0	Criteria to qualify for CDM (e.g. minimun energy generating capacity etc.) may be mentioned. (Government of India)	Noted. Chapter 12 discusses International Agreements and qualifying criteria.
10-17	A	0	0	0	0	Attention may be given for partially managed/ open dumping landfills as well which is more prevalent in developing economies.	Taken into account. To be addressed when considering uncertainties.

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						(Government of India)	
10-18	A	0	0	0	0	Chapter 10.2.3 Development trends and chapter 10.3.2 Regional trends. Would be of interest also to point out that the additional policy measures in EU member states are more far reaching compared to the EU landfill directive. Several countries have introduced bans on landfilling biodegradable organic waste for example Germany, Austria, Denmark, the Netherlands and Sweden. The Landfill Directive has set out to reduce land-filling of biodegradable waste to 65 % of such waste produced in 1995 by 2016 and demand capture and flaring of methane emissions, as far as possible with energy recovery. As a result 80% of previous emissions will eventually disappear as methane capture from landfills can never become 100% effective. The avoided emissions may be higher than 80%, if some Member States go beyond the EU diversion target, as is the case for example in Denmark, Germany and Austria. (Government of Sweden)	Accepted. We shall discuss country specific differences to the extent possible.
10-19	A	0	0	0	0	This chapter needs to address the implications of industrial waste management and minimization. U.S. Government (Government of U.S. Department of State)	Reject. This applies to the Industry Chapter.
10-20	A	0	0	0	0	This chapter is focused on municipal solid waste and should address the broader implications of industrial waste management and minimization . U.S. Government (Government of U.S. Department of State)	Reject. This applies to the Industry Chapter.
10-21	A	0	0	0	0	The wastewater sections need to be expanded. Emphasis seems to be on landfills. For example, the discussion on global emission trends does not mention wastewater although data are given. U.S. Government (Government of U.S. Department of State)	Accepted, to the extent that data are available. The issue of waste water data will also be discussed in relation to uncertainties and data needs.
10-22	A	0	0	0	0	The sources of data need to be more evenly discussed and referenced. The reports that are discussed in detail in this chapter are often products of or funded by one or more of the lead authors. If these are the only references this would be acceptable but in several cases, other references are not cited or are not given as much emphasis. U.S. Government (Government of U.S. Department of State)	Taken into account. To the extent possible, the chapter authors have cited all relevant literature and will expand if possible. It would have been helpful if specific references had been proposed. In no cases have reports or papers cited in this chapter been funded by the authors.
10-23	A	0	0	0	0	The purpose of the IPCC Assessment Report is to assess the current literature, not to make policy recommendations, suggest strategies or promote technologies. This chapter needs significant revisions to ensure the goal of the overall document is met. The language in this chapter should be reviewed to ensure that it is neutral.	Taken into account.

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						U.S. Government (Government of U.S. Department of State)	
10-24	A	0	0	0	0	The GHG benefits from improved waste management (recycling, waste prevention etc.) come not only from reduced energy demand, but also come from carbon storage -- both in trees from paper recycling (ie.trees not cut down due to use of recycled feedstock) and from carbon storage in soils when organic materials are recycled into compost that is applied to soils. Additionally there is the GHG reduction benefit from avoided emissions from disposal (principally methane but also fossil emissions from combustors). U.S. Government (Government of U.S. Department of State)	Noted.
10-25	A	0	0	0	0	The chapter uses units of Tg CO2e. Most of the rest of the report uses units of MtCO2-eq, which is the equivalent. It would help readers (including this reviewer) who are not as facile as the authors with these equivalences to convert to the units used throughout the rest of the report. U.S. Government (Government of U.S. Department of State)	Accepted. We will standardize according to TSU guidance.
10-26	A	0	0	0	0	Table 10.3 – move references to the bottom of the table, make title prominent. U.S. Government (Government of U.S. Department of State)	Taken into account. We will follow TSU guidance on formatting.
10-27	A	0	0	0	0	References need to be verified. There are a few places where the references are not correct for the statement. These are noted in the specific comments where appropriate. U.S. Government (Government of U.S. Department of State)	Noted.
10-28	A	0	0	0	0	Mitigation potential and cost are the among the most important outputs in this report. The chapter indicates that CH4 is the most important GHG emission from the waste management system. Table 10.6 contains a comprehensive analysis of mitigation potential and cost for CH4 in 2030 by region. This information should be summarized in the chapter's Executive Summary, and also added to Tables SPM.2 and TS.19, to provide the same information for the waste sector that is provided for other sectors. The Chapter enumerates the authors' concerns about data quality. These concerns should be noted in footnotes to tables SPM.2 and TS.19. U.S. Government (Government of U.S. Department of State)	Taken into account. Harmonization of information in SPM, TS and Chapter 10 to be addressed.
10-29	A	0	0	0	0	A reference to the BREFs "Waste Incineration (WI)" and "Waste Treatment (WT)" should be added. These documents describe the Best Available Techniques (BAT) for waste incineration and waste treatment in Europe and set ecological requirements for a high level plant performance. We propose the following	Taken into account. References and abbreviated text giving additional details on waste incineration and waste treatment will be added.

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						additional text: "Within the so called Seville-Process (European IPPC Bureau in Seville, Spain (http://eippcb.jcr.es), two Reference Documents on the Best Available Techniques (BREF) for waste incineration (WI) and waste treatment (WT) have been elaborated on the basis of the European Council directive 96/61/EC concerning Integrated Pollution Prevention and Control (IPPC). These BAT-documents set ecological requirements for a high level plant performance in Europe. The BREF WI is exclusivly dealing with thermal process of waste treatment, the BREF WT describes the non thermal ways of treatment (e.g. physical-chemical treatment, biological treatment, waste oil treatment, waste water treatment plants). Apart from the general standards (emissions values) for the media air and (waste)water, the BREF WI also contains BAT requirements for waste pre-treatment, waste storage, plant operation, energy conversion (energy efficiency) as well as on noise, odour and ash/slag quality. With these BAT repuirements the high level of waste incineration and treatment - that has been standard in some member states of the EU for a couple of years - will become a European standard for all member states. The BREFs WI and WT have been adopted in 2005 by the member states and the European Commission at the Information Exchange Forum (IEF) in Brussels." EIPPCB (2005) - European IPPC-Bureau: Reference Document on the Best Available Techniques for Waste Incineration, Seville, July 2005 (http://eippcb.jrc.es); Reference Document on the Best Available Techniques for Waste Treatment, Seville, August 2005 (http://eippcb.jrc.es) (Government of Germany)	
10-30	A	0	0	0	0	A reference to the BREFs "Waste Incineration (WI)" and "Waste Treatment (WT)" should be added. These documents describe the Best Available Techniques (BAT) for waste incineration and waste treatment in Europe and set ecological requirements for a high level plant performance. We propose the following additional text: "Within the so called Seville-Process (European IPPC Bureau in Seville, Spain (http://eippcb.jcr.es), two Reference Documents on the Best Available Techniques (BREF) for waste incineration (WI) and waste treatment (WT) have been elaborated on the basis of the European Council directive 96/61/EC concerning Integrated Pollution Prevention and Control (IPPC). These BAT-documents set ecological requirements for a high level plant performance in Europe. The BREF WI is exclusivly dealing with thermal process of waste treatment, the BREF WT describes the non thermal ways of treatment (e.g. physical-chemical treatment, biological treatment, waste oil treatment, waste water	Taken into account. References and abbreviated text giving additional details on waste incineration and waste treatment will be added. (copy of comment 10-29)

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						treatment plants). Apart from the general standards (emissions values) for the media air and (waste)water, the BREF WI also contains BAT requirements for waste pre-treatment, waste storage, plant operation, energy conversion (energy efficiency) as well as on noise, odour and ash/slag quality. With these BAT repuirements the high level of waste incineration and treatment - that has been standard in some member states of the EU for a couple of years - will become a European standard for all member states. The BREFs WI and WT have been adopted in 2005 by the member states and the European Commission at the Information Exchange Forum (IEF) in Brussels." EIPPCB (2005) - European IPPC-Bureau: Reference Document on the Best Available Techniques for Waste Incineration, Seville, July 2005 (http://eippcb.jrc.es); Reference Document on the Best Available Techniques for Waste Treatment, Seville, August 2005 (http://eippcb.jrc.es) (emissions values) for the media air and (waste)water, the BREF WI also contains BAT requirements for waste pre-treatment, waste storage, plant operation, energy conversion (energy efficiency) as well as on noise, odour and ash/slag quality. With these BAT repuirements the high level of waste incineration and treatment - that has been standard in some member states of the EU for a couple of years - will become a European standard for all member states. The BREFs WI and WT have been adopted in 2005 by the member states and the European Commission at the Information Exchange Forum (IEF) in Brussels." EIPPCB (2005) - European IPPC-Bureau: Reference Document on the Best Available Techniques for Waste Incineration, Seville, July 2005 (http://eippcb.jrc.es); Reference Document on the Best Available Techniques for Waste Treatment, Seville, August 2005 (http://eippcb.jrc.es) (Government of Germany)	
10-1	B	0	0	0	0	There are serious reservations about the projected landfill gas emissions included in Section 10.4.7. These emissions estimates are unrealistic; comparing the Monni et al global emissions to US emissions (using a Tier 2/3 FOD method) would suggest that the US emitted over half of global emissions in 1990. In addition, a peer-reviewed, comprehensive study has been published that is not referenced in this chapter: the U.S. EPA Global Mitigation of Non-CO2 Greenhouse Gases. This EPA study has undergone an expert peer-review process, is based on published EMF-21 analysis, and is comprehensive across all regions and all non-CO2 gases. U.S. Government (Government of U.S. Department of State)	Taken into account. We will discuss the differences between these two studies and an additional AEA Technology study in a comparison of the three approaches.
10-2	B	0	0	0	0	Chapter needs to be rewritten to incorporate a more balanced view of the literature	Taken into account. We would have

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						and a more complete set of references. For example, there are multiple papers available in the peer-reviewed literature that calculates global waste generation trends. Currently, only one author is cited. U.S. Government (Government of U.S. Department of State)	welcomed the information from this reviewer on the particular papers mentioned in this comment.
10-31	A	0	0	0	0	The second order draft Chapter 10 places landfilling in the dominant role for managing greenhouse gases from wastes in the future, claiming that gas collection systems are effective. This is maintained even though there is no methane in wastes. Methane only is generated when organic discards are disposed of in large lined landfills. Buried deep in the text of the report is the admission that, on a long term basis, landfill gas collection systems, which only capture approximately 20% of landfill gases, are ineffective. Moreover, none of the several competing alternative approaches for managing waste (including, in the order of the waste hierarchy, composting and waste to energy--including conversion technology) produce methane in volume. It is an incontrovertible fact that landfilling suffers from substantial negative externalities which are not given appropriate consideration in this draft. Among them is the fact that their basic design, according to the US EPA, is fatally flawed. Given the fact that these externalities are not appropriately accounted for, landfilling often enjoys an understandable cost advantage that appears to undergird the draft's bias as to the technology's future prospects and growth. If the externalities were properly accounted for, the alternatives in all likelihoody would not be more expensive than landfilling. An unbiased weighing of the data and the externalities associated with the various waste management alternatives will lead the authors to conclude that waste-to-energy is the environmentally prefered waste management technology that will best help combat global warming. NOTE: A more complete presentation of our concerns has been laid out in a separate letter that accompanies this spreadsheet. (Peter Anderson, RecycleWorlds Consulting Corp)	Taken into account. Chapter 10 cites published literature relating to landfill gas collection efficiencies. We will expand the discussion on alternatives to landfilling with additional information. Furthermore, we will pay more attention to the comparison of mitigation potential of landfilling with alternatives.
10-32	A	0	0	0	0	The introduction of a specialized chapter is a very good initiative, so as to speak directly with the relevant professionnels such as Municipal Engineers or Planners. (ANTOINE BONDUELLE, Université Lille II)	Noted.
10-33	A	0	0	0	0	The chapter uses units of Tg CO2e. Most of the rest of the report uses units of MtCO2-eq, which is the equivalent. It would help readers (including this reviewer) who are not as facile as the authors with these equivalences to convert to the units used throughout the rest of the report. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted. We will standardize according to TSU guidance (repeat of comment 10-25A)
10-34	A	0	0	0	0	Mitigation potential and cost are the among the most important outputs in this	Taken into account. Harmonization of

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						report. The chapter indicates that CH4 is the most important GHG emission from the waste management system. Table 10.6 contains a comprehensive analysis of mitigation potential and cost for CH4 in 2030 by region. This information should be summarized in the chapter's Executive Summary, and also added to Tables SPM.2 and TS.19, to provide the same information for the waste sector that is provided for other sectors. The Chapter enumerates the authors' concerns about data quality. These concerns should be noted in footnotes to tables SPM.2 and TS.19. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	information in SPM, TS and Chapter 10 to be addressed (repeat of comment 10-28A).
10-25	B	0	0	0	0	This chapter is clearly set out and succinctly answers the key questions in relation to the mitigation potential of the waste sector. The authors should consider, however, including confidence readings for their estimations of the mitigation potential of the sector. (Government of Australia)	Taken into account. Uncertainty will be addressed in the revised text to the extent possible.
10-35	A	3	1	3	47	The Executive Summary should include a description of waste-to-energy's current worldwide commercial application and GHG benefit. The current draft's Executive Summary cites the commercial status, GHG reduction, and energy recovery potential of landfills but ignores the current and potential contributions afforded by modern waste-to-energy (WTE, i.e., incineration with energy recovery). WTE is proven technology with 130 million Mg of waste combusted annually in over 600 plants in 35 countries. In 2002, European Union WTE plants generated 41 million GJ of electrical energy and 110 million GJ of thermal energy (Themelis, 2003). Life cycle analysis has shown that in the U.S. alone WTE plants have reduced GHG emissions by 11 million metric tons of carbon equivalents per year (Thorneloe et al, 2002). References for this comment: Themelis, Nickolas, 2003: An Overview of the Global Waste-to-Energy Industry, Waste Management World, 2003-2004 Review Issue, July-August 2003, pages 40-47. Accessible at http://www.seas.columbia.edu/earth/papers/global_waste_to_energy.html Thorneloe, Susan, K. Weitz, S. Nishtala, S. Yarkosky, and M. Zannes, 2002: The Impact of Municipal Solid Waste Management on Greenhouse Gas Emissions in the United States, Journal of Air and Waste Management Association, 52:1000-1011, September 2002. Accessible at http://www.seas.columbia.edu/earth/wtert/Thornelowepaper.pdf	Taken into account. The Executive Summary will be revised to take into account revisions in the text, where we will expand the discussion on alternatives to landfilling with additional information. Furthermore, we will pay more attention to the comparison of mitigation potential of landfilling with alternatives.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Brian Bahor, Covanta Energy Corporation)	
10-36	A	3	1	3	47	The Executive Summary should emphasize the collective GHG reduction benefits of modern waste-to-energy (WTE, i.e., incineration with energy recovery). The current draft's Executive Summary gives significant attention to landfill gas collection and utilization (page 3, lines 19-33) but omits mention of WTE, despite its demonstrated superiority to landfilling when it comes to both GHG control and energy generation. By failing to describe WTE's collective benefits in the Executive Summary, decision-makers may not fully understand the vital role WTE can play in GHG reduction. WTE has the following GHG benefits: 1) WTE eliminates GHG and NMVOC that would otherwise be emitted from landfills. WTE is a short-term, controlled combustion process that destroys virtually all organic matter with certainty, thereby eliminating its CH4 and NMVOC generating potential. This controlled process (including all requisite monitoring and reporting) contrasts with landfill gas technologies that rely on long term, relatively uncontrolled and inefficient processes to collect and destroy emissions after they have already been generated. Strategically, it is preferable to prevent GHG emissions generation rather than try to control them after-the-fact. 2) WTE recovers energy much more efficiently than landfills equipped with gas collection and energy recovery. WTE captures and utilizes the entire heating value of the waste, both biogenic and non-biogenic, producing about 2200 MJ of electricity per Mg of waste (550 kilowatt-hours per short ton of waste, USDOE/EIA, 1995). In contrast, landfill gas-to-energy recovers much less energy. Typical landfill methane yield is 100 cubic meters CH4/Mg waste (USEPA, 2005, Annex 3.14, page 232). From 20% to at most 70% of the LFG produced is actually collected (IPCC draft report, Table 10.4). Using an average internal combustion engine electrical generation efficiency of 30%, a landfill gas to energy project is calculated to produce from 230 to 790 MJ electricity per Mg of waste, or only 10% to at most 36% of the energy produced by WTE. Even if the non-biogenic portion of the WTE production is ignored, WTE still produces two to seven times more electricity per Mg of waste managed. 3) WTE facilities are typically designed to recover materials such as ferrous and non-ferrous materials for recycling, thereby reducing fossil CO2 emissions that would otherwise occur because recycling is more energy efficient than production from raw minerals. As an example, the 89 facilities in the U.S. recovered 640,000 Mg of ferrous and 19,000 Mg of non-ferrous metals, representing 2.5% of the total	Taken into account. The Executive Summary will be revised to take into account revisions in the text, where we will expand the discussion on alternatives to landfilling with additional information. Furthermore, we will pay more attention to the comparison of mitigation potential of landfilling with alternatives.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						waste processed (Kiser and Zannes, 2004). 4) WTE frequently reduces transportation-related GHG emissions. In the U.S., land constraints near urban areas frequently require that waste be long-hauled to distant landfills. With their relatively small footprint, WTE facilities can be located within the waste shed and avoid fuel consumption and emissions associated with waste long-hauling. When all these benefits are considered simultaneously, as in life cycle analysis, implementation of WTE has been shown to actually reduce GHG emissions, energy consumption, and other pollutant emissions (Thorneloe et al, 2005). In addition, it should be noted that WTE offers other environmental benefits related to ground and surface water protection, land use, and ash reuse. References for this comment: USEPA, 2005: US Emission Inventory 2005, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2003, EPA 430-R-05-003, April 2005. Accessible at http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2005.html U.S. Department of Energy, Energy Information Administration, 1995: Background Information and 1990 Baseline Data Initially Published in the Renewable Energy Annual 1995, Chapter 7B, Waste-to-Energy Technology. Accessible at http://eia.doe.gov/cneaf/solar.renewables/renewable.energy.annual/backgrnd/tablecon.htm Kiser, J., and M. Zannes, 2004: The 2004 IWSA Directory of Waste-to-Energy Plants, Integrated Waste Services Association. Accessible at http://www.wte.org/2004_Directory/IWSA_2004_Directory.html Thorneloe, S., K. Weitz, and J. Jambeck, 2005: Moving from Solid Waste Disposal to Materials Management in the United States, presented at the Tenth Waste Management and Landfill Symposium, Cagliari, Italy, October 3-7, 2005. Accessible at http://siteresources.worldbank.org/INTUSWM/Resources/ThorneloeA209Final.pdf (Brian Bahor, Covanta Energy Corporation)	
10-37	A	3	3	3	17	This paragraph needs to be revised. It is currently very policy oriented. Discussion of flexible policies and regulations to expand waste management options is inappropriate. This paragraph sounds more like promotion than assessment. U.S. Government (Government of U.S. Department of State)	Taken into account. The sentence will be modified to align with US Government comment 10-42A to read “Flexible strategies and financial incentives can expand waste management options to achieve GHG

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
							mitigation goals".
10-38	A	3	3	3	3	Effective waste management can be, but is not necessarily, effective GHG mitigation. U.S. Government (Government of U.S. Department of State)	Noted. The sentence will be redrafted "Effective waste management is necessary to achieve effective mitigation of GHG emissions".
10-39	A	3	5	3	5	"..proved public health, and contribute to sustainable development" may be replaced by "..proved public health, maintenance of surface water and ground water sources and …..". The reason is in developing countries in India solid waste disposal in water bodies has created a major problem and given that good quality water is becoming a a scare good. (Joyashree Roy, Jadavpur University)	Agreed. The sentence will be redrafted "improved public health, maintain water resources and…"
10-40	A	3	11	3	13	.Waste minimization is mentioned as an option to mitigate GHG emissions many places in chapter 10; page 3 Line11-12, p.4 L 31, p 5 L2-3, p 7 L12, p22 L11-13, p 26 Line 44, p 29 L 39, p 32 L23-24, p 34 L21. The focus seems to be mainly on post-consumer emissions and the improved energy efficiency and fossil avoidance. We would like to stress that waste prevention also can reduce the need for input of other resources and the associated emissions of GHGs as well as other emissions, important in the context of sustainable development. . An example of this is given in a study of nitrogen in the food chain in Norway, carried out at the Norwegian University of Life Sciences, where both downstream and upstream impacts of different waste management measures are taken in consideration.(Bakken, L and Bleken, M.A (1997) The Nitrogen Cost of Food Production, Ambio Vol 26, No 3, May 1979) The study compares the effects on the need for N-input in agriculture, of a number of actions, a.o recycling of food waste to fodder and soil and improved utilization for human consumption. It shows that a 20 % reduction of refused meat, egg and milk products in Norway reduces the need for N-input to soils with 15 000 tons/year, (about 15 % of the annual unput of fertilizer) compared with only 6000 tons for the composting of 100 % of all food waste in Norway. SFT has estimated the effects of reduced application of fertilizer-N on GHGs in Norway in (SFT 2005, in Norwegian: Reduksjon av utslipp av klimagasser i Norge, en tiltaksanalyse for 2010 og 2020). According to this report will a reduction of input in Norwegian agriculture of 15 000 tons of N/year result in a reduction of 120-140 000 tonn CO2-eq/year. In addition will come the reduction of GHGs associated with the production and transport of fertilizer, feed and animals, as well as other	Taken into account. N cycling is more appropriate to the Agriculture chapter. We will also amend the sentence on lines 11-13 to include resource utilization.

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						environmental benefits. Relevant instruments would be better production planning in agriculture, better management and storage in food processing industry, food distribution, restaurants and catering and information to households. We would suggest the following change in the sentence on p.3 in Line 11-13 "In addition, waste minimization, recycling and re-use represent a growing but largely undefined potential for indirect reduction of GHG emissions through improved energy and resource efficiency, and the avoidance of the use of fossil fuel and other resources and associated emissions of GHGs" (Government of Norwegian Pollution Control Authority)	
10-41	A	3	13	3	13	".…….Flexible policies" may be replaced by "Goal oriented, conscious choice of flexible policies". This is to take care of non existence of any policies at all on waste management in many developing countries. Also given that in many places in the overall report possibility of carbon free nuclear power use has been highlighted which further necessitates emphasis on need for well defined waste management policy. Integration of waste management policy with urban planning is another issue needs to be highlighted explicitly given the boom in urban growth in developing countries that is expected over next hree decades. (Joyashree Roy, Jadavpur University)	Rejected. Nuclear waste is discussed in the Energy Chapter. Integration of waste management and urban planning is addressed in the Chapter but not in the Executive Summary.
10-42	A	3	13	3	14	Financial incentives should be added to flexible national policies and regulations. U.S. Government (Government of U.S. Department of State)	Accepted. The sentence will be modified to align with US Government comment 10-37A to read "Flexible strategies and financial incentives can expand waste management options to achieve GHG mitigation goals".
10-43	A	3	19	3	20	What is the source for landfill CH4 recovery of 105 MtCO2e/year? U.S. Government (Government of U.S. Department of State)	Noted. Willumsen 2003 is referenced in the Chapter but following TSU guidance, no references are used in the Executive Summary.
10-44	A	3	20	3	20	The statement that recovery is stabilizing emissions is not substantiated. U.S. Government (Government of U.S. Department of State)	Taken into account. The sentence will be redrafted to state "Landfill CH4 recovery for energy use has been fully commercial since 1975, currently exceeds 105 Mt CO2e/yr, and is currently playing a major role in reducing landfill CH4 emissions from developed countries".

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10-45	A	3	21	3	22	In fact, if more controlled landfilling practices are implemented in developing countries, with the increasing of the methane recycle and other measures, the methane emission will decrease, as like in developed countries today. (Government of China Meteorological Administration)	Taken into account. The sentence will be redrafted "Accelerating the introduction of landfill CH4 recovery in developing and EIT countries, assisted by Kyoto mechanisms such as CDM and the JI, has the potential to significantly reduce future landfill CH4 emissions."
10-46	A	3	27	3	28	What is the source for 500 Mt CO2e/year reduction - is this from a new CDM baseline projection? U.S. Government (Government of U.S. Department of State)	Noted. Monni et al 2006 is referenced in the Chapter but following TSU guidance, no references are used in the Executive Summary.
10-47	A	3	40	3	47	This paragraph needs to be revised. It appears to be suggesting policy actions. U.S. Government (Government of U.S. Department of State)	Taken into account. The paragraph will be redrafted to read "Consistent and coordinated data collection and analysis at the national and international level…" and the final sentence deleted.
10-48	A	3	46	3	47	Add after….. From…. 'improvement in national data collection system and' (Government of India)	Taken into account. See comment 10-47 above.
10-56	A	4	0	0	0	In the introduction -or even in the executive summary- one should find reference to other chapters which could be concerned by waste, such as Industry and Agriculture, and reinsure the reader that no double counting occured. Best would be with a table or a graph showing wich parts of waste is accounted for in the 10th chapter. A second best would be only to mention this issue. (ANTOINE BONDUELLE, Université Lille II)	Noted. We believe the reviewer's concerns have been taken into account on page 4 lines 20-22.
10-49	A	4	1	35	39	Units of Tg CO2 are used occasionally in the Chapter – suggest changing to Mt CO2 U.S. Government (Government of U.S. Department of State)	Noted. We will standardize according to TSU guidance.
10-50	A	4	5	4	5	Note that an EPA Source Reduction characterization report published in 1999 found that waste generation correllated most closely with personal consumption expenditures (PCE). This report can be found at: http://www.epa.gov/epaoswer/non-hw/reduce/r99034.pdf. U.S. Government (Government of U.S. Department of State)	Accepted. Reference will be added.
10-51	A	4	16	0	0	From "mitigation" hang a footnote to read "In this Chapter 'mitigation' or 'emissions reductions' should be understood as net reductions in waste management related emissions, i.e. the emissions reductions plus absorption increases that are the net outcome of the fluxes of waste management related greenhouse gases.	Rejected. Absorption increases are not normally accounted for, and there are no data for the waste management sector in our knowledge.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Peter Read, Massey University)	
10-52	A	4	16	4	16	From "mitigation" hang a footnote to read "In this Chapter 'mitigation' or 'emissions reductions' should be understood as net reductions in waste management related emissions, i.e. the emissions reductions plus absorption increases that are the net outcome of the fluxes of waste management related greenhouse gases. (Peter Read, Massey University)	Rejected. Absorption increases are not normally accounted for, and there are no data for the waste management sector in our knowledge. (same as comment 10-51A above)
10-53	A	4	24	4	24	After end of sentence ("… within their respective sectors."), insert the following: "Many waste management strategies, especially in the areas of waste reduction and recycling, have substantial impacts on GHG emissions on a lifecycle basis, such as reductions in energy use and associated emissions when recycled materials are used in industry (see section 7.3 .6). This chapter focuses primarily on emissions from waste management facilities, which represent only a fraction of the lifecycle GHG impacts of waste management strategies (Ackerman 2000)." (Frank Ackerman, Global Development and Environment Institute, Tufts University)	Taken into account. We will include additional information related to a range of LCA studies.
10-54	A	4	28	4	28	Why cite landfill gas collection as the example of "appropriate waste and wastewater management"? Waste-to-energy (incineration with energy recovery) also directly reduces emissions by destroying wastes' organic matter which would otherwise produce methane when landfilled. In addition, by producing electricity and recovering ferrous metals, waste-to-energy offsets fossil CO2 from power plants and metals manufacturing facilities. (Brian Bahor, Covanta Energy Corporation)	Accepted. Landfill gas recovery will be taken out of the sentence.
10-55	A	4	42	4	44	"Although new concepts ……successfully implemented for decades". Implementation of the GHG mitigation technologies are mostly limited to developed countries. It remains far from satisfactory in the developing nations. Integrated approach to waste management is not observed in majority of the cases, e.g. piecemeal approach to managing wastes separately such as handling solid or liquid wastes.This should addressed to get the root cause of the problem and suggest some possible remedies. (Government of India)	Taken into account. The sentence will be revised to state "…technologies for GHG mitigation from waste are mature and have been successfully implemented for decades in many countries".
10-57	A	5	2	0	4	Attempts to define this potential has however been made in recent years in for instance the EU COM: A thematic strategy on the prevention and recycling of waste, COM (2005) 666 December 2005 and in a report from UBA in Germany from 2005. (Government of Sweden)	Noted. The COM(2005)666 sets goals, but has not defined the potential. The UBA reference could not be found.
10-58	A	5	6	7	22	Recommend a more substantive discussion of anaerobic. Recommend inclusion of	Noted. Within the page constraints of the

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						anaerobic and aerobic bioreactor landfill technology. Bioreactors are a potential source of greater CH4 emissions over a shorter duration as well as opportunity to reduce CH4 (aerobic significantly) and bring about additional recovery and utilization projects (see http://www.epa.gov/epaoswer/non-hw/muncpl/landfill/bioreactors.htm) U.S. Government (Government of U.S. Department of State)	document, further detail cannot be added.
10-59	A	5	8	5	8	I think that the use of the term "sequestration" is not appropriate in this context of landfill; I would prefer "storage". Also, make sure that the use of those two terms is in line with the agreed definitions. (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Accepted. Changed to storage.
10-60	A	5	10	5	12	According to the CRF tables submitted by Parties to the UNFCCC, the fraction of incinerated waste that is biomass is reported to fullfil the completeness and transparency requirements, however emissions arising from this fraction is not included in the national total. Therefore, I would suggest to replace the part "is not considered" by "is not taken into account" or "is not included". (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Accepted. Changed to "is not taken into account in inventories for the waste sector".
10-61	A	5	10	0	0	There are no mentions of the emissions from the refuse collection fleets. In cities of most developing countries, these emission could be cut in half by route rationalization and transfer stations. Fossil fuel could be dramatically reducted if these fleets switched to renewable fuels. (Sandra Cointreau, World Bank)	Noted. This is relevant to the Transport Chapter, and we believe this is a small part of that sector. The points regarding route rationalization, and the use of renewable fuels is to be added in our discussion of LCA.
10-62	A	5	11	5	11	Add landfills to the list U.S. Government (Government of U.S. Department of State)	Accepted.
10-63	A	6	5	6	7	"The major GHG emissions …… emissions occur upstream of treatment". Contribution of emissions upstream of wastewater is an uncertain area. This requires further studies to justify the above statement. (Government of India)	Accepted. The phrase "the major GHG emissions …… emissions occur upstream of treatment" will be deleted.
10-64	A	7	6	7	6	Reformulate as follows: "...solid waste disposal sites (e.g. open dumps, open burning) lead to esthetic pollution and serious public health problems resulting from among others…" (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Rejected. We believe the phrase “uncontrolled solid waste disposal sites…” includes open dumps etc and the sentence as written already addresses public health issues.
10-65	A	7	9	7	12	The text as written sounds dismissive of the TAR and previously published work, and the claim to have updated and expanded past work in this chapter is not really accurate with respect to recycling. Replace the first four lines of the paragraph with "Some major mitigation measures for the waste sector were addressed in the TAR (IPCC, 2001). A framework for analysis of GHG impacts of waste management,	Taken into account. The Reference to the TAR 2001 and Ackerman 2000 will be removed from here and moved to page 4 line 33 where it is in context. The remaining text will be rewritten “Major mitigation measures

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						oriented toward evaluation of the contribution of recycling programs, identified five categories of impacts: landfill emissions; incinerator emissions and energy recovery; reduction in industrial energy use and emissions due to recycling and waste reduction; carbon sequestration in forests due to decreased demand for virgin paper; and energy and emissions from long-distance transport of waste (Ackerman 2000). Here the primary focus is on waste management facility emissions, including landfill CH4 recovery for flaring or energy use; optimizing CH4 oxidation in landfill cover soils; alternative strategies to landfilling..." [then resume previous text] (Frank Ackerman, Global Development and Environment Institute, Tufts University)	included in this Chapter are landfill CH4 recovery…"
10-66	A	7	25	0	0	No developing countries have waste within a self-sustaining range of calorific value. Wet, as received, waste in these countries has a lower heating value under 1500 kcal/kg based on numerous studies conducted throughout the world. This paragraph is misleading and could create significant detriment to developing countries that are already beseiged by the false claims of incinerator vendors. Every plant built has been shut down due to inability to be energy self-sustaining, other that those in a couple of large Chinese cities. Even Seoul, Korea could not self-sustain incineration until AFTER it had graduated from the World Bank lending portfolio. Plants in Eastern Europe were shut down after Russian subsidies were discontinued, and even most of those were viable only when combined with district heating. (Sandra Cointreau, World Bank)	Taken into account. Text changed to "The energy value of mixed municipal waste ranges from <6 to >14 MJ/kg (Khan and Abu-Ghararath, 1991) with high values approaching low-grade coals (lignite). Thermal processes are most effective at the upper end of this range".
10-3	B	7	26	7	28	Conversion in available energy should be given for the bandwidth; the assumed mean value of 12 MJ/kg is hardly representative (also in Box 10.1) (Government of Germany)	Taken into account. Text changed to "Using the total waste generation shown below (Box 10.1) global waste in 2002 had an energy potential of 0.5 to >1 x 10^10 TJ".
10-67	A	7	33	7	37	Organization of "technology gradient" approach not clear or evidenced in subsequent sections U.S. Government (Government of U.S. Department of State)	Taken into account. See also comment below. Text amended as follows. "The waste sector is characterized by mature technologies whose diffusion is limited by local costs, policies, available land area, and public perceptions. The discussion of technologies and mitigation strategies for the waste sector (section 10.4.1) includes a range of approaches from low-technology/low-cost to high-technology/high-

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							cost measures".
10-68	A	7	38	7	40	The goal of this analysis should not be to suggest strategies, but rather to assess recent studies (see general comment above) U.S. Government (Government of U.S. Department of State)	Taken into account. See also comment above. Text amended as follows. "There is no single best option; rather there are multiple commercially-available technologies that can be collectively implemented to reduce GHG emissions and achieve sustainable development and public health goals".
10-69	A	7	44	10	5	I think that it would be good to address issues that are common to solid waste and wastewater like availability and reliability of data directly under the title "Status of the waste management sector" and then present issues specific to solid waste under a title "Solid waste generation" since the next section is related to "Wastewater generation". (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Rejected. There was extensive discussion of the chapter structure at the first order draft stage, and it is not possible to achieve page limitations with additional sections at this stage.
10-70	A	7	45	10	10	This section addresses data collection methodologies that are covered in the IPCC Guidelines. The guidelines addressed different methodologies for collecting and comparing data. This chapter should not cover the material but should refer to the guidelines when necessary. The guidelines provided a process with opportunities for comment and to suggest alternatives in this venue is inappropriate. U.S. Government (Government of U.S. Department of State)	Noted, but the different methods for calculating waste generation are relevant, part of the literature to be assessed in this chapter, and referenced in the IPCC 2006 guidelines. The text will be revised to "There are three major approaches which have been used to estimate global waste generation: country-specific statistical data, population-based estimates, or proxy variables linked to demographic or economic indicators for which national data are annually collected". The next two sentences, starting from "2006 IPCC guidelines", are deleted. A reference to IPCC 2006 guidelines will also be added here.
10-71	A	7	47	7	49	A more accurate statement would be that data is lacking for developing countries in particular. U.S. Government (Government of U.S. Department of State)	Rejected. Many developed countries do not have good quality data either.
10-72	A	7	48	7	48	"…...is questionable, definitions are not uniform,…...". The use of word 'questionable' may be too harsh here and may be 'not well documented'. Same in pp.8, Box 10.1, 3rd line etc. (Government of India)	Accepted. Text changed to "data quality is variable…"

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10-73	A	8	27	8	0	Box 10.1. It is questionable that the only method discussed for calculating trends in waste generation globally is from one of the lead authors. (Bogner et al 2003, Bogner 1992, 1998) This section should reference the multiple papers available in the peer-reviewed literature. This is a problem throughout the document. U.S. Government (Government of U.S. Department of State)	Taken into account. We will cite other literature as available.
10-4	B	8	35	8	35	Replace "recalcitrant" with "resistant" to make the meaning of the statement clearer. (Government of Australia)	Taken into account. Text changed to "Under the anaerobic conditions in landfills, lignin does not degrade significantly, while some fraction…"
10-74	A	10	2	0	0	Waste generation rates in cities of low income countries are not under 0.1 t/cap/day. They are usually between 1.5 and 2.5 t/cap/day. In middle income countries, they are usually between 2.5 and 3.5 t/cap/day. There is lots of available data. However, it is in each city's master planning efforts done by organizations such as JICA, ADB, IADB, etc. The World Bank has done several major reviews, including a recent one for China and an ongoing one for LAC. Also for LAC, there was a major study done by PAHO with extensive data from various cities. The body of global information has not been adequately examined for waste generation. (Sandra Cointreau, World Bank)	Taken into Account. We note the reviewer probably means t/cap/year. Text changed to "Solid waste generation rates range from 0.1 t/cap/yr in low income countries to >0.8 t/cap/yr in high income industrialized countries (Table 10.1)" and cited information supporting these ranges collected from recent studies 2001 – 2006.
10-75	A	10	2	10	4	A more updated reference should be used. Suggest: Global Mitigation of Non-CO2 Greenhouse Gases, United States Environmental Protection Agency, Washington, DC, 430-R-06-005, 2006. http://www.epa.gov/nonco2/econinv/international.html. U.S. Government (Government of U.S. Department of State)	Rejected. USEPA 2006 does not include waste arisings data.
10-76	A	10	10	10	22	These statistics need to checked. It seems inaccurate that 100% of North America has sanitation coverage. Additionally, the statistic for wastewater treatment coverage in North America is only 90%, this seems to contradict the earlier statement. U.S. Government (Government of U.S. Department of State)	Taken into account. North American numbers will be checked with USEPA sources.
10-77	A	10	10	10	15	It is somewhat unclear whether septic tanks are considered sewerage, particularly as it relates to the sentence in lines 14-15. Does North America include or exclude Mexico, given the 100% coverage represented (and if not, should this be mentioned)? U.S. Government (Government of U.S. Department of State)	Taken into account. The phrase US and Canada will be used. Numbers will be checked with USEPA sources.
10-78	A	10	17	10	17	Delete "by wastewater treatment" (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Accepted. Delete repeated phrase.

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10-79	A	10	24	10	35	"Estimates for CH4 and N2O…. drinking water supplies....". Wastewater collection and treatment of domestic and industrial wastewaters are the major areas of concern in developing countries. As much as 70% of the generated wastewater reaches surface water bodies or onto land before any GHG mitigation measures could be achieved. Why? (Government of India)	Taken into account. <25% treated is effectively the same as "as much as 70% is untreated". We will say "lack of infrastructure and lack of financial resources" are the reasons why.
10-80	A	11	5	11	10	In Table 10.2, the relation of average values (denoted by 'A' in column 2 and 3) with the Total (T) values for different regions are not clear. What is the basis of this avergaining? (Government of India)	Accepted. Totals will be retained. Averages will be removed for clarity.
10-81	A	11	11	12	17	Recognize the challenge of characterizing a broad array of "development trends" but certain statements and conclusions are insufficiently treated or misleading. There is a number of other drivers that dictate management choices (e.g., incineration not widely practiced in the U.S. due to poorer economics compared to landfilling, negative public perception). Since economics largely dictate the least costly solution briefly explain why more costly practices have been locally implemented. Compost comment not cited. Open space is not the primary driver for landfills, especially in a country like Korea where most of the country is mountainous and landfills are difficult to implement. While there is increasing interest in alternatives to conventional landfill disposal practices North America and Australia are not yet actively implementing "bioreactor" landfill designs. In the U.S. bioreactors can only be implemented in a very limited number by approved states under a EPA Landfill Research Development & Demonstration rule. Need citation for conclusion that local decisions regarding waste management are made based on least-cost environmentally-acceptable solution. U.S. Government (Government of U.S. Department of State)	Noted. Responses to this comment were made in the first order draft review, and the text was revised for the second order draft.
10-82	A	11	19	11	21	This sentence is incorrect. Landfilling may continue but for a variety of reasons, not because methane is being recovered for energy use. U.S. Government (Government of U.S. Department of State)	Accepted. The phrase will be revised to "In North America, Australia, and New Zealand, landfilling is expected to continue as the dominant method for large-scale waste disposal *and* larger quantities…"
10-83	A	11	21	12	2	BIOREACTORS/RECIRCULATION. The reference to a shift in N. America to bioreactors is incomplete in two respects with direct and critical implications for gas capture. First, it omits the fact that the wider pattern of operation away from "dry tomb" precepts, which is intended to isolate the wastes from liquids, is to leachate recirculation supplemented with other on-site sources of liquids such as	Taken into account. This level of detail is beyond the scope of this chapter, but we will cite bioreactor literature in the revised text.

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						redirected surface flows and leachate trucked or piped from other closed cells. The stated purpose of this change, which was permitted on an ad hoc basis by a memorandum outside of the rule-making process and without ever being systematically reviewed for validation, is to profit from a combination of wetting and higher decomposition in the following ways: recovery of airspace, reduction of leachate treatment costs and, in the few instances in which internal combustion engines (ICE) have been installed to generate power, to tends to increase the gas flows in the early years, by shifting those flows from the long term to the near term and thereby increase the utilization rate and economics of the system. Second, there is no reference to the extreme engineering challenges created for gas collection efforts when decomposition is encouraged and accelerated. Among the several challenges are (a) the inherent difficulty of capturing gas in field saturated conditions; (b) the tendency of the convention and mature rigid vertical wells to tilt and snap due to rapid differential settlement, and the consequence frequent recourse to less effective flexible horizontal pipes; (c) the common practice to reduce costs of using the same pipes to add and recirculate liquids; (d) the decision in order to encourage rainfall into the waste mass to deliberately delay installation of a final composite cap needed to prevent oxygen intrusion being pulled from the surface, with which negative pressures recurringly need to be damped down to prevent fires and poisoning the methanogenic process for high Btu gas; and (e) greater resulting densities of the more heavily wetting wastes that reduces the sphere of influence for gas draw. This raises a profound issue wholly ignored in the draft. There is a major body of thought concerned that warming events are advancing at a faster, and greater compounding, rate than the models had anticipated such that we may be approaching a tipping point, beyond which corrective actions will be ineffective. For this reason, increasingly efforts are being exerted to find quick near term reductions in current GHG emissions. In the waste sector, the draft appears to champion a change in policy that, by deliberately adding liquids ad hoc to a design intended to be based upon dry tomb principles in order to move the generation of gas that otherwise would not occur for decades to today, at a time when, at best, gas collection, which is relegated to last in line to efforts to reduce their already low cost profile, is problemmatic. This must be evaluated systematically, realistically, and without rose colored glasses bearing little relationship to the real world. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	
10-84	A	12	1	0	0	We concur with the importance of bioreactor landfills and believe that their value needs more attention in the document, and that rates of degradation in decay	Taken into account. We will cite bioreactor literature in the revised text.

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						models need significant adjustment. Also, recovery rates in deep landfills can be substantial, up to 90%, when properly managed. (Sandra Cointreau, World Bank)	
10-5	B	12	7	12	8	not by 2010 but by 2016 and not relative to 1990 but to 1995 (see 1999/31/EU Art. 5c); by 2009 there must be a 50% reduction relative to 1995 (Art. 5b) (Government of Germany)	Accepted.
10-6	B	12	9	12	9	It should be added that in certain European Countries like Germany, Switzerland and Austria landfilling of biodegradable organic waste is already forbbiden by national law (Government of Germany)	Noted. Further detail is beyond the scope of the chapter.
10-7	B	12	26	12	26	Add: Controlled landfilling combined with weighing the input material provides the possibility to improve the grave data problem on waste generation and the reliability on GHG inventories (Government of Germany)	Noted. Further detail is beyond the scope of the chapter.
10-85	A	12	34	12	41	If markets exist, informal recycling by waste pickers at certain disposal sites often removes materials that contribute to landfill CH4 e.g., paper and cardboard, but other scavenged materials of value do not contribute to landfill CH4 e.g., ferrous/non-ferrous metals. U.S. Government (Government of U.S. Department of State)	Noted. Further detail is beyond the scope of the chapter.
10-86	A	13	9	13	9	Add just after the word "continue" the following "to occur". (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Reject. Unnecessary editorial change.
10-87	A	13	10	0	0	Based on our field experience, we do not agree that emissions continue for several decades in moist tropical climates with significant incoming organic waste composition. Most developing countries would have emissions largely produced from year 1 to 10 after landfilling. (Sandra Cointreau, World Bank)	Reject. Our original statement is based on many scientific references covering many climates.
10-88	A	13	21	13	25	LANDFILLS RESPONSIBILITY OVER TIME. The referenced trend of landfill generated methane from Annex 1 countries, in addition to being based on calculations that use idealized short term capture rate assumptions instead of the average long term efficiences cited in the text on page 19, line 25, that understate responsibility by approximately a factor of 4 times, also is largely reflecting one time events. In the U.S., for example, New Source Performance Standards (NSPS) for large MSW landfills became effective in 1996, providing a one-time reduction in emissions in proportion to the average functioning of collection systems. That one-time bump will not recur on a going forward basis and the text should correct the numbers for the correct collection efficiencies cited in the text and then make	Noted. Chapter 10 cites published literature relating to landfill gas collection efficiencies.

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						clear that the past decline (adjusted appropriately) cannot be expected to recur. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	
10-89	A	13	24	13	0	EIT countries are often Annex I and the UNFCCC reference implies that you are talking about Annex 1 countries that report annual data. Clarify. U.S. Government (Government of U.S. Department of State)	Accepted. We will delete “and EIT” from this phrase.
10-90	A	13	26	13	37	"In developed countries ……Kyoto mechanisms such as CDM and JI". Implementation of Kyoto mechanisms in full vigour would certainly reduce the BAU estimates. This is not happening in wastewater treatment sectors. (Government of India)	Noted. Further detail is beyond the scope of the chapter.
10-91	A	13	26	13	0	suggest rewording: " for reporting non-Annex I countries" U.S. Government (Government of U.S. Department of State)	Noted. This is implied.
10-8	B	13	36	13	37	Delete "availability…..and JI'. Replace with "the availability of project-based emissions crediting mechanisms". (Government of Australia)	Taken into account. Sentence replaced with “Future reductions in emissions from the waste sector will partially depend on the post-2012 availability of mechanisms such as CDM and JI”.
10-92	A	13	39	14	20	This whole section needs to be revised. The explanations for the differences between the Monni et al and the Scheehle, Kruger paper are not sufficient. The Scheehle & Kruger paper uses country data and only fills gaps for those countries without data thus the emissions data for most countries with large landfill sources (US, European countries) are based on higher tier, country submitted methods using a decay rate. Additionally, the discussion suggests that the Monni et al projected growth is higher because of a delay in the impact of european regulations on waste impacting emissions levels. However, the European projections in Scheehle and Kruger are often from national communications and account for the delayed emissions impact. Finally, the emission estimates are just unrealistic. Comparing the Monni et al global emissions to US emissions (using a Tier 2/3 FOD method) would suggest that the US emitted over half of global emissions in 1990. This is not realistic. U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-93	A	13	41	13	42	"Information on N2O …… sewage treatment only". Inventory estimates of industrial wastewater emissions did not include nitrous oxides treatment as they are believed to be insignificant compared to emissions from domestic wastewater (IPCC 1996 Guidelines for Nat. GHG Inventories). Estimates were carried out only on domestic sewage based on per capita protein factors. (Government of India)	Noted. Further detail is beyond the scope of the chapter.

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10-94	A	14	10	14	17	Table 10.3 indicates CH4 emissions for the SRES A1B and B2 scenarios for 2050. The rest of the report indicates emissions for these scenarios for 2030. Chapter 10 should provide baseline estimates for the SRES scenarios for 2030 on this table to provide consistency with the rest of the report. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Noted. However, we will remove the SRES numbers from the table (since they are discussed in the text), and we will aim to provide Monni et al data for 2030 in the text.
10-95	A	14	10	14	17	Table 10.3 indicates CH4 emissions for the SRES A1B and B2 scenarios for 2050. The rest of the report indicates emissions for these scenarios for 2030. Chapter 10 should provide baseline estimates for the SRES scenarios for 2030 on this table to provide consistency with the rest of the report. U.S. Government (Government of U.S. Department of State)	Noted. However, we will remove the SRES numbers from the table (since they are discussed in the text), and we will aim to provide Monni et al data for 2030 in the text (repeat of comment 10-94)
10-96	A	14	20	0	0	first sentence is not clear; largest source of what? (John Nyboer, Simon Fraser University)	Accepted. "…of GHG emissions…" will be added.
10-97	A	14	23	15	6	In the text the reference is "Scheehle and Kruger (2006)" while at the bottom of the figure 10.4 it is mentioned "Scheehle and Kruger (2005), in review". Please write the correct reference. Furthermore, since the abovementioned document is still in review, make sure that it will be published before the AR4 adoption and acceptance and that any relevant changes from the review will be taken into account in the AR4. (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Accepted. Referencing will be reviewed.
10-98	A	15	9	15	10	MATURITY OF LANDFILL GAS COLLECTION. It is correct to state that the first commercial landfill gas collection currently in use was developed and installed in 1975. This was finally pursued at the Palo Verdes landfill, incidently, in direct response to the landfill having just blown up the adjoining church, the serious injury to 19 national guard soldiers six years earlier in North Carolina had not been sufficient to engender action. However, a control system that, as is later recognized on page 19, only captures 20% of lifetime gases, cannot properly be described as effective. Moreover, it is quite important to distinguish the rigid vertical wells that were developed there and used in dry tomb landfills from the ad hoc experimental horizontal co-utilization pipes used in the increasingly dominant leachate recirculating landfills. The distinction discussed earlier is critical. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	Noted. Chapter 10 cites published literature relating to landfill gas collection efficiencies. Further detail is beyond the scope of the chapter.
10-99	A	15	9	15	9	The sentence '….has been fully commercial…since 1975.." has been repeated several times (page 3 line 19, page 19 line 21). (Government of India)	Accepted. The repeated phrases will be removed.
10-100	A	15	10	15	11	Approximate >105 Mt CO2e/yr are recovered (insert for energy) globally. Recommend including flaring as a significant mitigation technique since the	Noted. This is discussed later in the paragraph.

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						amount of gas flared globally may be greater than utilized. U.S. Government (Government of U.S. Department of State)	
10-101	A	15	15	15	16	LANDFILL GAS TO ENERGY. Landfill gas to energy (LFGTE) is presented here and later as a major and unalloyed good for GHG reductions. The actual picture when real world conditions are considered are far more confusing, and any attempt to brush those considerations aside to leap to a conclusion that supports conventional wisdom is, in fact, not supportable. For one thing, as is explained in the next six cells that follow, actual long term gas collection efficiency is very low, not high. This is some considerable importance because the potential GHG benefits from LFGTE are a direct function of the effectiveness of gas capture. Unfortunately, this commentary mechanism does not permit the placement of tables, but I performed a sensitivity analysis to track this using all other USEPA assumptions. In short, at an 80% capture rate to reflect the EPA's 75% assumption plus the various enhancements from oxidation effects and others, the net GHG gain by avoiding emissions from power generation elsewhere are 14%, while at 20%, which is the Oonk and Boom value cited in the draft as the real world long term best estimate, the gain is only 3%, again with all other idealized assumptions used by EPA. An examination of some of those implied assumptions, however, would suggest that the putative GHG gain is actually a loss in the real world. FIRST, To economically recover the latent energy value in landfill gas with the equipment currently available, the gas collection systems are typically operated in ways intended to maximize methane capture and generation. That has distinct differences from managing a waste field to minimize fugitive emissions. For that reason, energy recovery can significantly work at cross-purposes with gas collection in three respects. The first two differences clearly reduce average capture rates at landfills with energy recovery, while the third has uncertain effects. Our attempts to tease out field data out of well reports in order to quantify all of these cross-currents were unsuccessful, so crude estimates were made where the general direction of the impacts were clear. (a) Throttling Gas Collection Wells to Maintain High Btu Content. To optimize gas collection, the system should be operated for maximum efficiency at all times, short of overpumping and drawing air from the surface that might cause a fire. For gas is continuously being generated and, if released uncontrolled, the emissions threaten health and the global environment. When energy recovery is added to the equation, however, the focus on maximizing gas capture is lessened in the interest of maximizing methane levels, because energy recovery requires only high Btu content gas. The two competing concerns can work	Noted. Chapter 10 cites published literature relating to landfill gas collection efficiencies. Further detail is beyond the scope of the chapter.

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						at cross-purposes. Electric generation requires a ratio of methane in landfill gas of close to 50%, depending upon the type of generating unit used. Continuously excavating landfill gas, unfortunately, can make it impossible to maintain such high Btu gas. For, when negative pressures are exerted to extract methane out of the waste load, significant volumes of condensed moisture — necessary for further methane production — is drawn out of the refuse at the same time. Indeed, more than half of the weight of the landfill gas consists of condensate. As the collection systems continues pulling gas, inadequate moisture remains behind to keep generating high methane gas. Unless costly propane is mixed in with Btu deficient landfill gas, the proportion of methane in the landfill gas will fall below the level needed for the generators that produce electricity, and the surrounding field becomes tapped out for producing power. To prevent that, it is a well known fact that gas managers throttle back on those wells where low methane ratios are recorded in order to give that surrounding field time to recharge. But, when gas collection is damped down, more of the landfill gases escape uncontrolled to the atmosphere. Of course, the fact that the fugitive emissions are lower Btu gas does nothing to minimize the health impacts from the hazardous compounds on neighbors and only slightly lessens the proportion of methane per cubic foot of landfill gas adding to the atmosphere. Thomas Bilgri, et al., "Investigating the Impact of NSPS Guidelines," Waste Age (December 2000), at p. 140. (b) Delaying Final Cover to Increase Moisture Levels. Reports from the field suggest that more aggressive and systematic efforts are made in sites with LFGTE to increase rain infiltration before installing the final cover in order to maximize gas generation with high Btu methane content. By increasing moisture when decomposition is occurring, the proportion of methane in the gases generated will also increase. Moreover, because the cap, which is being delayed, is necessary for proper gas collection function, the increase in methane levels will be occurring when there is inadequate gas collection. More research needs to be done to document actual field practices in order to quantify its impact. (c) Reducing Negative Pressure to Almost Eliminate Oxygen Infiltration. Another reason that operators managing site for maximum energy recovery may throttle the collection system is to keep infiltrating oxygen levels at even lower levels than permissible without energy recovery. For those landfills without LFGTE, the operator need only concern himself or herself with damping the vacuum forces in the wells to keep oxygen levels less than the lower explosive limit (LEL) of 5% in order to avoid fires. Only when those levels are approached does the well need to be throttled, reducing gas collection	

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						efficiency, in order to reduce the draw air from the surface through leaks in the cap. However, when energy is being recovered, and high methane levels must be maintained, then much lower levels of oxygen infiltration are a concern, because oxygen can poison the methanogenic process at less than 1%, sometimes as low as 0.1%. Because these constraints are 5 to 50 times more stringent than landfills without energy recovery, there is a significant incentive to more aggressively repair tears in the cap, though, if that becomes difficult, to reduce the negative pressures through the collection pipes to insure not drawing any air from the surface. How the two cross-currents will balance out in practice is not something about which there is not any data, and clearly more research is needed to find out. Pending that being done, the conservative view would seem to be to assume that the two cancel each other out. SECOND, the USEPA's methodology for assuming what power generation emissions are displaced are incorrect. Their model assumes the average emissions of all fossil plants in their relative proportion and with their performance as it was in 1996. A short precis of a longer analysis shows that both are incorrect. For one thing, (,)	
10-102	A	15	21	15	24	It should be explained that these additional measures (horizontal collection systems and biocovers) are not completely effective even when installed. Landfill gas collection technology is inefficient, resulting in lifetime gas collection efficiencies as low as 20% (as stated on page 19, line 27). (Brian Bahor, Covanta Energy Corporation)	Noted. Chapter 10 cites published literature relating to landfill gas collection efficiencies.
10-9	B	16	1	16	2	Actual data: Between 1990 and 2003 landfill CH4 emissions decreased by 36% due to …. (source: by member states notified landfill CH4 emissions in: Deuber, Herold 2005: "Overview on inventory methods and parameters used in the waste sector in European greenhouse gas inventories - Background paper for Workshop on waste (CRF Sector 6), Berlin May 2005 (Government of Germany)	Taken into account. The paragraph "For the EU15, trends indicate that landfill CH4 emissions are declining…" will be updated with EU emissions data for 2005 or 2006.
10-103	A	16	10	17	0	Figure 10.5 – title should precede the figure, footnotes should remain at the end. U.S. Government (Government of U.S. Department of State)	Taken into account. We will follow TSU guidance on formatting.
10-104	A	16	19	16	0	EPA 2001 did not prove that wastewater emissions are correlated to population (see general comment) . U.S. Government (Government of U.S. Department of State)	Accepted. Sentence deleted (at page 16 line 10)
10-105	A	16	20	16	0	Wastewater emissions can actually decrease with industrialization because latrines	Noted, but the sentence begins "In general"

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						cause more emissions than wastewater treatment plants. U.S. Government (Government of U.S. Department of State)	and additional detail is beyond the scope of this chapter.
10-106	A	17	0	17	0	Be consistent with references. Choose EPA or US EPA. Also, if you use the Global Non-CO2 emissions report for nitrous oxide, it should be the preferred report for methane as well and the most recent version should be used. Alternatively you could use the Scheehle, Kruger paper for both. U.S. Government (Government of U.S. Department of State)	Taken into account. We will follow TSU guidance on formatting.
10-107	A	17	24	17	0	Figure 10.5 This figure is unclear. It is difficult to determine the region associated with each section on the pie chart. U.S. Government (Government of U.S. Department of State)	Taken into account. We will follow TSU guidance on formatting.
10-10	B	18	10	18	10	Add: In Germany municipal solid waste is completely incinerated with energy recovery or treated in MBT with production of RDF since middle of 2005 (Government of Germany)	Noted. Further detail is beyond the scope of the chapter.
10-108	A	18	14	0	0	Incineration in developing countries is not "less common"...it is basically not existent. While this statement on incineration (not being the technology of choice) is appreciated….It is too little too late in the document which makes statements early on that will create problems in developing countries. (Sandra Cointreau, World Bank)	Rejected. There are currently waste incinerators in a number of developing countries.
10-109	A	18	23	18	23	"The information in brackets about the offsets should include some additional detail on the potential size of the offsets or refer to the additional detail depicted on page 34, lines 42-44." . U.S. Government (Government of U.S. Department of State)	Taken into account. The phrase in brackets is deleted. The Cost and Potential section will be revised to improve clarity and to take such detail into account.
10-110	A	18	32	18	35	A cement kiln is not an incineration furnace, but manufactures its product while co-processing wastes. Therefore, please use "co-combustion" in stead of "incineration". (Claude LOREA, CEMBUREAU, The European Cement Industry)	Accepted. For "industrial incineration" we will replace with "co-combustion".
10-111	A	18	32	18	35	The industry has never applied their cement kilns as incineration furnace, but manufactured the product by co-processing with municipal solid wastes. Therefore, I would suggest to use "co-processing" in stead of "incineration furnace" and add the following literature* which will be published on Vol.2, No.4 issue (October 25) of "Journal of Life Cycle Assessment, Japan" as follows: * Title : "Proposals for Classification and an Environmental Impact Evaluation Method for Eco-Services: Case study of Municipal Waste Treatment in Cement Production" Co-Authors : Kohei Morimoto, Hong X. Nguyen, Tomonori Honda, Miki Chihara,	Taken into account (see comment 10-110 above). For "industrial incineration" we will replace with "co-combustion". These references are not yet available for consideration.

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						Ying Wang, and Ryoichi Yamamoto Please note that the authors have received a possible reconsideration judgment from Journal of Life Cycle Assessment, Japan and they confirm to submit an amended document by September 22 as requested. These technologies include landfilling with landfill gas recovery, post-consumer recycling, composting of selected waste fractions, MBT with landfilling of residuals, anaerobic digestion, and incineration and other thermal processes [production of RDF(refuse derived fuel) and co-processing at industrial furnaces such as cement kilns] (Onuma et al., 2004 and Morimoto et al., 2006). (Yoshito Izumi, Taiheiyo Cement Corporation)	
10-112	A	18	32	18	35	These technologies include landfilling with landfill gas recovery, post-consumer recycling, composting of selected waste fractions, MBT with landfilling of residuals, anaerobic digestion, and incineration and other thermal processes [production of RDF(refuse derived fuel) and co-processing at industrial furnaces such as cement kilns] (Onuma et al., 2004). (Eiichi Onuma, 0)	Taken into account (see comment 10-110 above). For “industrial incineration” we will replace with “co-combustion”.
10-113	A	18	32	18	35	Comments: We have never applied a cement kiln as incineration furnace, but manufactured the product by co-processing with municipal solid wastes. "Co-processing" is NOT just "incineration", using not only as fuels, but also "materials". Therefore, please use "co-processing" in stead of "incineration furnace". (Government of Japan)	Taken into account (see comment 10-110 above). For “industrial incineration” we will replace with “co-combustion”.
10-114	A	18	33	18	33	It should be "MBP" instead of "MBT" (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Rejected. This abbreviation has been standardized to MBT.
10-115	A	18	36	0	0	Please don't say "have yet to be applied" as if someday they should be. (Sandra Cointreau, World Bank)	Rejected. These are being built now at full scale, and our text will be revised to say “At the "high technology" end, there are also advanced thermal processes for waste such as pyrolysis and gasification, which are beginning to be applied in the EU, Japan and elsewhere”.
10-127	A	19	0	19	0	This comment is based on the argument above (in comment 10,p18,31). Please insert a figure reflecting this in the upper right corner of Figure 10.6. (Claude LOREA, CEMBUREAU, The European Cement Industry)	Rejected. The label in the Figure “Incineration and other thermal processes” covers co-combustion technologies.
10-128	A	19	0	0	0	Figure 10.6. Insert the Figure of "co-processing at industrial furnaces" to Figure 10.6 (Government of Japan)	Rejected. The label in the Figure “Incineration and other thermal processes” covers co-combustion technologies.

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10-116	A	19	1	19	0	The industry has never applied their cement kilns as incineration furnace, but manufactured the product by co-processing with municipal solid wastes. Therefore, I would suggest to amend Figure 10.6 as follows: Insert "co-processing at industrial furnaces" in upper right corner of Figure 10.6. as below (Yoshito Izumi, Taiheiyo Cement Corporation)	Rejected. Further detail is beyond the scope of this general Figure.
10-117	A	19	1	19	0	Insert the Figure of "co-processing at industrial furnaces" to Figure 10.6 as below (separate word doc on interacticve website TSU) (Eiichi Onuma, 0)	Rejected. Further detail is beyond the scope of this general Figure.
10-118	A	19	1	19	5	Figure 10.6: In fact there are some application of icineration treatment, anaerobic digestion in developing countries. (Government of China Meteorological Administration)	Accepted. We will delete both arrows on Figure 10.6.
10-119	A	19	23	21	2	Flaring should be included. Globally, there are more flares in operation than the 1150 LFGE projects and represent a significant and often cheaper mitigation technology. While 90% recovery may be achievable this is certainly not the case at most landfills and even less so in developing countries. EPA uses a default 75% (85% possible) recovery under best conditions at modern engineered landfills. U.S. Government (Government of U.S. Department of State)	Taken into account. This is discussed previously (see comment 10-100). Chapter 10 also cites published literature relating to landfill gas collection efficiencies.
10-120	A	19	24	19	26	EFFECTIVENESS OF GAS COLLECTION - INTRODUCTION. There are numerous errors in the draft's presentation of the data bearing on the effectiveness of landfill gas collection systems so serious as to deprive it of any utility. Three of the main ones are briefly described in the next three cells due to space limitations in the spreadsheet that preclude their all being placed here. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	Rejected. Chapter 10 cites published literature relating to landfill gas collection efficiencies.
10-121	A	19	24	19	26	(5) EFFECTIVENESS OF GAS COLLECTION - TEMPORARY STORAGE. The cited study for mass balance analysis (Spokas 2006) relies upon a moving target value for gas storage to balance the equations. Gas storage, outside of ephermeral barometric phenomenon is not a valid construct, lending concern that it is being used as a further fudge factor. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	Rejected. Chapter 10 cites published literature relating to landfill gas collection efficiencies.
10-122	A	19	24	19	26	(4) EFFECTIVENESS OF GAS COLLECTION - GAS GENERATION ASSUMPTION WIDE VARIATION. As noted in the prior comment, landfills are not a controlled environment due to their highly heterogenous compostion, along with variation in, among other things, precipitation, runoff control, cover practices, compaction levels, waste depth, etc. This is why, as noted, the estimates of gas generation per ton of waste in place vary by wide margins by a factor of more than	Rejected. Chapter 10 cites published literature relating to landfill gas collection efficiencies. The London study is more appropriate for WG1, or inventory verification, since it is not a mitigation study.

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						40 times. Without having a population with a substantially narrower degree of uncertainty, and a larger population from which to make regression estimates, any mass balance exercise, which is built on the generation rate, is a useless exercise in futility. The fact that more recent studies of actual background concentration levels as an alternative model of analysis reaches dramatically different conclusions only reinforces this point. Not that the ground concentration model is without its own set of problems, but rather it illustrates that any claim to scientific precision, or even approximation, for mass balance approaches is without foundation. See, e.g., P. O'Brien, "London methane emissions: Use of diurnal changes in concentration and C13 to identify urban sources and verify inventories," 106 J. of Geogphysical Research 7427 (April 16, 2001). (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	
10-123	A	19	24	19	26	(3) EFFECTIVENESS OF GAS COLLECTION - FIRST ORDER DECAY MODEL INCOMPLETE. Although the first two reasons make any further discussion of the irrelevant instantaneous rate unnecessary, it may be noted that the mass balance study design is not suitable for even a limited analysis of point-in-time collectioin efficiencies. For one thing, the design builds first on the first order decay model. There is a major flaw in this attempt to mathematically represent the pattern of gas generation in landfills over time. That flaw relates the fact the formula uses the theoretical decay rate, represented as “k,” when the actual decay rate in a year is dependent on there being sufficient levels, and adequate distribution, of moisture, which is a limiting condition, along with necessary temperatures, pH and microorganisms. As a result of this error, the equation fails to recognize that substantial methane potential will often remain when gas production seems to have ended and produce gas in the early years less than indicated, and this is most important, far more in the later years when there is functioning collection system at all. That is to say, first, the model assumes that more biological degradation occurs initially than, in fact, actually occurs. The methane generation rate, or “k” in the equation, is specified to be a constant value as part of an equation intended to reflect how much gas will actually be generated from a unit of decomposable material during one year. At the outset, a MSW landfill in the U.S. will consist of approximately 67% decomposable matter. As time proceeds and decomposition continues, that organic fraction, including its moisture content, decreases in absolute value and also proportionately relative to the inert fraction, which remains constant by weight. After each year passes following closure of the landfill, then, there will be that much less undegraded	Noted. Chapter 10 cites published literature relating to landfill gas modeling. The FOD model is the approved method for national inventories. Further detail is beyond the scope of the chapter.

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						organic matter to which the methane generation rate can be applied in the following year (the standard " - e-kt " decay rate function in the equation). However, in fact, in a landfill the rate of actual methane generation is affected by other factors, which, although not specified in the equation, do vary, and do so with significant implications for the validity of the study design. In particular, "[m]oisture is essential for anaerobic decomposition" that creates methane after the oxygen in the incoming waste is exhausted. Similarly, EPA's formal guidance in AP-42 for estimating landfill emissions carefully states: "The potential CH4 generation capacity of refuse (Lo) is dependent on the organic (primarily cellulose) content of the refuse not bound up in lignin and can vary widely by a factor of more than 40 time [6.2 to 270 m3 CH4/Mg refuse (200 to 8670 ft3/ton)]. (U.S.E.P.A. Office of Air Quality Planning and Standards and Office of Air and Radiation, Emission Factor Documentation for AP-42, Section 2.4, Municipal Solid Waste Landfills (Revised August 1997).) The value of the CH4 generation constant (k) is dependent on moisture, pH, temperature, and other environmental factors, as well as landfill operating conditions." When insufficient volumes or inadequate distribution of moisture occurs, then the actual gas generation during its first wave of production will be less than the constant generation rate shown by k. That difference in the degradable carbon potential will be retained with the remaining waste and be available to create more gas if additional moisture reenters the site at a future time. For these reasons, the particular form of the first order decay model used is wholly inappropriate to model annual emissions of landfill gas. For it fails to account for the moisture levels in that year, which infiltrate into the waste body, and that are a necessary precondition for the theoretical annual rate of decomposition to actually occur. A new model is necessary that adjusts the putative constant k for the availability in that year of the other necessary preconditions for decomposition. Most important to remember is the fact that the accumulating difference between theoretical kt and actual emission rate in a year, ka, is carried forward as the residual amount of convertible carbon. That residual remains inside the waste load at closure to later be mobilized when, after maintenance ends, the integrity of the final cover degrades and moisture infiltrates the site. The inability of currently structured First Order Decay models to properly account for emissions by time makes any attempt at accurately conducting a true mass balance analysis in the uncontrolled conditions of a heterogeneous landfill impossible. It is an exercise devoid of meaning and wholly susceptable to producing whatever result is desired. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	

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10-124	A	19	24	19	26	(2) EFFECTIVENESS OF GAS COLLECTION - LONG TERM NOT POINT-IN-TIME. Second, and most fundamental, the first reference to the high collection efficiency, when it is addressed on a point-in-time basis is predicated upon the wrong definition. This is not something that can responsibly be disputed. The IPCC protocols make clear that the emission assessments are not made at a single point in time. There is no restriction on what "is released virtually instantaneously...as long as the biogenic carbon would eventually be released ... over a period of a few decades." As noted, in the Framework Convention on Climate Change, the purpose of the framework "is to stabilize GHG concentrations in the atmosphere at a level, and over a time frame, that will minimize manmade climate disruptions," which result from accumulating levels of carbon over long periods of time just as we see today. "Any use of GWPs, the IPCC 's Second Assessment stated, "should be based on the effects of the greenhouse gases over a 100-year time horizon." Further, there is a determinative reason that "decades" must be interpreted to be not less than 100 years when considering methane emitters. That relates to the fact that methane exhibits substantially greater warming potential than CO2. To be able to compare the different greenhouse gases to each other, an integral part of these calculations is the relative impact of methane to other gases on what is called a "carbon equivalent" basis. Also, because of the different residence times of various gases in the atmosphere, that calculation must make an assumption as to the time period over which it is made. IPCC protocols indicated that methane is 23 times more potent at trapping heat than CO2 when that conversion is calculated over a 100 year time frame. If a shorter period were used, the conversion factor would have to be greater than the 23 times that EPA uses in estimating landfills' GHG responsibility because methane breaks down in the environment over a shorter interval than CO2. For example, were a 20 year time period used for converting methane to CO2., then the GWP of methane would be 62 times carbon dioxide, rather than the initial 21 (more recently 23) multiplier, according to conversion tables. If we were to extrapolate from that conversion data, the 1-year conversion factor, were that to make any sense, would suggest that methane has 430 times the warming potential of CO2 on a one year basis. Using the proper multiplier for a 1-year analysis of 430, then, would imply that landfills' responsibility for greenhouse gases is 29.6% instead of EPA's estimated 2.2%. This means a clear understanding of what emissions occur in the out-years following the end of any maintenance at the site – reaching to 100 years after the first waste emplacement – is essential to answer the question of how much landfill gas adds to biogenic greenhouse gases,	Rejected. Chapter 10 cites published literature relating to landfill gas collection efficiencies.

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						and the draft's inference otherwise is inapposite to the facts. In that regard, as the draft concedes, calculated on a long term basis, average "recovery efficiencies may be as low as 20%," citing Oonk and Boom. This is, coincidently, very close to the 19% estimate that we have calculated in an upcoming report, "from Beneath the ground: Gas from landfills threatens overheating the earth," with Larry Bingham and Prof. Rodney Stevenson. With this set, placing landfill's capture rate at around 20%, which means almost all of it escapes into the atmosphere, there is no basis to repeatedly conclude that gas collection is mature and effective. The chapter should state that the collection of methane from landfills, which is the only waste management alternative to create methane in volume, is ineffective. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	
10-125	A	19	24	19	26	(1) EFFECTIVENESS OF GAS COLLECTION - CONTRADICTORY CITATIONS UNRESOLVED. First, the draft provides two citations at diametric variance to each other – one implying that the collection efficiency rate is 90% and the other 20% – without suggesting how the two can be reconciled. Even though no means to reconcile the two is provided, without any reasoning the draft later persists in stating as its conclusion (at pp. 3, 5 and 29) that landfill gas collection is effective. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	Rejected. Chapter 10 cites both numbers from published literature in order to compare the effect over different timeframes.
10-126	A	19	25	0	0	Do these lifetime recovery rates as low as 20% apply here, where we are talking about new systems designed for optimizing gas capture. Please qualify the statement based on the conditions where these low rates apply and state the norms that usually occur. (Sandra Cointreau, World Bank)	Noted. Chapter 10 cites both high and low numbers from published literature in order to compare the effect over different timeframes.
10-129	A	20	6	20	33	OXIDATION. The draft largely relies upon either laboratory or, as previously detailed, useless mass balance analyses to support a claim for substantial oxidation effects for CH4 in a well maintained thick compost layer on top of a landfill cell under idealized conditions of temperature, moisture etc. In addition to, again, the disturbing reliance on idealized constructs instead of real world conditions, here, as elsewhere, the draft suffers from a disturbing lack of precision on matters where distinctions are critical. If we are talking about a landfill designed in the U.S. to Subtitle D specifications, for example, that includes a final cover of which a low permeable geomembrane is an integral part. Oxidation first appeared in the technical literature in the Czepiel study, P. M. Czepiel, et al., "Quantifying the effect of oxidation on landfill methane emissions," Journal of Geophysical Research (July, 20, 1996)., at p. 16,720, which found in field and laboratory studies	Noted. Chapter 10 cites published literature relating to landfill gas oxidation. Further detail is beyond the scope of the chapter.

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						during 1994 that 10% of the methane generated in a landfill was oxidized in the cover soil over the course of a year. When the gases that are emitted are diffused throughout the overlying soil blanket, as would have been the case with most landfills constructed before 1991, this study would be arguably applicable. However, modern landfill gases are not diffused at the surface throughout that earthen layer in the U.S., because, since 1991 a composite cap has been required under that soil blanket, including in practice a 60-mil (or 1/16") high density polyethylene plastic membrane that effectively impedes the passage of gases from the waste into that cover soil. This is key. It means that instead of the methane diffusing throughout the topsoil for maximum oxidizing effect, the gases that are released above the landfill are concentrated in high fluxes at a handful of cracks and tears in the plastic sheet. Concentrated high flux emissions quickly overwhelm the capacity of the topsoil to oxidize the escaping methane through these hot spots. Czepiel expressly stated that not only was his study not done at a landfill with a synthetic geomembrane, but also, "[p]eriodic maintenance of the cover materials has minimized significant surface cracks" in the clay layer, as well. That is to say, nothing in his study can be used to describe what happens to the methane that flashes through a small number of hot spots on the top face of the landfill. He further reemphasized again in his conclusion that his findings did not apply when gases are released in high fluxes through narrow cracks: "Waste settlement, surface erosion and soil dessication often promote significant surface cracking, providing paths of minimal resistance to gas flow, effectively bypassing microbial influence. Our study generally lacked surface cracks, although his characteristic may not be representative of the entire spectrum of landfill surfaces." Furthermore, a consultant for the U.K. Department on the Environmental conducted a comprehensive study involving 250 measurements at a landfill with a composite cover and found that there was no oxidation effect: "Methane oxidation is only observed where the diffusion gradient through the cap is very small, and therefore the methane oxidizing bacteria can cope with the rate of supply of gas. When higher fluxes predominate there is little evidence either for or against methane oxidation being a significant component of emission control." AEA Technology, Methane emissions from UK landfills (UK Department of the Environment, Transport and the Regions, 1999), at p. 2-9. A similar field examination by researchers at a Swedish landfill corroborated the U.K. findings. G. Borjesson, et al., "Effects of gas extraction interruption on emissions of methane and carbon dioxide from a landfill and on methane oxidation in cover soil," Journal on	

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						Environmental Quality, at p. 1182. (PETER ANDERSON, CENTER FOR A COMPETITIVE WASTE INDUSTRY)	
10-130	A	20	7	0	0	This material on the value of soil cover in reducing CH4 is quite good. It seems that there also should be mention of the value of compost as a carbon sink. (Sandra Cointreau, World Bank)	Noted. Further detail is beyond the scope of the chapter.
10-131	A	20	7	20	32	Given limited experience with combined gas collection and biocovers it is premature to claim these technologies as “extremely effective”. This section should include a description of any full scale experience with these combined technologies and any limitations with regard to maintenance, operational variability, and gas channeling resulting from fissures in the landfill impermeable cover. (Brian Bahor, Covanta Energy Corporation)	Taken into account. The sentence “Therefore, the combination of engineered gas extraction and natural CH_4 oxidation can be extremely effective to reduce emissions” will be removed.
10-132	A	20	7	20	39	CCS could be mentioned in this section as a way to achieve negative carbon emissions by capturing the CO2 from combustion of the CH4 (which is biogenic). U.S. Government (Government of U.S. Department of State)	Rejected. Further detail is beyond the scope of the chapter.
10-133	A	20	34	20	38	BIOREACTOR EFFECT ON REDUCING GAS COLLECTION EFFICIENCY. Without any technical support, the draft makes the bald claim that "implementation of bioreactor landfill designs" will "reduce landfill methane emissions." Again, as discussed in some detail earlier, bioreactors, which blend inchoately with leachate recirculation in practice, shift long term gas generation to the present in conditions that present enormous engineering challenges for effective gas collection. In addition to the critical alarm bells that any deliberate decision to move far off GHG production to the present raises for those concerned with tippiing points, the default assumption, pending actual data, could only prudently be that capture rates will deteriorate significantly. The present absence of data cannot responsibly default to a incredulously high capture rate assumption for the confounding field conditions involved. (,)	Noted. Chapter 10 cites published literature relating to landfill gas collection efficiency. Further detail on bioreactor landfills is beyond the scope of the chapter.
10-134	A	20	35	0	0	Given that landfills designed as bioreactors can achieve over 90% emission reduction, as in Los Angeles, CA, why is it that compost isn't being considered to have at least the same level of emission reduction and to have it immediately. More input on rates of emission reduction would be helpful, as the current decay model is not providing adequate incentive for carbon finance. (Sandra Cointreau, World Bank)	Noted. The first statement of the reviewer does not appear in this Chapter. We consider that additional details regarding compost are beyond the scope of this chapter.
10-135	A	20	36	20	39	More discussion of aerobic and anaerobic bioreactors should be added under CH4	Rejected. Further detail is beyond the scope of

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						management (for a good discussion see: http://www.epa.gov/epaoswer/non-hw/muncpl/landfill/bioreactors.htm) U.S. Government (Government of U.S. Department of State)	the chapter.
10-136	A	20	41	20	41	Replace the term "sink" with "stock" since according to the agreed definition of sink, landfill is not removing C from the atmosphere. (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Taken into account, but we prefer the word "storage".
10-137	A	20	44	20	46	This is a policy statement that appears to promote the use of landfills for GHG mitigation without regard for other environmental considerations. U.S. Government (Government of U.S. Department of State)	Taken into account. The word "more" has been removed from the sentence.
10-138	A	20	47	21	2	"The fraction of C storage…..perspective". The example (of Hashimoto and Moriguchi 2004) seems to provide only 'Japanese perspective' of the fraction of C storage in landfills. Can it not be taken as a general example applicable as default for other regions? (Government of India)	Accepted. Text replaced with "The fraction of C storage in landfills can vary over a wide range as a function of the original waste composition and landfill conditions (for example, see Hashimoto and Moriguchi, 2004)."
10-139	A	21	5	21	25	Include stronger reference to world's best practice incineration methods as the impacts on air pollution should be considered. Environmental standards for waste incineration and landfill have been made more stringent in recent years. The new regulations are based on EU common minimum standards, Directive 1999/31/EC on landfill and Directive 2000/76/EC on incineration. The aim is to lessen the impact on soil, water and air. (Kirsten Macey, Climate Action Network Europe)	Taken into account. References and abbreviated text giving additional details on waste incineration and waste treatment will be added.
10-140	A	21	9	0	0	Replace "Consomi" with "Consonni" (Stefano Caserini, Politecnico di Milano)	Accepted.
10-11	B	21	12	21	12	In scandinavian countries, urban incinerators have historically supplied fuel for district heating of residential and commercial buildings, resulting in an energy efficiency of appr. 80% of the available energy in waste (Government of Germany)	Taken into account. Additional details on use of waste incineration for district heating and their energy efficiency will be included as available.
10-141	A	21	16	21	17	While incineration and other waste-to-energy (WTE) processes are more capital-intensive than landfills, overall economics are project-specific. The cost-effectiveness of WTE is related to alternative disposal costs, transportation costs, energy prices, and recovered material prices. In the densely populated Northeast U.S., WTE can be competitive in large part because plants can be located near the center of the waste shed, avoiding the significant waste hauling costs to distant landfills.	Taken into account. We will expand the discussion on waste to energy.

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						(Brian Bahor, Covanta Energy Corporation)	
10-142	A	21	16	21	20	Since 1996 large and small MSW incinerators have been subject to US emission standards (40 CFR part 60) The section on incineration should include discussion of US practices. This should incorporate the point that US incinerates approximately 17 percent of its waste. U.S. Government (Government of U.S. Department of State)	Noted. Further detail is beyond the scope of the chapter.
10-143	A	21	17	0	0	Questioning whether any incinerators meeting EU standards for air emission are operating at a cost of under 80 Euros/tonne. The cost presented may be taking revenues into consideration, which would be applicable in high income countries only. Cost data needs to be claried, versus cost minus revenue. (Sandra Cointreau, World Bank)	Accepted. The incineration cost will be updated to >80 Euros/tonne (with references) to improve clarity.
10-12	B	21	18	21	19	Electrical efficiencies from incineration are limited (main focus: preferably complete thermal distruction of waste in compliance with stringent emission standards; limited steam parameters due to corrosion problems); modern incinerators with 100% electricity production (no heat) achieve maximum appr. 22% (>30% as indicated is rather unrealistic); typically incinerators produce 100% heat or electricity and heat; in any case both electrical and thermal efficiency should be given to characterize incinerators (e.g. 20% electrical efficiency, 0% thermal; e.g. mean values for Germany are 10% net electrical efficiency and 30% net thermal efficiency) (Government of Germany)	Noted. To the extent possible, we will examine additional references.
10-13	B	21	23	21	24	Fluidized bed incineration is a proper combustion concept for homogenous waste (e.g. sewage sludge); for mixed waste like municipal solid waste moving grate systems still are the technically preferred option; therefore it is not really correct to speak of "advanced combustion concepts" in this context (Government of Germany)	Accepted. The word advanced in the sentence will be removed: “In recent years, these combustion concepts have penetrated the market, including fluidized bed technology”.
10-14	B	21	33	21	34	Anaerobic digestion produces CH4, CO2 and also a humic fraction (with a lower C-content and if dewatered properly additionally a lower salt, nutrient and e.g. heavy metal content; dewaterd and after-composted digestate is qualified to be used as substrate in horticulture and private gardening (Fischer, P., Schmitz, H.-J.: Composts from residues of anaerobically treated household waste and their suitability in growing media. Institute of Soil an Plant Nutrition FH Weihenstephan, Freising, Germany 1996), (Fischer, P., Schmitz, H.-J., Jauch, M.: Verwertung fester Rückstände aus Vergärung von Bioabfällen. Institut für Bodenkunde und Pflanzenernährung. Staatliche Versuchsanstalt für Gartenbau, FH Weihenstephan, Freising, Germany 1997), (Fischer, P. (FH Weihenstephan): Eigenschaften und	Noted. Further detail is beyond the scope of the chapter.

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						Verwendung fester Rückstände aus der vergärung von Bioabfällen. In: Vergärung von Bioabfällen. Seminar 09. Dezember 1998 Wackersdorf. Bayerische Landesanstalt für Umweltschutz (Hg)), (Deutsche Bundesstiftung Umwelt, DBU 1998: Neue Komposte für Gartenbau); the use of the differing term biosolids is unnecessarily irritating (Government of Germany)	
10-144	A	21	35	21	35	In a.o. Norway and Sweden and Denmark biogas is used also as a fuel in transportation, eg in waste transportation vehicles and buses, and in district heating systems. We would suggest that these options are added to the text. (Government of Norwegian Pollution Control Authority)	Taken into account. Amend sentences to "Anaerobic digestion produces CH_4, CO_2 and biosolids. In particular, Denmark, Germany, Belgium, and France have implemented anaerobic digestion systems for waste processing, with the resulting biogas used for process heating, electrical generation, and other uses". Further detail is beyond the scope of the chapter.
10-145	A	21	35	21	36	In a.o. Denmark and Germany organic waste is often mixed with manure before treatment in anaerobic plants. This enhances the economy of the treatment of manure and facilitates the application of waste as a fertlizer in agriculture. These advantages are documented in (L. H. Nielsen & K. Hjort-GregersenSocio-economic Analysis of Centralised Biogas Plants Rapport nr. 136 Copengaen 2002) and (Kurt Hjort-GregersenEconomy in Centralised Biogas Plants Development and state in 2002 Rapport nr. 150 Copenhagen 2003) Both eports in Danish with english summaries. (Government of Norwegian Pollution Control Authority)	Noted. Further detail is beyond the scope of the chapter.
10-15	B	21	44	21	44	Depending on quality, the residual solids can be recycled as substrate for horticulture or private gardening, as fertiliser or soil amendments …. (Government of Germany)	Noted. Further detail is beyond the scope of the chapter.
10-146	A	21	48	21	49	Add source, % or actual number of MBT plants or tons of waste treated "…widely implemented in Germany, Austria and other EU countries" U.S. Government (Government of U.S. Department of State)	Taken into account. We will attempt to add EU data if available.
10-16	B	22	3	22	4	Composting may occur either in open windows or in closed buildings with exhaust air collection and treatment. In Germany closed systems are mandatory, the treatment has to be in compliance with stringent emission standards (Government of Germany)	Noted. Further detail is beyond the scope of the chapter.
10-147	A	22	5	0	0	Too little positive support for composting, which is a preferred technology for	Noted. The chapter authors consensus is that

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						developing countries in need of support from economic instruments such as carbon finance. Give it a break please. Why this bias??? (Sandra Cointreau, World Bank)	this is one of many technology choices but not necessarily a preferred technology for developing countries
10-148	A	22	7	0	0	Paragraphs 10.4.2 or paragraph 10.4.4 should mention the difficulties in using the gas produced in equipped landfills or the manufactured biogas because of local policies for health or the access to the grid. The example could be the major landfill of Montech near Toulouse, where important subsidies have been spent to equip the site with methane recovery. A report by a public body has questioned in 2000 the innocuity of landfill gas (Conseil Supérieur d'Hygière Publique de France 2000, Direction Générale de la Santé, annual report, Paris France). Although this issue has been addressed many years ago (e.g. 1982 report on work by Johns Hopkins University for Argonne National Laboratory and Gas Research Institute, a research jointly funded by the U.S. natural gas industry and the U.S. Dept. of Energy), this has been enough to halt any use of the gas, in a context compounded by the reluctance of utilities to purchase or transport such small local productions of gaz, even upgraded to pipeline quality (Record 2003, "Méthanisation des déchets organiques", Ref. O1-048/1A p. 182). (ANTOINE BONDUELLE, Université Lille II)	Taken into account. Barriers restricting the use of landfill gas will be briefly addressed.
10-149	A	22	10	22	24	Inclusion of Germany's waste management programe: With the 1994 Closed Substance Cycle and Waste Management Act, other specific product-, substance- and installation-based legal provisions and voluntary agreements with sectors of industry, policy-making has restructured waste management in Germany over the past 15 years. See Jürgen Giegrich and Regine Vogt (2004) The contribution of waste management to sustainable development in Germany - Section on municipal waste, IFEU Institute Heidelberg. (Kirsten Macey, Climate Action Network Europe)	Taken into account. Literature relating to successful recycling strategies will be cited in the appropriate section.
10-150	A	22	10	22	24	Highlight the successful schemes of waste recycling in Sweden: In Sweden, more than 90 per cent of household waste is recycled, reused or recovered. "The impact of waste on climate derives mainly from emissions of methane from landfill sites. Less landfill and more recycling will reduce the relative contribution made by waste to Swedish climate impact from around 4 per cent in 1990 to about 1 per cent between 2008 – 2012" A Strategy for Sustainable Waste Management: Sweden's Waste Plan, Swedish Environmental Protection Agency 2005 p.54 (Kirsten Macey, Climate Action Network Europe)	Taken into account. Literature relating to successful recycling strategies will be cited in the appropriate section.
10-151	A	22	22	22	23	This sentence should be removed. Ideally, it should be replaced by "Further work is	Rejected. Further detail provided is beyond

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						needed to quantify the benefits of recycling, and to estimate the additional benefits available through expansion of cost-effective recycling programs." The text as currently written makes the inappropriate suggestion that the impacts of recycling are less predictable or more variable than the impacts of the waste management facilities described elsewhere in the chapter. However, the industrial processes involved and recycling are in fact more predictable than the biological processes involved in methane generation in landfills, for instance. The GHG impacts of recycling scrap steel in an electric arc furnace, rather than producing steel from iron ore, are much more reliably known than most waste management facility impacts. If not using the alternative text proposed above, it would be better to either say nothing, or to reiterate that the substantial industrial benefits of recycling have been incorporated into chapter 7 (section 7.3 .6) in this report. (Frank Ackerman, Global Development and Environment Institute, Tufts University)	the scope of the chapter. Much of the comments pertain to industrial recycling.
10-152	A	22	24	22	24	Add: "Recent research (Sathre and Gustavsson, 2006) has shown that the carbon balance of biomass cascading is most affected by land-use considerations, i.e. alternative possible uses for the land when less biomass harvest is needed because of material re-use. This suggests that a broad system analysis is required to accurately determine climate impacts of waste management practices." Reference: Sathre, R. and Gustavsson, L. 2006. Energy and carbon balances of wood cascade chains. Resources, Conservation and Recycling, 47(4):332-355. (Government of Sweden)	Noted. Further detail is beyond the scope of the chapter.
10-153	A	22	28	22	28	Change "ranging from energy-intensive advanced technologies to natural purification processes" to "ranging from natural purification processes to energy-intensive advanced technologies" (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Accepted.
10-154	A	22	30	22	41	"However, systematic …… deep systems". Onsite treatment of wastewater or decentralised treatment systems may be favourable in reduction of methane and nitrous oxides. This may be suitable for developing countries as about 70% of the population in the country is yet to be provided with sewerage systems. (Government of India)	Noted. Further detail is beyond the scope of the chapter.
10-155	A	22	31	22	34	This sentence implies that technology is available to “reduce or eliminate” N2O emissions from wastewater systems, but does not indicate mitigation potential or cost. This information should be added to Table 10.6, rather than just considering the mitigation of CH4. Ideally, Table 10.6 would also include information about avoided fossil fuel CO2 emissions from waste-to-energy projects, and mitigation of	Noted. There are no existing studies to address these issues.

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						waste sector F-gas emissions, if such technology exists. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	
10-156	A	22	31	22	34	This sentence implies that technology is available to "reduce or eliminate" N2O emissions from wastewater systems, but does not indicate mitigation potential or cost. This information should be added to Table 10.6, rather than just considering the mitigation of CH4. Ideally, Table 10.6 would also include information about avoided fossil fuel CO2 emissions from waste-to-energy projects, and mitigation of waste sector F-gas emissions, if such technology exists. U.S. Government (Government of U.S. Department of State)	Noted. There are no existing studies to address these issues.
10-157	A	23	16	27	5	Section 10.4.7: More updated reference should be used: 1) Delhotal, C., F. de la Chesnaye, A. Gardiner, J. Bates, and A. Sankovski. In press. "Estimating Potential Reductions of Methane and Nitrous Oxide Emissions from Waste, Energy and Industry." Energy Journal. 2) Global Mitigation of Non-CO2 Greenhouse Gases, United States Environmental Protection Agency, Washington, DC, 430-R-06-005, 2006. http://www.epa.gov/nonco2/econinv/international.html. U.S. Government (Government of U.S. Department of State)	Accepted.
10-158	A	23	26	23	26	Delete "GHG gases from" (G. H. Sabin Guendehou, Benin Centre for Scientific and Technical Research)	Taken into account. We will edit this sentence for clarity.
10-159	A	23	26	24	1	Table 10.4 shows cost data only for the U.K. and the Netherlands. It would be more representative to also include developing countries and the U.S., for example. (see suggested references above) U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-160	A	23	26	24	6	More up-to-date global sources should be used for Tables 10.4 and 10.5 (see suggested references above) U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-161	A	24	0	24	0	Table 10.5: The cost information for CH4 control warrants a better explanation, including assumptions regarding the amount of landfill gas generated over a 100 year life and what fraction was collected. (Brian Bahor, Covanta Energy Corporation)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-162	A	24	3	24	6	Table 10.5 shows costs for the Netherlands - it would be helpful to show other countries as well for a comparison. (see suggested references above) U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-17	B	24	3	0	0	Table 10.5 calculations are not comprehensible, informations on boundary conditions might be helpful; besides does a study from 1996 still reflect the actual cost-effectiveness ?	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Government of Germany)	
10-163	A	24	10	24	15	Decisions about old waste and new waste are distinct and separate. Old waste landfills can be retrofit to recover gas without committing to landfilling new waste. Indeed the combination of old waste gas collection and new waste thermal processing could be the most effective GHG reduction option. (Brian Bahor, Covanta Energy Corporation)	Taken into account. The word "only" will be deleted from the sentence "In contrast, waste minimisation, recycling and various alternatives to landfilling (such as biological and thermal processes[1]) will *only* impact emissions in the future".
10-164	A	24	16	27	5	Does the Mitigation costs take into consideration savings of CO2 when waste is incinerated (waste to energy)? It is unclear from the text. If costs for an EU country are shown it is important that the study use the most recent costs for for instance landfilling. Higher requirements are introduced on the environmental safety of landfills which means higher costs for this strategy. Cost calculations from 1996 in the Netherlands are old. (Government of Sweden)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-165	A	24	16	25	8	Add information on IR scenario (now only three scenarios are described) (Government of Finland)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-166	A	24	16	25	0	The baseline scenario presented is very pessimistic (about a six-fold increase between 2000 and 2050). While there is some discussion in regard to overestimation of the emissions, are the numbers presented realistic enough to be so prominently displayed (in Figure 10.7a)? U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-167	A	24	17	27	5	The bulk of section 10.4.7 is devoted to the Monni et al 2006 study, but a peer-reviewed, comprehensive study has been published that is not referenced in this chapter: the U.S. EPA Global Mitigation of Non-CO2 Greenhouse Gases. This EPA study has undergone an expert peer-review process, is based on published EMF-21 analysis, and is comprehensive across all regions and all non-CO2 gases. (see suggested references) U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-168	A	24	17	27	5	How does the Monni et al projections compare with other studies (including U.S. EPA, IEA or the models used in the EMF-21 excercise? Adding a comparison table will help to put the Monni study in perspective. U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.

[1] The term incineration is used here to encompass also waste-to-energy concepts like

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10-169	A	24	23	25	1	A 5% annual increase in landfill methane recovery in developed countries is unrealistic. At some point diminishing returns will be reached. This is especially true in Europe where less organic matter will be reaching landfills. A quick check was done on US data and such a trend would result in near zero emissions, a noble but unrealisitic goal. U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies. Clarification will be provided that there is an upper limit to landfill methane recovery in the modelling study.
10-170	A	24	26	0	0	footnote not complete (Stefano Caserini, Politecnico di Milano)	Accepted. Editorial correction needed.
10-171	A	25	1	25	9	Most of the assumptions are not justified. Is there a citation for 15% per year? The developed country historical growth would seem more accurate. Why a 5% per year growth in incineration? In some developed countries, incineration appears to have reached a level point and a 5% annual growth does not appear accurate. U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-172	A	25	13	25	0	Why is current legislation not included? U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies. We are citing existing references rather than generating a new analysis.
10-173	A	25	18	25	19	The following statement appears misleading: "the estimated abatement potential is not capable of mitigating growth in emissions" . The potential as estimated by the assumptions in the Monni et al paper suggest the above statement but the assumptions are faulty, do not include current or planned legislation and do not look at economic or technical feasibility. Including other sources that look at this issue would be useful and not mislead the reader. U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-174	A	26	0	26	0	Figure 10.7b: While the text clearly indicates that calculated CH4 reductions from baseline for the various scenarios are additive, the graph gives the impression that the high landfill methane recovery rate (“HR”) scenario is superior to the other options. This is misleading for several reasons relative to waste-to-energy: 1) waste-to-energy avoids more GHG emissions on a per ton basis when considering the complete story (avoided CO2 from fossil fuels, avoided methane and recovery of metals), and 2) the text suggests a larger growth rate (15%) for landfilling than waste-to-energy (5%). Either is sufficient reason to re-calculate the values for a fair comparison. (Brian Bahor, Covanta Energy Corporation)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.

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10-175	A	26	5	26	25	Change the name of "CDM by 2012" to "CDM ending in 2012" to be in accordance with Monni at al., 2006, or demove the scenario from the figure, as it is nor described in the text. (Government of Finland)	Accepted.
10-176	A	26	28	26	28	add "paper" to read "increased paper recycling (IR)" to be in accordance with Monni at al., 2006 (Government of Finland)	Accepted.
10-177	A	26	35	26	36	How is the EMF-21 cost data adjusted to the various baselines? Mitigation options and potential will vary depending on the baseline. Some of the alternate baseline scenarios proposed include some mitigation, which would reduce the additional mitigation potential. U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-178	A	26	36	26	37	How are the mitigation costs & emission reductions used in the Global TIMES model? Unclear how the model works from the text. U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-179	A	26	41	26	42	Replace the sentense "With early implementation of mitigation measures, the time frame could be shortened.", with "Realisation of these mitigation levels would require early implementation of the mitigation measures." (Government of Finland)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-180	A	26	44	26	44	See the comment above to p 3 concerning waste minimisation (Government of Norwegian Pollution Control Authority)	Taken into account. See previous response to comment 10-40A.
10-181	A	27	0	27	0	Table 10.6: Footnote “b” recognizes waste-to-energy reduces GHG’s by avoiding both CH4 release from landfills and CO2 release from fossil fuel (both from electricity generated and ferrous recovery); however, the calculation does not fairly represent this fact. It simply suggests to the reader who takes the time to read the footnote that this issue exists. If the intent of this table is to advance information that enables informed decision-making, then the values should be adjusted to recognize the complete picture. Individual project leaders will not have the time or capabilities to do this on a site-specific basis and, as a consequence, the true GHG avoidance potential of waste-to-energy will be lost in the details of the footnotes. (Brian Bahor, Covanta Energy Corporation)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-182	A	27	0	27	0	Check and correct the numbers for Mechanical-biological treatment for Non-OECD and Global (should be zero in other cost classes than the highest) and correct the Total line of the table correspondingly according to Monni et al, 2006 (Government of Finland)	Accepted.
10-183	A	27	0	27	0	Add the unit of emission reductions (Tg CO2 eq of CH4 reduced) to the Table.	Accepted.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Government of Finland)	
10-184	A	27	1	0	0	What are the units of reduction in this table? (John Nyboer, Simon Fraser University)	Accepted. Units will be added.
10-185	A	27	1	27	6	The units for the cells in this table are missing. They need to be added. Also, since Table 10.3 indicates that CH4 emissions are the projected to account for almost 90% of total GHG emissions from the waste management sector, the regional breakdown and more comprehensive cost breakdown contained in this table should appear in both Table SPM.2 and Table TS.19. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Accepted. Units will be added. The Cost and Potential section will be revised to improve clarity and to take into account other studies. Updated data from the waste sector needs to be included in SPM and TS.
10-186	A	27	1	27	6	Table 10.6 is confusing. Reviewers cannot determine the meaning of the values presented in the columns (assumed megatons CO2eq). Are the values cumulative in the columns? The units for the cells in the heading are unknown. Footnote 3 - What is an "instaneous annual reduction"? U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies. Updated data from the waste sector needs to be included in SPM and TS.
10-18	B	27	1	27	0	Table 10.6 is highly confusing. The table needs to be reformulated and clarified. U.S. Government (Government of U.S. Department of State)	Taken into account. The Cost and Potential section will be revised to improve clarity and to take into account other studies.
10-187	A	28	1	28	1	Please spell "Fluorinated gases" correctly!! (,)	Accepted.
10-188	A	28	1	28	45	Using the example of the EU Directive on Stationary emissions from fluorinated gases it is clear that the cost of containing and destroying f-gases is substantial. Literature shows that containing these gases is not certain and the costs could rise to over 50EUR per tonne Anderson, J (2005) Is STEK as good as reported? Uncertainties in the concept underlying the proposed European Regulation on fluorinated gases, IEEP p. 2. Containment regulations do little to promote alternatives in the market when these are subject to similiar requirements (ibid p.12). (Kirsten Macey, Climate Action Network Europe)	Noted. Further detail is beyond the scope of the chapter.
10-189	A	28	1	28	45	Inclusion of cost of phasing out f-gases from domestic refrigeration as at the end of life there is a large amount of greenhouse gases that need to be removed and destroyed. Ecofys and Oko-recherche estimated the costs of various abatement options for equipment using fluorocarbons. The switch from HFCs to hydrocarbons in domestic refrigeration was among the cheapest of them: €3.40/tonne CO2. By comparison, the estimated cost for containment measures in larger equipment, similar to those described by the Regulation, is over €18/tonne according to another study for the European Climate Change Programme. Currently, EU Emissions	Noted. There are no global estimates for F-gases emissions from the waste sector. Further detail is beyond the scope of the chapter.

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						Trading allowances are trading at almost €25/tonne.The estimated cost of recovering the 80% of HFCs that remain at the end of the useful life of a refrigerator is €90/tonne CO2 . Emissions from domestic refrigeration could be cut by 1.1 MT per year in 2010 through the elimination of HFCs. Anderson, J (2005) Marketing and use restrictions for HFCs in small refrigerators and freezers, IEEP. (Kirsten Macey, Climate Action Network Europe)	
10-190	A	28	1	28	45	This discussion of fluorinated gases does not indicate either a global emission rate or mitigation potential and costs. If these can be estimated, they should be. If not, a statement that they cannot be estimated, and the reasons why it is not possible to make the estimates, should be added to this section. The information that some fluorinated gases may be biodegraded in landfills is new and should appear in the chapter Executive Summary. (Lenny Bernstein, L. S. Bernstein & Associates, L.L.C.)	Noted. There are no global estimates for F-gases emissions from the waste sector. Further detail is beyond the scope of the chapter. Data supporting the biodegradation of F-gases in landfills is new research and the information is limited.
10-191	A	28	1	28	45	This discussion of fluorinated gases does not indicate either a global emission rate or mitigation potential and costs. If these can be estimated, they should be. If not, a statement that they cannot be estimated, and the reasons why it is not possible to make the estimates, should be added to this section. The information that some fluorinated gases may be biodegraded in landfills is new and should appear in the chapter Executive Summary. U.S. Government (Government of U.S. Department of State)	Noted. There are no global estimates for F-gases emissions from the waste sector. Further detail is beyond the scope of the chapter. Data supporting the biodegradation of F-gases in landfills is new research and the information is limited.
10-192	A	28	1	28	45	Section 10.4.8 on fluorinated gases: suggested reference for projections: USEPA 2006. See suggested references above for mitigation. U.S. Government (Government of U.S. Department of State)	Noted. However, this document does not contain projections for the waste sector.
10-193	A	28	2	0	45	The summary of mitigation options and the text in the chapter does not at all include the possibility to replace fossil fuels in vehicles with CH4 from anaerobic biological treatment of organic waste and wastewater- bio methane. This mitigation option has come to use to some extent now in Sweden and the number of cars are growing. The policy instruments used are mainly tax exemptions and investment grants. In 2005 0,2% of the totally energy used for road traffic in Sweden came from bio-methane. The interest for this mitigation option are growing in other countries as well. (Government of Sweden)	Noted. Further detail is beyond the scope of this chapter, which addresses waste.
10-194	A	28	10	28	11	Statement that end of life issues are only relevant to foams is too broad. For instance, refrigerants can remain for years after disposal of household A/C equipment. U.S. Government (Government of U.S. Department of State)	Accepted. We will change “only relevant” to mainly relevant” in the text.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
10-195	A	29	4	29	15	While many of the latest enclosed flares can achieve >99% destruction efficiency the majority of operational flares are lower depending on type (e.g., many existing candlestick with lower efficiencies) and disposal conditions (e.g., quality of the gas, open dump site, O&M). U.S. Government (Government of U.S. Department of State)	Taken into account by existing text. Further detail is beyond the scope of this chapter.
10-196	A	29	4	29	15	Source of VOC removal and H2S to comply with manufacturer's warranty? VOCs typically not removed and H2S removal only necessary due to odor issues. However, certain manufacturers' may require removal of siloxanes (primarily derived from household beauty and health care products) due to operational issues in engines in boilers that may result without proper maintenance. For better description of air quality issues associated with landfill gas and suggested improved text, see: http://www.epa.gov/lmop/faq-3.htm. U.S. Government (Government of U.S. Department of State)	Taken into account. Discussion will be shortened to focus on air quality issues. Siloxanes are not relevant to air quality issues. "Hydrogen sulfide is mainly a problem at sites which co-disposed large quantities of construction and demolition debris containing gypsum board. Emissions of NOx can sometimes be a problem for permitting biogas engines as new sources in strict air quality regions".
10-197	A	29	5	29	6	The statement beginning "Uncontrolled emissions of collected landfill gas…" is misleading. In the U.S. many landfills are allowed to emit gas without flaring or energy recovery. U.S. EPA rules requiring gas collection and combustion only apply to large landfills (as is correctly stated on page 30, line 9). According to EPA, in 2003 25% of generated landfill gas was flared and 22% was used to recover energy; the majority of landfill gas was not "collected" (USEPA 2005, Table 8-4). According to another source, of nearly 330 landfills in the U.S. collecting gas, 70% of captured gas is used to generate thermal or electric energy, and the rest is flared. Nearly 1300 landfills do not capture any landfill gas (Themelis and Ulloa, 2005). These facts show that landfill gas emission control is far from complete, even in the U.S., a developed country. References for this comment: USEPA, 2005: US Emission Inventory 2005, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2003, EPA 430-R-05-003, April 2005. Accessible at http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2005.html Themelis, N. and P. Ulloa, 2005: Capture and Utilization of Landfill Gas, Renewable Energy, 2005, Accessible at http://www.seas.columbia.edu/earth/wtert/sofos/Themelis_Capture%20and%20Utilisation%20of%20Landfill%20Gas.pdf	Taken into account. The phrase beginning "Uncontrolled emissions of collected landfill gas…" will be removed.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						(Brian Bahor, Covanta Energy Corporation)	
10-198	A	29	17	29	26	Focus on VOC fluxes through cover soils is interesting but does not merit such discussion in this chapter without proper treatment of other VOC control measures, mainly efficient combustion of landfill gas and as required by regulation in the U.S., Canada, and Europe. U.S. Government (Government of U.S. Department of State)	Taken into Account. The two sentences "Uptake (negative emission) occurs when air in urban areas and above landfill sites contains elevated NMVOCs (especially aromatics from mobile sources), and soil gas profiles indicate that the direction of diffusive flux is from the atmosphere into the soil. In contrast, emissions from temporary cover areas are mainly positive and higher, on the order of 10-5 to 10-4 g/m-2/d-1 for individual species" will be removed.
10-199	A	29	29	29	32	We are not aware of credible information that supports a recommendation to remove plastics or chlorinated compounds in order to achieve dioxin and furan emission control. Indeed, studies have shown little if any relationship between waste chlorine content and dioxin/furan emissions from municipal waste combustors. The determining factors for emission control are good combustion practices and efficient air pollution control devices such as scrubbers, baghouses, and carbon injection. (Brian Bahor, Covanta Energy Corporation)	Taken into account. The BREF document on waste incineration will be cited here.
10-200	A	29	33	0	0	Emission control standards are the same in Germany than in EU. I will change "Modern incinerators must meet stringent emission control standards in Japan, EU, the U.S., and other developed countries". (Stefano Caserini, Politecnico di Milano)	Accepted. Paragraph will read "Modern incinerators must meet stringent emission control standards in Japan, EU, the U.S., and other developed countries. For reducing incinerator emissions of volatile heavy metals and dioxins/dibenzofurans, the removal of batteries, plastics, and other waste materials containing heavy metals (Pb.Cd) and chlorinated compounds is recommended prior to combustion".
10-201	A	29	35	0	0	Policy measures in Sweden to reduce waste: In Sweden it has been illegal to landfill sorted burnable waste since 2002, and landfilling organic waste has been banned since 2005. (SFS 2001:512). The aim of these bans is to improve resource conservation and reduce environmental impact. To make recycling easier, a requirement for sorting burnable waste at source was also introduced in 2002. The	Noted. Further detail is beyond the scope of the chapter.

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						Landfill Tax Act (1999:673) was introduced in January 2000. The purpose of the tax is to increase the financial incentive for reducing waste quantities and treating and recycling waste in a more sustainable and resource-efficient way. Local Investment Programmes (LIP) qualified for government grants averaging approximately 30 per cent of the investment. These grants were awarded between 1998 and 2001. It is estimated that the amount of waste put into landfill was reduced by 370,000 tonnes as a result of investment grants to improve waste management. A Strategy for Sustainable Waste Management: Sweden's Waste Plan, Swedish Environmental Protection Agency 2005 p.65 (Kirsten Macey, Climate Action Network Europe)	
10-202	A	30	6	0	0	Other than carbon finance and various EU-country landfill taxes, possibly the most important incentive to reducing landfill gas is special motivational pricing from electricity grids for renewable energy. US tax credits for landfill gas are valuable motivators. An additional reference on economic instruments was the paper done for IADB several years ago, and posted on the World Bank's www.worldbank.org/solidwaste (Sandra Cointreau, World Bank)	Noted. the Paragraph will be revised thus: "Landfill CH4 recovery has also been encouraged by several country-specific economic and regulatory incentives. In the U.K., for example, the Non Fossil Fuel Obligation (NFFO), requiring a portion of electrical generation capacity from non-fossil sources, provided a major incentive for landfill-gas-to-electricity projects during the 1980's and 1990's. It has now been replaced by the Renewables Obligation (RO). In the U.S., as mentioned above, the implementation of Clean Air Act (CAA) regulations in the early 1990's provided a regulatory driver for gas recovery at large landfills; in parallel, the U.S. EPA Landfill Methane Outreach Program provides technical support, tools, and resources to facilitate landfill gas energy projects in the U.S. and abroad. Also, periodic tax incentives in the U.S. have provided an economic incentive for landfill gas utilization—for example, almost 50 of the 400+ commercial projects in the U.S. came on line in 1998, just before the expiration of federal Section 29 tax credits. A small U.S. tax credit has again become available for

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							landfill gas and other renewable energy sources; in addition, some states also provide economic incentives through tax structures or renewable energy credits. Other drivers include state requirements that a portion of electrical energy be derived from renewables as well as green power programs that allow consumers to select renewable energy power providers". We were unable to locate the reference cited.
10-203	A	31	3	31	3	Anaerobic digestion should be added in addition to recycling, composting and incineration. For wet organic waste, it is the only method utilizing both the energy and nutrient content. Incineration of such waste leads to loss of nutrients and with little energy recovery. Instruments are "feed-inn tariffs for electricity" or other mechanisme securing a favourable payment for "green energy" and investment support . (Government of Norwegian Pollution Control Authority)	Accepted.
10-204	A	31	6	31	23	MentionThis is another location to mention role of CCS in achieving negative carbon emissions from management of landfills. U.S. Government (Government of U.S. Department of State)	Noted. Further detail is beyond the scope of the chapter.
10-205	A	31	13	31	17	Revise: "…in parallel, the U.S. EPA Landfill Methane Outreach Program provides technical support, tools, and resources to facilitate landfill gas energy projects in the U.S. and abroad. Also, periodic tax incentives in the U.S. have provided…" U.S. Government (Government of U.S. Department of State)	Accepted. See text in 10-202 above.
10-206	A	31	14	31	23	Suggest adding a reference to the U.S. Energy Policy Act of 2005 which was signed into law and includes provisions for renewed and expanded tax credits for landfill CH4; provides bond financing, tax incentives, grants, and loan guarantees; and extends renewable energy production incentives to landfill CH4. U.S. Government (Government of U.S. Department of State)	Noted. Further detail is beyond the scope of the chapter.
10-207	A	31	15	31	16	Suggest rewriting sentence as follows: "More recently, 17 countries and 350 government and non-governmental organizations are working together under the Methane to Markets Partnership to provide assistance for developing CH4 recovery and use projects around the world." U.S. Government (Government of U.S. Department of State)	Noted. Sentence highlights Methane to Markets program but further detail is beyond the scope of the chapter.

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10-19	B	31	15	31	15	The authors should include a list of the partners in the methane to markets program to illustrate that other developed countries (including Australia) are also involved. (Government of Australia)	Noted. Further detail is beyond the scope of the chapter.
10-208	A	31	35	0	0	CER is not defined anywhere (certified emission reduction?) (John Nyboer, Simon Fraser University)	Noted. CER is in the abbreviations list.
10-209	A	32	6	0	0	Please tone down this paragraph which opens with "thermal processes can most effectively exploit the energy value of post consumer waste" This statement is relevant for high income countries only, and will create confusion and bad decision-making in developing countries. Subsidies for construction of incineration should not be encouraged, while it is appropriate to support proper energy buying prices for any energy created. Landfill taxes are not for purposes of encouraging incineration, but for purposes of encouraging waste reduction practices and recycling, as well as for showing the true costs of environmental externalities to society. Biased and troubling language. (Sandra Cointreau, World Bank)	Noted. The section on incineration will be revised. We will delete “Promoting” from titles of sections 10.5.2 and 10.5.3. However, incineration is currently being successfully practiced in a number of developing countries which we will cite where possible.
10-210	A	32	6	32	6	Add to the end of first sentence… “as well as destroy the organic fraction of waste, which is cause of GHG and NMVOC when landfilled.” (Brian Bahor, Covanta Energy Corporation)	Rejected. Landfill issues and comparisons are discussed elsewhere in the Chapter.
10-211	A	32	6	32	13	Thermal processes can potentially also employ CCS technologies U.S. Government (Government of U.S. Department of State)	Noted. Further detail is beyond the scope of the chapter.
10-212	A	32	6	32	0	“Promoting” in the titles for 10.5.2 and 10.5.3 should be removed. U.S. Government (Government of U.S. Department of State)	Accepted.
10-213	A	32	15	0	0	One area of increasing activity that could be mentioned here is the life cycle, cradle-to-grave activities of some industries as they take responsibility for their product over its functional life. This would also have an impact on what appears in Table 10.8. See Interface Inc., and Ray Anderson's work in this area (http://www.interfacesustainability.com/). (John Nyboer, Simon Fraser University)	Taken into account in Sect 10.5.3. Further detail is beyond the scope of the chapter.
10-214	A	32	20	32	13	Additional and important drivers include state renewable requirements that a portion of energy be derived from renewable energy and green power programs that allow consumers to select renewable energy options. U.S. Government (Government of U.S. Department of State)	Taken into account in Sect 10.5.1. Further detail is beyond the scope of the chapter.
10-215	A	32	21	32	0	The language stating that "In general, EPR programs are expensive and that the environmental and economic benefits are still under debate" is overly broad -- this	Accepted. Text will be revised.

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						may be true for some EPR programs (it is an extremely broad concept) but there are many of these programs with known benefits and minimal incurred cost to the consumer. ItThink it would be more accurate to state that EPR programs range in complexity and cost -- and one reason this concept has gained traction is that while they can be expensive (though not always) they tend to shift costs of disposal from municipalities (which are straining under the load) to manufactures (and ultimately to consumers). U.S. Government (Government of U.S. Department of State)	
10-20	B	32	34	33	2	In Germany over 50% of waste from households is recycled because 56% of the generated waste is collected seperately. Separate collection of biowaste is financed via collection fees (private households), separate collection and recycling of packaging materials (glas, paper, plastics) via producer responsibility (packaging ordinance) (Government of Germany)	Noted. Further detail is beyond the scope of the chapter.
10-216	A	33	2	0	0	Add new material: "The holistic strategy described in Chapter 2 Section 2.3.4 would see energy firms, driven by biofuel or forestry obligations imposed in their country of sale, seeking to use biotic waste materials either directly as raw material for biofuel production or indirectly as fertiliser for enhanced biotic productivity. For instance, such firms could finance the development of riparian biofuel plantations watered by municipal waste water (possibly enriched by municipal sludge, providing the toxic content does not inhibit tree growth) and acting as a barrier to run-off from adjacent farming operations." (Peter Read, Massey University)	Noted. Further detail is beyond the scope of the chapter.
10-217	A	33	2	33	0	Add new material: "The holistic strategy described in Chapter 2 Section 2.3.4 would see energy firms, driven by biofuel or forestry obligations imposed in their country of sale, seeking to use biotic waste materials either directly as raw material for biofuel production or indirectly as fertiliser for enhanced biotic productivity. For instance, such firms could finance the development of riparian biofuel plantations watered by municipal waste water (possibly enriched by municipal sludge, providing the toxic content does not inhibit tree growth) and acting as a barrier to run-off from adjacent farming operations." (Peter Read, Massey University)	Noted. Further detail is beyond the scope of the chapter.
10-21	B	33	9	33	9	Delete "nor" replace with "and". (Government of Australia)	Accepted.
10-218	A	33	14	33	0	Methane capture is limited to existing landfills, where dumping all wastes, without segregation did not take place. With the advent of segregation of biodegradable	Taken into account. Other possibilities for CDM within the waste sector will be

Chapter-Comment	Batch	From Page	From Line	To Page	To line	Comments	Considerations by the writing team
						waste before landfilling will reduce the future scope for methane capture. One must address the other options through CDM. There is not much support for such activities. (Government of India)	considered if data are available.
10-22	B	33	40	33	40	Add: Nevertheless, a time series comparison of waste from households and GDP in Germany (1990 to 2001) shows a clear decoupling of economic growth and waste generation (Giegrich, J., Vogt, R.: The contribution of waste management to sustainable developement in Germany. Umweltbundesamt FKZ 203 92 309. April 2005) (Government of Germany)	Taken into account. The reference will be added to Section 10.1 of the Chapter.
10-219	A	34	10	35	7	Simplistic analysis. Significant conclusions/opinions with no citation to support. For suggested text see <http://www.methanetomarkets.org/events/2005/all/breakout-landfill.htm> and more specifically the presentation U.S. Perspectives on Global Opportunities for Landfill Methane Capture and Use (slides 9-16) U.S. Government (Government of U.S. Department of State)	Noted. Citation does not add additional information on long term trends, beyond what is in this section and other parts of the report. We will seek references to provide additional support where available.
10-220	A	34	40	34	42	All modern combustion-based waste-to-energy technologies, including the more popular mass burn systems, provide such mitigation potential. This benefit is not limited to “advanced technologies” such as fluidized bed combustion. (Brian Bahor, Covanta Energy Corporation)	Accepted. Sentence will be revised.
10-23	B	34	40	34	42	Here again, fluidizes bed combustion is not an advanced technology regarding heterogenous waste like municipal solid waste (Government of Germany)	Accepted. Sentence will be revised.
10-221	A	34	42	34	43	The sentence "When the fossil fuel offset is also taken in account, The GHG impact can even be negative" seems to be unclear. (Government of Norwegian Pollution Control Authority)	Accepted. Sentence will be revised.
10-222	A	34	44	0	0	add in the references "Consonni et al., 2005" (Stefano Caserini, Politecnico di Milano)	Accepted.
10-223	A	35	10	35	20	Include more examples of wastewater management programs particularly highlighting the different programs for developing and developed countries as well as residential sector. For residential waste water systems see: Sustainable House by Michael Mobbs, A Choice Book, 1998; and The Water Efficient Garden A Guide to Sustainable Landscaping in Australia by Wendy van Dok, Water-efficient Gardenscapes 2002 (Kirsten Macey, Climate Action Network Europe)	Noted. Efficient water use in landscaping is beyond the scope of the chapter.
10-224	A	35	11	0	0	add "much" to "lower": GHG emissions from wastewater are much lower than	Rejected. Globally, and considering N2O and

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						emissions from solid waste management. There is more than one order of magnitude of difference. (Stefano Caserini, Politecnico di Milano)	CH4, this is not the case.
10-225	A	35	11	35	19	"GHG emissions ……. lower emissions of methane and nitrous oxides".Current estimates show lower estimates of methane from wastewater in comparison with solid waste. A large portion of the emissions from uncollected wastewater remains outside the realm of current estimates. (Government of India)	Accepted. We will add a phrase covering this topic.
10-226	A	35	23	35	39	"In addition to providing GHG mitigation….. Johannesburg Summit goals". Lack of capital is the major point for GHG mitigation. How to manage this is not well addressed. (Government of India)	Noted. We state "The major impediment in developing countries is the lack of capital". The source of that capital is beyond the scope of this report.
10-227	A	36	0	36	0	Table 10.8: Regarding controlled landfilling with landfill gas recovery and utilization and controlled landfilling without landfill gas recovery: The Comments column should identify that air emissions include air toxics and CH4 with the amount depending on the landfill design and landfill gas management practices. References for this comment: U.S. Environmental Protection Agency, Office of Air Quality and Standards, (1997): Emission Factor Documentation for AP-42, Section 2.4, Municipal Solid Waste Landfills. August 1997. U.S. Environmental protection Agency, Office of Research and Development: First-order Kinetic Gas Generation Model Parameters for Wet Landfills, EPA-600/R-05/072. Department for Environment, Food and Rural Affairs (2004): Review of Environmental and Health Effects of Waste Management: Municipal waste and Similar Wastes, March 2004. (Brian Bahor, Covanta Energy Corporation)	Noted. Further detail is beyond the scope of the Table, but is discussed elsewhere in the text.
10-228	A	36	0	36	0	Table 10.8: Additional comments in the column for "Thermal processes…" should include the following in order to present the complete potential of waste-to-energy as identified elsewhere in the report: 1) Complete avoidance of CH4 emissions as compared to landfills 2) Less air emission impact when considering air toxics 3) Recovers materials such as ferrous metal for reprocessing 4) Generates more renewable energy per ton of MSW than any other process.	Noted. Further detail is beyond the scope of the Table, but is discussed elsewhere in the text.

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						(Brian Bahor, Covanta Energy Corporation)	
10-229	A	36	0	37	0	Table 10.8 contains a great deal of useful information and would deserve being expanded in some concluding remarks. (Government of France)	Noted. This is discussed in Section 10.6.3 before the Table.
10-24	B	36	1	36	55	Table 10.8: The authors need to provide an explanation for their conception of what constitutes "Vulnerability to climate change". (Government of Australia)	Noted. This overarching concept is beyond the scope of this chapter and is discussed elsewhere in other chapters and in WG2.
10-230	A	37	1	37	0	in the colon for Comments Anaerobic biological treatment the following comment should be added: "Can produce useful secondary materials (nutrients and compost) if quality control on inputs and process operations". Under sust.dimensions, economic, should be added "nutrient recovery" (Government of Norwegian Pollution Control Authority)	Taken into account. Under economic, we will add “use of biosolid products”.
10-231	A	39	14	0	0	Replace "Consomi" with "Consonni" (Stefano Caserini, Politecnico di Milano)	Accepted.
10-232	A	39	24	39	26	Delhotal reference should be updated. The final version of Delhotal's draft chapter was published in: Global Mitigation of Non-CO2 Greenhouse Gases, United States Environmental Protection Agency, Washington, DC, 430-R-06-005, 2006. http://www.epa.gov/nonco2/econinv/international.html. U.S. Government (Government of U.S. Department of State)	Accepted.
10-233	A	42	17	42	17	Names of S.Syri and I. Savolainen should be vice versa (Government of Finland)	Accepted.