The Potential Contribution of Waste Management to a Low Carbon Economy

Executive Summary

Report commissioned by Zero Waste Europe in partnership with Zero Waste France and ACR+

Prepared by Ann Ballinger and Dominic Hogg

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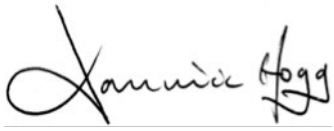
Approved by



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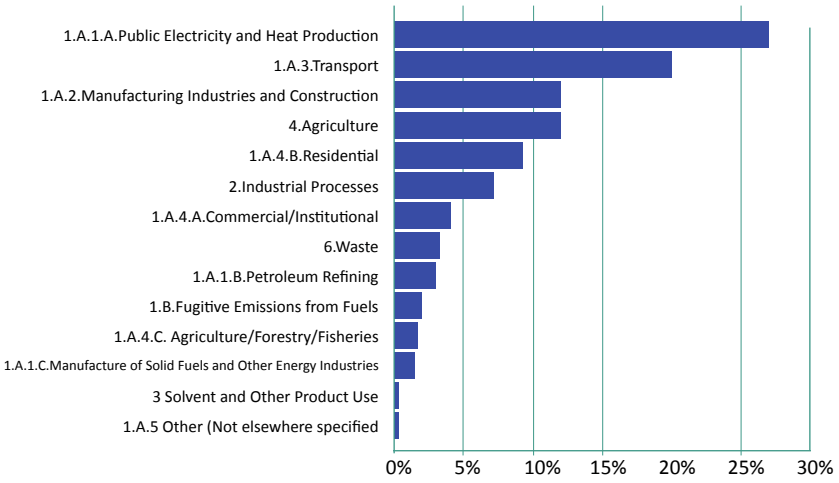
One could be forgiven for thinking, when considering the reporting of greenhouse gas (GHG) inventories, that waste management is responsible for a limited proportion of GHG emissions from Europe. The Reporting of GHG emissions from the EU-28 in 2012 suggests that the sector 'waste' accounted for just over 3% of total GHG emissions (the gases responsible for causing global climate change). Other countries tend to show similarly low contributions to their inventory from 'waste'. These low shares might lead one to believe that this is a sector which can do relatively little to contribute to reducing GHG emissions from the EU, and indeed, globally.

Figure E- 1: Contribution to EU Emissions by 'Sector', 2012



Source: *EEA (http://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer)*

Share of total emissions (sectors 1-7 excluding 5. LULUCF) (%à - 2012 - Tg (million tonnes) - EU28

Yet studies by various bodies indicate that the potential contribution of waste prevention and management to GHG abatement could be far greater than the total reported emissions under the 'waste' part of the inventory reported to the UNFCCCC[1]. These studies appear to indicate that the potential savings to be made from further improvements in waste management (of the order 150-200 million tonnes CO_2 equ.) exceed the level of emissions reported under the 'waste' part of the inventory (of the order 100 million tonnes CO_2 equ., and already down from a figure of the order 170 million tonnes CO_2 equ. in 1995)[2]. As this report notes, the means of reporting emissions inventories to the UNFCCC includes, under the 'waste' chapter, only a very limited representation of the extent to which improved waste management systems, reconceptualised as resource management systems, can play in greenhouse gas reduction. A range of beneficial impacts from improved resource and waste management are effectively recorded in other parts of the overall inventory.

As this report notes, the means of reporting emissions inventories to the UNFCCC includes, under the 'waste' chapter, only a very limited representation of the extent to which improved waste management systems, reconceptualised as resource management systems, can play in greenhouse gas reduction. A range of beneficial impacts from improved resource and waste management are effectively recorded in other parts of the

1 Okopol (2008) Climate Protection Potentials of EU Recycling Targets, http://www.eeb.org/publication/documents/Recycling-ClimateChangePotentials.pdf; Prognos Ifeu and INFU (2008) Resource savings and CO_2 reduction potential in waste management in Europe and the possible contribution to the CO2 reduction target in 2020, Prognos in cooperation with IFEU Heidelberg, INFU Dortmund, October 2008; Günter Dehoust, Doris Schüler, Regine Vogt and Jürgen Giegrich (2010) Climate Protection Potential in the Waste management Sector – Examples: Municipal Waste and Waste Wood, Umweltbundesamt (UBA), January 2010, https://www.umweltbundesamt.de/sites/default/files/medien/461/publikationen/4049.pdf Projections of Municipal Waste Management and Greenhouse Gases, ETC/SCP working paper 4/2011, European Environmental Agency (EEA), August 2011; European Commission (2014) Impact Assessment Accompanying the document, Proposal for a Directive of the European Parliament and of the Council amending Directives 2008/98/EC on waste, 94/62/EC on packaging and packaging waste, 1999/31/EC on the landfill of waste, 2000/53/EC on end-of-life vehicles, 2006/66/EC on batteries and accumulators and waste batteries and accumulators, and 2012/19/EU on waste electrical and electronic equipment, Brussels, 2.7.2014, SWD(2014) 207 final.

2 The figure comes from European Environment Agency (2014) Annual European Union Greenhouse Gas Inventory 1990–2012 and Inventory Report 2014, Submission to the UNFCCC Secretariat, Technical Report No. 09/2014.

overall inventory.

The problems associated with properly seeing the positive role, at the global level, that can be played by improved resource and waste management are further exacerbated by the fact that the inventories for specific countries are based on activities that take place within their borders. Since both primary and secondary materials are widely traded, the way in which activities such as waste prevention, reuse and recycling reflects on these inventories varies depending upon whether a country imports primary products, or whether it is a producer of those primary products: if the former, then waste recycling and prevention activities will have little or no impact on their inventories; if the latter, then the impact is potentially far more significant. The counterintuitive element in this – and arguably, this applies in greater force to end-of-life resource management than to any other field of activity – is that activities undertaken domestically with a view to addressing a global problem might have no impact, and even a counterproductive one, in domestic inventories.

For both the above reasons, the exhortation to policy makers in the IPCC's Fifth Assessment Report to have waste management policy driven by climate concerns seems to have missed the point:

….waste management policies are still not driven by climate concerns, although the potential for GHG emission reductions through waste management is increasingly recognized and accounted for.

The IPCC's own report offered little by way of concrete evidence as to why any country would consider that its waste management policies should be driven by climate concerns. On the contrary, the opaque manner in which the potential upside of more positive waste management is accounted for in UNFCCC inventories and IPCC reports – it is effectively hidden - is itself an obstacle to policy makers recognizing the potential in this regard.

There are other methodological issues which are deserving of attention: the guidance from IPCC on how to develop inventories has been interpreted, erroneously, to imply that when considering alternative approaches to managing waste, emissions of CO_2 of non-fossil origin can be ignored. This issue gives rise to a misunderstanding of the extent to which some technologies can contribute positively to climate change mitigation.

Within UNFCCC inventories, the ability of the biosphere to act as a sink is, in each country's inventory, supposed to be addressed through accounting for the change in land use and forestry cover, this indicating the change in the extent to which soils and vegetation can act to sequester carbon, and through understanding the stock of harvested wood products prior to their reaching the end of their useful life. However, the extent to which this approach, when combined with the various assumptions made under the industry, energy and waste sections of the inventory, could be said to deal properly with the issue of biogenic carbon, remains problematic, and may be leading to significant underestimates of the contribution made by biogenic CO_2 to global climate change.

There is a significant difference between the way in which biogenic emissions of CO_2 are generated by different waste treatment processes. Where landfills are concerned, methane which is captured, whether for energy recovery or flaring, is converted to CO_2, and some uncaptured methane may be oxidised at the cap of the landfill site. These emissions occur over an extended period of time. If the same waste is, for example, combusted, then the emissions of CO_2 occur instantaneously. These processes clearly have very different time profiles. The rate at which emissions occur might be considered to be of relevance, not least since this may have implications for how effectively they can be sequestered by the less than instantaneous growth of biomass

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E.1.0 Key Findings

Our research indicates that changing waste management practices can generate significant climate change benefits. The effects of different approaches is shown in conventional terms (excluding biogenic CO_2 emissions) in Figure E- 2. As this shows, the main benefits come from waste prevention, and from recycling, particularly of dry materials.

Whilst the benefits from biowaste treatment processes such as composting and anaerobic digestion are less substantial than those relating to the recycling many of the dry materials, the benefits from food waste prevention are significant: to the extent that separate collection of food waste can give rise – in both households and in businesses - to enhanced awareness of what is thrown away (and hence, to a preventive effect), so the benefits of such an approach might be considered more effective.

Where residual waste treatment and disposal are concerned, these tend to make contributions to climate change emissions rather than helping to reduce emissions overall. Indeed, the benefits of switching from landfill to incineration are slight. Furthermore, as energy systems decarbonise, so the impact of the processes for which the net effect is more strongly determined by the amount of energy generated will tend to decline. Because it seems unlikely that climate change can be arrested without significant decarbonisation of energy sources, so it would appear that technologies such as incineration will become less attractive over time.

Figure E- 2: Indicative Climate Change Impacts of Key Waste Management Activities (excl. CO_2 from biogenic sources)

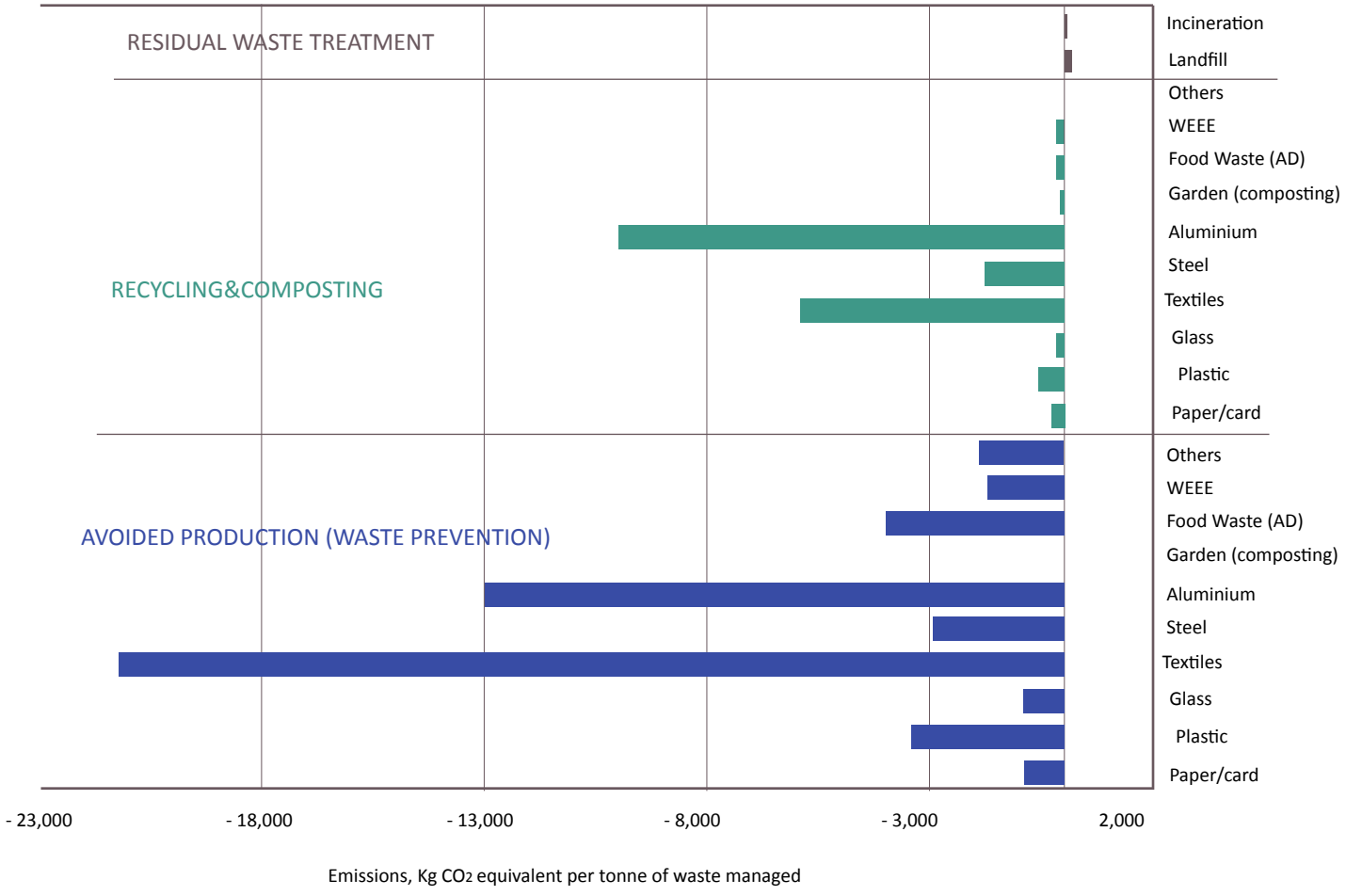


Figure E- 3: Indicative Climate Change Impacts of Key Waste Management Activities (incl. CO_2 from biogenic sources)

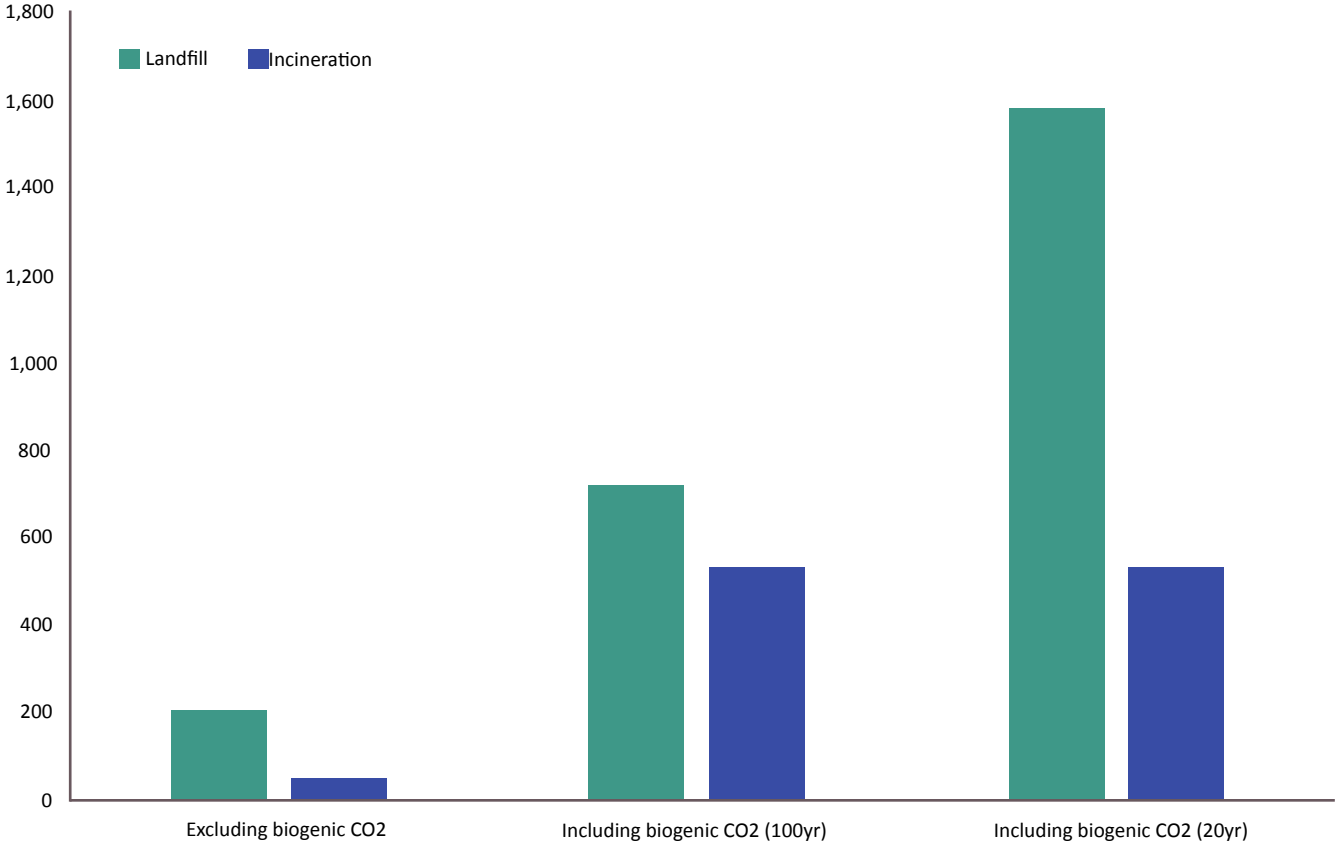


Figure E- 3 presents again the data for residual waste, this time showing results including the biogenic CO2 emissions over two time periods – the conventionally used 100 year timeframe - as well as the shorter 20 year timeframe. The relatively limited benefits associated with switching from landfill to incineration become more apparent where results over a 100 year timeframe are considered. In the Main report, we show how these benefits can be reversed as the energy supply becomes decarbonised. The benefits of anaerobic digestion (of food) relative to composting (of garden waste) also become more apparent.

Looking forward, and reflecting on the above results, it is clear that a climate friendly strategy, as regards materials and waste, will be one in which materials are continually cycling through the economy, and where the leakage of materials into residual waste treatments is minimised. Looked at from the perspective of energy, this is akin to conserving the embodied energy (and associated emissions) within materials rather than seeking to generate energy from these materials. By doing this, the energy used in making what is consumed will be reduced, and by rather more than the energy which might otherwise be generated from thermally treating the waste.

1) Consumption of materials per capita is low or high
2) The recycling rates are low or high, and
3) Residual waste is disposed at landfills or incinerated.

The outcomes of the different scenarios are given in Figure E- 4. They clearly indicate that:

1) The dominant effect is that associated with emissions from production of the materials that become waste, illustrating the value of reducing materials consumption;
2) The effect of recycling is also strong, and helps to reduce the emissions associated with the system;

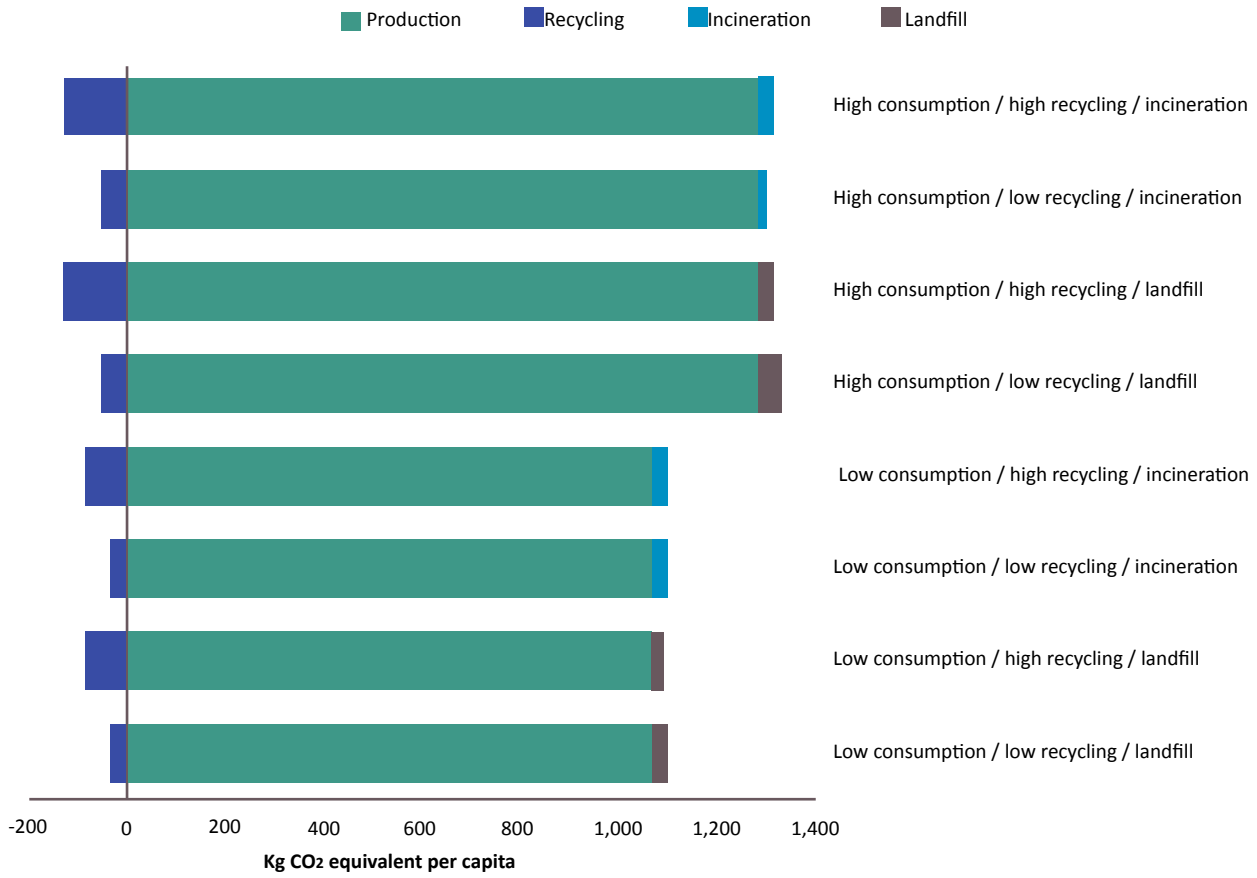
3) The management of waste as residual waste makes a net contribution to the climate change balance. There is not that much difference between the landfill and incineration scenarios.

At the higher levels of recycling under high consumption levels, more substantial benefits associated with recycling can be seen, but this is not sufficient to outweigh the larger emissions impact from the higher consumption levels.

Where policy, and the monitoring of performance, has been concerned, we find that in Europe, for the most part, policy is moving in the right direction: the withdrawal of the legislative proposal that formed part of the first so-called Circular Economy package was disappointing, but the promise of a more ambitious replacement raises prospects for gains to be made. There remain, however, contradictory messages and incentives, partly driven by the fact that the biodegradable part of waste is considered to be a source of renewable energy. This leads to unjustified support measures, and implicit subsidies, for generating energy from waste.

Furthermore, the success or failure of a Member State's waste management policy continues to be measured by European institutions in terms of how little is landfilled: yet precisely because other treatments for residual waste offer limited climate change benefits (if, indeed, they offer any in scenarios where energy systems are being decarbonised), the focus should be on how much waste 'leaks' into any form of residual waste treatment. It follows that policies such as landfill bans have the potential to be counterproductive (as well as being unjustified on grounds of costs and benefits), and that the more appropriate measure is to make all residual waste treatments less attractive relative to recycling and waste prevention through fiscal measures.

Figure E- 4: Illustrative Example - Production Emissions and Waste System Emissions (Impacts per person)



E.2.0 Recommendations

In order to ensure that the prevention and management of waste is accorded the significance it deserves from the perspective of climate change, we make the following recommendations:

Recommendation 1: Waste policies should be designed to manage waste in the upper tiers of the waste hierarchy (i.e. recycling or above)

Generally, waste policies that move waste increasingly into the upper tiers of the hierarchy are likely to be beneficial for climate change. The waste management hierarchy offers a reasonable guide to managing waste sustainably: waste prevention leads to the greatest gains, with recycling options, especially for the dry materials, following closely behind. The main issues lie with the way the hierarchy indicates that residual waste should be managed. In the EU, incineration facilities are classified as recovery where they meet a specific criterion related to energy efficiency. Although the rationale for this seems questionable, a recent study from the JRC suggests that this criterion might be further relaxed in circumstances where temperatures are generally higher. This is despite the fact that simply switching waste from landfill to incineration is likely to lead to limited climate change benefits, and even a worsening of the emissions where energy sources are becoming decarbonised.

Recommendation 2:
Indicators of waste management performance should shift from 'how much is landfilled?' to 'how much residual waste is generated?' [3]

One of the key indicators that has been used by DG Environment, Eurostat and the EEA to assess waste management performance is the amount of waste landfilled, with lower figures being deemed indicative of superior performance. This would be a sensible indicator to use if it were true that landfill performed dramatically less well than all other options, and if all other options performed more or less equally well. This is not true: 'not landfilling' can lead to very different strategies and outcomes, and within the EU, there are countries with similarly low rates of landfilling, some of whom have high recycling rates, and low levels of incineration, and others who are in the opposite situation. The analysis in Figure E-2 shows that it will be waste prevention and waste recycling effects that are the dominant determining factors in climate change performance. The shift to a focus on residual waste would also help Member States focus their attention not on capital-intense residual waste treatments (that have the potential to lock them in to low recycling rates), but on moving waste into the upper tiers of the waste hierarchy.

Recommendation 3:
The implementation of blanket bans on the landfilling of waste should be resisted. Since, for materials widely found in mixed residual waste, material-specific landfill bans are not enforceable, the focus should be on measures to encourage, or mandate, the separation of waste for preparation for reuse or recycling;

3 By 'residual waste', we mean the waste that is left over after households and businesses have sorted their waste for recycling, as well as the contraries from sorting facilities and plants for treating separately collected biowaste. This is usually a mixed waste fraction, and is typically sent for landfilling, incineration or MBT (mechanical biological treatment).

Linked to the previous recommendation, landfill bans may have counterproductive effects since at the time when they enter into force, then to the extent that they are enforced, there is a requirement to have in place sufficient treatment capacity to ensure that all residual waste can be dealt with at facilities that are not landfills. This can lead to a situation in which the country's waste strategy becomes locked in to low recycling rates. Unsurprisingly, it is Member States which have implemented bans that have excess capacity in residual waste treatment, and which are now seeking to make use of that capacity through importing waste from other Member States.

Similarly, where materials widely found in residual waste are concerned – such as plastics – material specific landfill bans are likely to be unenforceable for the material on its own, and would tend to lead to a complete ban on landfilling if the intention of regulators was to fully enforce the ban (since 100% recycling of all plastics might prove difficult). Policies should 'positively' drive waste up the hierarchy rather than simply banning resort to the lowest tier of the hierarchy, and forcing sometimes excessive investment in residual waste treatment capacity. Hence, landfill taxes, extended to other residual waste treatments, and requirements to sort waste, or to provide households with collection services of a minimum quality, will tend to deliver far superior results. The use of pay-as-you-throw systems is made more 'incentive compatible' where the costs of disposal / residual waste treatment are higher, and is to be encouraged once convenient systems for segregation of wastes are in place.

Recommendation 4
Member States should reconsider their support mechanisms for renewable energy: in particular, they should immediately discontinue support for all forms of energy from residual waste. This includes the use of implicit subsidies, such as exemptions from taxes on heating fuels, unless there are 'balancing' incineration taxes in place.

Given that part of the rationale for developing renewable sources of energy is to address climate change, it seems counterproductive to maintain support for those which might contribute to climate change. The case for supporting measures for the generation of energy from waste on the basis that waste is 'a renewable resource' makes no sense when set against the waste hierarchy. As countries improve in their prevention, reuse, and recycling, so less and less residual waste will be available. It is stretching the definition of 'renewable' beyond what is credible to argue that residual waste could be a source of 'renewable' energy.

Recommendation 5
At the same time, it would make sense to consider the withdrawal of any form of support for the utilisation, directly, of harvested biomass for renewable energy generation / renewable fuels

In a world where there will be increasing pressure on land, it must surely be questionable to use biomass directly for energy when the land used to grow it could be used for food, or for manufacturing prior to the resulting waste materials being recycled: only when waste materials are 'leaking' from the system, or when food waste is being digested, should they be used for energy generation. Currently, the use of primary biomass for energy and fuel is widely subsidised. It is intensely ironic that the waste hierarchy suggests wood wastes would only be combusted once the potential for reuse and recycling has been fully explored: yet the virgin resource can be combusted directly and be subsidies to boot. This is a fundamental misallocation of resources resulting from perverse economic incentives.

Recommendation 6
Consideration needs to be given as to how to integrate 'waste' within the framework of European policies to tackle climate change. One way would be to consider its integration within the EU-ETS. Another would be to consider reinforcing the Effort Sharing Decision, making GHG emission reduction targets with appropriate ambition for the waste sector. Particular attention would need to be paid to ensuring the benefits of recycling and reuse were adequately recognised, even where the recycling and reuse took place in other countries;

Although electricity generation is an activity for which, under the EU-ETS, (with some exceptions) no free allowances are issued, waste facilities which generate energy are not included in the EU-ETS. This is an implicit subsidy. Although the Commission has frequently urged Member States to remove environmentally harmful subsidies, the EU-ETS, as a measure for which the Commission has substantial responsibility, affords an implicit subsidy to waste facilities which generate electricity. An incinerator generating electricity might generate electricity with a carbon intensity of around 600g CO_2 per kWh, almost double the carbon intensity of a modern gas-fired power station.

Recommendation 7
In the short-term, and in the absence of a move to consumption-based inventories, it would be helpful to include:
o as an addendum to the 'waste' section of the inventory, the estimated GHG effects of recycling (including where materials collected for recycling are exported), and
o in the Industry chapter, the extent to which industries make use of recycled materials (and the implied level of emissions saving).

The focus on landfilling highlighted in Recommendation 2 is somewhat perpetuated by the structure of GHG inventories as reported to the UNFCCC. Even the IPCC's own reports, though they refer to waste as a sector, appear to confine themselves, artificially, only to measures which address the number reported under the 'waste' aspect of the inventory (in the main, ways of reducing methane emissions from landfills). [4] This gives a misleading impression as to the extent to which improved waste prevention and management can deliver emissions reductions (even though the emissions reductions might, in the round, be captured by a global inventory).

Recommendation 8
Recognising the uncertainty associated with the way in which emissions from the AFOLU (agriculture, forestry and other land use) Sector are accounted for, inventories should include emissions of biogenic CO_2 from incineration (and biomass power plants) until such time as the accounting methods have across countries been assessed in terms of the adequacy of the treatment of this matter.

Although inventories are developed with the intention, in principle, of capturing biogenic CO_2 emissions through the AFOLU Section, in practice, the manner in which this occurs is such that one cannot be confident

4 Consider that recycling metals instead of landfilling them makes no contribution to reducing landfill emissions, but a considerable one from the perspective of the emissions associated with energy used in manufacturing, as indicated in Figure E- 2.

that the CO_2 emitted from, for example, harvested wood products, is captured under the Tier 1 and other Member State methodologies. Given that, in principle, emissions of biogenic CO_2 from waste treatment plants (and biomass power plants), and to a lesser extent, landfills, are capable of being linked reasonably well to activity data, then it would seem sensible to incorporate these within inventories rather than assuming that the approaches identified by IPCC in the AFOLU Section are adequate for accounting for these.

Recommendation 9
All lifecycle studies engaged in comparative assessments of waste treatments should incorporate CO_2 emissions from non-fossil sources in their comparative assessment:

Whatever the merits of the approach to assembling inventories in IPCC Guidelines, it is a mistake to assume that 'CO_2 from non-fossil sources doesn't matter' in comparative assessments of waste treatment facilities. The argument that CO_2 from such sources is all 'short-cycle', and so, can be ignored, is tantamount to assuming a separation in the pools of carbon dioxide from fossil and non-fossil sources. It is as though the argument runs that the climate only changes if emissions of CO_2 come from fossil sources. This is so obviously wrong that it seems genuinely surprising that this argument could ever have been considered acceptable: in a comparative assessment of the contribution of waste management alternatives to climate change, the only correct way to proceed is to account for emissions (and sinks, if this is applicable) of all greenhouse gases since they will all have 'warming potential', irrespective of their origin.

Recommendation 10
In the longer term, it would be preferable to move towards consumption based inventories. The information requirements might be significant (although, arguably, if other countries are gathering appropriate inventories, it should be possible to do this).

Many authors have argued reporting inventories on the basis of what is consumed by a country is superior to the existing approach, where emissions are reported based on production within the reporting country. Under the former approach, carbon leakage can occur, whereby businesses transfer their operations to other countries, or countries progressively become more reliant on imports of goods to satisfy demand.[5] DDepending on the boundaries used in the inventory assessment, different mitigation options may be indicated; the approach also tends to reduce the importance of emissions contributions from developing countries.[6] Conversely, for most European countries, consumption-based inventories result in higher emissions than their production-based counterparts. One paper which carried out this analysis at a European level suggested that emissions for the EU-27 from 2009 using the production based approach to be 4,059 million tonnes CO_2 equivalent, whilst the equivalent figure using their consumption-based approach was 4,823 million tonnes CO_2 equivalent. [7]

Consumption based inventories typically have higher uncertainties, and involve a significant data collection effort.[8] In addition, countries would need to work closely together to encourage mitigation efforts, thereby reducing the impact of imported goods. Perhaps because of these last two points, policy is currently linked to production or territorial inventory, and in particular the national UNFCCC inventory produced under guidance of the IPCC which is the subject of the discussion in the next section.

5 http://ec.europa.eu/clima/policies/ets/cap/leakage/index_en.htm

6 Glen P. Peters and Edgar G. Hertwich (2008) CO2 Embodied in International Trade with Implications for Global Climate Policy, Environmental Science & Technology, Vol. 42, No.5, 2008, http://www.cepe.ethz.ch/education/EnergyPolicy/PetersHertwich.pdf

7 http://www.wiod.org/conferences/groningen/paper_Boitier.pdf

8 http://www.publications.parliament.uk/pa/cm201012/cmselect/cmenergy/1646/1646we12.htm

Recommendation 11
Regional funds (and funding from international financial institutions) urgently need to re-consider their funding of waste management projects.

The more capital intense waste management options lie closer to the bottom of the waste management hierarchy than the top. The tendency for those engaged in funding organisations, on the other hand, is to see disbursement of capital as a key indicator of success. In such a situation, large amounts of capital can create as many problems as it solves. Whilst it is one thing for private capital to back specific projects, those disbursing regional funds, and the international financial institutions, need to develop innovative models of funding that facilitate projects for prevention, reuse, repair, remanufacturing, and recycling rather than residual waste treatments. The lack of innovation in this regard is extremely disappointing, not least given the limited climate change benefits that are achieved through such projects (notwithstanding the claims made for them).

Fundamentally, the role that waste prevention and improved waste management can play in reducing GHG emissions risks being significantly understated. The current guidelines for preparing inventories are useful for specific purposes, but they are apt to obscure the potential role to be played by better waste and resource management in climate change mitigation. Instead of focusing on waste as a potential source of supposedly renewable energy, the focus must fall on how best to retain the energy which is embodied in (the manufacture of) materials and products, as well as reducing waste generation in the first place.