ZERO WASTE EUROPE

Incineration in the EU-ETS: a set of suggestions for its inclusion

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Executive Summary

On June 22, 2022, the European Parliament approved the reform of the EU Emissions Trading System (EU ETS), including potential inclusion of municipal waste incineration (MWIs) installations. From January 1, 2024, MWIs are included for monitoring, reporting and verification (MRV) without an obligation to surrender allowances for reported emissions.

The EU-ETS Directive mandates the Commission to review by July 2026 the feasibility of including MWIs in the EU ETS considering emissions reduction and waste management impacts.[1] Incinerators for which the main share of what is combusted is waste that is not hazardous and is not defined as municipal waste, are already included in the EU-ETS, and have to surrender allowances for reported emissions. Inclusion of MWIs is long overdue, and the review, whilst not necessary for the suggested purposes, offers an opportunity to consider how best MWIs should be included in the EU-ETS.

This study examined the EU-ETS Directive, associated guidance, and relevant legislation. Key issues considered include the scope of inclusion (MRV only or full), the threshold for installation size, and the treatment of emissions from waste incineration. We also reviewed policy recommendations for zero-rating non-fossil CO2 emissions and the implications of different waste management practices

Key recommendations for policymakers are:

1. **Power and Heat:** Both power and heat from incineration should be included in the EU ETS without free allowances for heat generation. This aligns with the inclusion of the buildings sector in 2027, avoiding the need to apportion emissions between power and heat.

2. **Fossil- and Non-fossil CO_2 Emissions**: It is obviously not true that all emissions of CO_2 matter. The atmosphere does not distinguish between fossil and non-fossil CO_2 in terms of its response to emissions: the radiative forcing effect is the same for both.

   The EU-ETS Directive effectively suggests that emissions of non-fossil CO_2 from MWIs are zero-rated for the purposes of reporting. We argue that this decision is tied to decisions regarding how inventories are compiled, showing that if different approaches to reporting an inventory of GHGs were taken, it would be essential that these same emissions are accounted for. Indeed, if an equivalent approach to the one for agriculture, forestry and other land use was adopted for fossil fuels, an equivalent decision would be that we need not consider CO_2 emissions from burning fossil fuels.

[1] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

If EU-ETS installations emitting non-fossil CO_2 are fitted with carbon capture and storage, they could claim to be carbon negative. This would be based on the view that non-fossil CO_2 emissions 'don't count' when they are emitted from an installation, but their capture *is* to be counted. If the capture of non-fossil CO_2 matters, then surely, so does 'not emitting' the same CO_2? And if not emitting non-fossil CO_2 matters, then emitting it must matter also.

All CO_2 emissions from incinerators, whether fossil or non-fossil, should be reported. Installations should be required to surrender allowances covering emissions of CO_2 of both fossil and non-fossil origin. The suggested zero-rating of non-fossil CO_2 undermines the objective of the policy.

3. **Inventories and Policy Instruments**: GHG inventories seek only to report on sources and sinks of GHGs, and to try to give a faithful and accurate representation of these as they are. It is not their purpose to determine whether there are better outcomes that could have been achieved. The goal of a policy maker is different: they must design the policy so as to meet the objectives of the policy as far as possible, and in an efficient manner.

   The design of policy should not be guided by principles used for compiling an inventory. When considering the inclusion of municipal waste incinerators (MWIs) and other incinerators within the EU-ETS, policymakers should be guided by the policy's objective.

4. **Cascading Principle**: When conducting the study as outlined in Article 30(7) of the EU-ETS Directive, attention should be given not only to landfills but also to recycling and waste prevention. The inclusion of municipal waste incinerators (MWIs) within the EU-ETS should not undermine the cascading principle and must be consistent with achieving the objectives of the EU-ETS Directive.

5. **Other Waste Management**: The Article 30(7) report is asked to consider other waste management processes, and in particular, landfills with a view to including them under the EU-ETS. Methane emissions are to be included for maritime transport in future, but relatively few emissions trading schemes include landfills. We have argued elsewhere that landfills in the EU should be required to stabilise waste prior to landfilling to reduce methane emissions.[2] Inclusion of landfills within the EU-ETS could, theoretically, incentivise this, but in practice, measuring emissions from landfills is not straightforward. In any event, most countries, with few exceptions, already apply landfill taxes, and it might be easier to use tax differentials to drive down GHG emissions from landfills. If stabilisation of waste occurs prior to landfilling, this should improve the GHG performance of a landfill system, potentially improving the performance of landfill so that it is superior to incineration.[3]

   Several Member States already have taxes in place on incineration, and more have taxes in place for landfill, with some having implemented bans on some landfilling. Where recycling and waste

[2] Equanimator (2021) *Rethinking the EU Landfill Target*, Report for Zero Waste Europe, October 2021.
[3] Dominic Hogg (2022) *The Case for Sorting Recyclables Prior to Landfill and Incineration*, Special Report prepared for Reloop, June 2022.

prevention are concerned, an EU-ETS functioning with no free allowances for industry, and with a carbon border adjustment mechanism in place should help incentivise recycling, albeit imperfectly. It would be reasonable to assume that a share of existing Member State taxes on incineration and a greater share of taxes on landfill are justified (sometimes explicitly) based on the associated GHG emissions. It would make sense, therefore, for guidance to be given, in the light of decisions made, to Member States as to how they might consider adjusting existing taxes (recognising that tax remains a matter for Member States).

The analysis of incineration and other waste management options should consider their relative performance, including the extent to which benefits and impacts are already, or will be, internalised by existing policies such as the EU-ETS. This analysis could also help inform guidance on how existing economic instruments might be partially or wholly replaced by the EU-ETS.

6. **20 MW Threshold:** The specification of the proposed threshold for inclusion can be interpreted in various ways. Though it may capture most existing facilities, it may need lowering to prevent smaller facilities emerging in future specifically seeking to avoid inclusion within the EU-ETS. The EU-ETS Directive notes that by 31 July 2026, the Commission is to report on the feasibility of lowering the 20 MW total rated thermal input thresholds for the activities in Annex I from 2031.[4] Alignment with the threshold in the Industrial Emissions Directive, or dropping to 10MW would be sensible.

7. **Drafting Issues:** The Directive's language could be improved to ensure that a legal interpretation of the wording reflects the Directive's intent.

[4] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

Introduction

Equanimator is pleased to have been asked by Zero Waste Europe (ZWE) to consider the modalities by which incineration should be included within the European Union's system for greenhouse gas emission allowance trading (henceforth, the EU-ETS), and the rules that could apply to the inclusion of incinerators.

On 22 June 2022, the European Parliament approved the reform of the EU Emissions Trading System (EU ETS), which paved the way for the possible inclusion of municipal waste incineration plants as of 2026. For the time being, where incinerators do not incinerate either hazardous waste or municipal waste, they are already included under the EU-ETS. Some Member States chose to include other incinerators as per Article 24 of the EU-ETS Directive (*Procedures for unilateral inclusion of additional activities and gases*), which enables Member States to expand the coverage of the EU-ETS by opting in activities, installations and greenhouse gases not originally covered by the scheme.[5] Denmark and Sweden elected to include incineration within the scope of the EU-ETS, both doing so from 2013.[6]

As of 1 January 2024, installations for the incineration of municipal waste are included in the EU ETS, but pending a further decision, only for the purpose of monitoring, reporting and verification, without an obligation to surrender allowances for the emissions reported. Article 30(7) of the EU-ETS Directive mandates the Commission to perform a review by July 2026 to assess the feasibility of including municipal waste incineration (MWI) installations in the EU ETS as follows:[7]

> *By 31 July 2026, the Commission shall present a report to the European Parliament and to the Council in which it shall assess the feasibility of including municipal waste incineration installations in the EU ETS, including with a view to their inclusion from 2028 and with an assessment of the potential need for an option for a Member State to opt out until 31 December 2030. In that regard, the Commission shall take into account the importance of all sectors contributing to emission reductions and potential diversion of waste towards disposal by landfilling in the Union and waste exports to third countries. The Commission shall in addition take into account relevant criteria such as the effects on the internal market, potential distortions of competition, environmental integrity, alignment with the objectives of Directive 2008/98/EC of the European Parliament and of the Council (38) and robustness and accuracy with regard to the monitoring and calculation of emissions. The Commission shall, where*

[5] The term EU-ETS Directive is used as shorthand for the Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

[6] Energistyrelsen (2018) *Annex 1 to Denmark's First DRAFT Integrated national energy and climate plan pursuant to Articles 3-11 and Annex I of Regulation [Governance] on the General Framework For Integrated National Energy and Climate Plans, Part 1: General framework, Section A: National Plan*, 30 November 2018; Ellen Philipsson (2020) *Emissions trading for waste incineration plants with energy recovery in Sweden*, Master's thesis in Energy and Environmental Engineering, Linköping University Department of Management and Engineering, Spring Semester 2020.

[7] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

appropriate and without prejudice to Article 4 of that Directive, accompany that report with a legislative proposal to apply the provisions of this Chapter to greenhouse gas emissions permits and the allocation and issue of additional allowances in respect of municipal waste incineration installations, and to prevent potential diversion of waste.

In the report referred to in the first subparagraph, the Commission shall also assess the possibility of including in the EU ETS other waste management processes, in particular landfills which create methane and nitrous oxide emissions in the Union. The Commission may, where appropriate, also accompany that report with a legislative proposal to include such other waste management processes in the EU ETS.

The inclusion of MWI is overdue. Even if one excludes the emissions of carbon dioxide derived from combusting wastes of non-fossil origin – which may account for around 50% of carbon dioxide emissions from MWIs – incinerators are likely to be the most carbon intense forms of power generation once coal is phased out, and are only marginally better performers than gas fired boilers if operated in heat only mode, assuming a high level of use of the heat generated.[8] Some countries apply taxes to incineration, but these are often at low levels, and most countries with taxes on incineration apply higher taxes on landfill. Several countries apply a tax on landfill, but no tax on incineration.[9]

The EU-ETS Directive, inter alia, '*provides for the reductions of greenhouse gas emissions to be increased so as to contribute to the levels of reductions that are considered scientifically necessary to avoid dangerous climate change*."[10] The question is how the inclusion of incineration can be designed to support that objective. In principle, the inclusion of incineration under the EU-ETS ought to provide an opportunity to support management of waste in a manner consistent with existing waste Directives, and such as to contribute to the reduction in greenhouse gas emissions sought through the EU-ETS Directive.

This report considers various decisions that might be considered relevant as regards the way forward for including municipal, and other, waste incineration within the EU-ETS.

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[8] D. Hogg (2023) *Debunking Efficient Recovery: The Performance of EU Incineration Facilities*, Report for Zero Waste Europe, January 2023. See also J. and S. Dowen (2021) *Good Practice Guidance for Assessing the GHG Impacts of Waste Incineration*, July 2021. The latter publication uses real world data from operators to show that power was generated at more than twice the carbon intensity of combined cycle gas turbines. These figures would be more or less doubled if CO_2 emissions from wastes of non-fossil origin were included.

[9] Since the turn of the previous decade, UK rates of household waste recycling have been stagnant. With no incineration tax in place, and with landfill tax increasing from £48 per tonne in 2010 to £126 per tonne in 2024, the principal change has been an increase in incineration, mostly oriented only to power generation, and a fall in the quantity landfilled.

[10] Article 1, Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

Approach

The approach to the work is as follows:

1. Key aspects of the EU-ETS, as it is currently framed, and as it might be deemed to be relevant to the EU-ETS, are considered;
2. Incineration releases emissions of both fossil- and non-fossil CO_2. Incineration can also generate both heat and power. We consider questions regarding the share of the total emissions from incineration which should be considered relevant for inclusion under the EU-ETS. In doing so, we consider how other policy and law addresses these issues, and the extent to which they are consistent.
3. We consider how carbon capture and storage should be included in the scheme.
4. We consider how the nature of the energy output from incineration should be reflected in the scheme
5. We make recommendations regarding what we consider the best way to incorporate incineration within the EU-ETS.

The EU-ETS

In this Section, we briefly present the EU-ETS, focussing on the overarching concepts, and the matters which might be considered relevant to determining how incineration should be included in the system.

Overarching Effect

The EU-ETS is a system which seeks to achieve a reduction in greenhouse gas emissions in an economically efficient manner. The system operates as a so-called cap-and-trade scheme. The 'cap' refers, broadly speaking, to an overall constraint on the quantity of emissions of the gases that are included in the system that can be emitted by the sectors (and hence, the installations) that are within the scope of the system in a given year (though in practice, some rules allow for flexibility across years). The trading element is important from the perspective of economic efficiency, and is made all the more relevant as the breadth of sectors included in the system increases. In essence, the trading part of the system relies on a market being created for the buying and selling of allowances, each allowance representing a unit of emission of greenhouse gases. Trading in these allowances, under the constraint of a cap, gives rise to a situation where the sectors within scope of the EU-ETS have a choice as to whether they seek to abate emissions, or purchase allowances to cover those emissions which they still generate. Trading allows for more of the emissions reduction to be undertaken by those for whom the costs of doing so are lower, allowing others to purchase allowances from the market where their costs of abatement are higher. The value of allowances at any given point in time results from the interplay of the demand for allowances (how much are the sectors emitting / do they seek to emit under profitable operation) and the quantity of allowances made available to the market (as a consequence of the setting of the cap, and other rules that affect the supply of allowances into the market).

Because the EU-ETS has been, in relative terms, a front-runner as regards pricing emissions of greenhouse gases (notably, CO_2), there have been concerns that the effect of the emissions pricing would undermine the competitive position of industries which were in sectors whose products and services were widely traded, and could lead either to installations seeking to reduce costs by re-locating outside the EU, or to a greater share of production originating from facilities domiciled outside the EU (so-called carbon leakage). For this reason, in early phases of the EU-ETS, many sectors were recipients of 'free allowances' (they were allocated a tranche of allowances that would reduce the extent to which they needed to purchase - they could also sell - allowances). Changes to the EU-ETS are (and have been) to be implemented which will reduce the extent to which allowances are made available free of charge, and to increase the share of the available allowances that are being auctioned to participants. This will be given additional impetus by the decision to introduce a carbon

border adjustment mechanism. Articles 9, 9a and 10-10e of the EU-ETS Directive set out most of the relevant rules.[11]

Article 8 covers coordination with Directive 2010/75/EU (The Industrial Emissions Directive, or IED[12]). We have commented elsewhere that the treatment of incineration under the IED has not appreciated that, up until incinerators are included within the EU-ETS, the fact that they have mostly been out of the scope of the EU-ETS should, perhaps, have led to a greater focus on GHG emissions from incineration than is given to this matter in the IED, and in particular, the associated BREF note for waste incineration.[13] Although the IED effectively allows for GHG emissions to be overlooked in the case where installations are included under Annex I of the EU-ETS, prior to recent changes to the EU ETS, this was not the case.

From 2026, the rules on the exclusion from the EU ETS of installations using predominantly biomass will be significantly changed, with a lower threshold (95% instead of 'exclusive' use) and requiring that the biomass complies with the sustainability and greenhouse gas savings criteria put forward by the RED II (Renewable Energy Directive).

Matters Relevant to the Inclusion of Incineration

The EU-ETS applies to activities listed in Annexes I and III of the EU-ETS Directive, and to the greenhouse gases listed in Annex II of the same document.[14] Annex III was added through the most recent (2024) amendment to the Directive, and follows the decision to include buildings, road transport and other sectors within the EU-ETS. Chapter IVa of the EU-ETS indicates that auctioning of these allowances will commence in 2027, though regulated entities will be required to hold a greenhouse gas emissions permit from 2025. The significance of this is that prior to the amending Directive, heating of buildings was not covered by the EU-ETS: now, however, heating is covered. That is relevant for the discussion around the form of energy delivered by incinerators.

Until the May 2023 amendments to the EU-ETS Directive, Annex I, setting out activities included under the EU-ETS, had read:

> *Combustion of fuels in installations with a total rated thermal input exceeding 20 MW (except in installations for the incineration of hazardous or municipal waste)*

[11] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.
[12] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).
[13] See Equanimator (2021) *Rethinking the EU Landfill Target*, Report for Zero Waste Europe, October 2021, https://zerowasteeurope.eu/library/rethinking-the-eu-landfill-target/.
[14] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024 .

It might be useful to consider that there are broadly three 'pools' of waste which could be incinerated:

(a) Municipal waste (and wastes derived from such wastes, such as SRF – note that these might not be classified as 'municipal waste' under the List of Waste);
(b) Non-hazardous wastes which are no municipal waste (for example, plastics and wood from construction and demolition activities); and
(c) Hazardous wastes.

Even before the 2023 amendments, the incineration of wastes of type (b) was covered by the ETS-Directive. This is confirmed in the most recent Guidance on Annex I:[15]

> *The IED in force at the time of publication of this guidance defines a "waste incineration plant" as a stationary or mobile technical unit and equipment*
>
> > *"dedicated to the thermal treatment of wastes with or without recovery of the combustion heat generated, through the incineration by oxidation of waste as well as other thermal treatment processes, such as pyrolysis, gasification or plasma process, if the substances resulting from the treatment are subsequently incinerated."*
>
> *If an installation is found by the competent authority to fall under this definition and if the waste incinerated falls predominantly under the category "municipal" or "hazardous" (according to the European Waste List[34]), then it is not subject to the EU ETS Directive in respect of any incineration that takes place at that installation, except for cases discussed in chapter 6* [i.e., those cases included as a result of the recent amendments - see below).

The Guidance has a problem here in that some cases covered by the IED definition to which it refers are clearly not ones where the wastes are used as fuels (if there is no recovery of the heat generated): the ETS definition applies to the 'combustion of fuels'. Nonetheless, it suggests that where incinerators are 'predominantly' dealing with municipal or hazardous waste, then they did not have to be included in the EU-ETS. The Guidance also seeks to make a similar demarcation with regard to coincineration.

Following the amendments, a new sentence has been added, so that Annex I of the EU ETS Directive now reads:[16]

> *Combustion of fuels in installations with a total rated thermal input exceeding 20 MW (except in installations for the incineration of hazardous or municipal waste)*

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[15] European Commission (2023) *Guidance on Interpretation of Annex I of the EU ETS Directive (excl. aviation and maritime activities): Update Applicable from 2024*, 19 December 2023.

[16] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024. Note that the Articles 13 and 14 mentioned in the extract cited relate to monitoring and reporting, and verification and accreditation, respectively.

> *From 1 January 2024, combustion of fuels in installations for the incineration of municipal waste with a total rated thermal input exceeding 20 MW, for the purposes of Articles 14 and 15.*

The distinction between these two clauses is important because the units covered under the first paragraph would be required to surrender allowances for the emissions reported, whilst units covered by the second paragraph are included, for the time being, only for monitoring and verification purposes. The distinction, therefore, matters for the time being (and in particular, for the period from 1 January 2024 until such time as the units covered in the second paragraph are required to surrender allowances).

There are three issues related to this paragraph;

a) The use of the term 'fuel';
b) The reference to municipal waste only (and the relation between 'use as a fuel' and 'municipal waste'); and
c) How we should understand the 'total rated thermal input'.

These are discussed below.

Combustion of Fuels

We commented above on the significance of the term 'fuel'. There is no definition of 'a fuel' applicable to the EU-ETS Directive as a whole: we would suggest this is an oversight, and also, that the term is used unwisely in the new paragraph of Annex I (as well as the old one).

The EU-ETS Directive includes a definition of 'fuel', but its application is restricted to Chapter IVa. The definition is as follows (at Article 3):

> *(af) 'fuel' for the purposes of Chapter IVa of this Directive means any energy product referred to in Article 2(1) of Directive 2003/96/EC, including the fuels listed in Table A and Table C of Annex I to that Directive, as well as any other product intended for use, offered for sale or used as motor fuel or heating fuel as specified in Article 2(3) of that Directive, including for the production of electricity;*

The Directive being referenced is the Directive on restructuring the Community framework for the taxation of energy products and electricity (the so-called Energy Tax Directive). The fuels referenced therein are essentially commodity products, and do not include 'wastes', although at some point, wastes might be used to manufacture some of the fuels mentioned therein: were that to be the case, there would likely be some 'end of waste' criterion which, where applicable, would lead to the 'waste' ceasing to be such (and being classed as a product, that product being a class of 'fuel').

The notion of a fuel is, generally, one of a commodified *product*, but wastes are not "products" until they have achieved "end of waste" status. Wastes are not usually regarded as "fuels" for that very reason, and although

there is a CEN standard for 'solid recovered fuel' (SRF), this is a loose standard and seems aimed more at classifying grades of 'materials with calorific value' derived from waste (there being grades which might be considered progressively more 'fuel-like' in nature). In particular, achieving the CEN standard does not confer upon the resulting SRF the status of "product" as opposed to "waste", and SRF is still treated as "a waste".

The Waste Framework Directive (WFD) defines 'material recovery' as

> *'material recovery' means any recovery operation, other than energy recovery and the reprocessing into materials that are to be used as fuels or other means to generate energy. It includes, inter alia, preparing for re-use, recycling and backfilling;*

Energy recovery (including at incineration) is deemed distinct from '*reprocessing into materials that are to be used as fuels*'. They are not the same thing.

On the other hand, the WFD defines the recovery activity, R1, as '*Use principally as a fuel or other means to generate energy*'. There is history behind what lies within and without this definition, and as of 2008, the definition includes municipal waste where the activity achieves the R1 criterion as set out in a footnote in Annex II of the WFD. It might be considered, therefore, that municipal waste is only being used 'principally as a fuel' when the R1 threshold criterion is met.

This, though, becomes potentially perverse: if a facility fails to meet the R1 criterion, the waste is not being used 'principally as a fuel', and the incinerator becomes a disposal (D10) operation. Does that mean it no longer falls within the EU-ETS? Under the wording of the EU-ETS Directive, that would appear to be the case (the waste is not used as a fuel). If something is 'used principally as a fuel', however, that does not grant it the status of 'a fuel'.[17]

Installations for the Incineration of Municipal Waste

The Updated Guidance of December 2023 makes the same reference to the IED definition of 'waste incineration plant' as was cited above. It notes, '*The IED does not contain a definition of "municipal waste incineration plant", as waste incinerators in general are designed to use many waste types in a flexible way.*' The Guidance proposes the following approach:[18]

> *the competent authority should assess waste incineration installations not yet included in the EU ETS on a case-by-case basis, using the installation's IED permit and its documentation of waste streams*

[17] A cat may make use of a flower bed principally as a toilet: that does not imply that the flower bed is 'a cat's toilet'.
[18] European Commission (2023) *Guidance on Interpretation of Annex I of the EU ETS Directive (excl. aviation and maritime activities): Update Applicable from 2024*, 19 December 2023.

received in the past (or planned to be used, in case of new installations) to decide whether it is an MWI installation that needs to be included in the EU ETS for MRV obligations from 2024 onwards.

The following may be used for a step-by-step assessment:

1. *If the installation or unit does not have an IED permit stating the activity "5.2 Disposal or recovery of waste in waste incineration plants", the installation or unit is probably not relevant*[65].
2. *As has been argued above, units which according to the IED permit are designed, equipped, built and operated for the incineration of certain types of hazardous waste because they fulfil the criterion of combustion gas temperature above 1100°C can be considered units for the incineration of hazardous waste and can remain excluded in line with clause 5 of Annex I of the EU ETS Directive.*
3. *Based on the IED permit and the documentation of actually used waste streams:*
   a. *If only a narrow, specific range of (sorted, not mixed) waste types is used, it is likely that it is non-municipal waste, in particular where specific (industrial) sources of the wastes can be identified;*
   b. *A broad range of wastes, or highly mixed wastes containing materials typical for household wastes, indicate that it may be an MWI installation or unit;*
   c. *A large percentage (**in terms of energy content**) of hazardous wastes (all waste numbers indicated by an asterisk in the European Waste List), indicates that it might be an installation or unit not exclusively used for municipal wastes. Fractions listed in section 20 of the European Waste List but marked as hazardous waste should be treated like hazardous rather than municipal waste in this assessment. This would be consistent with the fact that also for the plant design and permit conditions the hazardous character of such waste would prevail*[66]

The assessment of the predominant waste type should cover the previous three years[67] *or longest period possible if the start of operation was within the last three years. The predominant waste type is defined as the type of waste **with the largest share in mass** (municipal waste, hazardous waste or other wastes). The following results are possible:*

- *The predominant type is hazardous waste. In this case the installation (or unit) remains outside of the EU ETS.*
- *The predominant type is other waste (neither municipal, nor hazardous). In this case, the installation or unit should be fully included in the EU ETS, i.e. not only for MRV purposes.*
- *The predominant type is municipal waste. In this case the installation should be included for MRV from 2024 onwards.*
- *All three types of waste are used with no clearly dominant waste type. The installation should be fully included in the EU ETS, as it is not an installation "for the incineration of hazardous or municipal waste" only.*

The first underlined extract above – related to the activity as described in a permit – is a risky one. Exactly how Member States choose to implement the IED, and how the permit classifies the installation unlikely to be fixed

in all Member States. Furthermore, the description of the activity could include, as per the Waste Framework Directive, a description as an R1 installation.

An important question raised by the above is 'what does 'predominant' mean?' The case given in the Guidance as an example is instructive:

> *Example:*
> *A given installation that incinerates waste uses the following types of waste: 34% municipal waste, 33% hazardous waste, 33% other wastes. The predominant waste type is municipal waste. Therefore, the installation should be included for MRV only from 2024 onwards.*[19]

A waste type appears to be 'predominant', therefore, when it accounts for 'the largest share' of what is incinerated by mass (though calorific value is also mentioned in the extract from the Guidance mentioned above, and although the ultimate concern ought to be to control carbon dioxide emissions).

It most likely follows, from the Guidance, that the majority of 'dedicated' incineration facilities in the EU are, subject to their exceeding the 20MW threshold (see below), under the scope of the second paragraph, and hence, would be included initially for the purposes of monitoring, reporting and verification (MRV) only. There is, though, much in the definition and the guidance that could be improved upon to clarify what is to be included under the EU-ETS, and to what extent (in full, or, for the time being, for MRV purposes only).

It is worth drawing attention to the fact that the 'use principally as a fuel' (see above) at MWIs applies to, '*incineration facilities dedicated to the processing of municipal solid waste*'[20]: the use of the term, "dedicated" would suggest that the criteria is relevant to facilities that deal with municipal waste *only* (or that laying claim to being an R1 operation is applicable only to the incineration of municipal waste). Depending on how strictly one interprets this, then where municipal waste is the 'predominant' waste stream incinerated by an installation, the remaining wastes would not be being used 'principally as a fuel'. It ought to be straightforward to clarify the intent of the law, perhaps by elaborating suitable worded rules based around the position that the Guidance seeks to reach.

Total Rated Thermal Input

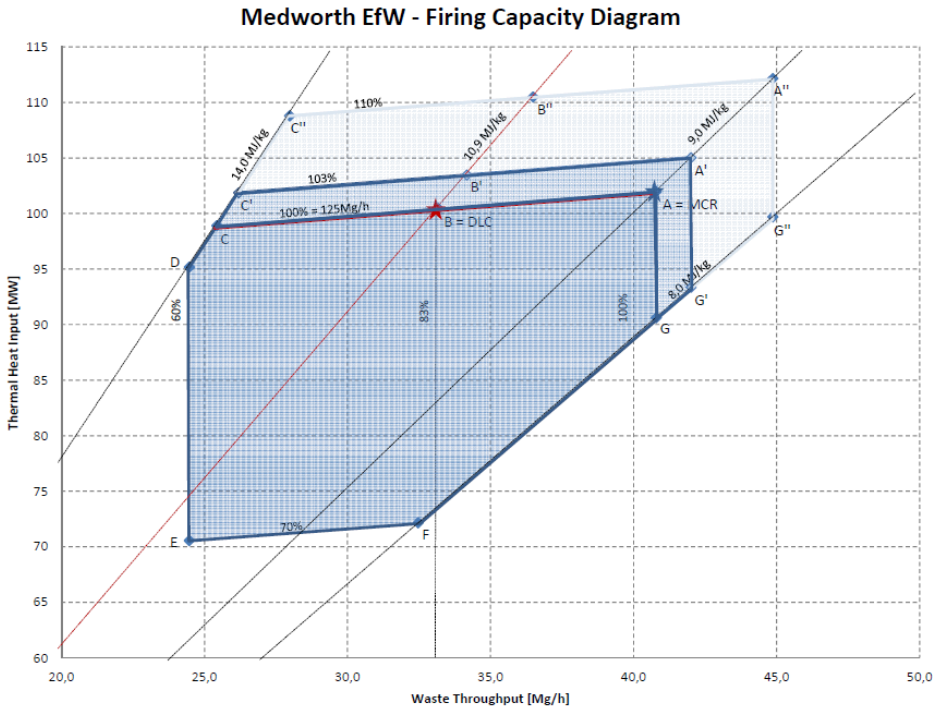
Another definitional issue regards the way in which the term, 'total rated thermal input' is to be understood. The MRV requirement is based on '*combustion of fuels in installations for the incineration of municipal waste with a total rated thermal input exceeding 20 MW*'. In the first instance, this is simply ambiguous in that it is unclear as to whether the total rated thermal input is to be understood as the maximum thermal input that

[19] Note that, given the mention in the Guidance of an instance where '*All three types of waste are used with no clearly dominant waste type*', the example given suggests this would need to be exactly equal shares, which seems an unlikely combination to arise.
[20] Directive 2008/98/EC of the European Parliament and of The Council of 19 November 2008 on waste and repealing certain Directives.

the installation is capable of managing, or the thermal input of the 'fuels' being combusted. The wording is also unclear as to whether, at facilities that incinerate non-municipal wastes as well as municipal waste (to the extent that one accepts this, as per the Guidance), whether it is the calorific content of the municipal waste only that has to exceed the 20MW threshold, or whether this threshold is to be applied to the totality of waste input to the facility.

Incinerators are designed with some flexibility around the mass and calorific value of the input waste stream (as exemplified in firing diagrams): if the intention was that a unique value for the total rated thermal input of the facility should be given, then that would leave some leeway for stating a thermal input below the maximum. For example, a recent proposal in the UK was accompanied by the firing diagram in Figure 1. The table at the right-hand side indicates a variation in thermal input from 70 to 100 MW and beyond.

Figure 1: Firing Diagram for Proposed Medworth (UK) Incineration Facility



	Waste Throughput	Thermal Input	NCV
	Mg/h	MW	MJ/kg
A = MCR	40,8	102,0	9,0
B = DLC	33,2	100,5	10,9
C	25,4	98,9	14,0
D	24,5	95,2	14,0
E	24,5	70,6	10,4
F	32,5	72,2	8,0
G	40,8	90,6	8,0
A'	42,0	105,0	9,0
B'	34,2	103,5	10,9
C'	26,2	101,9	14,0
G'	42,0	93,4	8,0
A''	44,9	112,2	9,0
B''	36,5	110,5	10,9
C''	28,0	108,8	14,0
G''	44,9	99,7	8,0

Source: MVV (2012) Environmental Statement, Chapter 14: Climate, Medworth Energy from Waste Combined Heat and Power Facility, June 2022.

Guidance states that:

> *The maximum rated thermal input is normally specified by the manufacturer and is displayed on the technical device with the consent of an inspection body. Where different fuels or fuel mixes can be used, leading to different maximum thermal inputs, the highest possible thermal input should be used.*
>
> *When no information from the manufacturer is available, the operator of the installation must provide to the competent authority an estimate based on best available information (for example maximum*

fuel throughput achieved in 24 hours during the last calendar year). As in most cases the exhaust gas has a temperature above 100°C, and in line with monitoring requirements defined by the MRR, net calorific values (NCV) are considered most appropriate for determination of the thermal input.

Although a fully harmonised approach should be the aim for the EU ETS, it is recognised that in some Member States gross calorific values (GCV) are used for specifying nameplate capacity. For practical and simplicity reasons only, the use of GCV in these Member States is considered acceptable. [...]

The rated thermal input may be reduced by operators compared to the original unit's design by technical means.[32] Such reduction of the rated thermal input may be accepted by the competent authority in the determination of the installation's total capacity provided that the change is permanent and cannot be reversed without major technical intervention or without consent of the competent authority, and the existence of those restrictions and their permanent nature are in fact verifiable by the competent authority.

The Guidance leaves considerable leeway for interpretation:

a. Even if the MWI includes a maximum rated thermal input on the device, the choice as to whether to use NCV or GCV is likely to be of greater significance for wastes, which have a relatively high moisture content, and where flue gas condensation may be a relevant approach to enhance heat recovery, than for most commoditised solid, liquid and gaseous fuels. The equivalent mass that translates into the threshold value is likely to vary by 15-25% or more, so that relative to NCV, a 'typical' MSW of around 9.5 GJ/tonne (NCV) might exceed the 20MW threshold at an input of around 60 thousand tonnes of waste. Relative to NCV, the threshold might be exceeded at around 50 thousand tonnes of waste. The choice would seem to be of relevance;
b. The use of the maximum thermal input would be an odd choice if the facility rarely, if ever, approaches that thermal input (perhaps because of local competition for waste feedstock);
c. The 'maximum fuel throughput' is also open to some manipulation through smoothing rates of throughput to a facility (this might be reasonable practice, not least if it avoids throughputs falling below the minimum that is desirable for the installation).

It remains unclear whether the inclusion of incineration in the EU-ETS is to be considered in relation to the total rated thermal input of the facility, and even if that is the case, whether it is the calorific content of the municipal waste what is combusted therein that is to be reported on.[21]

[21] This matter is further complicated by what is set out at Art 2(1) of the EU ETS Directive:

'Where an installation that is included within the scope of the EU ETS due to the operation of combustion units with a total rated thermal input exceeding 20 MW changes its production processes to reduce its greenhouse gas emissions and no longer meets that threshold, the Member State in which that installation is situated shall provide the operator with the options of remaining within the scope of the EU ETS until the end of the current and next five-year period referred to in Article 11(1), second subparagraph, following the change to its production processes. The operator of that installation may decide that the installation is to remain within the scope of the EU ETS until the end of the current five-year period only or also of the next five-year period, following the change to its production processes. The Member State concerned shall notify the Commission of changes compared to the list submitted to the Commission pursuant to Article 11(1).'

Finally, it seems reasonable to ask why the threshold has been set at 20MW. What is the rationale for the choice? Whilst it may be true that *most* MWIs in the EU at present are likely to be (depending on how they interpret the requirement) above the 20MW threshold, the decisions made here have the potential to change that in future. Economies of scale (and the quantum of capital involved) tend to push facilities towards sizes well above 50-60kt (the EU average appears to be around 200kt), but full inclusion under the ETS, with no free allowances, might influence the decision whether to build new facilities below the threshold. The 20MW threshold is different to, and likely far above, the threshold level at which an installation would need a permit under the Industrial Emissions Directive.[22] Dropping the threshold to 10MW, or aligning the threshold with the IED, might be sufficient to make the diseconomies of such small scale sufficient to make it unlikely that the threshold would directly affect the capacity decision.

Annex III

The new Annex III covers, inter alia '*Release for consumption of fuels which are used for combustion in the buildings, road transport and additional sectors.*' The sectors covered are elaborated as follows:[23]

> *The buildings and road transport sectors shall correspond to the following sources of emissions, defined in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, with the necessary modifications to those definitions as follows:*
>
> > *(a) Combined Heat and Power Generation (CHP) (source category code 1A1a ii) and Heat Plants (source category code 1A1a iii), insofar as they produce heat for categories under points (c) and (d) of this paragraph, either directly or through district heating networks;*
> >
> > *(b) Road Transportation (source category code 1A3b), excluding the use of agricultural vehicles on paved roads;*
> >
> > *(c) Commercial / Institutional (source category code 1A4a);*
> >
> > *(d) Residential (source category code 1A4b).*

The inclusion of buildings, therefore, covers heat, and so whatever arguments there may have been hitherto for excluding (or offering free allowances for) heat generation from incineration under the EU ETS, this has now disappeared (and would effectively constitute an implicit subsidy to heat from incineration plants).

See Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

[22] The 3 tonnes per hour threshold is equivalent to (at typical calorific values for municipal waste) less than half the 20MW threshold under the EU-ETS (see Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control).

[23] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

There are also exclusions:[24]

> *(a) the release for consumption of fuels used in the activities listed in Annex I, except if used for combustion in the activities of transport of greenhouse gases for geological storage as set out in the table, row twenty-seven, of that Annex or if used for combustion in installations excluded under Article 27a;* [...]
>
> *(c) the release for consumption of hazardous or municipal waste used as fuel.*

Both of these exclusions use the term '*release for consumption*', which Article 3(ag) of the EU-ETS Directive defined through reference to Article 6(3) of Directive (EU) 2020/262,[25] which in turn makes reference to 'excise goods', defined in Article 1 of the same Directive as including '*energy products and electricity covered by Directive 2003/96/EC*' (the Energy Tax Directive). The 'energy products' covered by the Energy Tax Directive are listed under Article 2 of that Directive.[26] It is far from obvious that the term '*release for consumption*', circuitously defined as it is, can have application to 'municipal waste' (or hazardous waste) when used in an incinerator to generate heat, since it does not appear to fall under the definition of an excise good (if one of the relevant fuels were made from municipal waste, then that might be different): the context here (Annex III) is heating, so the use of waste to generate electricity is not relevant.[27] [28]

The various 'inclusions' and 'exclusions' implied by Annexes III seem to further complicate matters what was already a complicated picture regarding what incinerators are included when, and to what extent, in the EU ETS. As we noted above, there are broadly three types of waste which could be incinerated:

a) Municipal waste (and wastes derived from such wastes, such as SRF – note that these be classified differently under the List of Waste);
b) Non-hazardous non-municipal wastes (for example, plastics and wood from construction and demolition activities); and
c) Hazardous wastes.

The position might be, if our interpretation of the law as it is written is correct, that:

---

[24] Ibid.
[25] Council Directive (EU) 2020/262 of 19 December 2019 laying down the general arrangements for excise duty.
[26] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.
[27] Note that the ETD does include, in Annex II, Member States' reduced rates / exemptions from the tax rates in the ETD, and many include wording to the effect of: '*waste oils which are reused as fuel, either directly after recovery or following a recycling process for waste oils, and where the reuse is subject to duty*' (Ibid.). Since oils are 'excise goods', then such a specification is understandable. The ETD, by setting minimum tax rates for the list of fuels mentioned, and excluding waste from its scope when used for heating, has enabled incinerators in some Member States to benefit from higher revenues from sale of heat than would otherwise apply, in effect, an implicit subsidy to incineration.
[28] It seems bizarre to seek to link what is no doubt an intended 'exclusion' of municipal and hazardous waste by virtue of cross-referencing a term that is applied to 'excise goods': so many other possibilities present themselves, with the approach taken in drafting not only complicating matters, but failing, ultimately to achieve what one imagines was the intended outcome.

(i) installations at which the largest share, by weight, of waste being incinerated is b) above are included fully under the EU ETS subject to their exceeding the 20MW threshold (see above);[29]

(ii) to the extent that they generate heat (they are not excluded from Annex III for reasons explained), installations at which the largest share, by weight, of waste being incinerated is b) above are included under the EU-ETS (as per Annex III) and are required to surrender allowances. The 20MW threshold does not apply to Annex III activities, but a key question would be the means by which to apportion emissions to 'heat' as opposed to power in the case of CHP facilities;

(iii) to the extent that they generate electricity, installations at which the largest share, by weight, of waste being incinerated is b) above may or may not be included under the EU-ETS (as per Annex I) depending on whether or not one takes the view that what happens at MWIs is the 'combustion of fuels'. Of course, some auxiliary fuels are combusted at MWIs, but the language being used leaves much to be desired from a strict legal perspective;

Note that waste of type b) in our classification above is treated in various ways where it does not constitute the majority, by weight, of what is combusted:

(iv) at an installation where the largest share, by weight, of what is combusted is hazardous waste, it will be excluded from the EU-ETS unless the installation concerned is configured to supply heat (such a facility would be included as per Annex III); or

(v) at an installation where the largest share, by weight, of what is combusted is municipal waste, then potential inclusion follows (ii) and (iii) above

Waste of types a) and b) would not be included, as far as we can discern, where such waste was combusted at an incinerator at which the largest share of waste combusted was hazardous, and where no heat was exported.[30] This does raise the distinct possibility that there will arise incentives for non-hazardous wastes which are not of municipal origin to be incinerated at facilities which combust, predominantly, hazardous wastes. Indeed, these facilities might have a major advantage in dealing with such wastes where they are of fossil origin.

This interpretation is clearly not what is intended by the EU-ETS Directive as drafted. That intent, we believe, is broadly as follows:

1. Waste of Type (a) is included under Annex I for MRV purposes only.
2. Waste of Type (b) is included under Annex I either:

[29] The detailed application of the threshold remains somewhat ambiguous - if the installation combusts other wastes, then does the 20MW threshold apply only to the non-hazardous non-municipal wastes, or to the installation as a whole. Recognising that the key question, ultimately, is how the requirement for allowances is to be calculated, then either is possible (and the Guidance does little to close this question down).

[30] As noted above, the Guidance includes the following: '*The predominant type is hazardous waste. In this case the installation (or unit) remains outside of the EU ETS.*'

i) fully within the EU-ETS (under Annex I) as a consequence of being incinerated in facilities which are used predominantly for combusting non-hazardous non-municipal waste; or

ii) fully within the EU-ETS (under Annex III) as a consequence of being released for consumption as a fuel to be combusted in the buildings, road transport and additional sectors (where not already included under Annex I); or

iii) for MRV purposes only, where the waste is combusted at a facility predominantly combusting municipal waste.

This waste would not be included, as far as we can discern, where the waste was combusted at an incinerator which combusts, predominantly, waste that is hazardous.[31] This does raise the distinct possibility that there will arise incentives for non-hazardous wastes which are not of municipal origin to be incinerated at facilities which combust, predominantly, hazardous wastes. Indeed, these facilities might have a major advantage in dealing with such wastes where they are of fossil origin.

3. Waste of Type (c) is included only to the extent that it is combusted at incinerators which combust, predominantly, either municipal (MRV only), or non-hazardous non-municipal wastes (full inclusion).

Neither our interpretation (if correct) nor the intent (if we understand it correctly) are particularly straightforward. The drafting could have made this simpler, even accounting for the fact that at the heart of the problem is the fact that different incinerators are to be included in different ways, ad on different timelines.

Gases Covered

Annex II of the EU-ETS Directive lists a range of gases included within the scheme as follows:[32]

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur Hexafluoride (SF_6)

[31] See previous footnote.
[32] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

The above list is mainly, with the exception of methane, a list of long-lived climate pollutants, though maritime transport will be required to report methane emissions from 1 January 2026. For incinerators, the only greenhouse gas considered relevant as regards the EU-ETS is carbon dioxide.

Article 30(7) of the EU-ETS Directive, regarding the review to assess the feasibility of including municipal waste incineration (MWI) installations in the EU ETS, states:

> *In the report referred to in the first subparagraph, the Commission shall also assess the possibility of including in the EU ETS other waste management processes, in particular landfills which create methane and nitrous oxide emissions in the Union. The Commission may, where appropriate, also accompany that report with a legislative proposal to include such other waste management processes in the EU ETS.*

It would be remiss of the Commission if it did not consider the fact that nitrous oxide (N_2O) emissions are usually recognised as originating from incineration (albeit they are usually considered to be relatively small). It would also be odd to consider N_2O emissions from landfills, but not from incinerators. Annex VI of the Implementing Regulation on monitoring and reporting bases its emissions factors on data from the IPCC 2006 Guidelines:[33] on the basis of kg GHGs per TJ NCV, as regards combustion activity itself, the default N_2O emissions are reported in the 2006 IPCC Guidelines as 1.5-15kg for incineration, with a default of 4kg, whereas for landfill gas, they are given as 0.03 – 0.3, with a default of 0.1kg.[34] Although these emissions relate only to combustion, as regards landfill disposal itself, the IPCC Guidelines note; '*No methodology is provided for N_2O emissions from SWDS because they are not significant*'.[35] Similarly, as we have highlighted previously, the nature of the material that is to be landfilled should be considered when estimating methane emissions: if existing law had been better specified, no waste would be landfilled today without prior biostabilisation to reduce methane emissions.

Summary

The Drafting of the EU-ETS directive, as regards the potential inclusion of incineration, leaves much to be desired. We doubt that a strict interpretation of the text gives the result that was probably intended. Some of the difficulty has clearly arisen as a result of the varied considerations in respect of the timing of inclusion of installations managing different types of waste, an issue made somewhat more complex by virtue of the inclusion of 'buildings' (heating) on a slightly different schedule.

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[33] Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012.

[34] IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2: Energy, Chapter 2: Stationary Combustion*. Geneva, Switzerland: IPCC.

[35] IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 5: Waste, Chapter 3: Solid Waste Disposal*. Geneva, Switzerland: IPCC.

Why does a threshold of 20MW apply? The IED (referenced in Guidance) applies to facilities which have a capacity for non-hazardous waste, greater than 3 tonnes per hour. That equates to a tonnage less than 25,000 tonnes at an availability of 90%. With an NCV of 9.5 GJ/tonnes, that would typically be equivalent to a thermal input well under half the 20MW limit. In principle, the approach could leave facilities – still – under the IED, but not within the EU-ETS in any form, and still with BREF notes that fail to urge any improvement in GHG performance.

The rationale for exempting hazardous waste incineration is, to say the least, contestable. The exemption has the effect of subsidising, implicitly, the management of wastes that are hazardous. That diminishes (relative to the counterfactual) any incentive to change production processes, or product manufacture, away from using hazardous materials. As regards CO_2 emissions in particular, why would the nature of the wastes be an appropriate basis for awarding such an implicit subsidy? These are emissions with global relevance, and it barely matters from where they are emitted. What could possibly be the argument for exempting the incineration of hazardous wastes from the application of emissions trading?

The mention of 'fuels', as opposed to wastes, is unfortunate, but understandable given the origins of, and the subject matter of most of, the text. There is, though, a need for accuracy and clarity in the phrasing. How is the (or any other) threshold to be applied? It should not be so difficult to elaborate a more consistent set of rules for MWI, recognising that the gap between the NCV- and GCV-determined maximum rated thermal inputs are likely to be large.

Article 30(5) of the EU-ETS Directive notes that by 31 July 2026, the Commission is to report on the feasibility of lowering the 20 MW total rated thermal input thresholds for the activities in Annex I from 2031.[36]

[36] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

Incineration in the EU-ETS – What Emissions will be Included?

Incineration releases emissions of both fossil- and non-fossil CO_2. (as well as amounts of nitrous oxide, or N_2O). Incineration can also generate both heat and power. Various pieces of EU policy and law have been developed to address some of the matters that arise regarding the extent to which energy from incineration should be considered as either renewable, or zero-rated for the purposes of assessing the impact of incineration on climate change. Other parts of EU policy and law have sought to establish a means through which the emissions from an incinerator should be 'apportioned' to the generation of power, and the generation of heat, where incinerators export both forms of energy.

In this Section, we explore the existing policy and legal framework and set it in the context of a wider understanding of the impact. We examine questions regarding the share of the total emissions from incineration that should be considered relevant for inclusion under the EU-ETS. In doing so, we consider how other policy and law addresses these issues, and the extent to which they are consistent.

EU Policy and Law

What Does the EU-ETS Directive Say?

Article 14(1) of the EU-ETS Directive indicates that implementing acts will be adopted which provide (inter alia):[37]

> *for the application of the sustainability and greenhouse gas emission-saving criteria for the use of biomass established by Directive (EU) 2018/2001, with any necessary adjustments for application under this Directive, in order for such biomass to be zero-rated. They shall specify how to account for storage of emissions from a mix of zero-rated sources and sources that are not zero-rated. They shall also specify how to account for emissions from renewable fuels of non-biological origin and recycled carbon fuels, ensuring that such emissions are accounted for and that double counting is avoided.*

[37] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

The Directive referenced is the Renewable Energy Directive.[3839] The relevant implementing act is Implementing Regulation (EU) 2018/2066, which was updated at the end of 2023 to account for, inter alia, the inclusion of incineration, whilst the preamble also noted, at recital (4):[40]

> *New rules on biomass and the determination of biomass fraction need to be laid down to provide for necessary adjustments for the application in the EU Emissions Trading System (EU ETS) of sustainability criteria for biomass, including biofuels, bioliquids and biomass fuels. Further adaptation is provided to improve and align existing rules with the provisions of Directive (EU) 2018/20015, as already updated in the relevant guidance documents.*

There are two approaches set out for estimating /measuring emissions from stationary installations (of which, incineration is an example): a 'calculation-based' methodology, and a 'measurement-based' methodology. As regards the calculation-based approach, the implementing act, Art 30(2) states:[41]

> *The operator shall be required to determine the biomass fraction only for mixed fuels or materials. For other fuels or materials the default value of 0% for the biomass fraction of fossil fuels or materials shall be used, and a default value of 100% biomass fraction for biomass fuels or materials consisting exclusively of biomass*

Article 38 concerns Biomass source streams, and Article 38(2) states:[42] *The emission factor of biomass shall be zero. For the purpose of this subparagraph, Article 38(5) shall apply.* Article 38(5), in turn, sets out requirements for biofuels, bioliquids and biomass fuels to fulfil:[43] *'the sustainability and the greenhouse gas emissions saving criteria laid down in paragraphs 2 to 7 and 10 of Article 29 of Directive (EU) 2018/2001."* Fuels derived from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues, are treated different, though, and *'required to fulfil only the criteria laid down in Article 29(10) of Directive (EU) 2018/2001.'* Particularly favourable treatment, however, is given to any energy derived from municipal waste:[44]

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[38] Directive (EU) 2018/2001 of the European Parliament and of The Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

[39] Annex I para 1 of the EU ETS Directive also makes clear that some installations should not be covered by the Directive by virtue of the nature of the biomass they combust, and the contribution made by combusting such biomass to emissions:

> *Installations where during the preceding relevant five-year period referred to in Article 11(1), second subparagraph, emissions from the combustion of biomass that complies with the criteria set out pursuant to Article 14 contribute on average to more than 95 % of the total average greenhouse gas emissions are not covered by this Directive*

(see Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024). This is unlikely to be the case with incineration facilities other than in extreme cases, and effectively addresses installations such as those which generate energy from, for example, wood.

[40] Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012.

[41] Ibid.

[42] Ibid.

[43] Ibid.

[44] Ibid.

'*Electricity, heating and cooling produced from municipal solid waste shall not be subject to the criteria laid down in Article 29(10) of Directive (EU) 2018/2001*'

It follows that as regards municipal wastes, to the extent that they may be included within the EU ETS, the CO2 emissions from the biomass fraction will be zero-rated.

It is worth noting that the Annex VI, referenced in Article 31(1) (see above) includes the default factors for municipal and other wastes as shown in Table 1. We have included the range from the original source (which is not included in Annex VI of the Implementing Regulation), serving to highlight the uncertainty around these values, as expressed in the source document.[45]

Table 1: Reference values for calculation factors (Article 31(1)(a)): Fuel emission factors related to net calorific value (NCV) and net calorific values per mass of fuel.

Fuel type description	Emission factor ($t\ CO_2$ /TJ)	Net calorific value (TJ/Gg)	Source
Industrial wastes	143 (range 110-183)	n.a.	IPCC 2006 GL
Municipal waste (non-biomass fraction)	91,7 (range 73,3 – 121,0)	n.a.	IPCC 2006 GL

Source: Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012.

Presumably, the inclusion of only the 'non-biomass' fraction in Annex VI was deemed appropriate because the CO_2 from biomass is deemed zero-rated, but in a calculation-based approach, it would be sensible to ensure consistency in the calculation relative to what is observed: that might necessitate the biomass equivalent being known (which is given in the same source document). Below, we show the emissions from the biomass fraction of municipal waste, alongside the figures from the same document for some well-known fossil fuels.

Table 2: Reference values for calculation factors (Article 31(1)(a)): Fuel emission factors related to net calorific value (NCV) and net calorific values per mass of fuel

Fuel type description	Emission factor ($t\ CO_2$ /TJ)	Net calorific value (TJ/Gg)	Source
Municipal waste (biomass fraction)	100 (range 84,7-117,0)	n.a.	IPCC 2006 GL

[45] IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 2: Energy, Chapter 2: Stationary Combustion*. Geneva, Switzerland: IPCC.

Coking Coal	94,6 (range 87,3-101,0)		IPCC 2006 GL
Other Bituminous Coal	94,6 (range 89,5-95,7)		IPCC 2006 GL
Sub-Bituminous Coal	96,1 (range 92,8-100,0)		IPCC 2006 GL
Natural Gas	56,1 (range 54,3-58,3)		IPCC 2006 GL

Source: Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012.

Regarding the measurement-based approach, Art 43(4) states:[46]

> *4. Where relevant, the operator shall determine separately any CO_2 amount stemming from biomass and subtract it from the total measured CO_2 emissions. For this purpose the operator may use:*
>
> > *(a) a calculation based approach, including approaches using analyses and sampling based on EN ISO 13833 (Stationary source emissions — Determination of the ratio of biomass (biogenic) and fossil-derived carbon dioxide — Radiocarbon sampling and determination);*
> >
> > *(b) another method based on a relevant standard, including ISO 18466 (Stationary source emissions — Determination of the biogenic fraction in CO_2 in stack gas using the balance method);*
> >
> > *(c) an estimation method published by the Commission.*
>
> *Where the method proposed by the operator involves continuous sampling from the flue gas stream, EN 15259 (Air quality — Measurement of stationary source emissions — Requirements for measurement sections and sites and for the measurement objective, plan and report) shall be applied.*
>
> *For the purpose of this paragraph, Article 38(5) shall apply.*

Although the measurement-based approach does not explicitly reference the zero-rating of biomass (which appears not in Article 38(5) but in Article 38(2)), one assumes it was intended to apply to both approaches.[47]

[46] Commission Implementing Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012.

[47] Strictly speaking, from reading the text as it has been drafted, the zero rating applies to the calculation-based methodology, but not to the measurement-based methodology: Article 38(5) has little relevance independently of reference to 38(2).

Article 29(10) of Directive (EU) 2018/2001

The relevant extracts of Article 29(10) of the RED, which set out criteria as regards non-municipal waste in order for it to qualify for a zero rating, are:[48]

> *10. The greenhouse gas emission savings from the use of biofuels, bioliquids and biomass fuels taken into account for the purposes referred to in paragraph 1 shall be: [...]*
>
> > *(d) for electricity, heating and cooling production from biomass fuels used in installations that started operating after 20 November 2023, at least 80 %;*
> >
> > *(e) for electricity, heating and cooling production from biomass fuels used in installations with a total rated thermal input equal to or exceeding 10 MW that started operating between 1 January 2021 and 20 November 2023, at least 70 % until 31 December 2029, and at least 80 % from 1 January 2030; [...]*
> >
> > *(g) for electricity, heating and cooling production from biomass fuels used in installations with a total rated thermal input equal to or exceeding 10 MW that started operating before 1 January 2021, at least 80 % after they have been operating for 15 years, at the earliest from 1 January 2026 and at the latest from 31 December 2029; [...]*
>
> *An installation shall be considered to be in operation once the physical production of biofuels, biogas consumed in the transport sector and bioliquids, and the physical production of heating and cooling and electricity from biomass fuels has started.*
>
> *The greenhouse gas emission savings from the use of biofuels, biogas consumed in the transport sector, bioliquids and biomass fuels used in installations producing heating, cooling and electricity shall be calculated in accordance with Article 31(1).*

Article 31(1) sets out approaches which can be used, referencing Annex VI for biomass fuels, Part B of which sets out the relevant methodology for biomass derived from wastes.[49] Because:

a) the fossil fuel comparators (Annex VI Part B para 19) are relatively carbon intense (659g CO_2/kWh electricity, or 763.2 g CO_2/kWh electricity in outermost regions, and 288 g CO_2/kWh heat, or 446 g CO_2/kWh heat if it can be shown that coal is being displaced)[50]; and

[48] Directive (EU) 2018/2001 of the European Parliament and of The Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

[49] Ibid.

[50] Ibid. The full text reads (para 19): '*For biomass fuels used for the production of electricity, for the purposes of the calculation referred to in point 3, the fossil fuel comparator $EC_{F(el)}$ shall be 183 g CO_2 eq/MJ electricity or 212 g CO_2 eq/MJ electricity for the outermost regions.*
For biomass fuels used for the production of useful heat, as well as for the production of heating and/or cooling, for the purposes of the calculation referred to in point 3, the fossil fuel comparator $EC_{F(h)}$ shall be 80 g CO_2 eq/MJ heat.

b) because Annex VI Part B para 13 notes that:

'*Emissions of CO_2 from fuel in use, e_u, shall be taken to be zero for biomass fuels. Emissions of non-CO_2 greenhouse gases (CH_4 and N_2O) from the fuel in use shall be included in the e_u factor*'; and

c) because Annex VI Part b para 18 states that:

'As a general rule, wastes and residues including all wastes and residues included in Annex IX shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection of those materials irrespectively of whether they are processed to interim products before being transformed into the final product"

then it would appear that even the 80% savings will be met by non-municipal biomass wastes.

No account has to be taken, for example, of the likelihood that, for every unit of biomass energy for which there is a unit of energy generated at the relevant saving relative to the fossil fuel comparator, there is (roughly) a unit of energy generated with more than double the carbon intensity of the fossil-fuel comparator.

For biomass fuels used for the production of useful heat, in which a direct physical substitution of coal can be demonstrated, for the purposes of the calculation referred to in point 3, the fossil fuel comparator $EC_{F(h)}$ shall be 124 g CO_2 eq/MJ heat.'

Is the Proposed Approach in the EU-ETS Directive Justified?

We noted in the introduction to the previous Section that combustion of waste includes both fossil and non-fossil elements. The fossil-derived sources of waste that emit GHGs are principally plastics (including most fossil-derived textile wastes), as well as other combustible organic substances in waste. The sources of non-fossil (biomass-derived) CO_2 are wastes are derived from a range of materials, the main ones being:

- Paper and cardboard;
- Wood;
- Textiles of non-fossil origin derived from crop biomass (such as cotton, etc.);
- Textiles of non-fossil origin derived from livestock (such as wool, leather, etc.);
- Food wastes;
- Garden / parks wastes; and
- Faeces (in disposable nappies).

The EU-ETS essentially zero-rates biomass in municipal waste, and through referencing to the RED criteria, makes it highly likely that waste from non-municipal sources will also be zero-rated as regards the biomass fraction. The question is whether this is justified.

In the general case, one finds that the discussion as regards the EU-ETS, as a policy, is confounded by a range of inter-related problems. In this Section we focus on some of these.

Confusing Guidelines for Reporting Emissions in an Inventory with Decisions to be Made in Policy Implementation

First and foremost, we challenge the rationale, in the design and implementation of policy, of ignoring non-fossil CO_2 emissions at the point of combustion in incinerators (and biomass power stations). Brack set

out a number of the reasons that have been given to rationalise the assumption of a zero-rating for emissions, from using woody biomass for energy including:[51]

1. Since the emissions are (re-)absorbed by growth and regrowth of biomass, they don't need to be considered;
2. The carbon has already been absorbed during the growth of the trees that are logged and burnt.
3. As long as the trees are harvested from a forest that is sustainably managed, their carbon emissions should be considered to be zero: effectively, forest growth, replacing the logged trees, cancels out the emissions released when burnt.
4. As long as the forest as a whole or forests in general are expanding, emissions from combustion can be ignored

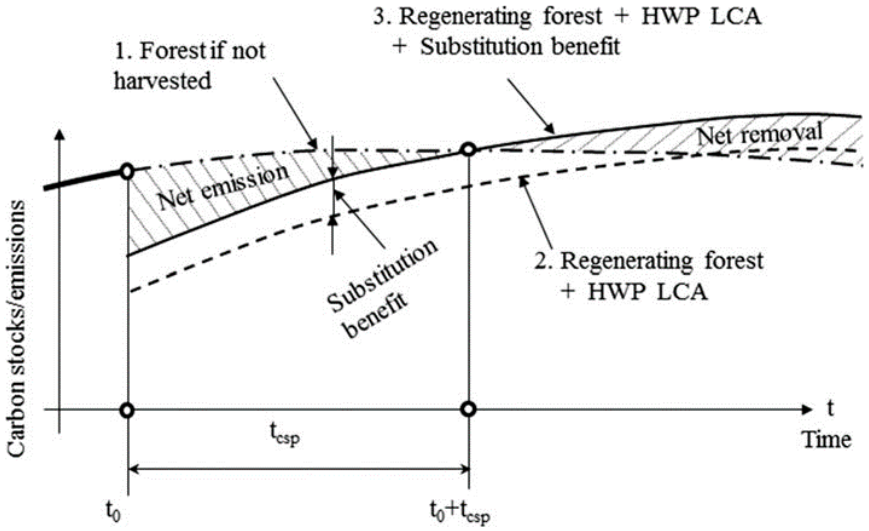
Arguments against these supposed rationales generally focus on the error which is incurred by not accounting for what would have happened if wood was not harvested, and / or if land was not required for forestry. Numerous studies have sought to show that, to choose to harvest wood to generate energy from it (or to use it for any other purpose) is not an activity whose only consequences, as far as the impact on climate change is concerned, are accounted for by the removal of the carbon in the forest stock.[52] A good representation of part of the argument used is shown in Figure 2: the timing of emissions is deemed to matter, and the argument is made on the basis of what would have happened if the wood had not been harvested.

In a recent publication, Searchinger et al argue:[53]

> *regrowth from previous forest harvests is not a result of present forest harvests. If all wood harvesting suddenly ceased, the losses of carbon from the world's forests would greatly decline and the recovery of forests from previous harvests would continue, providing a reduction in atmospheric carbon that would continue for many years. Current harvests influence forest regrowth in the future; as forests harvested today recover, the forests will start to take out of the atmosphere the carbon added by the harvests, paying off a so-called carbon debt. Counting recovery from previous harvests as land-use change accurately accounts for past human activity, but it does not accurately represent the consequences of current forest harvests. It understates the effect of current, ongoing harvests.*[54]

[51] D. Brack (2017) *Woody Biomass for Power and Heat Impacts on the Global Climate*, Chatham House Research Paper, February 2017.
[52] See, for example, Brack D., Birdsey R. and Walker W. (2021) *Greenhouse gas emissions from burning US-sourced woody biomass in the UK and EU*, Report for Chatham House, 2021; Quiggin D. (2021) *BECCS deployment. The risks of policies forging ahead of the evidence*, Chatham House Report, 2021; EASAC (2022) *Forest bioenergy update: BECCS and its role in integrated assessment models*, EASAC, 2022;
[53] T. Searchinger et al (2023) *The Global Land Squeeze: Managing the Growing Competition for Land*, Washington, DC: World Resources Institute.
[54] The concept of a 'carbon debt' can be gleaned as follows: '*Overall, in the year burned, the committed emissions of wood are at least two times—and often three times—higher than those of fossil fuels for the same amount of electricity or heat, creating what is known as a "carbon debt"* (see T. Searchinger et al (2023) *The Global Land Squeeze: Managing the Growing Competition for Land*, Washington, DC: World Resources Institute). That debt can be 'paid back' by regrowth of forest over a period of time, but the time period varies depending on a range of issues.

Figure 2: Net greenhouse gas effects and time to carbon sequestration parity for harvested wood products (HWP) that originated from a sustainably managed forest stand



Note: The three curves represent different combinations of forest and HWP carbon analysis. The shaded area on the left between curves 1 and 3 represents cumulative net emissions, while the shaded area on the right represents cumulative net emission reduction. LCA = life-cycle analysis of carbon stocks and emissions; t_0 = the time when the forest is harvested; t_{csp} = time to carbon sequestration parity.
Source: J. Chen et al (2018) Assessing the greenhouse gas effects of harvested wood products manufactured from managed forests in Canada, Forestry 2018; 91, 193–205.

The underlined point in the above extract is especially interesting since policymakers who decide upon zero-rating for biomass are often influenced by the approach which the IPCC proposes in its Guidelines for Members to report their greenhouse gas inventories under the UNFCCC. For example, the UK's Office for National Statistics generates greenhouse gas emissions for the UK on a territorial basis, on a residence basis, and on a consumption basis. The territorial emissions are explained as follows:[55]

> *Territorial emissions are used to inform progress on UK-wide emissions targets and are published by the Department for Energy Security and Net Zero (DESNZ).*
>
> *These estimates include emissions produced within the UK's geographical borders. They take into account emissions and removals from:*
>
> - *activities of businesses in the UK no matter where they are registered in the world;*
> - *the activities of people living in the UK as well as visitors from outside the UK; and*
> - *land in the UK, including forests and crop or grazing land.*

[55] UK Office for National Statistics (2024) *Measuring UK greenhouse gas emissions: Summary of the three measures of UK greenhouse gas (GHG) emissions: territorial, residence and footprint*, https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/measuringukgreenhousegasemissions

They currently exclude emissions or removals from:

- *international aviation and shipping;*
- *UK residents and UK registered businesses abroad; and*
- *production of goods and services the UK imports from other countries;*
- *CO_2 emissions of biogenic origin, for example, burning wood, straw, biogases, and poultry litter. This avoids double counting as these emissions are reported against the land use sector (as a change in carbon stock) of the territory in which the biomass is harvested*

Biogenic CO_2 emissions are not excluded because they are 'deemed irrelevant', but because they are deemed to have *already been counted elsewhere in the inventory*. This is important since the IPCC Guidelines are often invoked in support of the 'zero-rating' position. It is, therefore, instructive to examine how the IPCC Guidelines have come to this position, and indeed, whether that position should be considered relevant to policy decisions made vis a vis the EU-ETS Directive.

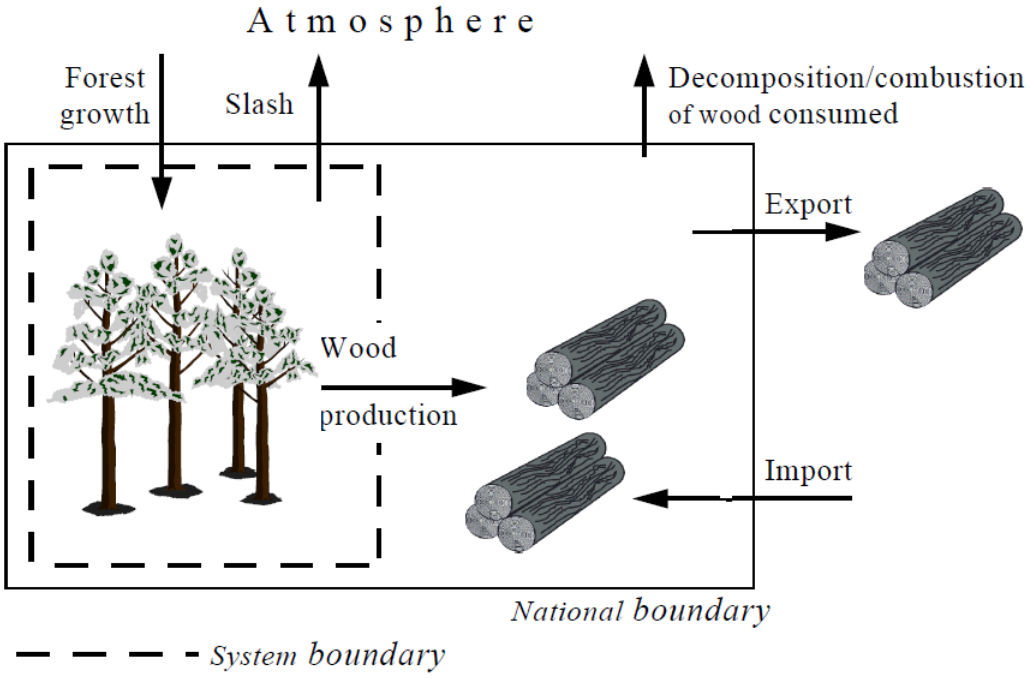
IPCC Guidelines

Prior to Good Practice Guidelines being developed in 2003, and the issue of 2006 Guidelines, the IPCC's default approach assumed that the way in which harvested wood products were subsequently used was irrelevant for compiling an inventory of greenhouse gas emissions (see Figure 3). Since the removal of harvested wood from the forest stock was taken into account by making a deduction from the carbon contained in the forest biomass, the emission of the hitherto sequestered carbon in the harvested wood was deemed to have been 'already accounted for' in the inventory. Note here that the aim of the inventory is not to identify what *should happen*, or *should have happened*, but it aims to provide an account of emissions and sinks that were deemed relevant at the time. As regards the emissions of GHGs and accounting for them in inventories, whether or not, or when, that carbon was released was effectively deemed irrelevant, other than to the extent that it would have contributed to estimations of methane emissions from landfills (though these were not calculated based on the amount of wood harvested).

This assumption within the accounting system almost certainly lies behind the view that carbon dioxide emitted from biomass is 'carbon neutral', or should be 'zero-rated' at the point of its combustion. But as we show below, this does not mean that these emissions are irrelevant, or should be considered so. Indeed, choices as to how to compile an inventory, and where to report emissions, will be influenced by a desire to avoid double counting. The inventory is also not necessarily interested in (and it appears not to inform) whether 'not harvesting wood' may have led to a reduction in GHG emissions. Ideally, of course, inventories do support 'doing what is right', but as we have reported elsewhere, there are good reasons to believe this is not what the existing system of reporting inventories achieves.[56]

[56] See D Hogg (2022) *Problems in the Reporting of GHG Emissions from 'Waste': Indicators and Inventories*, Equanimator Report, February 2022. More broadly, key issues in terms of how inventories are apt to mis-lead are a) in respect of the overall approach, reporting emissions on a territorial basis rather than a consumption basis; b) in converting emissions to 'carbon dioxide equivalent'

Figure 3: IPCC default approach (considers only stock changes in forests: assumes that stock changes in HWP =0)



Removal = *Stock change* = *(stock change forest)*
= *(forest growth - slash -wood production)*

Source: Kim Pingoud (2008) Different approaches of accounting for Harvested Wood Products, presentation at European Forest Week: The Role of Wood Products in Climate Change Mitigation, 21 October 2008, FAO, Rome.

It was recognised that the default approach described above failed to account for the possibility that harvested wood products (HWPs) could, depending on how they were being used, lead to a build-up in stocks of hitherto sequestered carbon in products in use (in society), as well as in landfills. Hence, the IPCC has sought to account for the potential for the way in which HWPs are used in society to become either a net source or a net sink (sequester) of emissions of that carbon which was the result of CO_2 intake by forests, but which was removed from the forest as harvested wood.[57] The IPCC Guidelines have considered, by and large, four different approaches, each of them aiming to overcome the perceived limitations of the default approach described above, which effectively negated the possibility of HWPs being either net sources, or net sinks, of CO_2.

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requiring equivalence factors to be used to express the effects of gases whose effect on global temperature increase varies enormously in the temporal dimension; and c) the issue we are discussing here – the way in which the 'non-fossil' inventory is considered.

[57] This process started with Good Practice Guidance, and has subsequently been integrated in the IPCC's 2006 Guidelines and the 2019 Refinement. Guidance was also issued in the context of the Kyoto Protocol (see Intergovernmental Panel on Climate Change (2003) *Good Practice Guidance for Land Use, Land-Use Change and Forestry*. Geneva, Switzerland: IPCC; IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products*. Geneva, Switzerland: IPCC; IPCC (2014) *2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol*, Hiraishi, T., Krug, T., Tanabe, K., Srivastava, N., Baasansuren, J., Fukuda, M. and Troxler, T.G. (eds) . Geneva, Switzerland: IPCC; IPCC (2019) *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products*. Geneva, Switzerland: IPCC.

The four different approaches the IPCC presents are not an exhaustive choice of the possible approaches The range of approaches considered are effectively a constrained set:[58]

> *Estimates of HWP Contribution are designed to be consistent with those for other sectors of these guidelines, specifically:*
>
> > *1. All CO_2 released from HWP is included in the AFOLU* [Agriculture, Forestry and Other Land Use] *Sector;*
> >
> > *2. CO_2 released from wood burnt for energy in the Energy Sector is not included in the Energy Sector totals (although CO_2 emissions from biofuels are reported as a memo item for QA/QC purposes). CH_4 and other gases from HWP used for energy is included in the Energy Sector;*
> >
> > *3. CO_2 released from HWP in SWDS is not included in the Waste Sector totals although CH_4 emissions from HWP are included.*
>
> *Methods in this chapter estimate release of carbon: this carbon may also be counted as methane emissions in the Waste Sector. This potential double counting of carbon release to the atmosphere can be corrected by subtracting the carbon emitted in the methane emissions from HWP in landfill from the carbon emissions estimated in this chapter (see guidance on how to make an optional correction in Section 12.2.1.5).*

In other words, approaches were sought that would preserve the decisions that had already been made vis a vis other 'sectors' covered by the Guidelines, and to ensure all relevant CO_2 emissions were reported under the Agriculture, Forestry and Other Land Use (AFOLU) part of the inventory.[59] In this way, the approaches were designed such that CO_2 from burning wood, or from incineration of wastes of non-fossil origin, or emitted from landfills, could continue to be excluded from totals. Note, though, that the first two of these should already have been reported as information items, and that the third of these could have been derived straightforwardly in the context of calculations of methane emissions already being undertaken: it would not have been difficult to configure the inventory reporting such that these were counted (see below).[60]

The four approaches proposed by the IPCC in the 2006 Guidelines were:

1. Stock change approach;
2. Production approach;
3. Atmospheric flow approach; and

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[58] IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products*. Geneva, Switzerland: IPCC.

[59] The 2006 IPCC Guidelines were structured in 5 Volumes: General Guidance and Reporting; Energy; Industrial Processes and Product Use; AFOLU; and Waste. The Common Reporting Format tables are essentially structured along these lines though with the emissions from AFOLU split into tables for agriculture, and ones for land use, land-use change and forestry.

[60] In essence, the landfill models assume a partitioning of carbon being degraded in landfills between methane and carbon dioxide. Only the methane is counted in inventories, but the modelling implies the simultaneous estimation of the amount of CO_2 released.

4. Simple decay approach.

The atmospheric flow approach gives quite different results to the others. The stock-change, production and simple decay approaches are inconsistent with the overarching approach taken by the IPCC which focuses, in the inventory as a whole, on so-called territorial emissions. Only the atmospheric flow approach gives results under which the country where the emissions take place is the country which reports those emissions. The atmospheric flow, stock-change and production approaches each assume that the amount of HWP harvested is already deducted in other parts of the AFOLU inventory. The simple decay approach is different:[61]

> *the simple Decay Approach differs from Production Approach in that HWP pool is considered to be related to activities in the forest and hence does not assume instant oxidation of wood in the year of harvest. This means the amount of harvest in a year (Variable H, remains part of the AFOLU carbon pool (e.g., forest or other land area) and not counted as a part of emissions. The amount estimated for simple decay is the amount of emissions from HWP each year (*$\uparrow C_{HWP\ DH}$*).*

There is, therefore, considerable latitude in the approaches chosen: however, all approaches seek to account for the emissions associated with HWP in the AFOLU part of the inventory.

Notwithstanding this point, the chosen approach for the majority of EU Member States is the so-called 'production approach'. In this approach, whether HWPs are a source of, or a sink for, CO_2 depends on a) the quantum of HWPs entering the 'pool' in a given year; b) how the products are used; c) the lifetime of those products in the use phase; and d) the fate of those products at the end of their life.[62] This is shown in Figure 4. The equations set out in the 2006 IPCC for assessing CO_2 emissions under AFOLU using the production approach are:[63]

$$CO_2 \text{ emissions from AFOLU} = -44/12 \bullet [\Delta(\text{AFOLU without HWP}) + \Delta C_{HWP\ IU\ DH} + \Delta C_{HWP\ SWDSDH}]$$

or

$$CO_2 \text{ emissions from AFOLU} = -44/12 \bullet [\Delta(\text{AFOLU without HWP}) + H - \uparrow C_{HWP\ DH}]$$

where $\uparrow C_{HWP\ DH} = E_{DOM} + E_{EX\ DOM}$.

The contribution made by HWP excludes the contribution from the first term in the above equations since this is reported in other parts of the AFOLU inventory. It reduces to:[64]

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[61] IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products*. Geneva, Switzerland: IPCC.

[62] The role played by the end-of-life phase was effectively downplayed in the 2019 Refinement to the 2006 Guidelines. Our understanding is that it is, though, the 2006 Guidelines that are still meant to guide inventory preparation (it is a strange feature of the UN process that working groups undertake work, and are requested to do so, but it can be years before changes in the approaches used are adopted by all Parties).

[63] IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products*. Geneva, Switzerland: IPCC.

[64] Ibid.

$$HWP\ Contribution\ to\ AFOLU\ Net\ CO_2\ emissions\ PA = -44/12 \bullet [\Delta C_{HWP\ IUDH} + \Delta C_{HWP\ SWDSDH}]$$

or

$$HWP\ Contribution\ to\ AFOLU\ Net\ CO_2\ emissions\ PA = -44/12 \bullet [H - \uparrow C_{HWP\ DH}]$$

Note that the approach, as set out in the IPCC Guidelines, effectively partitions HWP between 'products in use' and 'products in SWDS' (see Figure 4). The approach taken to the 'products in use' is of interest because unless the stock of the stock of HWP in use and the HWP in solid waste disposal sites are being tracked as separate pools, then the CO_2 emissions from HWP reduce to the rate at which the HWP products reach the end of their life. In the IPCC approach, HWP products in use are treated as though their useful lifetime follows an exponential decay function. This seems questionable. It would be odd if long-life wood products were lost maximally after the first year (the rate of loss effectively being treated as a constant share of what is present), and odder still if the implied assumption was that otherwise long-life wood products have effectively lost half their mass through decay after 30 or so years.

Even if products fell out of use in such a way, that would not imply that the carbon embodied within them is instantaneously liberated. That is why the end-of-life fate of materials matters: might the wood reused? Could it be recycled (and into what and with what lifetime)?[65] Is the paper and cardboard recycled (and at what rate does it cascade through to an end-of-life fate)? What is the fate of whatever is recycled? Is it the same for wood from construction as it is for cardboard used as packaging? How much of each is incinerated, or co-incinerated, or landfilled? Which of these occurs, and it what proportion will determine the pace at which the carbon in the end-of-life HWPs are released into the atmosphere, and so, materially affect the calculation as regards the source / sink capacity of HWPs.[66] These are the questions which the introduction of the HWP concept were designed to uncover, but the approaches recommended appear ill-suited to deal with them.

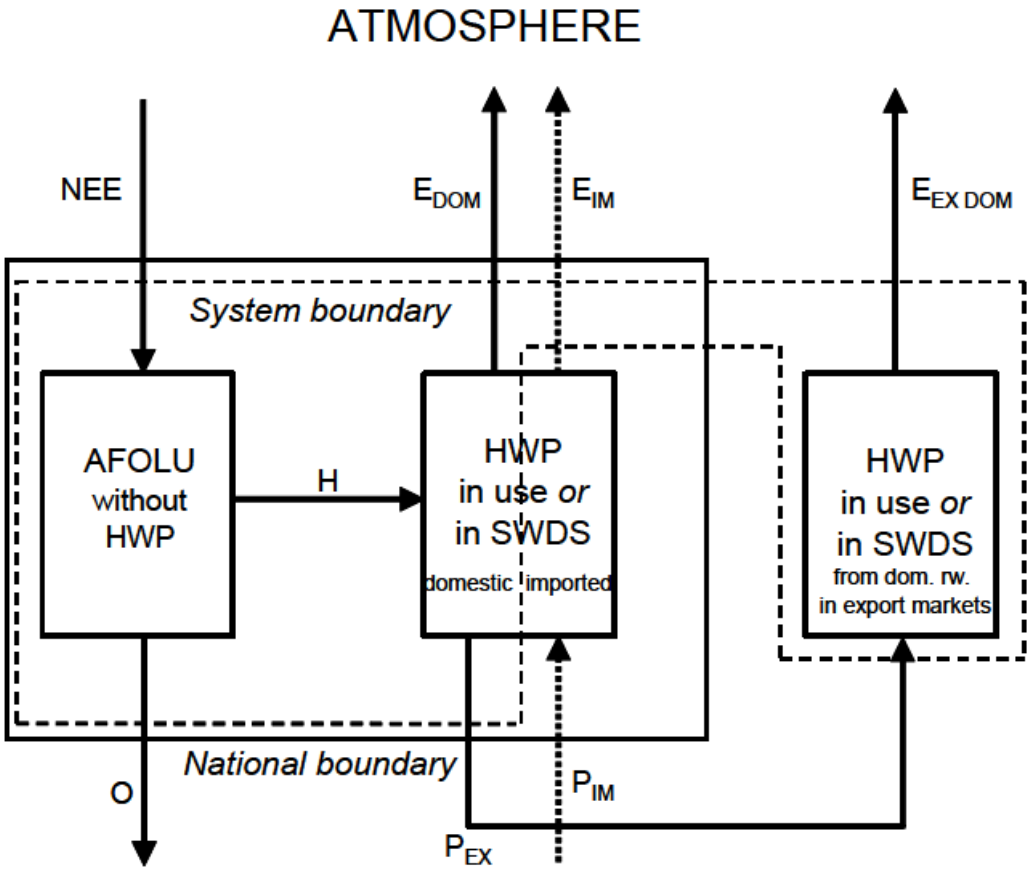
Figure 4: Schematic of the Production Approach Showing System Boundary

[65] The potential consequences of this beyond an 'inventory-based' approach are highlighted in Footnote 80 below.

[66] This is clearly recognised in the 2006 IPCC Guidelines, which state:

> *HWP includes all wood material (including bark) that leaves harvest sites. Slash and other material left at harvest sites should be regarded as dead organic matter in the associated land-use category in Chapters 4, 5, 6, 8 and 9 of the Guidelines and not as HWP. HWP constitutes a carbon reservoir2. The time carbon is held in products will vary depending on the product and its uses. For example, fuelwood and mill residue may be burned in the year of harvest; many types of paper are likely to have a use life in uses less than 5 years which may include recycling of paper; and sawnwood or panels used in buildings may be held for decades to over 100 years. Discarded HWP can be deposited in solid waste disposal sites (SWDS) where they may persist for long periods of time.*

(see IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products*. Geneva, Switzerland, IPCC).

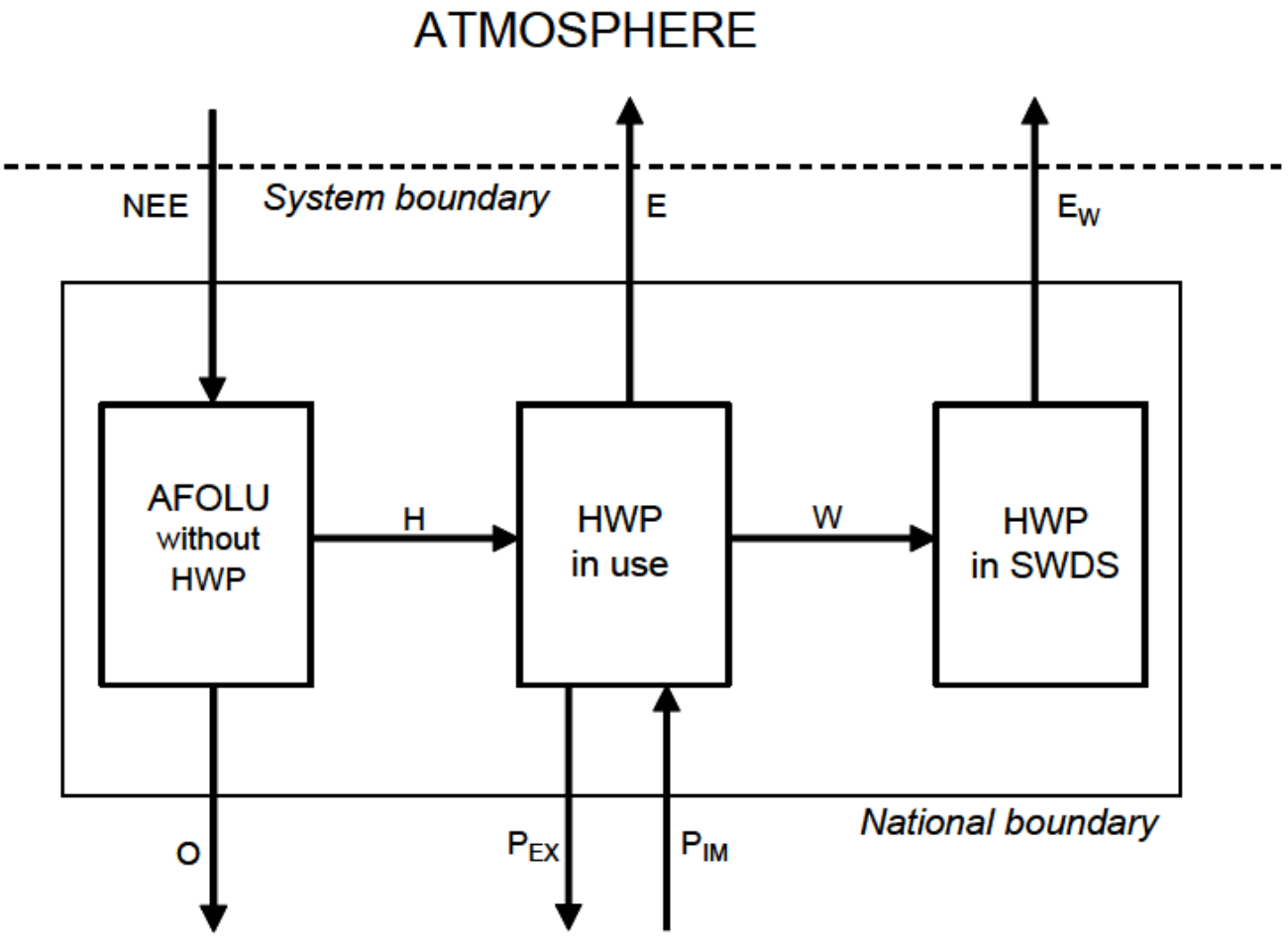


Note: NEE = net ecosystem exchange of carbon, E_{DOM} = carbon release to the atmosphere from the pools of domestically grown HWP in use and in SWDS, E_{IM} = carbon release to the atmosphere from the pools of imported HWP in use and in SWDS, $E_{EX\ DOM}$ = carbon release to the atmosphere from the pools of domestically grown but exported HWP in use and in SWDS, H = carbon transfer in the form of harvested wood biomass transported from harvest sites, P_{EX} = carbon transfer in the form of HWP exports, P_{IM} = carbon transfer in the form off HWP imports, O = possible other cross-border carbon transfers from rest of AFOLU (assumed zero here). Note: Only those HWP in the export markets that are produced from domestic roundwood are within the system boundary, not those only processed in the reporting country but made from imported roundwood. The transfer P_{EX} can in principle include both.
Source: IPCC (2007) 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products. Geneva, Switzerland.

The critical point is that even with the attempt to account for the potential for HWPs to act as sources or sinks of GHG emissions, the assumption is that the carbon removed as HWPs is 'accounted for already' in the AFOLU part of the inventory. One can argue about whether or not the approach to dealing with HWPs makes sense, but the key question is whether it would be reasonable for the assumption to be made in the EU-ETS Directive that the CO_2 from incinerating wastes derived from non-fossil materials should be zero-rated.

It is trivial to demonstrate that the assumption regarding 'zero-rating' of biomass at the point of combustion is simply a consequence of the approach to developing an inventory. Suppose one considers the atmospheric flow approach, which is already included in the 2006 IPCC Guidelines, and depicted as shown in Figure 5.

Figure 5: Atmospheric flow approach as per 2006 IPCC Guidelines



Note: NEE = net ecosystem exchange of carbon, E = carbon release to the atmosphere from HWP in use, E_W = carbon release to the atmosphere from HWP in SWDS, H = carbon transfer in the form of harvested wood biomass transported from harvest sites, W = carbon transfer of wood waste into SWDS, P_{EX} = carbon transfer in the form of HWP exports, P_{IM} = carbon transfer in the form of HWP imports, O = possible other cross-border carbon transfers from rest of AFOLU (assumed zero here).
Source: IPCC (2007) 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products. Geneva, Switzerland.

The equations given in the 2006 IPCC Guidelines for calculating emissions from AFOLU are as follows (the numbering of the equations is ours):

$$CO_2 \text{ emissions from AFOLU} = -44/12 \bullet (NEE - E - E_W) = -44/12 \bullet (NEE - \uparrow C_{HWP\,DC}) \qquad [1]$$

$= -44/12 \bullet [\Delta (AFOLU\ without\ HWP) + \Delta C_{HWP\ IU\ DC} + \Delta C_{HWP\ SWDS\ DC} + P_{EX} - P_{IM}]$ [2]

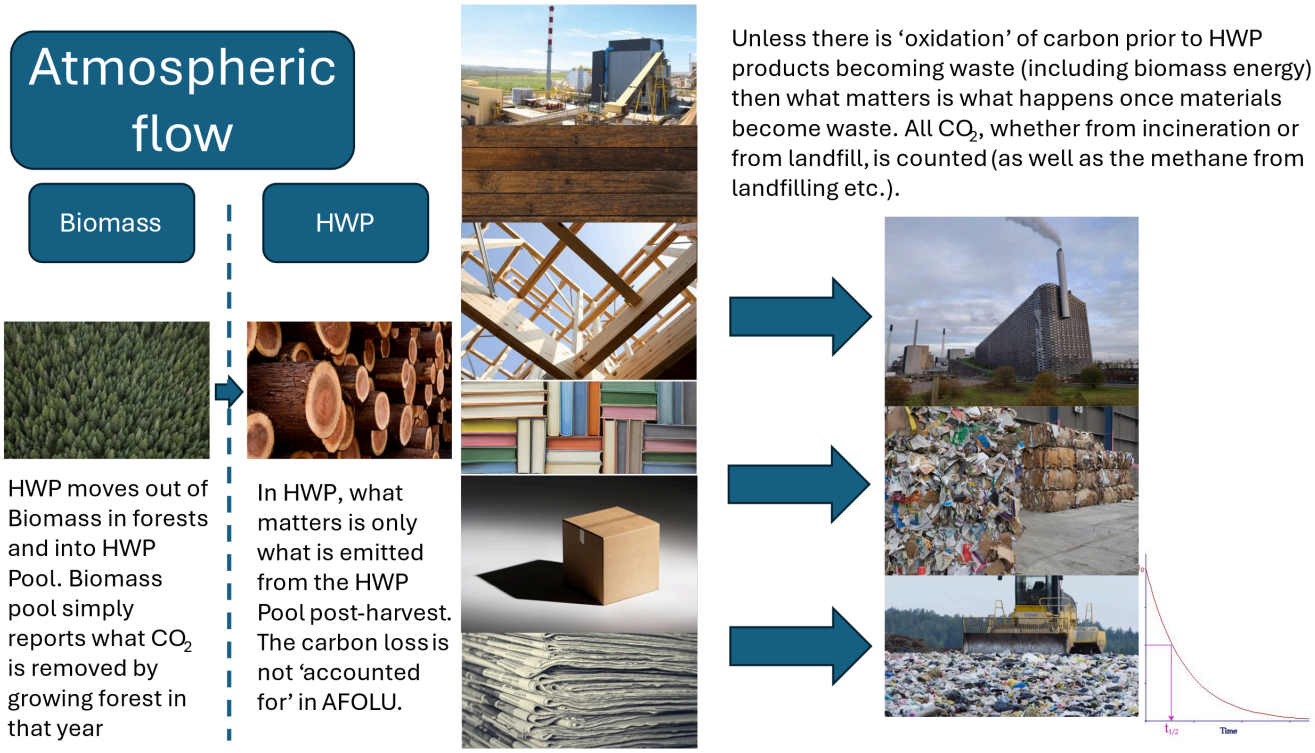
or

$= -44/12 \bullet [\Delta (AFOLU\ without\ HWP) + H - \uparrow CHWP\ DC]$

The second equation includes, as the first term, a term related to the change in the carbon in biomass in the AFOLU part of the inventory. The first equation does not. In fact, the first equation – which is the simplest one – requires that the AFOLU sector only reports the net ecosystem exchange of carbon. It does not require the AFOLU sector to deduct the quantity of biomass harvested as HWPs. In this case, the most important emissions determining the outcome are the emissions of CO_2 and other GHGs from the combustion of HWPs, or from landfilling. They are essentially all that matters other than any GHG emissions deemed to result from direct degradation of HWPs whilst they are in use (i.e. before they are combusted / landfilled etc.).

The 2006 Guidelines proceed to somewhat different formulations of this approach because, as noted above, the aim is to have all emissions reported in the AFOLU sector, and to retain consistency with the 'carbon pools' convention applied across the sector. If one chooses to break those conventions, which look rather arbitrary, the whole picture changes. Non-fossil CO_2 emissions suddenly matter, and they matter a lot. The effect of the approach is shown in Figure 6.

Figure 6: Schematic Showing an Atmospheric Flow Approach to Inventories (in which emissions of CO_2 of non-fossil origin cannot be zero-rated)



Source: Equanimator

The additional benefit of this approach is that in principle, it should be far easier to deliver sensible answers on the basis of this approach given that:

a) CO_2 emissions of non-fossil origin from combustion should already be reported as an information item;
b) Emissions of methane from landfills are already reported: reporting on CO_2 emissions from landfills as well as methane emissions implies a completely trivial extension of existing models;[67]
c) The approach is consistent with the overarching 'territorial emissions' approach;
d) Countries reporting under other approaches are not required to make assumptions about what happens to HWPs they export, and whose fate is then completely outside their own control.

[67] It might be argued that methane emissions from landfills might not be accurately reported in inventories so that the approach might not be so reliable. That may well be true (see, for example, Riley Duren et al., (2019) California's methane super-emitters, *Nature*, Vol 575, vol. 7781. (2019), https://pubmed.ncbi.nlm.nih.gov/31695210/ ; D. Carrington and Seán Clarke (2024) Revealed: the 1,200 big methane leaks from waste dumps trashing the planet, The Guardian, 12 February 2024, https://www.theguardian.com/environment/2024/feb/12/revealed-the-1200-big-methane-leaks-from-waste-dumps-trashing-the-planet ; Max Krause et al. (2023) *Quantifying Methane Emissions from Landfilled Food Waste*, U.S. Environmental Protection Agency, October 2023, https://www.epa.gov/system/files/documents/2023-10/food-waste-landfill-methane-10-8-23-final_508-compliant.pdf). If it is, there is clearly a need to improve these since they are potentially more important, at least as far as short-term warming is concerned, than the linked CO_2 emissions (in other words, this is not a reason not to choose a method based on understanding CO_2 emissions from landfills – these estimates need to be improved in their accuracy).

Another benefit of this approach is that it simplifies matters enormously since the need to account for what is entering the HWP pool in one or other form, and the requirement to model the loss of HWPs from the pool using far from robust methods of estimating the statistical distribution of product lifetimes, essentially disappear.[68]

We can further highlight the slightly absurd nature of using the way an inventory is configured to drive policy decisions. Considering what alternative approaches there could be to configuring the inventory for emissions from fossil fuels. Suppose one were to adopt a 'stock-change' approach to dealing with emissions from 'the fossil carbon pool'. There would be a fossil carbon pool from which (rather like the various pools of carbon containing material in AFOLU) resources are extracted each year. The extraction would lead, as with the AFOLU sector, to a reduction in the carbon stored in the fossil carbon pool. The main difference is the absence of any net ecosystem exchange in relation to the fossil carbon pool. An outline of this approach is shown in Figure 7 (which is configured so as to give figures equivalent to what each reporting country would include under its own inventory). The boundary has been drawn to give the same answer as is currently reported under inventories.

The emissions would be reported in the inventory as:

$$= 44/12 \bullet [EXT - P_{EX} + P_{IM}]$$

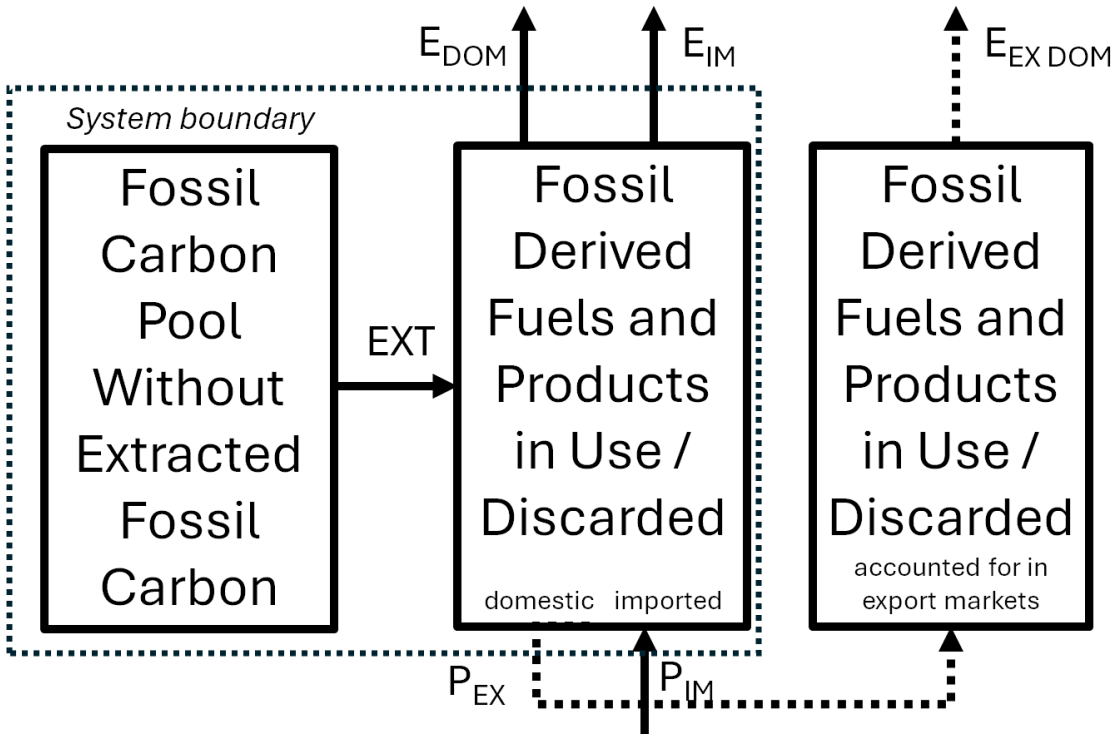
Or, analogous to the situation where HWP might lead to a net sequestration / emission of non-fossil CO_2 emissions,

$$= 44/12 \bullet [EXT - P_{EX} + P_{IM}] - \Delta C_{FF\,IS\,D} - \Delta C_{FFP\,IU\,D} - \Delta C_{FFP\,SWDS\,D}]$$

Where $\Delta C_{FF\,IS\,D}$ = the change in carbon retained in those fossil fuels that are held in stocks domestically (inventories); $\Delta C_{FFP\,IU\,D}$ = the change in carbon retained in fossil fuel products in use domestically; and $\Delta C_{FFP\,SWDS\,D}$ = the change in carbon retained in solid waste disposal sites domestically.

Figure 7: Stock Change Approach to Dealing with Fossil Fuels and Fossil -derived Materials (equivalent to the production approach for HWP)

[68] As noted above, this assumes that the loss of HWPs due to direct degradation when in use is limited. The validity of that assumption should undoubtedly be questioned, but the proportion of wood products being devoured by living organisms whilst in use, whilst undoubtedly non-zero, might be expected to be, in the aggregate, relatively limited prior to its end-of-life relative to what happens after its end of life. If that proves not to be the case, then some estimation of the losses that occur could be made. There is already a requirement, under the Waste section of the inventory, to report burning of waste, which though it occurs to a greater extent in countries with limited waste collections services, no doubt occurs to an extent in (some) EU Member States also (though whether what is combusted is what was assumed to have been harvested as HWP is another matter – the wood might be from 'settlements', and not robustly accounted for).



Note: E_{DOM} = carbon release to the atmosphere from domestic use of domestically extracted fossil fuels and from waste management of fossil-derived materials, E_{IM} = carbon release to the atmosphere from domestic use and from waste management of fossil fuels and fossil-derived materials imported from overseas, $E_{EX\ DOM}$ = carbon release to the atmosphere taking place in other countries linked to domestically extracted, but exported, fossil fuels and fossil-derived materials, EXT = carbon transfer in the form of fossil fuels extracted from domestic deposits, P_{EX} = carbon transfer in the form of exports of fossil derived fuels / products, P_{IM} = carbon transfer in the form off imports of fossil derived fuels / products.
Source: Equanimator

Had this accounting approach been used for fossil fuels, then presumably, just as policy makers might choose, today, to ignore emissions of CO_2 of non-fossil origin because 'they are accounted for elsewhere', so it would be consistent to ignore all emissions of CO_2 that were of fossil origin also, such as combustion of coal, or oil, or gas (they would be accounted for as extractions from the fossil fuel pool). As indicated above, there might be a need, for accuracy, to account for the fact that there could be a build-up, or draw-down, of stocks of fossil-derived products in society, based on the net impact of the carbon in the annual extracted quantity of fossil fuels, and the emissions from their use / management at end-of-life. Doing this in a manner analogous to that used for HWP would be somewhat complex: it would likely be far easier to account directly for the emissions associated with combustion of fuels, use of products and the emissions of GHGs from end-of-life management (including incineration). That, of course, is what currently happens. It is the equivalent of the atmospheric flow approach advocated for non-fossil carbon in Figure 5 and Figure 6 above. Why do inventories deal with fossil-carbon through a flow approach, and non-fossil carbon through a stock-approach? Why not consider both in the same way? If we did, we would 'count' all emissions of CO2 related to biomass

combustion within inventories (and presumably, policy makers would follow this lead). The choices being made by policy makers, though, are clearly being unduly influenced by the choice as to how to report an inventory. This is not a sensible state of affairs.

None of this is to argue that the current approach to gathering data for the purposes of developing an inventory is necessarily 'wrong' if the emphasis is on, as it is for the IPCC, preparing and maintaining inventories that are transparent, complete, consistent, comparable and accurate.[69] We do believe, however, that the way that the IPCC chooses to develop its inventories might not always be helpful in supporting decision makers: there are, after all, different ways to compile the inventory. The IPCC approach for non-fossil carbon, however, moves our attention away from where the emissions actually occur.

Policy makers need to recognise that the purpose of an inventory process is not to create incentives for GHG reduction: it does not seek to indicate whether one or other course of action may be better or worse, but rather, it seeks to report on the sources of, and sinks for, emissions that occur. It seeks to give a full report of emissions under an agreed set of approaches. Some of the decisions regarding how to report an inventory may, it is reasonable to say, have normative consequences: for example, the decision to focus (most) reporting on those emissions which originate within a given country assigns responsibility to Parties in line with their production rather than their consumption.

The EU-ETS Directive does not cover emissions from the land use sector so there is no issue of double counting which might arise if emissions from burning wastes on non-fossil origin (or other biomass) are fully rated as relevant emissions for installations in scope of the EU-ETS Directive. The Directive is not intending to provide a component of an inventory (though cross checks would be sensible). The Directive is seeking to reduce GHG emissions (as per Article 1), not simply 'add up the emissions occurring in a given year'.

Inventories, though (see below), focus on the change in the stock of biomass that takes place, and indeed, this might be a legitimate basis upon which to compile an inventory whose principle aim it to record emissions and removals that take place in a given year. The inventory process does not need to consider what would have happened had the wood not been harvested at all (the counterfactual): it is only concerned with what happens, not what might have happened.

Policies such as the EU-ETS, which aim to reduce GHG emissions, will, if they choose to zero-rate CO_2 emissions from biomass, distort decision making. The radiative forcing contribution made by a molecule of CO_2 is not affected by whether or not the molecule is of fossil- or non-fossil origin.

The above presentation serves to highlight the fact that the assumption that 'burning biomass is carbon neutral' is a particular perspective that is linked to:

[69] See IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 1: General Guidance and Reporting, Chapter 1: Introduction to the 2006 Guidelines*. Geneva, Switzerland: IPCC.

a) A specific approach to accounting for flows of emissions of carbon dioxide: other equally valid approaches are available;
b) A misconception that the approaches, and associated assumptions, that are used to report an inventory of emissions, where there is no relevant counterfactual (one reports things 'as they are') are directly transferable to the field of policy formulation, where counterfactuals matter, and where the explicit aim should be to influence decisions so that there is improvement relative to what would otherwise happen in the absence of the policy.

All emissions matter: the atmosphere does not discriminate between sources of a carbon dioxide molecule in deciding whether or not they might contribute to radiative forcing. Zero-rating of CO_2 from wastes of non-fossil origin is not justified.

A Presumption of Instantaneous Oxidation

The introduction of the HWP concept can be seen as an acknowledgement that, even within an inventory, the idea that removal of carbon within trees from the AFOLU account implied that the carbon within the trees, other than that remaining within other carbon pools in AFOLU, was instantaneously oxidised, was not correct. There was, prior to HWP being introduced to the AFOLU sector, no scope offered for a change in the amount of carbon held in stocks by society. This assumption gives no weight to matters such as the timing of emissions (other than of methane from landfills, insofar as some of that may be linked to how HWP are managed).[70] Hence:

> *In previous IPCC guidance on HWP (IPCC 1997, IPCC 2006, IPCC 2014), reference has sometimes been made to making the assumption of "instantaneous oxidation" or to "reporting zero" for HWP, when the actual assumption being made is that of a "steady-state HWP pool". However, strictly, making either of these assumptions is not the same as making the assumption of a "steady-state HWP pool", hence the use of these other terms in this context is generally avoided in this refined guidance.*

The discussion above – regarding the different ways of preparing an inventory - helps make the point that although policy-makers may seek to justify the zero-rating of biomass combustion on grounds that it is already accounted for in the inventory, what is being 'already accounted for' are the very CO_2 emissions associated with biomass combustion, incineration, landfilling etc. that occur subsequent to the harvesting, and which are being zero-rated. It is not, after all, the act of harvesting wood that is the source of emissions of CO_2 of relevance to the inventory: those emissions arise only when the HWP are either combusted for energy generation (in which case, the IPCC seems to suggest that the wood used never formally enters the HWP pool), when they are oxidised in use, or when they are managed as waste. The emissions were not made irrelevant because of where they are reported in the inventory: recording them in one part of an inventory rather than another does nothing to alter the fact that they contribute to climate change. The concern within

[70] Looking beyond the inventory, it also gives no weight to a counterfactual where the HWP are not removed.

an inventory is to avoid double counting, though timing of emissions still remains an issue. The concern of a policy maker seeking to address climate change should be to reduce all emissions that contribute to that. Given that a molecule of CO_2 of non-fossil origin will have the same effect as one of fossil origin, the best approach will be to account for all sources, and all sinks / removals as and where they occur.

The EU's Inventory

At the time of writing the 2006 Guidelines, the IPCC stated:[71]

> *Harvested wood products constitute a component of the carbon cycle for which carbon stock changes can be estimated (guidance provided in Chapter 12), based on national-level data; however, estimation and reporting of greenhouse gas emissions for HWP is currently a matter of policy negotiations.*

The pace at which changes are made in reporting systems and inventories is slow, and the decisions taken to implement, formally, proposed changes are also slow. So, although there are 2019 refinements to the 2006 IPCC Guidelines, the requirements as regards HWP are still rather open. The 2019 refinements stated, regarding the HWP Chapter:[72]

> *Chapter 12 provides methodological guidance for estimation of C stock changes and emissions from harvested wood products, and is neutral with regards to the multiple alternative approaches to inventory estimation that are given.*

In other words, there are a number of approaches that could be taken to account for HWP in an inventory, and no one of them is specifically recommended. The less than helpful nature of this can be gleaned from a statement in the HWP Chapter of the 2006 Guidelines:[73]

> *The approaches that have been identified are mutually exclusive in the sense that a global or regional estimate of annual HWP Contribution would only be correct if all the different countries provided estimates using the same approach.*

It follows that neutrality towards the approach to be taken most likely comes at the expense of potential inconsistencies arising where Parties choose different approaches to estimating emissions from the HWP pool. We mentioned above that different approaches give different results. The IPCC Guidelines state:[74]

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[71] IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 1: Introduction*. Geneva, Switzerland, IPCC.
[72] IPCC (2019) *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 1: Introduction*. Geneva, Switzerland, IPCC.
[73] IPCC (2007) *2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products*. Geneva, Switzerland, IPCC.
[74] Ibid.

The system boundary of an approach is not necessarily the same as the national boundary of a country.

In the AFOLU sector, excluding HWP, changes in carbon stocks or carbon fluxes in forests and other wood producing lands are estimated consistently with national boundaries. For HWP, estimation depends on the selected approach.

The 'stock-change' approach for HWP involves estimating changes in carbon stocks in the HWP pool within the national boundaries. Hence, carbon stock changes in the HWP pool are reported by the country where the wood products are used (i.e. reported by the "consuming country").

The 'production' approach involves estimating changes in carbon stocks in the HWP pool consisting of products made from wood harvested in a country. The HWP pool thus consists of all products made from wood that is harvested domestically, i.e. those products that are consumed domestically and also those products that are exported and used in other countries. In other words, when applying the 'production' approach the "producing country" reports carbon stock changes from HWP produced by that country, regardless of where the HWP are consumed and used.

The 'atmospheric-flow' approach involves estimating fluxes of CO_2 from and to the atmosphere from HWP, taking place within national boundaries. When applying the 'atmospheric-flow' approach, the CO_2 emissions and removals arising from HWP are thus reported by a country where the wood products are used (i.e. by the "consuming country").

The 'simple-decay' approach involves estimating fluxes of CO_2 from and to the atmosphere from HWP, associated with woody biomass harvested from the forests and other wood-producing lands within a country. When applying the 'simple-decay' approach, the CO_2 emissions and removals arising from HWP are thus reported by a country where the wood products are produced (i.e. by the "producing country"), regardless of where the HWP are consumed and used.

The point is that for a reporting country, the approach taken changes the answer one gets. As much was recognised by Pingoud, who highlighted the way in which the choice of approach would affect emissions of countries that we exporters, and importers, respectively, of HWPs.[75]

For this reason, it is far from clear that 'following the IPCC Guidelines' will present a 'true' picture of what is happening. We mentioned above that EU Member States generally approach HWPs using the production approach. Yet few EU Member States appear to report on the HWP contained within SWDS (landfills). The submission of CRF Tables for the EUA for 2021 included an entry in the cell for 'gains' in SWDS as "NO", which denotes 'not occurring'.[76] Yet several of the Member States do not assert that there are no additions to the SWDS stock (this would be akin to saying there was zero landfilling of any wood, card, paper, etc. across the EU

[75] Kim Pingoud (2008) *Different approaches of accounting for Harvested Wood Products*, presentation at European Forest Week: The Role of Wood Products in Climate Change Mitigation, 21 October 2008, FAO, Rome.
[76] European Union. 2023 Common Reporting Format (CRF) Table, downloaded from https://unfccc.int/documents/627830

area): they tend to report "NE" (which is used to denote 'not estimated') or sometimes NA (presumably, 'not available), or the cells are empty.[77] Other things being equal, this likely understates the calculation of net sequestration of HWP in SWDS since the effect is to imply immediate oxidation of HWP as they reach end-of-life.

Given that many Member States include very limited information on landfills – and for some, by no means all, the absence of any landfilling of HWPs may be a reasonable assumption - it might be asked how emissions from HWP are modelled. It appears that it is assumed that CO_2 is released at the end of a product's life, assuming exponential decay. The validity of such a function for this purpose is open to question. An exponential decay function might not provide a sensible estimate of the profile in time over which HWPs are effectively retired from use. A more likely (and well-used) function is a log-normal distribution.[78] One study considering the change in carbon stocks in buildings found this the most suitable function, and exponential decay functions to be the least suitable.[79] Exactly how making a change in the functional form would affect a given Member State's claimed net sequestration is unclear since the effect would depend upon the time-profile of the extraction of HWPs entering use. It would, however, affect the reported outcomes.

We also noted above that a production-based accounting approach for HWPs is not consistent with the overarching approach elsewhere in the IPCC inventories, where the focus is on territorial emissions. The boundaries of the HWP production-based approach extend to countries to which HWPs are exported by the reporting country. It is demanding, to say the least, for a reporting country to track the exported HWP through their lifetime, and then, to the end-of-life fate of those HWPs (whatever the functional form used for product lifetimes). The 'account' would need to consider the change, over time, of the fate of HWPs at end-of-life in all the countries to whom HWPs originating from the reporting country had been exported. As others have pointed out, this implies the reporting country including, within its inventory, changes in carbon stocks over which it has no control. [80] Indeed, in footnote 19, we highlighted the quantity of HWP assumed to be sequestered in HWP in the US. The approach adopted states:[81]

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[77] Submissions made by various Member States, downloadable from https://unfccc.int/ghg-inventories-annex-i-parties/2023 . The sequestration of carbon in solid waste disposal sites is not necessarily trivial. The US reported, for 2021, that: 'The estimated net uptake of C in HWP was 102.8 MMT CO_2 Eq. (28.0 MMT C) in 2021 (Table 6-8, Table 6-9, Table A-192, and Table A-193). The majority of this uptake, 65.1 MMT CO_2 Eq. (17.7 MMT C), was from wood and paper in SWDS. Products in use accounted for an estimated 37.8 MMT CO_2 Eq. (10.3 MMT C) in 2021' (see US EPA (2023) *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021. U.S. Environmental Protection Agency*, EPA 430-R-23-002. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021).

[78] This was used, for example, by Geyer et al in their study of the fate of plastics – see Roland Geyer, Jenna R. Jambeck and Kara Lavender Law (2017) Production, use, and fate of all plastics ever made, *Science Advances*, 2017 (3).

[79] See Ryoto Matsumoto , Chihiro Kayo, Satoshi Kita, Kentaro Nakamura, Christian Lauk & Ryo Funada (2022) Estimation of carbon stocks in wood products for private building companies, *Scientific Reports* (2022) 12:18112.

[80] See, for example, Kim Pingoud (2008) *Different approaches of accounting for Harvested Wood Products*, presentation at European Forest Week: The Role of Wood Products in Climate Change Mitigation, 21 October 2008, FAO, Rome.

[81] US EPA (2023) *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021. U.S. Environmental Protection Agency*, EPA 430-R-23-002. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021.

> '*The United States uses the production approach to report HWP contribution. Under the production approach, C in exported wood was estimated as if it remains in the United States, and C in imported wood was not included in the estimates.* [...] *A key assumption for estimating these variables that adds uncertainty in the estimates was that products exported from the United States and held in pools in other countries have the same half-lives for products in use, the same percentage of discarded products going to SWDS, and the same decay rates in SWDS as they would in the United States.*'

It is clear that the production approach is not just demanding in respect of what happens within a country, but to be properly conducted, assessments require knowledge of what is happening with, amongst other things, waste management in all countries to which HWP are exported. If reporting countries adopt different conventions to reporting on HWP, the 'global answer' will be incorrect. Even if they all chose the production approach to report HWP, they would need to make correct assumptions regarding how domestic and exported HWPs were treated. That assumes, of course, that all reporting countries report what is happening in AFOLU chapters consistently, and that all HWP from various forms of land use are captured. This is incredibly demanding.

The 2019 Refinement to the 2006 IPCC Guidelines

We noted above that some Member States appear not to consider the change in HWP stocks in SWDS (landfills) in their calculations. The 2019 Refinement to the 2006 Guidelines essentially removes consideration of the fate of HWP when they fall out of use. It is, effectively, indifferent to the nature of end-of-life management (our understanding is that the 2006 Guidelines are still intended as the basis for reporting). Hence:

> *The discussion of approaches presented here focuses on estimating CO_2 emissions and removals arising from HWP in use, according to the defined approaches. Harvested biomass used for energy purposes and wood biomass disposed of in SWDS are discussed separately in Sections 12.5 and 12.6.*

and:

> *In the methods provided in this Chapter, losses of HWP in use are assumed to result in CO_2 emissions to the atmosphere, with no explicit representation of the subsequent retention of disposed wood in SWDS and eventual CO_2 emissions from SWDS. It may be useful to quantify the CO_2 emissions from wood biomass disposed of in SWDS to allow checks on consistency in the estimation of emissions in the Waste and AFOLU sectors.*

In essence, this moves one further away from (not closer to) any prospect of an accurate representation of the way in which the use of, and fate of, HWP may or may not give rise to net sequestration or net release of CO_2

(and other GHGs). The Refinement goes into detail regarding the availability of data on the use of wood products, but it remains reliant on a first order decay model. It states:[82]

> *It is assumed that "immediate losses of the HWP pool due to final processing of wood along the processing chain (see Figure 12.A.1, Annex 12.A.2) are described realistically by the exponential decay pattern" (Pingoud and Wagner 2006).*

This citation suggests that the authors quoted established that the losses referred to were described realistically by exponential decay. They did not, however, do so. A more complete extract from the (start of the) original paper reads:[83]

> *The objective of this paper is to provide simple methods based on analytical solution of FOD differential equation that could be applied globally in national inventories at the lowest tier levels, being a slight improvement on the existing methods. For comparison, in the 2003 Good Practice Guidance of IPCC the suggested Tier 1 and Tier 2 methods for HWP are based on numerical finite-difference approximation of the FOD equations. In the 2000 Good Practice Guidance of IPCC the presented solution for FOD in SWDS is clumsy and mathematically inexact. The basic statistics on HWP to be applied is the global FAO statistics providing yearly national data since 1961. These statistics enable estimation of carbon dynamics of semi-finished HWP pools by FOD models considered in this paper.* ***The final products are implicitly included in above pools and immediate losses of the pools due to final processing (e.g. in construction) are assumed to be included and described realistically by the exponential decay pattern.*** *For the estimation of the carbon balance in SWDS no statistics are collected at the global level and data availability among countries varies. For SWDS the delayed FOD decay model together with a model for permanent carbon sequestration into SWDS are assumed to describe realistically the behavior of degradable organic carbon in SWDS.*

What is cited as evidence in the 2019 Refinement to the 2006 Guidelines is actually, itself, an assumption in the paper being cited.

The Refinement does include Sections discussing HWP in SWDS, and on where different pools of material should be reported under different approaches. The former includes a glib statement regarding the potential for 'inconsistency in estimates of CO_2 emissions and removals arising from HWP in the AFOLU sector and estimates for wood disposed of in SWDS in the Waste sector.' The latter, as if to emphasise some of the difficulties highlighted above, highlights that different approaches to reporting HWP would necessitate reporting of combustion emissions by different reporting entities (the producing country, or the consuming country) – see Table 3.[84]

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[82] IPCC (2019) *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products*. Geneva, Switzerland; IPCC.

[83] K. Pingoud and F. Wagner (2006) Methane Emissions from Landfills and Carbon Dynamics of Harvested Wood Products: The First-Order Decay Revisited. *Mitigation and Adaptation Strategies for Global Change* 11(5): 961-978.

[84] It is unclear why the producing country would report the emissions from burning unutilized wood harvest residues, though it may have been assumed that these were unlikely to be exported (so the producing country would be the consuming country).

Table 3: Reporting of CO_2 Emissions from Wood Biomass Burnt by Producing and Consuming Countries Under Different HWP Approaches

<table>
<tr><th>Element of wood biomass</th><th>Assumption of 'a steady-state HWP pool'</th><th>'Stock-change' approach</th><th>'Production' approach*</th><th>'Atmospheric-flow' approach</th></tr>
<tr><td>Unutilized wood harvest residues</td><td rowspan="4">Producing country</td><td rowspan="2">Producing country</td><td rowspan="4">Producing country</td><td>Producing country</td></tr>
<tr><td>Harvested wood biomass used directly as energy feedstocks</td><td rowspan="3">Consuming country</td></tr>
<tr><td>Industrial residues from manufacturing semi-finished wood products</td><td rowspan="2">Consuming country</td></tr>
<tr><td>Industrial residues from manufacturing finished wood products in use**</td></tr>
<tr><td>Wood biomass collected and burnt as post-consumer waste</td><td colspan="3"></td></tr>
</table>

* Discussion of the 'production' approach in this section also applies for the 'simple-decay' approach (see Section 12.3 and Annex 12.A)

** In the case of the 'stock-change' approach, strictly, CO_2 emissions from wood biomass collected and burnt as post-consumer waste are only reported by a consuming country if the finished wood products are consumed and used in the country where they are manufactured and are not exported to another country.

Source: IPCC (2019) 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 12: Harvested Wood Products. Geneva; IPCC.

Waste Materials that are not HWPs

Not all wastes of non-fossil origin are end-of-life HWPs. In terms of how GHG emissions associated with materials which become waste are accounted for or reported, whether in the reporting of inventories or in the monitoring of progress against nationally determined contributions (NDCs), these wastes are dealt with differently. This is shown in Table 4.

Table 4: Methodologies for 'Counting' Emissions from Different Contributing Sources of Solid Waste

Waste	Inventories IPCC Guidelines
Food wastes (plant-based)	Volume 4: Agriculture, Forestry and Other Land Use Chapter 5: Cropland
Waste textiles of non-fossil origin (plant based)	Volume 4: Agriculture, Forestry and Other Land Use Chapter 5: Cropland

Food wastes (livestock-based)	Volume 4: Agriculture, Forestry and Other Land Use Chapter 10: Emissions from Livestock and Manure Management
Waste textiles of non-fossil origin (livestock based)	Volume 4: Agriculture, Forestry and Other Land Use Chapter 10: Emissions from Livestock and Manure Management
Garden / park wastes	Volume 4: Agriculture, Forestry and Other Land Use Chapter 8: Settlements if not in other Chapters
Faeces (and menstruation products) (in nappies (and tampons, etc.))	Volume 5: Waste Chapter 6: Wastewater Treatment and Discharge
Wood waste	Volume 4: Agriculture, Forestry and Other Land Use Chapter 4: Forest Land Chapter 12: Harvested Wood Products
Waste paper and card	Volume 4: Agriculture, Forestry and Other Land Use Chapter 4: Forest Land Chapter 12: Harvested Wood Products

We highlighted above that:

1. the way in which inventories are compiled lies behind the decision that combustion of biomass should be treated as 'zero carbon' at the point of combustion;
2. that changing the approach to compiling inventories enables us to see how questionable this decision is; and
3. that there is a difference between
    a. decisions made regarding approaches to compiling a complete inventory, where double counting is to be avoided, and where what is reported is 'the world as it is'; and
    b. decisions made regarding how policy might be configured so as to drive behaviour that delivers the best outcomes relative to the 'policy off' scenario.

As regards the last of these points, whist ideally inventories are compiled in a manner such that a) informs b), in reality, the approach recommended by IPCC does not do this, and nor does it seem to be guided by a principle that seeks to ensure that this happens.[85]

[85] See IPCC (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 1: General Guidance and Reporting, Chapter 1: Introduction to the 2006 Guidelines. Geneva, Switzerland. The emphasis is on preparing and maintaining inventories that are transparent, complete, consistent, comparable and accurate. These are sensible objectives for the specific task.

To the extent that much of the above discussion has focussed on HWP, how does that discussion affect the other 'non-HWP' waste materials listed in Table 4?

The answer is relatively simple: if counterfactual scenarios are to be properly credited through the implementation of policy, then the situation least likely to incur errors is the one where all sources and sinks within the scope of policy are included. The qualifier 'that are in the scope of the policy' may merit some qualification: if, for example, the scope of the policy is such that it excludes some sources / sinks for which those subject to the policy are responsible, but which are not added / credited, then that might trigger thinking about the approach. But the decision as to 'what to do with waste' is not one of these. The decision as to whether waste is landfilled, or incinerated, for example, is extraordinarily unlikely to affect the extent to which forests, or croplands are managed so they act as sources or sinks for GHGs. Even if they did, the correct approach would be to account for those sources and sinks as and where they occur, recognising that decisions on land use are taken by others. On the other hand, the decision to 'zero-rate' emissions from managing these materials as waste makes it more likely that materials are wasted, and other things being equal, that sinks will be enhanced.[86]

We noted above that there is an interesting asymmetry between the HWP sector and the other sectors from which we harvest goods for use in society. Whilst most food products will be consumed fairly swiftly, there are products – of plant and of animal origin – that we would not expect to be consumed in this way, for example, garments made of cotton, or of wool, or of leather. Increasingly, one sees the development of products for the construction sector based on mycelium, or made using cellulosic fibres. A key focus for those engaged in making bio-based materials is the replacement of fossil-derived materials, especially plastics, including through manufacture of conventional polymers using biomass, whilst research funds are also being devoted to manufacturing plastics using captured CO_2.[87] The size of the 'harvested agricultural products' pool is largely unknown, but it is reasonable to expect it to grow, and the extent to which it does so is likely to be affected by policy decisions such as the exclusion of / zero-rating of carbon dioxide emissions at the point of combustion. The competition with other uses, notably for energy, and also, other end -of-life management routes will be affected by such decisions.

It is difficult to see how the change in stocks of materials derived from non-woody biomass can (continue to) be overlooked in inventories. It would be sensible to adopt an approach as per Figure 6 above where the AFOLU accounting focused purely on the exchange of greenhouse gases in the crop / livestock sectors, with the subsequent emissions from harvested crops and livestock products being reported explicitly thereafter

[86] Consider, for example, that a high cost of disposal might promote greater recycling of paper and card. Other things being equal, the greater recycling reduces the requirement for pulp from primary sources, and reduces the amount of HWP required (somewhere in the world) to be harvested.

[87] A vast swathe of the materials we use – whether derived from fossil material, or non-fossil material - have 'carbon' as the central building block of the molecule: how will we make 'stuff' in future where emitting CO_2 is to be avoided? Can we make use of CO_2 captured that is otherwise emitted to make materials?

(and not as information items). This would remove a drawback that Pingoud, in his review of HWP approaches, suggested that the atmospheric flow approach would suffer from:[88]

> *'wood trade would be treated in totally different manner compared to other biomass. For instance, imported wood-based biofuels would form a C emission in the importing country, whereas all the other imported biofuels would remain C neutral ("discontinuity").'*

Logically, the issue should be approached by dealing with all biomass in the same way so that there would be consideration of the fate of harvested crop and livestock products within inventories. As we noted above for wood products, this ought to imply a fairly straightforward change in the existing inventories, since CO_2 from energy generation and from incineration where energy is generated should already be being reported as an information item. Since methane emissions from various processes such as landfilling and wastewater treatment are already reported, a relatively trivial extension would enable the carbon dioxide emissions associated with methane-generating processes to be reported. Emissions of CO_2 from composting and anaerobic digestion would also be reported: as regards the outputs of those processes, the timing of emissions would need to be accounted for when, for example, carbon is mineralised following application of compost to soil (this would be reported under AFOLU as the outputs were transferred to the soil-carbon pools of the land where the outputs were applied).

Similar considerations apply to biomass in Settlements. Here, the IPCC 2006 Guidelines state:[89]

> *The biomass pool in settlements has woody and herbaceous components. For woody biomass, carbon stock change is calculated as the difference between biomass increment and biomass loss due to management activities. For herbaceous biomass (such as turfgrass or garden plants) in Settlements Remaining Settlements, the carbon stock change in biomass can usually be assumed to be zero.*

It would be of interest to know how many reporting countries accurately track the change in the stock of woody and herbaceous biomass in settlements. They should, generally, report emissions from what being managed as waste.

Policy-related decisions, as opposed to those concerning the compiling of inventories, should treat all sources and sinks of fossil and non-fossil derived GHG emissions equally. This is essentially what inventories also do, but they have a decision as to where in the inventory these emissions are to be reported and counted (and where they are to be reported as memorandum items only so as to avoid double counting). In respect of policy decisions, all sources and sinks – of carbon dioxide, methane and other greenhouse gases – within the scope of policy should be included unless there are very good reasons not to do so.

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[88] Kim Pingoud (2008) Different approaches of accounting for Harvested Wood Products, presentation at European Forest Week: The Role of Wood Products in Climate Change Mitigation, 21 October 2008, FAO, Rome.

[89] IPCC (2006) 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Volume 4: Agriculture, Forestry and Other Land Use, Chapter 8: Settlements. Geneva, Switzerland.

Other Relevant Matters

Conflating the question of what is 'renewable' with what is 'zero-carbon'

The inclusion, or not, of biomass under the EU-ETS is being linked to a question of whether or not a particular feedstock used for the generation of energy may be considered 'renewable'. These are two distinct questions and they might not necessarily have the same answer,[90] but in providing answers to the questions, they have become entangled – see below).

The question of whether something is, or is not, a renewable source of energy is, typically (it need not be) a binary one, based on the nature of that source.[91] The question of what emissions may be associated with accessing that source remains, though, a relevant one, even if one chooses to define a given source of energy as 'renewable'. As much is implicitly accepted in the RED Directive itself, in how criteria for sustainability and greenhouse gas emissions savings are set. Exactly how one defines that threshold is not the issue – indeed, this has evolved over time, not least as regards 'biomass', and because it has been recognised that the consequences of using biomass for energy generation may be far from positive, particularly as regards the net effect of using biomass as regards emissions of greenhouse gases.

It is, though, extraordinarily difficult to justify – as a result of the criteria in the RED which, via the ETS Directive, allow for zero-rating of CO_2 of non-fossil origin – approaches in relation to climate change where a source of energy is treated differently from the perspective of climate change depending on whether it has first been manufactured into a product or not. Consider wood: criteria have to be met in order for the wood to be zero-rated if used directly to generate energy, but if wood is first processed into a product, and is subsequently incinerated to generate energy after it has become waste, no such criteria apply. Now, that may reflect a

[90] Nuclear power is generally considered low carbon, but it is not renewable. There is a debate regarding whether and under what circumstances biomass power should be considered 'low carbon', and policy makers should, perhaps ask more searching questions as to whether it is renewable also – the definition of renewable energy used in the EU's RED effectively pre-determines the answer (see below).

[91] Here, it might be considered that there could be 'levels' of renewability ascribed. Indeed, to the extent that it is typically 'mixed waste' which is incinerated, the existing approaches require some identification of the eligible fraction that is considered to be renewable.
But in the case of municipal waste, it matters not from what sources the eligible fraction was itself derived – whether it was from vegetables sourced from vertical farms in Copenhagen, or cardboard derived from use of single-use cups in cafes across Europe, or cotton in poly-cotton mixes used to make shirts that are used once before being discarded, or silk curtains crafted in the 1800s, or discarded beef sourced from deforested land in Brazil, or palm oil in biscuits sourced from converted land in Indonesia, or woody biomass from garden prunings, or discarded furniture which was manufactured in the year 2020, or discarded furniture that was manufactured in the 1600s, or an unconsumed loaf of bread. All of this, when burned in an incinerator (or used to generate energy in other ways) counts towards the generation of 'renewable' energy. As they say, 'go figure!'.

pragmatic decision: how do we know the nature of the source of all the materials that become waste? But it does raise questions regarding the rationale for the application of the criteria (and of the zero-rating).

What the EU-ETS Directive should be laser focussed on is the consequences for climate of the activities included within its scope. That it has sought to be consistent with a set of criteria developed for a different purpose, and which have been evolving in response to problems associated with earlier decisions to identify energy sources as 'renewable' even though they were linked to problematic land-use changes, is disappointing. Whilst cross-referencing of policies might be desirable in many instances (to provide for consistency in approach), the use of such cross-referencing should ensure that what is being cross-referenced is relevant. If a biomass fuel is considered renewable if it achieves a given level of savings relative to an outdated fossil fuel comparator, then it is considered renewable. Even at the upper end saving (80%) relative to the outdated comparator (659 g CO_2/kWh), by the time when that has to be achieved, the average carbon intensity of EU power generation is likely to be of a comparable level (in 2022, it stood at 251g CO_2/kWh).[92] What this would mean is that biomass power would be zero-rated even though it was generating electricity at a similar carbon intensity (at least, according to the established methodology) to the rest of EU power generation, for which allowances would need to be purchased. The EU-ETS Directive seems to suggest that even though savings from biomass may be less than 100% to qualify as renewable, the balance of emissions (the fraction of the comparator emissions which is not saved) would be zero-rated as well as the proportion that is saved. Evidently, because of the (non-)application of the qualifying criteria for energy derived from waste, the problem is amplified for this source, not least since the source of the materials becoming waste is unknown.

'Waste' is not a Renewable Resource

In the context of the RED, there is no definition of the term 'renewable', only 'energy from renewable sources' or 'renewable energy', these terms being deemed equivalent, and defined as:[93]

> *energy from renewable non-fossil sources, namely wind, solar (solar thermal and solar photovoltaic) and geothermal energy, osmotic energy, ambient energy, tide, wave and other ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas, and biogas*

Biomass is defined, in turn, as:[94]

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[92] European Environment Agency (2023) Greenhouse gas emission intensity of electricity generation in Europe, 24 October 2023, https://www.eea.europa.eu/en/analysis/indicators/greenhouse-gas-emission-intensity-of-1 . An 80% reduction on an alternative with intensity 659g CO2/kWh could be met by delivering power at 132g CO_2/kWh. This is over half the carbon intensity of the 2022 EU-27 average, which the EEA expects to fall to between 110-118g CO_2/kWh by 2030. By 2026, the projected carbon intensity would be around 183gCO2/kWh so that 'zero-rated' generation from biomass could be generating electricity at a carbon intensity more than 70% of the emissions of the projected EU-27 average. Why would such a process be zero-rated when others are not?

[93] Directive (EU) 2018/2001 of the European Parliament and of The Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

[94] Ibid.

the biodegradable fraction of products, waste and residues from biological origin from agriculture, including vegetal and animal substances, from forestry and related industries, including fisheries and aquaculture, as well as the biodegradable fraction of waste, including industrial and municipal waste of biological origin;

Waste might be considered to be "'stuff' we should be seeking to minimise (and that is the priority for managing waste under EU policy and law), and which, where it is generated, we need to manage in the best way. To suggest that 'stuff we are trying to minimise' should be considered a source of 'renewable' energy is perverse. From the perspective of, for example, a food processing company, 'waste' implies wasted raw materials, as well as a waste of the other resources used to process the wasted material. No one is setting out to 'renew' the generation of waste, and EU legislation on waste, as well as the Industrial Emissions Directive, is aimed at designing out waste and reducing waste generation through resource efficiency. As well as seeking to reduce waste, EU waste legislation seeks to increase the amount of waste which is recycling (and reused), and sets target to reduce landfilling. "Landfill gas", even if it is a "non-fossil source", should not be considered a source of renewable energy. The same applies to the combustion of "industrial and municipal waste of biological origin". These are no more 'renewable' as sources of energy than are waste plastics, which are also targeted for increased reduction, reuse and recycling.

'Waste' is not a renewable source of energy, even if some of what becomes waste is biodegradable in nature.

Carbon Capture (Utilisation) and Storage

Regarding carbon capture and storage, the ETS Directive states (under Article 30):[95]

> *5. By 31 July 2026, the Commission shall report to the European Parliament and to the Council on the following matters, accompanied, where appropriate, by a legislative proposal and impact assessment:*
>
> > *(a) how negative emissions resulting from greenhouse gases that are removed from the atmosphere and safely and permanently stored could be accounted for and how those negative emissions could be covered by emissions trading, if appropriate, including a clear scope and strict criteria for such coverage, and safeguards to ensure that such removals do not offset necessary emission reductions in accordance with Union climate targets laid down in Regulation (EU) 2021/1119;*
> >
> > *(b) the feasibility of lowering the 20 MW total rated thermal input thresholds for the activities in Annex I from 2031;*
> >
> > *(c) whether all greenhouse gas emissions covered by this Directive are effectively accounted for, and whether double counting is effectively avoided; in particular, it shall assess the accounting of the greenhouse gas emissions which are considered to have been captured and utilised in a product in a manner other than that referred to in Article 12(3b).*
>
> *6. When reviewing this Directive, in accordance with paragraphs 1, 2 and 3 of this Article, the Commission shall analyse how linkages between the EU ETS and other carbon markets can be established without impeding the achievement of the climate-neutrality objective and the Union climate targets laid down in Regulation (EU) 2021/1119.*

Article 12(3b), to which the above refers, states:

> *3b. An obligation to surrender allowances shall not arise in respect of emissions of greenhouse gases which are considered to have been captured and utilised in such a way that they have become permanently chemically bound in a product so that they do not enter the atmosphere under normal use, including any normal activity taking place after the end of the life of the product.*

In November 2022, as part of the European Green Deal, the Commission presented a legislative proposal for an EU certification framework for carbon removals, and provisional agreement between the European

[95] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

Parliament, the European Commission and the Council on an amended text was reached on 20 February 2024.[96] The recitals to the text of the provisional agreement are somewhat ambiguous as to whether this would form the basis for the Article 30(5a) requirement (see above). Recitals 6, 14 and 30 are instructive, and Article 1 states:[97]

> *This Regulation does not apply to emissions falling within the scope of Directive 2003/87/EC, with the exception of the storage of CO_2 emissions from biofuels, bioliquids and biomass fuels that meet the sustainability criteria and greenhouse gas emissions saving criteria established under article 29 of Directive (EU) 2018/2001, with any necessary adjustments for application under Directive 2003/87/EC, as set out in the implementing acts referred to in Article 14 of Directive 2003/87/EC, in accordance with Annex IV of Directive 2003/87/EC*

Article 12(1), however, suggests that the reports envisaged at Article 30(5a) will still hold weight in the final analysis:

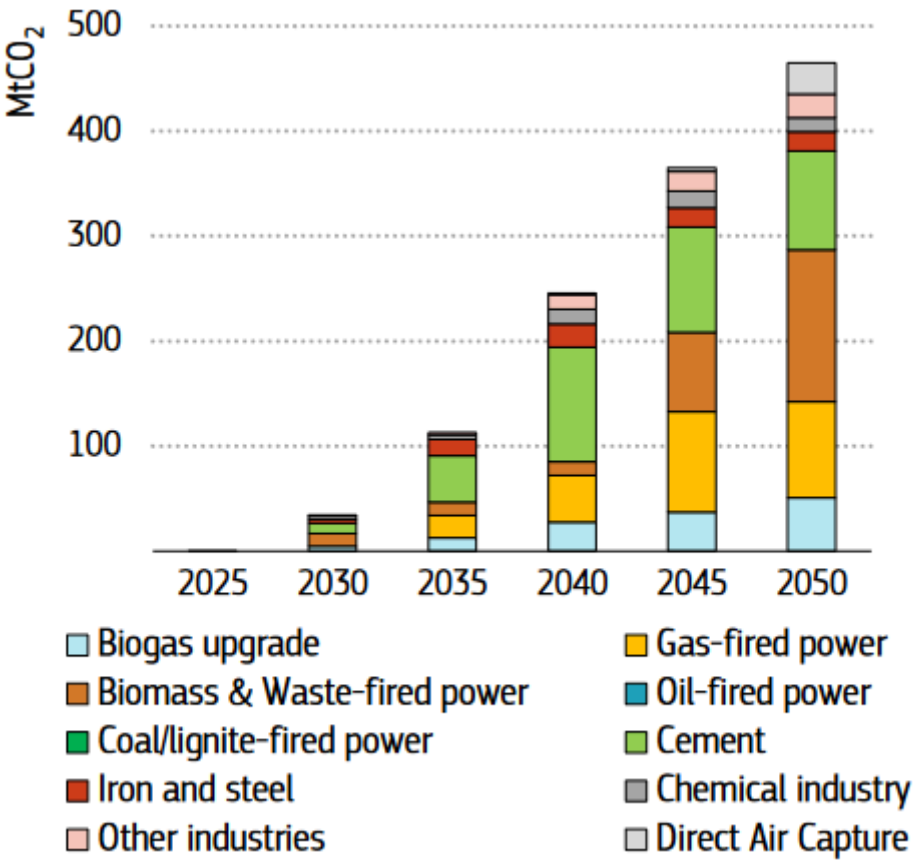
> *By…[OJ: 4 years after the entry into force of this Regulation], the Commission shall establish and duly maintain a Union wide registry for permanent carbon removals, carbon farming and carbon storage in products, to make publicly available the information related to the certification process, in an accessible way, containing, as a minimum, the information set out in Annex IIa, taking into account the reports referred to in Article 30(5a) of Directive 2003/87/EC and Article 17(3) of Regulation (EU) 2018/841 ('Union registry').*

The suggestion here is that certification of schemes vis a vis permanent carbon removals, which is the subject of this draft Regulation, might provide a method for certification, but would not rule on how 'negative emissions' could be accounted for and included within the EU ETS.

Within scenarios of the EU's pathway to net zero as modelled by the JRC, carbon capture from 'biomass and waste-fired power' is expected to be the source of the largest contribution to CO_2 capture (see Figure 8). It is not easy to disaggregate the respective contributions from 'biomass' and from 'waste-fired power' in the underlying report, so the specific contribution from waste as opposed to other biomass is not clear.

Figure 8: CO_2 captured by source in the EU, 2025-2050, based on the net-zero in the EU in 2050

[96] Proposal for a Regulation of the European Parliament and of The Council establishing a Union certification framework for permanent carbon removals, carbon farming and carbon storage in products, 2022/0394 (COD).
[97] Ibid.



Source: JRC analysis based on the POTEnCIA model, in Itul, A., Diaz Rincon, A., Eulaerts, O.D., Georgakaki, A., Grabowska, M., Kapetaki, Z., Ince, E., Letout, S., Kuokkanen, A., Mountraki, A., Shtjefni, D. and Jaxa-Rozen, M., (2023) Clean Energy Technology Observatory: Carbon capture utilisation and storage in the European Union - 2023 Status Report on Technology Development, Trends, Value Chains and Markets. , Luxembourg: Publications Office of the European Union.

Both sectors – biomass power generation, and incineration – are eyeing up the potential for what has been termed 'carbon negative' energy generation. Hence, for example:[98]

> *One key advantage of waste-to-energy plants is not just in providing "low-carbon" energy and zero waste, but its potential "negative carbon" contribution towards climate change mitigation targets.*
>
> *Using CCS in the waste-to-energy industry presents a particular opportunity for bioenergy with carbon capture and storage (BECCS); one of the few abatement technologies that can be carbon negative. BECCS involves the utilisation of biomass as an energy source and the capture and permanent storage of the CO_2 produced.*

[98] David T. Kearns (2019) Waste-to-Energy with CCS: A pathway to carbon-negative power generation, 2019 Perspective, Global CCS Institute. See also CEWEP (2022) Waste-to-energy Climate Roadmap: the Path to Carbon Negative, https://www.cewep.eu/wp-content/uploads/2022/06/CEWEP-WtE-Climate-Roadmap-2022.pdf

The IPCC Sixth Assessment Report also noted:[99]

> *Depending on the origin of the waste used, the integration of WTE and carbon capture and storage (CCS) could enable waste to be a net-zero or even net negative emissions energy source (Kearns 2019; Wienchol et al. 2020). For example, in Europe only, the integration of CCS with WTE facilities has the potential to capture about 60 to 70 million tonnes of carbon dioxide annually (Tota et al. 2021).*

Incinerators used to make the claim that they were 'carbon negative' by virtue of the 'avoided emissions' from energy generation. As long as:

a) the emissions from combustion of wastes of non-fossil origin were 'not counted'; and
b) the energy generated from incinerators was assumed to be derived from fossil fuels with high carbon intensity per unit of energy content, such as oil, or coal,

so, an analysis could be conducted that generated a negative result for the CO_2 emissions from the incinerator.

Today, the analysis is different: energy systems in the EU are decarbonising, and it is more difficult to sustain an assumption that the GHG emissions 'avoided' as a result of energy generation are greater than the GHG emissions from burning waste, even if one does not count the non-fossil CO_2 emissions (it is made impossible to do so if the non-fossil CO_2 emissions are included). This approach to the analysis – where a 'carbon dioxide' credit would be applied to the avoidance of alternative energy sources - was typically conducted in the context of a comparative analysis vis a vis other waste management options.

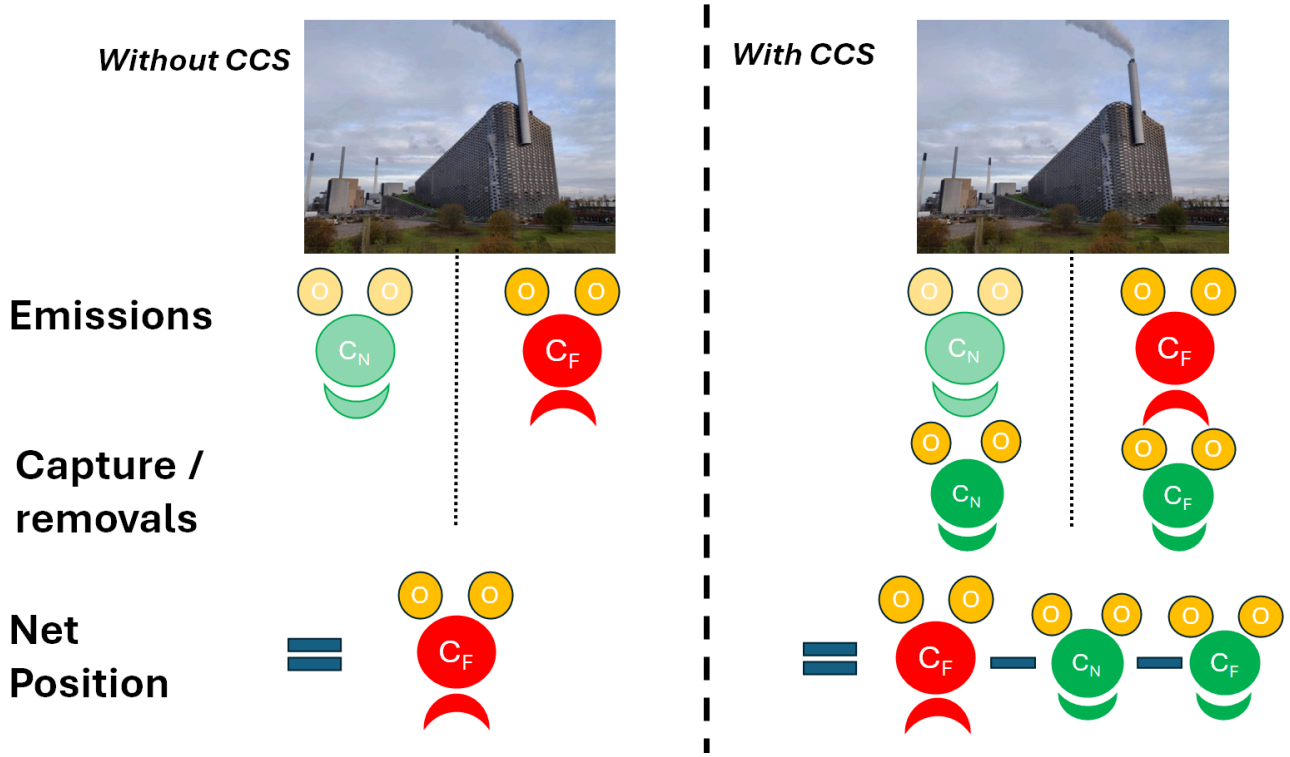
Within the EU ETS, however, the analysis focuses on the installation itself, and the fate of emissions from it. It is argued that an incinerator can be carbon negative if:

a) the emissions from combustion of wastes of non-fossil origin are 'not counted'; and
b) the application of carbon capture and storage enables the capture from the flue gas of an amount of CO_2 that exceeds the fossil-derived CO_2 emissions; and
c) the capture and storage of CO_2 emissions is credited to the installation itself.

Carbon capture and storage does not distinguish between fossil- and non-fossil sources CO_2, so captures both. As a result, if the non-fossil CO_2 is zero-rated when emitted, but counted when removed, the possibility for an installation to claim that its net CO_2 emissions are negative arises. This is shown conceptually in Figure 9. The 'Net Position', in terms of emissions, can be negative if the captured (fossil and non-fossil) CO_2 exceeds the quantity of CO_2 emitted from combusting wastes of fossil origin, if CO_2 from combustion of wastes of non-fossil origin.

Figure 9: Figurative Representation of Case Where CO_2 Emissions from Wastes Derived from Non-fossil Materials are Zero-rated on Emission, Shown With and Without carbon Capture and Storage, with all CO_2 Storage Counted as CO_2 Removals

[99] IPCC (2022) *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Chapter 6: Energy Systems*. Cambridge University Press, Cambridge, UK and New York, NY, USA



Note: C_N denotes carbon from wastes of non-fossil origin; C_F denotes carbon from wastes of non-fossil origin; red 'CO_2 molecules' count as emissions for which allowances have to be surrendered; green 'CO_2 molecules' count as removals so they reduce the number of allowances that have to be surrendered; transparent green C_N 'CO_2 molecules' are zero-rated.
Source: Equanimator

This approach raises further questions regarding the principle of ignoring emissions of non-fossil CO_2 at the point of combustion. If the emissions of non-fossil CO_2 are to be ignored in determining the need to purchase EU allowances, then why should capturing the same non-fossil CO_2 be deemed worthy of a credit? Surely, if the CO_2 is 'worth capturing', then it's 'worth not emitting'? As we have highlighted above, a stock answer is that 'the emission has been accounted for elsewhere in the inventory',[100] But as we demonstrated above, this does not mean these emissions are not relevant: it means that they were effectively counted in another part of the

[100] In its response to a consultation on the inclusion of waste within the UK-ETS, the relevant UK department, DESNZ, stated: '*We proposed that the UK ETS would apply to the processing of fossil waste only. This would mean that participants would only have to surrender UK allowances for their fossil emissions, in line with IPCC standards on estimating the climate impact of waste incineration*.' It cited the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories in a footnote as 'Standards on Estimating the Climate Impacts of Waste Incineration': this is a misrepresentation of what the IPCC Guidelines do (see UK Government, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland (2023) Developing the UK Emissions Trading Scheme: Main Response. June 2023). As we have highlighted above, the IPCC Guidelines are related to preparation of inventories. The IPCC document states: '*Consistent with the IPCC Guidelines, only CO_2 emissions resulting from the incineration of carbon in waste of fossil origin (e.g. plastics, certain textiles, rubber, liquid solvents, and waste oil) should be included in emissions estimates. The carbon fraction that is derived from biomass materials (e.g. paper, food waste, and wooden material) is not included*.' It would have been helpful to add '*in this part of the inventory*' (see IPCC (2018) *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 5: Waste*, Geneva, Switzerland: IPCC).

inventory. As we have also shown above, if a 'stock-change' approach had been taken to the fossil carbon pool (emissions of the fossil carbon pool would have been accounted for elsewhere in the inventory), we would also be ignoring the fossil-derived emissions: we would only be counting captured CO_2.

The suggestion that an incinerator, or a biomass energy facility, should be able to be considered 'carbon negative' under the EU-ETS is not a coherent one, and highlights the flaw in the position of 'ignoring' CO_2 from combustion of wastes of non-fossil origin. There is nothing wrong with crediting carbon capture and storage with the capture of emissions of CO_2 of non-fossil origin: the error is to ignore the emission in the first place.[101]

There is nothing that an incinerator does that will increase or diminish the ability of the biosphere to act as a sink.[102] On the other hand, reducing the costs of incineration will likely have the effect of, at the margin, reducing the pressure to prevent waste, and the incentive for recycling and reuse. Those effects will not be restricted to non-fossil materials, but will extend to all materials since incinerators generally manage mixed waste. Preventing waste, and recycling it, can, other things being equal, affect the amount of carbon stored in forests.[103]

Article 3(3) of the RED addresses the matter of cascading of biomass. It states:[104]

> *3. Member States shall take measures to ensure that energy from biomass is produced in a way that minimises undue distortive effects on the biomass raw material market and an adverse impact on biodiversity, the environment and the climate. To that end, they shall take into account the waste hierarchy set out in Article 4 of Directive 2008/98/EC and shall ensure the application of the principle of the cascading use of biomass, with a focus on support schemes and with due regard to national specificities.*

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[101] A similar point has been made by Rabl et al: 'In a part of the LCA community, a special convention has been established according to which CO_2 emissions need not be counted if emitted by biomass. For example, many studies on waste incineration do not take into account CO_2 from biomass within the incinerated waste, arguing that the creation of biomass has removed as much CO_2 as is emitted during its combustion. The logic of such a practice would imply absurd conclusions [...],the benefit of adding carbon capture and sequestration (CCS) to a biomass fueled power plant would not be evaluated because that CO_2 is totally omitted from the analysis. To avoid such conclusions, we recommend that emission and removal of CO_2 be counted explicitly at each stage of the life cycle.' (see A. Rabl A. Benoist, D. Dron, B. Peuportier, J. Spadaro and A. Zoughaib (2007) How to Account for CO_2 Emissions from Biomass in an LCA, *International Journal of Life Cycle Assessment*, 12(5), pp281.

[102] Even if it did so, then that sink capacity would, or should, be reflected in the way in which the AFOLU part of the inventory is applied.

[103] This is the approach adopted in the USEPA's WARM tool, in which the GHG impacts of waste management are modelled. The recycling / source reduction of paper is assumed to, at the margin, reduce harvested wood, change forest stocks as a result, and (for durable products, but not e.g. cardboard packaging) affect carbon stored in the 'in-use HWP pool. The USDA's forest carbon model is used to estimate the effects, and they are significant, and they persist over several decades. So, for example, the effect on the forest carbon stock of recycling Newspaper is 2 tonnes CO_2 per tonne recycled, and 3 tonnes CO_2 per tonne recycled for corrugated cardboard containers (see Chapter 4: Forest Carbon Storage, in U.S. Environmental Protection Agency (2023) Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Background Chapters, Office of Resource Conservation and Recovery, December 2023, EPA-530-R-23-017; and Chapter 2: Recycling, in U.S. Environmental Protection Agency (2023) Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Management Practices Chapters, Office of Resource Conservation and Recovery, December 2023, EPA-530-R-23-018).

[104] Directive (EU) 2018/2001 of the European Parliament and of The Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

The RED itself already indicates that energy from municipal waste does not have to meet GHG emissions saving criteria to qualify as renewable energy, but as we have argued above, this question is different to that of how an installation's GHG emissions should be assessed. In arriving at the determination it makes, the RED may or may not be (already) unduly distortive, but ignoring emissions of non-fossil CO_2 under the EU-ETS – whether for waste incineration or for biomass energy generation – clearly has considerable potential to distort decision making in such a way that the incineration of waste is awarded an implicit subsidy vis a vis recycling and waste prevention, and demand for biomass for energy use is stimulated to levels which are unwarranted. This will undermine the objectives of the EU ETS Directive. It is unwise.

Energy Outputs

Incinerators can be configured to generate either heat, or power, or both. Until relatively recently, the ETS was largely focussed on emissions related to the power sector. That might have led to a view that only emissions from power generation should be included, necessitating some consideration of how emissions from an incinerator should be 'apportioned' across power generation, and heat generation.

More recently, as noted above, 2024 amendments effectively include heating as a result of the decision to include buildings, road transport and other sectors within the EU-ETS. For this reason, it ought to be a straightforward decision to make as regards which emissions are to be reported since both heat and power would – by 2027 – be included within the EU-ETS. Had this change not been made, then as noted above, some apportioning of emissions across the power and heat outputs (where both power and heat were being generated) would have been required: we understand that some countries, such as Sweden, that already include incineration under the ETS have effectively allowed for emissions linked to heat to be treated differently to those from power. The rationale for doing so at the point incineration of MSW may be included in the EU-ETS seems now to have disappeared.

It should be considered that the emissions of GHGs from an incinerator are not strongly affected by the nature of the energy outputs: there might be implications for the nature of fuels imported by the facility, but the emissions from the combustion of the waste itself will not generally be affected. (There might be different embodied emissions associated with the build of the facility and the supporting infrastructure.) It is worth considering how apportionment could take place were that to be considered necessary. Here, one finds a tension between the different arguments made by the incinerator industry:

- On the one hand, there are arguments made regarding a case for exempting heat (giving free allowances) for emissions associated with heat;
- On the other hand, the argument is made that heat from incineration is 'waste heat' and should be assigned a low (even zero) carbon content.

Obviously, if the extreme case of the latter argument was taken, then all emissions would be apportioned to power anyway (however small the power output may be). That situation – where the totality of emissions could be assigned to a relatively small power output – seems a rather ridiculous one, and would leave some incinerators generating power at a carbon intensity of the order 2,000gCO_2/kWh, even without considering the non-fossil carbon dioxide emissions.

One apportionment method already linked to the ETS is the method outlined under Annex VII Part 8 of Regulation 2019/331,[105] which determines how free allowances should be allocated for heat outputs from co-generation under certain circumstances. This could be improved upon for the purposes of an apportionment exercise. For example, the carbon intensity of heat export could be ascertained through reference to a maximum possible efficiency of heat export, ignoring the generation of power. This would be used to ascertain the carbon intensity of heat to be applied on a CO_2 per kWh basis, given the actual emissions of the installation. This, multiplied the relevant output, would be deducted from the total emissions, with the remainder assigned to the power export. This method seems especially well-suited to incineration (and other thermal plants) given that the permitting process requires use that heat is recovered as far as is practicable.

In the case of the amended EU-ETS Directive, however, the argument for any form of special treatment for heat from incineration has disappeared. Indeed, to the extent that one might seek an incentive for using heat which could be used, but which is not (see below), the most effective approach is likely to be the inclusion of all forms of heat within the EU-ETS. In essence, to the extent that the price paid for heat increases as a result, so the incentive for making use of heat is enhanced.

We also note that Chapter IV of the Industrial Emissions Directive covers 'Special Provisions for Waste Incineration Plants and Waste Co-Incineration Plants', and Article 44, regarding Applications for permits, states:

> *An application for a permit for a waste incineration plant or waste co-incineration plant shall include a description of the measures which are envisaged to guarantee that the following requirements are met:*
>
> > *(a) the plant is designed, equipped and will be maintained and operated in such a manner that the requirements of this Chapter are met taking into account the categories of waste to be incinerated or co-incinerated;*
> >
> > *(b) the heat generated during the incineration and co-incineration process is recovered as far as practicable through the generation of heat, steam or power*

Article 50, on Operating Conditions, states again:

> *5. Any heat generated by waste incineration plants or waste co-incineration plants shall be recovered as far as practicable*

The word 'practicable' is, in general parlance, used to refer to something that 'can practically be done'. If operators have to include, in their permit applications, means to guarantee that '*heat generated during the incineration and co-incineration process is recovered as far as practicable through the generation of heat, steam or power*', and if facilities have to be operated so that '*Any heat generated by waste incineration plants*

[105] Commission Delegated Regulation (EU) 2019/331 of 19 December 2018 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council.

or waste co-incineration plants shall be recovered as far as practicable', what scope can there be for an incinerator to be awarded a permit to operate, and yet, for there to be additional heat available for use (let alone, which justifies an implicit subsidy)? According to the IED, the facility should have guaranteed from the outset that heat was recovered as far as practicable. If it failed to do that, it should not have been awarded a permit. The circumstances under which a) recovering heat is practicable at a later moment in time when b) it was not practicable at the point of permitting, seem unlikely to arise given that installations have existed for many years where recovering the vast majority of heat was clearly practicable.

The ETS Directive notes, at Article 8:[106]

> *Coordination with Directive 2010/75/EU*
>
> *Member States shall take the necessary measures to ensure that, where installations carry out activities that are included in Annex I to Directive 2010/75/EU, the conditions and procedure for the issue of a greenhouse gas emissions permit are coordinated with those for the issue of a permit provided for in that Directive. The requirements laid down in Articles 5, 6 and 7 of this Directive may be integrated into the procedures provided for in Directive 2010/75/EU.*
>
> *The Commission shall review the effectiveness of synergies with Directive 2010/75/EU. Environmental and climate-relevant permits shall be coordinated to ensure efficient and speedier execution of measures needed to comply with Union climate and energy objectives. The Commission may submit a report to the European Parliament and to the Council in the context of any future review of this Directive.*

It would run counter to the Union's climate and energy objectives to give particular weight, or additional credit, to activities which have to be undertaken anyway under the IED in order to acquire a permit to operate.

Because the buildings sector (heat) is to be included in the EU-ETS in future, and because the IED requires operators to guarantee the recovery of heat as far as is practicable simply in order to be awarded a permit to operate, there is no merit in issuing free allowances for heat. That may have been the case whilst the buildings sector was excluded from the EU-ETS, in which case, sensible apportionment would be required, but the inclusion of heat removes that rationale, and will itself add support for maximising practicable recovery of heat.[107]

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[106] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.

[107] The possibility of incentivising heat export is raised in the context of the UK's consultation on the UK-ETS. This is particularly egregious given that very few UK incinerators were ever required to recover heat 'as far as practicable': many were constructed 'CHP ready', a sop to future possibilities for heat export. Today, with incinerator capacity in the UK excessive relative to what will be required if Government targets are met, building heat networks in circumstances where capacity will be required to be scaled back

Recommendations

For context, we note that Article 30(7) of the EU-ETS Directive mandates the Commission to perform a review, by July 2026, to assess the feasibility of including municipal waste incineration (MWI) installations within the EU ETS with a view to their inclusion from 2028:

> *the Commission shall take into account the importance of all sectors contributing to emission reductions and potential diversion of waste towards disposal by landfilling in the Union and waste exports to third countries. The Commission shall in addition take into account relevant criteria such as the effects on the internal market, potential distortions of competition, environmental integrity, alignment with the objectives of Directive 2008/98/EC of the European Parliament and of the Council (38) and robustness and accuracy with regard to the monitoring and calculation of emissions. The Commission shall, where appropriate and without prejudice to Article 4 of that Directive, accompany that report with a legislative proposal to apply the provisions of this Chapter to greenhouse gas emissions permits and the allocation and issue of additional allowances in respect of municipal waste incineration installations, and to prevent potential diversion of waste.*
>
> *In the report referred to in the first subparagraph, the Commission shall also assess the possibility of including in the EU ETS other waste management processes, in particular landfills which create methane and nitrous oxide emissions in the Union. The Commission may, where appropriate, also accompany that report with a legislative proposal to include such other waste management processes in the EU ETS.*

The argument for including incineration within the EU-ETS is compelling: the only outstanding questions ought to be in relation to how that should be done.

Power and Heat

We have argued above that with the buildings sector to be included in the EU-ETS as of 2027, then given that MWIs would not be included until 2028, the argument for including only emissions apportioned to power (or to heat) has disappeared. To the extent that there may be a desire to encourage greater use of heat which is not currently utilised ('waste heat'?), there is no need to issue free allowances: the incentive should come from full inclusion of other heating fuels, which would be expected to increase the financial incentive for all those generating heat to identify potential users, and equally, for those using heat to seek lower cost supplies.

We recommend, therefore, that both power and heat from incineration should be in scope so that (for example) no free allowances are issued for heat generation. This will avoid the need to apportion incinerator emissions across power and heat.

Fossil- and Non-fossil CO_2 Emissions from Incineration

It is obviously not true that only emissions of fossil CO_2 matter. The atmosphere does not distinguish between fossil and non-fossil CO_2 in terms of its response to emissions: the radiative forcing effect is the same for both.

So why, then, would policy makers adopt a view that non-fossil sources of CO_2 – or CO_2 from biomass, including from combusting wastes of non-fossil origin – should not count towards the quantity of allowances required to be surrendered by EU-ETS installations (and allow some installations to be excluded altogether)? What is the rationale offered? An answer often given is that these emissions need not be considered because they have already been considered elsewhere in the compilation of an inventory of GHG emissions, to be specific, within the AFOLU part of the inventory. We have shown above, however, that an inventory of GHGs can be compiled in such a way that it is essential that these same emissions are accounted for (the AFOLU sector seeks to anticipate these).

We also noted that were EU-ETS installations that were emitting non-fossil CO_2 to be fitted with carbon capture and storage, they could claim to be carbon negative. This would be based on the view that non-fossil CO_2 emissions 'don't count' when they are emitted from an installation, but their capture *is* to be counted. If the capture of non-fossil CO_2 matters, then surely, so does 'not emitting' the same CO_2? And if not emitting non-fossil CO_2 matters, then emitting it must matter also. The argument that these emissions are already counted elsewhere in an inventory assumes that we are interested in compiling such an inventory, but we are not. In any event, as we previously noted, this argument is an artifice of the choice of approach to generating an inventory. We argued that had a similar 'stock-based' approach been taken to accounting for the stock of fossil carbon, then consistency would require that all fossil CO_2 emissions were also ignored.

We recommend that all emissions from incinerators are included within the EU-ETS and that installations are required to surrender allowances covering emissions of CO_2 of both fossil and non-fossil origin. The linkage made to sustainability criteria in the RED is not justified.

Inventories and Policy Instruments

The principles that may guide people in develop and inventory of GHG emissions are not necessarily the same as those which should guide a policy maker in designing policy instruments. The obvious example here is that if emissions of relevance to a given policy really were accounted for in a sector that is not covered by the policy, and were excluded from a sector that was covered by the policy so as to avoid double counting, there may be a need to include those emissions within the scope of the policy.

More important for the matter in question is the fact that GHG inventories seeks only to report on sources and sinks of GHGs, and to try to give a faithful and accurate representation of these as they are. It is not interested in whether there are better outcomes that could have been achieved. The goal of the policy maker is entirely different: they must design the policy so as to meet the objectives of the policy as far as possible, and in an efficient manner. In relation to this, there is an ongoing argument as to the merits or otherwise of zero-rating non-fossil CO_2 emissions, mostly as regards woody biomass, with the argument running that if biomass was not harvested, and if forests were allowed to continue to grow, there would be additional carbon stored in the forest stand relative to the situation where biomass is harvested. This argument is also implicit in the US EPA's modelling of the benefits of recycling of paper and cardboard (and waste prevention), for example, with the majority of those benefits linked to the impact of these activities on the additional sequestration which happens in forests. These arguments, ironically, do not imply that the way inventories are gathered is 'wrong': rather, they highlight, in our view, matters which should concern policy makers even if they need not necessarily concern those gathering inventories (who simply report the word as they find it).

We recommend that the design of policy should not take, as its guiding principles, those that govern the compiling of an inventory. In considering how to include MWIs and other incinerators within the EU-ETS, policy makers should take their cue from the objective of the policy.

Cascading Principle

The implications of policy makers adopting the 'inventory view' – of zero-rated biomass – would, we noted, tend to undermine Article 3(3) of the RED, which addresses the matter of cascading of biomass. This references the waste hierarchy:[108] yet if recycling of paper and card can lead, at the margin, to enhanced sequestration of biomass relative to harvesting, and if this effect is completely overlooked by zero-rating biomass, then the implicit subsidy (the avoided cost of allowances associated with zero-rated emissions) afforded to incineration of wastes of non-fossil origin will, at the margin, undermine the cascading principle (the incentive to avoid waste, or to recycle is diminished).

We recommend that when conducting the study envisaged at Article 30(7) of the EU-ETS Directive, attention should be given not only to landfills, but to recycling and waste prevention also. The way in which MWIs are included within the EU-ETS should not undermine the cascading principle, and should be consistent with achieving the EU-ETS Directive's objectives.

[108] Directive (EU) 2018/2001 of the European Parliament and of The Council of 11 December 2018 on the promotion of the use of energy from renewable sources.

Other Waste Management

The Article 30(7) report is asked to consider other waste management processes, and in particular, landfills with a view to including them under the EU-ETS. Methane emissions are to be included for maritime transport in future, but relatively few emissions trading schemes include landfills. Landfills in New Zealand have been required to surrender New Zealand Units under its Emissions Trading Scheme (ETS), using either a default factor for emissions or a Unique Emissions Factor,[109] which requires submission of data in line with Regulations. Waste is also included in South Korea's ETS.

We have argued elsewhere that landfills in the EU should be required to stabilise waste prior to landfilling to reduce methane emissions.[110] Inclusion of landfills within the EU-ETS could, theoretically, incentivise this, but in practice, measuring emissions from landfills is not straightforward. Most countries, with few exceptions, already apply landfill taxes, and it might be easier to use tax differentials to drive down methane emissions from landfills.

The scope of the report is to include consideration of how '*to prevent potential diversion of waste.*' It is not entirely clear to what this is referring but we suspect the concern regards diversion to landfill. It is important, though, for the EU-ETS Directive, given its objectives, to consider the GHG impacts of different options. As we have argued elsewhere, if stabilisation of waste occurs prior to landfilling, this should improve the GHG performance of a landfill system, potentially improving the performance of landfill so that it is superior to incineration.

Several Member States already have taxes on incineration in place. A greater number have taxes in place for landfill. Where recycling and waste prevention are concerned, an EU-ETS functioning with no free allowances for industry, and with a carbon border adjustment mechanism in place should help incentivise recycling, albeit imperfectly.

The inclusion of incineration within the EU-ETS enables (if implemented as above) a value to be assigned to the GHG-related externalities of incineration. If the same was to happen for landfill, the same would be true. It would be reasonable to assume that a share of existing taxes on incineration and on incineration are linked to their GHG emissions. It would make sense, therefore, for guidance to be given, in the light of decisions made, to Member States as to how they might consider adjusting existing taxes (recognising that tax remains a matter for Member States).

We recommend that the analysis of incineration and other waste management options considers their relative performance, taking into account the extent to which benefits and impacts are already (or will

[109] New Zealand Government (2010) Climate Change (Unique Emissions Factors) Amendment Regulations 2010, order in Council 2010/337.

[110] Equanimator (2021) *Rethinking the EU Landfill Target*, Report for Zero Waste Europe, October 2021; Dominic Hogg (2022) *The Case for Sorting Recyclables Prior to Landfill and Incineration*, Special Report prepared for Reloop, June 2022.

be) 'internalised' by existing policy, including the EU-ETS. This could also help inform guidance that could be given vis a vis existing economic instruments which the EU-ETS might (partially or wholly) replace.

The 20 MW Threshold

The MRV requirement is based on '*combustion of fuels in installations for the incineration of municipal waste with a total rated thermal input exceeding 20 MW*'. We find there to be two main issues with this criterion:

1. the first is that there is ambiguity as to (and considerable latitude in) how the total rated thermal input should be understood. The relevant Guidance does little to resolve this ambiguity and leaves considerable leeway for interpretation;
2. second, it seems reasonable to ask why the threshold has been set at 20MW. What is the rationale for the choice? Whilst it may be true that *most* MWIs in the EU at present are likely to be (depending on how they interpret the requirement) above the 20MW threshold, how the threshold is set has the potential to change that in future. Economies of scale (and the quantum of capital involved) tend to push facilities towards sizes well above 50-60kt (the EU average appears to be around 200kt), but full inclusion under the ETS, with no free allowances, might influence the decision whether to build new facilities below the threshold. Dropping the threshold to 10MW might be sufficient to make the diseconomies of such small scale sufficient to make it unlikely that the threshold would directly affect the capacity decision.

Article 30(5) of the EU-ETS Directive notes that by 31 July 2026, the Commission is to report on the feasibility of lowering the 20 MW total rated thermal input thresholds for the activities in Annex I from 2031.[111] It would seem appropriate, as noted above, to align the threshold with what is already in the Industrial Emissions Directive.

Drafting Issues

We note, in passing, that the EU-ETS Directive, as regards the inclusion of incineration and or MWIs specifically, could be better drafted. The language used is sometimes imprecise: it is unfortunate that terms such as 'fuel' are widely used to refer to wastes.[112] The inclusion in the scope of the EU-ETS Directive of buildings, and hence, heat, gave rise to an attempt to exclude MWIs from installations referred to therein, but this exclusion was made via an unnecessarily convoluted route that fails to achieve its intent. Whilst Guidance seeks to elaborate

[111] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, last amended on 29 February 2024.
[112] It would be straightforward to remove all reference to the use of the term 'fuel' in relation to incineration.

on intent, a recent legal decision has highlighted how Guidance may have over-interpreted what is set down in the Directive itself.

Strictly speaking, and following what we believe is the strict legal definition of specific terms used in the Directive, we believe that as it has been drafted, the way in which incinerators and MWIs would be included in the ETS-Directive is not as it appears was intended. It does not help, of course, that different incinerators are included within the scope of the EU-ETS Directive in different ways. Life – and drafting of the Directive - would be greatly simplified if all incinerators were included in the EU-ETS in the same way.

Which raises the rather obvious question as to why they are being treated in different ways: the inclusion of MWIs is long overdue.

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