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Waste incineration and landfill in the EU Emissions Trading System

Advantages and disadvantages

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Summary

In this report, the Swedish Environmental Protection Agency analyses the advantages and disadvantages of including waste incineration plants and new landfills in the EU Emissions Trading System (EU ETS), with the aim of reducing greenhouse gas emissions at EU level and achieving greater compatibility with the EU waste hierarchy. The background to this is the review of the EU ETS to be presented in 2026, in which the European Commission will, among other things, assess whether waste incineration plants should be included from 2028.

In the report, we have analysed a number of policy packages in order to clearly illustrate and highlight the possible effects of different policy choices and how greenhouse gas emissions from waste management can be reduced while remaining compatible with the EU waste hierarchy. The analysis was based on three criteria: (i) climate and environmental benefits, (ii) cost-effectiveness, and (iii) feasibility.

A central part of the analysis has also been to describe and summarise Swedish experiences of including waste incineration in the EU ETS and introducing a ban on the landfilling of organic and combustible waste.

Doing nothing is not an option, and market conditions need to be levelled out.

Doing nothing is not an option if incentives are to be created to reduce greenhouse gas emissions from waste management. The current EU approach, which essentially means that Member States are responsible for managing emissions from the waste sector themselves, is not sufficient to reduce emissions at the rate required for the EU to achieve net-zero emissions by 2050. Waste management also varies considerably between EU countries. In some countries, waste incineration dominates, leading to higher CO_2 emissions but relatively low methane emissions from landfills. In other countries, landfilling is the most common method, resulting in lower emissions from incineration but higher methane emissions. Emissions from waste incineration in the EU amount to just over 40 Mtonnes of$_{CO_2}$equivalents per year, with an additional approx. 75 Mtonnes of$_{CO_2}$equivalents from landfills.

One problem with the current system is that waste incineration plants in countries that have chosen to include them in the EU ETS will find it difficult to compete with landfill or less energy-efficient incineration in countries where emissions are not priced. As the price of emission allowances rises, this competitive disadvantage increases, which in the long run may mean that planned investments in, for example, mechanical recycling, post-sorting facilities or CCUS are not implemented, i.e. investments that are necessary for the EU to achieve net zero emissions by 2050. The inclusion of waste incineration in the EU ETS is therefore also justified by the need to ensure a level playing field for all facilities, regardless of Member State. If these conditions are not levelled out, there is a risk that waste will be transported unnecessarily long distances to avoid emission costs, or that certain countries will refrain from accepting mixed waste even though they have facilities that could effectively treat it.

Our assessment is that market conditions, and thus policy instruments, for waste management in the EU need to be harmonised in order for waste to be managed efficiently and in line with the waste hierarchy.

Policy instruments are needed higher up in the value chain to reduce the environmental and climate impact of plastics

Most emissions from waste incineration plants come from the incineration of fossil-based plastics. The most effective way to reduce these emissions would be through policy instruments that require the operator placing the plastic on the market to bear the cost of all emissions, including those in the waste stage, as well as policy instruments that promote the EU-wide waste hierarchy, such as preventive measures, increased reuse and material recycling.

A key challenge in including waste incineration in the EU ETS is that emission costs are only passed on upstream in the value chain to a limited extent. This means that the actor creating the problem does not have to bear the cost of the emissions generated in waste management. This is problematic, not least because the cost of emission allowances for Swedish waste incineration already accounts for 10–20 per cent of operating costs, and with emission allowance prices rising, operations risk becoming unprofitable. This also increases the risk of illegal waste management or the export of plastic waste outside the EU. If there are policy instruments that lead to the cost of emissions from waste incineration being passed on to consumer products, the price increase on these products would generally be only marginal. This means that the inclusion of waste incineration in the EU ETS would need to be supplemented with other policy instruments over time.

Including waste incineration and landfill in the EU ETS may be part of the solution

Sweden's experience shows that the inclusion of waste-to-energy plants in the EU ETS has served as an important complement in the waste sector. It has created stronger incentives to reduce emissions from plastic incineration, for example by several waste-to-energy plants now applying differentiated fees based on the plastic content of the waste, several plants investing in post-sorting of plastic, and several large waste-to-energy plants having extensive plans to invest in CCUS. These incentives have been created primarily in recent years as the price of emission allowances has increased and the degree of free allocation has decreased.

However, in order to avoid the risk of waste being increasingly directed to landfill, additional policy instruments are needed to reduce emissions from these sites as well. This could be achieved by the EU deciding to include landfill in the EU ETS or by introducing a ban on the landfill of combustible and organic waste.

Experience from Sweden shows that waste incineration plants can be included based on actual emission values. However, our analysis shows that landfills, when included in the EU ETS, should be subject to high default values that take into account the significantly greater uncertainty associated with these emissions. Basically, based on the EU waste hierarchy and our summary of the research, it is only in very unique situations that it may be better from a greenhouse gas emissions perspective to landfill waste than to incinerate waste with energy recovery. Unlike a landfill ban, including landfill in the EU ETS could also create economic incentives for the capture and use of landfill gas.

There are advantages to both including landfill in the EU ETS and introducing a ban on the landfill of combustible and organic waste in the EU. The ban could, for example, allow small landfills to be exempted from the EU ETS, which would reduce administrative costs while creating incentives to capture landfill gas from larger landfills. It would also enable the default values used for landfill to be replaced in the long term by actual emission values if measurement technology is developed without creating a risk of plastic waste ending up in landfill. An opening for using actual values for landfill could be created in the EU ETS, providing clear incentives to further develop and improve methods for measuring emissions from landfills.

In order to enable a smoother transition and increase acceptance of the inclusion of waste incineration plants in the EU ETS, an initial free allocation of emission allowances may be necessary, with a gradual phase-out. This could be justified partly by the fact that these plants deal with a socially important waste problem, and partly by the fact that there is a real risk of carbon leakage linked to waste as a raw material. Unlike other electricity and heat production, which always has to take place locally and cannot be imported from third countries (apart from certain border areas on the EU's external border), there is a risk that the waste will be exported to third countries or handled illegally. It may therefore be more justified for waste incineration plants to receive a higher free allocation than other electricity and heat producers. To achieve this, it may be necessary to introduce a new benchmark for waste incineration.

To ensure that the inclusion of waste incineration plants in the EU ETS works effectively, regulations for the management of hazardous waste also need to be reviewed and developed, as do the regulations for CCUS. Waste incineration with CCUS would also need to be classified as an environmentally sustainable economic activity according to the EU taxonomy, which is not the case today.

Another basic prerequisite for the effective inclusion of waste incineration and landfill in the EU ETS is that the risks of illegal handling and/or export of plastic waste outside the Union are addressed. This could be done, for example, by introducing requirements in the producer responsibility for products containing a lot of plastic that they should bear the emission costs incurred in waste incineration.

Pricing earlier in the value chain is an alternative

Emissions from plastic waste management can also be addressed through a levy or trading system (or alternatively a tax) that targets the fossil fuel industry or products containing plastic based on the emissions from plastic throughout its life cycle, while at the same time setting clear targets for reducing greenhouse gas emissions from waste incineration. It may be politically challenging to impose costs directly on products, but it is worth noting ( ) that since 2021, the EU has already had a "plastic tax" of €0.80 per kg for plastic packaging that is not recycled.

In addition to generating revenue for the EU budget, the plastic tax aims to create incentives for increased material recycling and reduced amounts of plastic on the market. However, it has had a limited regulatory effect so far, as many Member States have chosen not to introduce a corresponding plastic tax, but have simply paid the tax from their own national budgets. Revenue from the plastic levy amounts to just over €7 billion per year, which is roughly double what the revenue would be if waste incineration plants in the EU had to pay an emission allowance price of €100 per tonne of CO_2 .

A practical option, justified by the fact that the price of plastic products does not fully reflect their environmental and climate costs over their life cycle, could therefore be to increase the plastic tax and possibly introduce a tax on other product streams that contain plastic and are difficult to recycle but administratively easy to monitor. The revenue could be used primarily to finance investments that enable increased reuse and plastic recycling, and secondarily to enable CCS on waste incineration. A plastic tax that generates revenue could also be combined with the inclusion of waste incineration plants and landfills in the EU ETS, as this could effectively motivate the necessary investments without increasing the risk of illegal handling or export of plastic waste. It is thus an alternative to including requirements in producer responsibility.

1. Introduction

The EU faces major environmental and climate challenges related to its waste management, not least because of the growing amount of plastic and mixed residual waste, which both hinders material recycling and gives rise to significant fossil carbon dioxide emissions from waste incineration plants. Despite progress in recycling policy, a large proportion of waste consists of plastic that cannot be recycled or is not profitable to recycle because the costs of primary fossil-based plastic are much lower than the alternatives. The amount of plastic waste is also expected to increase in the long term, both due to increased demand for plastic products and extensive investment in new plastic production by the fossil fuel industry. At the same time, landfilling remains a common treatment method in many Member States. Landfilling gives rise to methane emissions originating from organic waste, but a large amount of plastic in a landfill can cause subsidence, which leads to more methane leaking out. Overall, emissions from these waste processes are not decreasing at the rate required for the EU to achieve its net-zero emissions target by 2050.

Furthermore, there are significant differences between EU Member States in how they have chosen to deal with emissions from waste incineration and landfills. Some countries, such as Sweden, Denmark and Lithuania, have chosen to include waste incineration plants in the EU Emissions Trading System (EU ETS1, which we refer to in this report as EU ETS), while Germany, for example, has chosen to keep the sector within the Effort Sharing Regulation (ESR) and, since 2024, in a national trading system. The regulation of landfills also differs between Member States, particularly with regard to the implementation and enforcement of the EU Waste and Landfill Directives (see Chapter 2), leading to significant differences in the rate at which emissions are reduced. The lack of uniform regulation makes it difficult to achieve the emission reductions from the waste sector at the rate required at EU level.

The upcoming review of the EU ETS in 2026, in which the European Commission will assess, among other things, whether waste incineration plants should be included in the trading system from 2028, provides a key opportunity to examine whether emissions from both waste incineration plants and new landfills should be covered by the EU ETS. The review also opens up the possibility of considering other types of policy instruments that could create clearer and more coordinated incentives to reduce emissions from the waste sector.

This report analyses the possible consequences of such a reform and a number of other policy options, focusing on environmental benefits, cost-effectiveness and feasibility. The analysis does not include other ways of managing organic fractions of waste, such as biological treatment and biogas production.

The report also summarises Swedish experiences of including waste incineration plants in the EU ETS and of introducing a ban on the landfilling of combustible and organic waste.

1.1 Background – waste incineration, waste streams and emissions

There are around 500 waste incineration plants in the EU, which handle approximately 80 million tonnes of waste.[1] Most of the plants are located in Germany, France, Italy, Sweden and Denmark. The plants in the Netherlands and Germany are on average larger than those in other countries. Fossil emissions from the plants amount to just over 40 million tonnes of carbon dioxide per year, which corresponds to 1 per cent of emissions from the sector covered by the Member States' climate commitments under the EU's Effort Sharing Regulation (ESR). In some countries, however, waste incineration accounts for a larger share of total emissions. In Sweden, for example, it accounts for around 7 per cent of total national emissions.

The amount of municipal waste landfilled annually in the EU is currently roughly equal to the amount incinerated, although these two treatment methods together have declined slightly over the past decade, from 122 million tonnes in 2014 to 115 million tonnes in 2024. At the same time, municipal waste accounts for only around 10% of all waste generated within the Union. The largest waste streams come from other sectors:

- construction and demolition waste accounts for around 40 per cent and consists mainly of inert material,
- mining and extraction waste accounts for around a quarter,
- the manufacturing industry accounts for around 10 per cent of a mixed waste stream.

In terms of total waste volume, significantly larger volumes go to landfill than to incineration; just over 20 per cent of all waste is landfilled, while only around two per cent is incinerated. Landfilled organic waste also produces methane, which means that emissions from landfills, according to Member States' inventories, amount to around 75 million tonnes of carbon dioxide equivalents per year – almost twice as much as emissions from waste incineration. These differences in treatment methods, waste streams and emissions are key considerations in the discussion on how to create incentives for reducing emissions from the waste sector at EU level.

One challenge is that the costs incurred in waste management have only a limited impact on the costs of companies that extract fossil raw materials, plastic producers or companies that place plastic-containing goods on the EU market. Unlike steel and aluminium, for example, where recycling is often economically viable and demand for recycled materials is higher, there are no clear economic incentives in the plastics value chain unless these are enforced by policy instruments. Current waste legislation primarily regulates the treatment of waste, but does not create sufficient incentives to reduce the fossil emissions associated with the life cycle of

[1] CEWEP - The Confederation of European Waste-to-Energy Plants

plastics. This means that policy instruments in the climate area need to be supplemented with other policy instruments in order to effectively limit the climate and environmental impact of plastics.

1.2 Structure and methodology of the report

Chapter 2 briefly describes the EU regulations relating to waste management in the EU that are relevant to this analysis. Chapter 3 describes Sweden's experiences of including waste incineration in the EU ETS. We also discuss a couple of key areas where the ETS Directive may need to be developed to make it more functional, including the management of hazardous waste and CCUS, as well as the EU Taxonomy Regulation. Chapter 4 provides a more in-depth analysis of emissions from landfills. We describe Sweden's experience of deciding to ban the landfilling of organic and combustible waste, and we highlight the conditions for measuring and verifying emissions and the risk of increased illegal waste management. Based on chapters 3 and 4, we then analyse a number of policy instrument options based on specific criteria. The analysis is based on literature studies, statistics and interviews with a number of actors, including the Ministry of Environment New Zealand, the industry organisations Energiföretagen, Avfall Sverige, CEWEP and several Swedish companies in the waste incineration and landfill sectors.

2. EU regulations for waste management

Many of the EU regulations that exist for the development of a circular economy aim to reduce the amount of waste that ends up in waste incineration or landfill. A central part of this is the waste hierarchy, which is a fundamental principle of *the Waste Directive*.[2] The waste hierarchy, which in Sweden is implemented through the Environmental Code[3] , has five steps:

1) Prevention – measures that reduce the amount of waste, reduce the amount of harmful substances in materials and products, or reduce the negative effects of waste on human health and the environment.
2) Preparation for reuse – a product or component that has become waste is cleaned, repaired or checked so that it can be used again without any other pre-treatment.
3) Material recycling – waste materials are processed into products, materials or substances, either for their original purpose or for other purposes.
4) Other recycling – waste is treated to produce energy, construction materials or used for backfilling and land spreading.
5) Disposal – waste is sent to landfill or, for example, treated in a soil bed, infiltration or discharge to water. Incineration without energy recovery is also considered disposal.

The waste hierarchy should be read as an order of priority, but without losing sight of the fact that an assessment must be made in each individual case. The most important assessment to be made on the basis of the waste hierarchy is that the treatment of waste that best protects human health and the environment as a whole should be considered the most appropriate, provided that the treatment is not unreasonable. This means that an assessment must be made for each waste management operation, and based on the above, in some cases landfill is the treatment that best protects human health and the environment.

Another important directive for this analysis is *the Landfill Directive*[4] , which aims to prevent or, as far as possible, reduce the negative effects of landfills on surface water, groundwater, soil, air and human health. This is done through technical requirements. In order to support the EU's transition to a circular economy, an amending directive[5] was adopted in 2018, which limits landfill from 2030 for all waste that is suitable for material recycling or other resource and energy recovery. The goal is to limit the proportion of municipal waste sent to landfill to 10 per cent

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[2] Directive 2008/98/EC.

[3] Chapter 15, Section 10 of the Environmental Code (1998:808).

[4] Directive 1999/31/EC

[5] Directive (EU) 2018/850.

by 2035. However, municipal waste is only part of the waste managed within the EU.

The Landfill Directive currently prohibits the landfilling of, for example, liquid waste, but there is no ban on the landfilling of combustible and organic waste. A ban on the landfilling of organic waste can be justified by the methane emissions caused by biodegradable waste[6] . The benefit of banning combustible waste is that it is more efficient to either handle the waste higher up in the value chain, for example through material recycling, or to incinerate it with energy recovery instead of sending it to landfill. However, a ban could be introduced through a revision of the directive. The Landfill Directive also stipulates that landfill gas must be collected from all landfills that receive biodegradable waste and that the landfill gas must be treated and utilised.[7] If the collected gas cannot be used for energy production, it must be flared. Effective capture of landfill gas could also be promoted through the BAT conclusions for landfills in *the Industrial Emissions Directive* (IED)[8] .

In addition to this, there are several EU regulations aimed at creating better conditions and incentives for increased material reuse and recycling, e.g. producer responsibility for various products (such as packaging, electronics and vehicles) and requirements for products to be designed for durability, reparability and recyclability (the Ecodesign Regulation[9]). Quota obligations for the use of recycled raw materials are a current issue within the EU and are included in the new Packaging Regulation[10] and will be introduced for PET bottles in accordance with the Single-Use Plastics Directive[11] and for batteries in accordance with the Battery Regulation[12] . There are also proposals in the ELV Regulation[13] and it is possible that several product groups may be affected, such as construction products.[14]

[6] Not all organic waste gives rise to methane emissions, e.g. inert carbon.

[7] Annex 1, point 4.2 Directive 1999/31/EC.

[8] Industrial Emissions Directive, 2010/75/EU.

[9] Regulation (EU) 2024/1781.

[10] l Regulation of the European Parliament and of the Council on packaging and packaging waste, COM/2022/677

[11] Directive (EU) 2019/904 of the European Parliament and of the Council.

[12] Regulation (EU) 2023/1542 of the European Parliament and of the Council.

[13] Proposal for a Regulation of the European Parliament and of the Council on circularity requirements for vehicle design and end-of-life vehicle management, COM/2023/451 final.

[14] SOU 2024:67,

3. Waste incineration – experiences and considerations

In this chapter, we describe Sweden's experiences of including waste incineration in the EU ETS, with a particular focus on measurement and verification. We also briefly touch on two areas where the ETS Directive[15] would need to be developed in order for the system to be effective when integrating waste incineration. One is the exemption for the incineration of hazardous waste (section 3.2), and the other is the incentives for CCUS on waste incineration (section 3.3). In section 3.4, we discuss waste incineration and the EU taxonomy for environmentally sustainable activities before concluding (section 3.5) with the risk of increased illegal waste management if waste incineration is included in the EU ETS.

3.1 Sweden's experiences

In Sweden, waste incineration has been included in the EU ETS since the third trading period, which began in 2013. This has been done on the basis of an interpretation of the European Commission's guidance[16] that the main purpose of so-called co-incineration plants (now called waste-to-energy plants in Sweden) is to produce heat and/or electricity.

The Swedish implementation of the directive's exemptions for hazardous waste and household waste has been revised since the system was introduced. Initially, installations whose main activity was the incineration of hazardous waste or household waste were exempted. For the second trading period, the criterion of "main activity" was removed and what became decisive was instead whether an incineration unit had a permit to incinerate hazardous waste or household waste.

Ahead of the third trading period, the European Commission stated in its guidance on Annex 1 to the Directive that installations or units classified as waste energy plants should be covered by the EU ETS.[17] Of 57 boilers investigated in Sweden, only two were not considered to be waste energy plants, as their primary purpose was to destroy waste.

In 2024, there were 15 large waste-to-energy plants in Sweden emitting over 50,000 tonnes of carbon dioxide and 30 smaller plants. Emissions from waste-to-energy incineration have increased from 1.8 million tonnes of carbon dioxide in

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[15] Directive 2003/87/EC.

[16] Guidance note on interpretation of the Scope of the EU ETS

[17] *Wherever the competent authority classifies the waste unit as co-incineration or as using other wastes than municipal and hazardous wastes, it is to be included in the EU ETS.*

2013 to 3.1 million tonnes of carbon dioxide in 2024, mainly due to increased imports of waste, better material recycling of waste other than plastic, and increased sorting of food waste , which leads to an increasing fossil fuel share in the waste that is incinerated. Emissions currently account for almost one-fifth of Sweden's emissions in the EU ETS.

Sweden's experience of including waste incineration in the EU ETS is that it has, to a certain extent, helped to create incentives for reduced emissions, including through differentiated fees based on the proportion of plastic, investments in post-sorting of plastic, and several large waste incineration plants have plans for CCUS. The fact that the effect has not been greater is largely due to the fact that waste-to-energy plants have only in recent years begun to incur significant costs for their emissions. Negative effects on waste management in general can also be noted, e.g. the emergence of blacklisted waste, i.e. waste that waste incineration companies refuse to accept because the emission costs are too high. The same thing has also been noted in Lithuania. This raises the question of what happens to this waste, which risks being disposed of legally or illegally (see section 4.3.2).

3.1.1 Requirements for measurement and verification

Prior to the inclusion of waste incineration in the EU ETS, there were concerns that it would not be possible to measure and verify emissions with sufficient quality. However, developments progressed rapidly and today, waste incineration plants whose carbon dioxide emissions exceed 50,000 tonnes per year must use Continuous Emissions Monitoring Systems (CEMS). The EU standard EN 14181 is followed to quality assure CEMS. This quality assurance is ongoing and has three levels:

- QAL1 – ensures that the instrument is approved and certified to measure carbon dioxide and the required concentrations.
- QAL2 – parallel measurements and reference methods to develop a calibration function that is performed when the system is installed or after major changes.
- QAL3 – ongoing checks during operation to monitor that CEMS continues to remain within approved limits.

In addition to this, there is a requirement for an annual external check (AST) involving a limited number of parallel measurements to confirm that the calibration is still valid.

Carbon dioxide emissions from CEMS in waste incineration can be reported with an uncertainty of 2.5–5 per cent.

CEMS only measures total carbon dioxide emissions, which means that the proportion of fossil and biogenic sources needs to be assessed in other ways. According to the Monitoring and Reporting Regulation ([18] , MRR), this should be done through:

[18] Guidance document No 7, CEMS monitoring.

- Flue gas sampling – 12 times per year under stable operating conditions.
- Accredited laboratory analysis of samples. The analysis is performed using the carbon-14 method, which is based on the knowledge that fossil carbon is free of ^{14} C, while biogenic carbon still contains ^{14} C. To calculate the biomass fraction, background radiation (PmC-ref) is also needed, i.e. a reference value for the percentage of modern carbon in the atmosphere. This reference value needs to be updated regularly and be regional.

In practice, the uncertainty for the biomass fraction in waste incineration using the carbon-14 method is estimated to be approximately ±3 per cent.

For waste incineration with carbon dioxide emissions below 50,000 tonnes per year, a calculation-based method is used to determine emissions. The Swedish Environmental Protection Agency publishes standard calculation factors for these facilities annually. This is permitted under the MRR ([19]), which allows Member States to provide standard factors to reduce the administrative burden on operators. The standard factors are developed based on the previous year's measured emissions at the larger facilities. The standard factors are also used in the greenhouse gas inventory. In this case, the Swedish Environmental Protection Agency presents at least the following each year:

- Biomass fraction – the estimated proportion of the waste stream that is biogenic carbon.
- Net calorific value – the amount of energy released per unit of waste during incineration.
- Preliminary emission factor – how much fossil carbon dioxide is emitted per unit of energy.

The uncertainty is greater with the calculation-based method using standard factors than when actual measurements are made. In some situations, the errors can be over ±30 per cent in the worst case, but in normal situations the errors are smaller.

3.2 Hazardous and municipal waste – exceptions need to be reduced

The incineration of hazardous waste is a source of significant emissions of fossil carbon dioxide, but is not currently covered by the EU ETS[20] . The European Court of Justice has clarified in a preliminary ruling that the assessment must be made not only at plant level but also at unit level (boiler level) and that a boiler may be exempted if the incineration of other waste is only marginal.[21] According to the

[19] Article 31(1)(c) of Regulation (EU) 2018/2066 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC.

[20] Article 2(1) of the ETS Directive.

[21] In the preliminary ruling of the Court of Justice of the European Union in case C-251/21 (Nouryon), it was stated that a combustion unit can only be exempted from the ETS if marginal amounts of fuel other than hazardous waste are used.

preliminary ruling of the European Court of Justice, it is therefore the actual composition of the waste, not the purpose of the incineration, that is decisive.

This means that different types of incineration plants continue to be subject to different rules. Several of the waste-to-energy plants currently included in the EU ETS also incinerate small amounts of hazardous waste. This means that these plants have a cost for incinerating hazardous waste that a plant that mainly incinerates hazardous waste does not have, as it is not covered by the EU ETS. The exemption for hazardous waste can thus act as indirect financial support for this form of treatment, which in turn can reduce the incentives to develop products and processes that avoid the use of hazardous substances.

We consider that exempting this type of activity from the system lacks clear environmental justification and risks weakening the EU ETS's function as a climate policy instrument. A more uniform application of the EU ETS, covering all incineration plants regardless of waste type, would contribute to greater legal certainty, stronger climate governance and better conditions for achieving the objectives of both environmental policy and the circular economy.

According to the Commission's guidance, installations where municipal waste is not the dominant type of waste should be fully included in the EU ETS. We consider that it is not only Sweden's waste-to-energy installations that have waste other than municipal waste as the dominant type and that they should therefore already be fully covered by the ETS at present. [22] However, we would like to point out that the current system regarding which facilities and units should be partially or fully included leads to considerable legal uncertainty, especially when we can see that implementation differs between countries. The preliminary ruling by the Court of Justice of the European Union has also added further complexity to the definitions of waste. The Commission's proposal should therefore clarify and harmonise the rules. The easiest way to achieve this is to include waste incineration plants fully in the EU ETS, regardless of the purpose of the plant or the waste/fuel mix used at the plant and in the respective units.

3.3 CCUS and other carbon dioxide transfer

Carbon capture, utilisation and storage (CCUS) will be crucial in reducing emissions from waste incineration to near zero, unless fossil-based plastics can be eliminated. To make this possible, technological development and learning are needed throughout the value chain. There is therefore a need for support for technical development and early commercialisation of these technologies, whether for the capture of atmospheric (DACC), biogenic (bio-CC) or fossil carbon dioxide (CC). The use of carbon dioxide (CCU) will also play an important role in the transition, not least because carbon atoms will be needed in several sectors to reduce emissions. In its report on positions in energy recovery,[23] , Avfall Sverige

[22] Guidance note on interpretation of the Scope of the EU ETS

[23] Waste Sweden positions – energy recovery.pdf

assesses that CCUS will be absolutely crucial if we are to have sustainable waste management in the future.

Our assessment is that including waste incineration in the EU ETS could provide a clearer and more harmonised incentive for CCUS in all Member States. Otherwise, it will be up to each individual Member State to create incentives for CCUS from waste incineration. Inclusion in the EU ETS would harmonise conditions, give technology development a push in the right direction and reduce the cost of CCUS, as demand would increase if a ban on the landfilling of combustible and organic waste were also included, or if landfilling were included in the ETS (discussed further in Chapter 5). However, it will probably be well into the 2030s before the price of emission allowances justifies investments in CCUS for waste incineration.

CCUS activities subject to authorisation within the EU ETS

The EU ETS creates incentives for investments in fossil CCS and certain CCU. The portion of fossil carbon dioxide collected for these two purposes does not need to be surrendered for emission allowances. When the ETS price rises, the incentive to capture carbon dioxide instead increases. Deductions may be made for geological storage of fossil carbon dioxide and carbon dioxide that is bound in a number of carbonates used in the construction industry and thus remains bound for several hundred years. There is also a requirement to surrender emission allowances from leaks from CCS, which applies to the entire value chain (capture, transport and storage).

In order for the investment calculation for CCUS at waste incineration plants to add up, biogenic emissions also need to be addressed in the EU ETS. In general, waste incineration plants have approximately 50 per cent fossil and biogenic flue gases, which means that offsetting is also needed for the biogenic portion. The European Commission's proposal, to be submitted in the summer of 2026, on how to create incentives for permanent sequestration will play a decisive role for the industry going forward.

However, there is already an opening through the handling of e-fuels in the EU ETS. If carbon dioxide is used to produce e-fuels, emission allowances must always be surrendered for the fossil portion in the production stage, either at the facility where the carbon dioxide originates, in this case a waste incineration plant, or at the facility where the carbon dioxide is used to produce e-fuel, provided that this facility is also included in the EU ETS. The e-fuel produced in this case will be counted as renewable, and users (e.g. aviation and maritime operators) will not need to surrender emission allowances for the use of the fuel. There is therefore already an incentive for biogenic carbon capture, as the producer does not need to surrender emission allowances for this use.

Permanent removals within the EU ETS

In 2026, the European Commission will report on how negative emissions (permanent removals), increased carbon storage, could be reported and included in emissions trading. In its analysis of the EU's climate targets and climate framework for 2040, the Swedish Environmental Protection Agency assesses that permanent removals need to be developed in several stages.[24] The costs of technical measures, such as bio-CCS and DACCS, are relatively high, which means that cheaper emission-reducing measures will only be implemented in the event of direct integration into the EU ETS. Only when the costs of reducing emissions become higher than the costs of bio-CCS and DACCS will it become relevant to use these units to offset emissions. The Swedish Environmental Protection Agency's conclusion is therefore that permanent removals initially need to be supported in order for the various technologies to be developed and mature. Direct integration should only be considered at a later stage.

The inclusion of permanent removals in the EU ETS means that waste incineration plants within the ETS that invest in some form of permanent removal will benefit positively due to their high proportion of biogenic emissions in municipal waste (approx. 50 per cent). This would mean that the biogenic share would not only be counted as zero, but would also result in credits that could be used to cover emissions or sold, depending on how the system is designed. By increasing the sorting of plastic in waste, facilities can influence emissions and further increase the biogenic proportion. However, this also risks leading to an increased risk of illegal handling of the sorted plastic waste.

3.4 Waste incineration with CCUS and the taxonomy

As already mentioned, the price of emission allowances in the EU ETS is significantly lower than the price that would be needed to make investments in waste incineration with CCS profitable. This means that some form of support will be needed. However, the current EU taxonomy[25] does not include waste incineration with CCUS as an environmentally sustainable activity, which makes this considerably more difficult. There is therefore a need to develop a definition of environmentally sustainable waste incineration in the taxonomy with SC (Substantial Contribution) and DNSH (Do No Significant Harm) criteria.

3.5 Waste incineration in the EU ETS increases the risk of illegal handling

The inclusion of waste incineration in the EU ETS may create an increased risk of illegal waste management, i.e. a form of circumvention of the requirement to pay for emissions. This may involve the export of waste to countries outside the EU or illegal waste management within the EU.

[24] Analysis of the EU's climate targets and climate framework for 2040 letter

[25] Regulation (EU) 2020/852.

There are countries outside the EU that have lower requirements for waste management or weaker implementation of regulations. Higher costs for waste incineration caused by the cost of emission allowances may make it more attractive to transport waste outside the EU. However, the risk of more waste being exported outside the EU is considered to have decreased as a result of tightening of the Basel Convention, an international agreement aimed at regulating the transboundary movement of hazardous waste and its disposal, particularly from industrialised countries to developing countries. Today, for example, mainly clean fractions of plastic are exported, as mixed and difficult-to-sort flows are now classified as notifiable waste. The Waste Directive has also stipulated, in Article 16, that waste should be managed as close to its source as possible. This means that the requirements have been tightened, but compliance can be challenging as it may require extensive and resource-intensive supervision.

Higher costs for waste incineration may also lead to waste being landfilled in EU Member States with weaker regulations. For example, Portugal has some of the lowest landfill costs in Europe, and countries such as Italy and the United Kingdom send waste there for landfill.[26]

Higher waste incineration costs caused by the purchase of emission allowances also risk making illegal waste management within the EU more attractive. These are cheaper measures that generally mean that waste is managed less resource-efficiently, especially landfill. This landfill may be illegal and thus create an increased risk of leakage of toxins, plastics and nutrients that have negative effects on the local environment (soil, watercourses and groundwater) and greenhouse gas emissions. Interpol has already warned that illegal plastic management has increased.[27] There are also several new examples of this problem, such as waste being incorrectly declared and exported to Spain for landfill, and plastic waste being stored in buildings in Italy that then burn down.

[26] Waste Sweden (2024).

[27] Interpol (2020).

4. Landfills – trade-offs

Landfills, which are the most common method of waste disposal in the EU, include storage on or in the ground of, among other things, household and industrial waste, ash from energy production and contaminated soil. The biggest climate impact from landfills is methane emissions to the air from the decomposition of organic waste, which inevitably occurs over a long period of time. Generally speaking, 95–99 per cent of emissions are of organic origin.

The primary question addressed in this analysis is whether landfilling should be included in the EU ETS. Initially (section 4.1), we show that it is almost always better for the climate to incinerate mixed organic and combustible waste than to send it to landfill. This means that including landfill in the EU ETS not only needs to create incentives for reduced emissions from landfill, but also needs to steer towards less landfill. In section 4.2, we therefore examine whether it is possible to create these incentives by including landfill in the EU ETS. Finally, in section 4.3, we examine whether it is possible to create these incentives in other ways. This analysis then forms the basis for a more in-depth analysis in chapter 5.

4.1 Waste incineration or landfill from a greenhouse gas emissions perspective

Comparing waste incineration and landfill from a greenhouse gas perspective is not easy, partly because the emissions have different primary sources. In waste incineration, the primary source is carbon dioxide emissions from the incineration of fossil plastics, while the primary source for landfill is organic material that decomposes and forms methane emissions. This means that emissions are also affected by the composition of the waste – a high proportion of plastic in waste incineration results in high emissions, while in landfill it can mean lower emissions.

Most scientific life cycle assessments (LCA) show that waste incineration with energy recovery is preferable from a climate perspective to landfilling the same waste.[28] However, LCA calculations that assume high efficiency in the collection of methane from landfills and the recycling of this methane into energy[29] may lead to landfill being preferable to waste incineration. For example, there's an American study that shows that landfilling is a better option if landfill gas collection is over 81 per cent and there's energy recovery from the gas, or over 93 per cent if the gas

[28] Anshassi & Towsend (2021). The studies concern combustible and organic waste.

[29] However, when methane is converted into energy, carbon dioxide is created. This carbon dioxide could be stored and possibly classified as a permanent sink. However, this may require that the proportion of fossil origin can be accounted for. If a certain proportion is considered to be of fossil origin, the issue of sustainability certification will cause problems for users of landfill gas, as they will need to surrender emission allowances for what is not considered sustainable and biogenic.

isn't recovered.[30] At the same time, this study shows that it is only under very specific conditions that the collection rate can approach 80 per cent, e.g. the concentration of non-methane organic compounds needs to be high, the waste feed rate needs to be high and the decomposition rates need to be low. At the same time, there are LCA studies that show that material recycling, gasification and anaerobic digestion result in lower emissions than both waste incineration and landfill.[31] However, this conclusion may change if CCS is available for waste incineration and the biogenic fraction is high enough to generate negative emissions.[32] However, it will still generally be more effective to take measures as high up in the value chain as possible, probably also in the longer term.

4.1.1 There are also other advantages

In addition to the climate benefit, there are also other advantages to not landfilling combustible waste. Combustible waste is often fossil-based and decomposes slowly, but chemicals, microplastics and carbon dioxide will leak during the decomposition process. Less land is also needed for landfills if the waste is disposed of in other ways. Certain types of combustible waste, such as fluff (residue from fragmentation[33]), create a risk of subsidence in landfills. This, in turn, can compromise the impermeable layers, with a risk of increased permeability. A large amount of plastic in landfills also risks creating subsidence that leads to cracks in the sealing layer, which in turn leads to more methane leaking out. In the worst case, this can have a greater impact than if the plastic is incinerated.

It is worth noting that even the disposal of clean plastic in separate landfills can be problematic. Although this could mean that fossil carbon dioxide is not released into the atmosphere, other environmental problems are created. In addition, requirements for this measure would create a risk of illegal handling. The consequence of this is that plastic is still incinerated, but without energy recovery. If this risk cannot be counteracted, this may be a worse option from a climate perspective.

4.2 Incentives for reduced emissions by including landfill in the EU ETS

Including landfill in the EU ETS would mean that emissions that are not of fossil origin would be included in the emissions trading system. It also means that emissions from a biological anaerobic decomposition process would be covered by the EU ETS for the first time, which otherwise primarily covers combustion and

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[30] Anshassi et al. (2021).

[31] See, for example, Ouedraogo et al. (2024).

[32] See Chandel et al. (2012) for an analysis of CCS in waste incineration.

[33] Mechanical separation of materials for material recycling.

process emissions from industry.[34] This means that no one has ever had to surrender emission allowances for methane emissions before. It also means that emissions with greater uncertainty will be included in the EU ETS. Including landfilling in the EU ETS therefore represents a major change.

As we have shown in section 4.1, it is almost always better to incinerate waste than to landfill it. This is also justified by the fact that it is in line with the EU waste hierarchy. A key question is therefore whether including landfilling in the EU ETS can create incentives for less landfilling of combustible and organic waste.

New Zealand has included methane emissions from waste sent to landfill in its emissions trading system – NZ ETS (see fact box for experiences from NZ ETS). The aim is therefore not to reduce emissions from waste that has already been landfilled. Including already landfilled waste in the EU ETS would be considerably more challenging, partly because it is not always clear who is responsible for a closed landfill site.

Fact box NZ ETS

Landfills were included in the NZ ETS in 2013, and waste incineration plants are also included. However, small landfills that are far from larger landfills are exempted as the administrative cost is considered to be too high. Small landfills that are geographically close to larger landfills are not exempted, as there is a risk that many small landfills will replace a larger landfill, which is generally more efficient. The inclusion of landfills in the NZ ETS has created incentives for investment in landfill gas capture, where the gas is most often used for electricity production. As it is the operator who deposits the waste who pays for the emissions, this has meant that landfill owners have increased their revenues through the capture of landfill gas. However, this is not entirely unproblematic, as it creates a vested interest in not expanding waste incineration, for example.

The NZ ETS in 2013 is based on a standardised emission factor of 0.91 tonnes of CO_2 eq. per tonne of waste; before 2022, it was 1.19 tonnes of CO_2 eq. per tonne of waste, unless another value could be justified. One effect of including landfill in the trading system is that the incentives to collect landfill gas have increased.

The emission factor used in New Zealand is similar to estimates for the EU. The European Waste Incinerators Association (CEWEP) has estimated emissions from waste in landfills to be:

- 1.0 tonnes CO_2 eq. per tonne of waste in landfills with poor or no methane collection and flaring.
- 0.6 tonnes CO_2 eq. per tonne of waste in conventional landfills with flaring and an average methane recovery rate of 50 per cent.
- 0.3 tonnes CO_2 eq. per tonne of waste at a methane collection rate of 80–90 per cent.[35]

[34] However, carbon dioxide leakage for transport to storage (CCS) is already counted as fossil fuel within the ETS, regardless of origin (biogenic/fossil). Since its adoption in 2003, the ETS Directive has listed methane as a regulated greenhouse gas in Annex II, but this greenhouse gas has not been implemented in any of the activities mentioned in Annex 1 until methane emissions are included for shipping from 1 January 2026.

[35] CEWEP (2022).

The companies Suez, Veolia and Wagaenergy have made calculations for France that show comparable results.[36] These calculations are based on the assumption of a 100-year perspective on greenhouse gases. This is significant because methane has a short lifespan in the atmosphere compared to carbon dioxide. If a 20-year perspective is used instead, the above emission factors for landfills increase by a factor of three. There are also studies in the scientific literature that consider a 20-year perspective to be a more relevant starting point.[37]

Emissions from landfills are subject to greater uncertainty than emissions from waste incineration, as they depend on the composition of the waste, the climate (temperature and precipitation), compaction and the covering of the landfill. This applies both when emissions are estimated using calculations and measurement methods. Measurements of landfill gas capture also have measurement uncertainties. The measurement uncertainty for the volume of gas collected can be ±5–±10 per cent. To assess the total uncertainty, it is also necessary to consider how much gas has been formed in total. Scientific studies indicate a total uncertainty of ±20–±50 per cent for calculation methods.[38] The United Kingdom reports measurement uncertainties of around ±53 per cent as a 95 per cent confidence interval.[39] However, a new satellite study shows that the reported values are significantly underestimated.[40]

4.2.1 Landfill emissions in relation to emissions from waste incineration

To avoid waste ending up in landfill instead of being sent for waste incineration, even though the latter is almost always a better option from a climate perspective (and in line with the waste hierarchy), the emission factors used need to be reasonable. In Figure 1, we compare average emissions per tonne of waste for waste incineration in 17 different Member States with methane emissions from landfills based on the default value used in New Zealand's national emissions trading system (NZ-ETS). To take into account the greater uncertainty surrounding emissions from waste going to landfill, we have also included a conservative default value that is 30 per cent higher than that used for landfill in the NZ-ETS. A higher default value can also be justified based on the uncertainties reported in the research and the fact that it may be relevant to consider a shorter GWP time horizon than 100 years in this case.

The figure shows that waste incineration has lower emissions per tonne of waste than landfills on average, and that the difference is even greater if a conservative estimate is used. Another conclusion is that emissions from waste incineration vary

[36] 2310_WAGA-SUEZ-VEOLIA_Landfill-Study_Report_vsent231011.pdf

[37] See, for example, Wang et al. (2019)

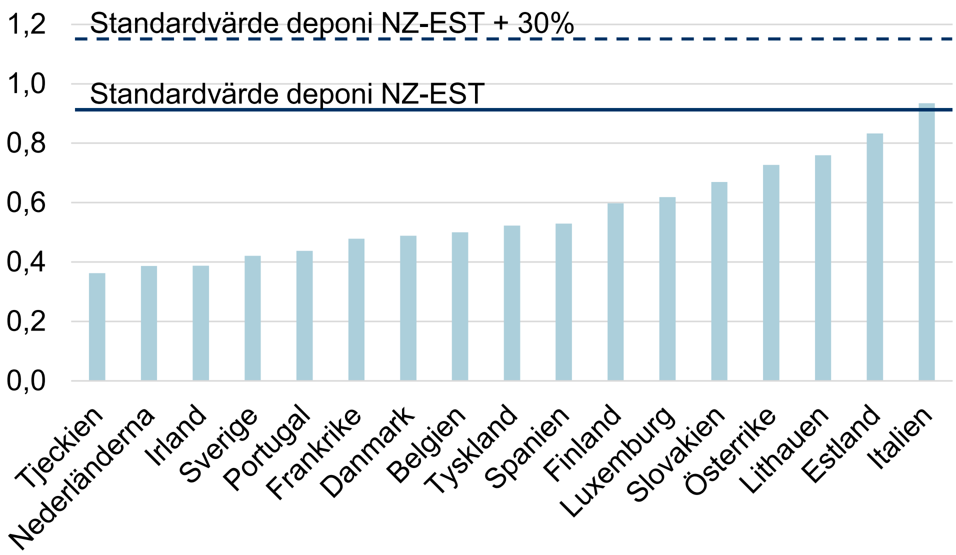
[38] Pheakdey et al. (2023).

[39] Sector, Gas, and Uncertainty Summary Factsheets - Greenhouse Gas Emissions

[40] Dogniaux et al. (2025).

considerably between countries. Italy's average emissions from waste incineration are in line with the default value used in the NZ-ETS.

Figure1 . Emissions from waste incineration in EU Member States and default value for methane emissions from landfilling (tonnes CO_2 eq. per tonne of combustible and organic waste)



Emissions (fossil carbon dioxide) from waste incineration on average for different EU countries according to Delft (2025). Emissions for Italy may be too high as the official statistics are incomplete. Compared to the standard value for methane from waste in landfills in the NZ ETS since 2021 and 30% higher to account for the extra uncertainty.

The figure does not take into account landfill gas capture. As already mentioned, emissions with 50% methane capture can be 0.6 tonnes CO_2 eq. per tonne, which is lower than greenhouse gas emissions from waste incineration in several EU Member States. However, this does not take into account the greater uncertainty associated with landfill emissions.

4.2.2 Increased risk of illegal handling

High default values for emissions from landfilling could motivate waste to be managed earlier in the value chain. At the same time, this means that the costs of landfilling increase, making it more profitable to manage waste illegally (see also section 3.4).

4.3 Other alternatives – Sweden's experience

Reducing the risk of waste ending up in landfill if waste incineration is included in the EU ETS does not necessarily require landfill to also be included in the EU ETS. Sweden is a good example of this.

There are currently 239 active landfills in Sweden[41] , as well as several thousand closed landfills. The ban on landfilling organic and combustible waste has helped

[41] According to the Swedish Environmental Reporting Portal, extract 1 December 2025.

to reduce emissions compared to what was previously the case. Bans on landfilling combustible waste and organic waste were introduced in Sweden in 2002 and 2005, respectively. However, exemptions may be granted in certain situations. In 2000, Sweden introduced a landfill tax on waste with the aim of steering waste away from landfill.[42] There are also EU legal requirements for mandatory sorting and separate collection of biodegradable waste (food waste and garden waste), which were introduced nationally at the beginning of 2024.[43] In addition, there are also policy instruments that have indirectly contributed to reducing the landfilling of organic material, such as regulations on municipal waste planning[44] (NFS 2020:6) and regulations on producer responsibility for certain goods. Sweden has also established support for investments and production of biogas. In addition, measures have been taken to reduce the amount of hazardous waste going to landfill.

Stricter regulations and technological developments have led to a sharp decline in the amount of waste sent to landfill in Sweden. In 2000, over 20 per cent of municipal waste was sent to landfill, compared with less than 1 per cent today. However, municipal waste accounts for only a fraction of the total waste sent to landfill in Sweden. The majority consists of non-combustible waste, particularly in the form of mining waste and soil. Greenhouse gas emissions from landfills have fallen by 90 per cent since 1990, and this decline is expected to continue.[45] Emissions from landfills are estimated to be 0.5 Mtonnes CO_2 equivalent in 2023. The Swedish greenhouse gas inventory assumes that 25 per cent of landfill gas is captured. With the ban on landfilling combustible and organic waste, waste that previously ended up in landfills has instead been sent for incineration with energy recovery, which has shifted emissions.

The reduction in emissions from landfills is mainly due to changes in waste management through reduced landfilling and an increase in the amount of non-hazardous waste going to incineration with energy recovery (see Figure 2). In addition to increased waste incineration, the reduction in emissions is due to several factors, primarily the increase in methane recovery from landfills and the decrease in landfilled organic waste, together with increased waste incineration and material recycling. This development is driven by both legislation and other policy instruments, in particular the aforementioned landfill ban. Overall, emissions from waste management in Sweden have decreased by approximately 15 per cent since 1990. However, this reduction would have been significantly greater, around one third, if net waste imports had not increased sharply, with a large proportion of this

[42] Prop. 1998/99:84.

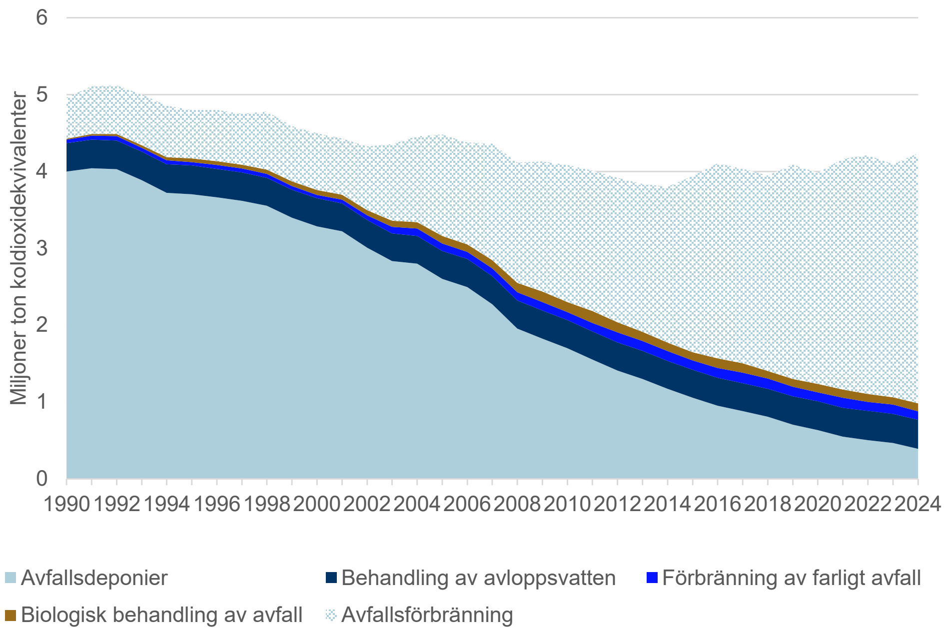
[43] Directive 2008/98/EC of the European Parliament and of the Council on waste and updating of the Waste Ordinance (2020:614) through an amendment decided by the Government on 22 December 2022 (amending Regulation (2022:1871) amending the Waste Ordinance.

[44] NFS 2020:6.

[45] Waste, greenhouse gas emissions

going to waste incineration. Approximately one quarter of the waste incinerated in Sweden today is imported.

Figure2 . Emissions from waste treatment in Sweden, including waste incineration



5. Policy instrument analysis

In this chapter, we highlight the consequences of a number of different policy instrument scenarios based on the aim of reducing greenhouse gas emissions from waste that ends up in waste incineration or landfill. The analysis is based on an EU perspective, which means that existing national legislation is not taken into account. Nor does it take into account the fact that EU regulations related to the circular economy are expected to develop in the future and create more incentives for the reuse and recycling of plastic. The actual effects are therefore much more difficult to assess than is done in this analysis. However, the purpose of the analysis is to create a greater fundamental understanding of the major advantages and disadvantages of including waste incineration and landfill gas in the EU ETS.

The following five scenarios are compared:

1) *Baseline scenario:* The current system is retained, i.e. policy instruments for reducing emissions from waste-to-energy plants and landfills are decided and applied at Member State level.
2) *Scenario – waste incineration in the ETS*: Requirement for waste incineration plants in the EU to be included in the EU ETS, but other policy instruments are managed at Member State level.
3) *Scenario – waste incineration in the ETS and landfill ban*: Requirement for waste incineration plants to be included in the EU ETS and a ban on landfilling combustible and organic waste to be introduced in the Landfill Directive.
4) *Scenario – waste incineration and landfill in the ETS*: Requirement for waste incineration plants and landfill to be included in the EU ETS based primarily on measured values, but taking into account that landfill of plastic is not appropriate.
5) *Scenario – waste incineration and landfill with standard emissions in ETS*: Requirement that waste incineration plants and landfill sites be included in the EU ETS, but where emissions from landfill sites are based on a number of conservative high standards, i.e. values that do not underestimate the actual emissions from new waste ending up in landfill sites[46] .

These scenarios have been developed to make the analysis transparent and to identify clear differences. To create a transparent comparison, we have used the criteria in Table 1. In reality, some of the scenarios can be combined, which we also discuss at the end of the chapter.

[46] Since decisions may cause capture to change over time, the effect of capture should not be fully taken into account, but at the same time be sufficiently balanced to create incentives for increased capture.

Table1 . Criteria and indicators for the analysis of policy instruments

Criterion	Indicator	Description
A. Climate and environmental benefits	A.1 Incentives for reduced landfill	The ability of the policy instrument to create incentives for reduced landfill in accordance with the waste hierarchy.
	A.2 Incentives for reduced emissions from waste incineration	The ability of the policy instrument to create incentives for reduced emissions from waste incineration.
	A.3 Incentives for reduced emissions from landfilling	The ability of the policy instrument to create incentives for reduced emissions of landfill gas from landfills.
B. Cost-effectiveness	B.1 Uniform price on emissions	The ability of the policy instrument to create a uniform price for emission reduction measures for waste incineration and landfills, taking into account uncertainties in emission values.
	B.2 Incentives for technological development of CCUS and measures higher up in the value chain.	The ability of the policy instrument to create incentives for technology development and learning that enable lower costs for CCUS in waste incineration and measures higher up in the value chain.
C. Feasibility	C.1 Administrative burden	The costs of implementing and enforcing the policy instrument for the state and companies respectively.
	C.2 Technical feasibility	The technical conditions for measurement and verification.
	C.3 Risk of circumvention	Waste is handled in a way that undermines the purpose of the regulations. Also concerns the risk of illegal waste management.
	C.4 Political acceptance	The conditions for the policy instrument to be compatible with the priorities, ambitions and comparative advantages of several countries. However, this indicator is sensitive to changes in the external environment.

5.1 Baseline scenario

This scenario is based on the assumption that policy instruments for reducing emissions from waste incineration and landfills will continue to be decided and applied at Member State level, i.e. that no significant policy changes will be implemented at EU level. In countries with waste incineration plants in the EU ETS, the high price of incineration may lead to increased landfilling (some of it illegal) or to certain smaller plants switching fuels. Our assessment is that some waste incineration will find it difficult to compete with alternative waste processes in other countries. This, in turn, may lead to some waste incineration plants closing down or to waste incineration plants blacklisting certain waste streams with a high plastic content in order to reduce their emissions and thus their costs. However, the effect is very difficult to quantify. This is partly because waste incineration serves several purposes and, in some contexts, can be operated at a loss. In addition, some of the waste may end up in waste-to-energy plants in Member States that have chosen not to include them in the EU ETS.

Climate and environmental benefits

This scenario is likely to result in less waste incineration with energy recovery and increased landfilling compared to other scenarios, with the possible exception of the scenario where only waste incineration is included in the EU ETS. The reason for this, as already mentioned, is that waste incineration included in the EU ETS will find it difficult to compete with landfill[47] or, alternatively, less energy-efficient incineration in other countries when the price of emission allowances rises. This scenario also means that it will be difficult to achieve profitability in post-sorting facilities and CCUS at waste incineration plants. This applies in particular to investments in CCUS, as this is very expensive.

From a climate perspective, increased landfill of plastic alone, provided it is managed appropriately, can result in lower emissions. However, such a development would not be in line with the underlying principles of the waste hierarchy and would not be desirable from a resource efficiency perspective. In addition, landfilling plastic can cause subsidence in landfill liners, leading to increased methane emissions, which in the worst case could lead to increased greenhouse gas emissions.

Cost efficiency

This scenario means that countries will have different incentives for waste management and that suboptimal solutions may be created. One consequence of this could be that waste is transported unnecessarily long distances or that certain countries choose not to accept mixed waste even though they have facilities that can effectively handle this waste. It also means that more waste may end up in waste incineration that only produces electricity and thus has lower energy efficiency.

This scenario will not create a uniform price for emissions. Nor will it create long-term incentives for CCUS in waste incineration, as this will not be profitable unless individual countries provide substantial support. The technological development of CCUS within the EU may therefore be hampered if waste facilities are not included in the EU ETS, which in turn will have negative effects on the conditions for other

[47] Unless, for example, landfill taxes are introduced that counteract this.

sectors that depend on CCUS for their transition. The transport sector may thus find it difficult to increase its use of e-fuels, which could make it more expensive to meet the EU's long-term climate targets.

It is also likely that some countries that have currently chosen to include them in the EU ETS will choose to exclude them from the system to protect them from higher costs. In that case, it will require more national support to bring about the necessary investments in CCUS, which risks making the transition more expensive.

Feasibility

The administrative burden will be comparable to today. However, the lack of harmonisation of regulations to reduce emissions in the EU can be expected to contribute to an increased risk of circumvention within the Union, as the economic benefits of doing so may increase. This could involve companies exploiting weaknesses in individual Member States' regulations and their implementation, as well as an increase in illegal waste management and the export of waste outside the Union.

The scenario is considered to be advantageous for large European waste companies with a lot of landfill, as profitability may increase. It may also generate revenue for Member States with weaker landfill regulations. The scenario is expected to disadvantage countries that have waste incineration in the EU ETS and regulations that severely restrict the possibility of landfill.

5.2 Scenario – waste incineration in the ETS

In this scenario, requirements to include waste incineration plants in the EU ETS are introduced, but no additional policy instruments to reduce emissions from landfills are introduced at EU level. As in scenario 1, this risks leading to more waste ending up in landfill (partly illegally, see section 3.5). Compared with the baseline scenario, however, slightly more investment in post-sorting facilities can be expected in this scenario.

Climate and environmental benefits

In this scenario, waste incineration plants will need to purchase emission allowances corresponding to their emissions, thus creating increased incentives to implement efficiency measures that reduce emissions from these plants. At the same time, there is a risk that the larger capital-intensive investments in CCUS technology needed to bring emissions close to zero will not be made, as it may be more profitable to send a larger proportion of waste to landfill (partly illegally). As in the previous scenario, increased landfill of plastic may, at best, result in lower climate emissions, but this is not desirable from a resource efficiency perspective or compatible with the waste hierarchy. There is therefore a real risk that this scenario will not provide sufficient incentives for investment in CCUS unless the EU introduces further regulation of landfills.

However, the outcome may be slightly better than the baseline scenario, as a price on emissions from waste incineration may provide incentives for investment in post-sorting facilities that enable increased material recycling and increased biological treatment, e.g. biogas production. However, it is uncertain whether the effect of this will be greater than the effect of more waste ending up in landfill (partly illegally).

Cost-effectiveness

A uniform price on emissions from waste incineration creates a certain increase in cost efficiency compared with the baseline scenario, as more efficient facilities are favoured and investments higher up in the value chain can become profitable. However, in a scenario where no additional regulation of emissions from landfills is introduced, the difference compared to the baseline scenario is considered to be limited. As we see that this scenario will not provide sufficient incentives for investments in CCUS, Member States may need to provide extensive support for such investments in the long term, which may increase the cost of the transition.

Feasibility

The administrative costs of waste incineration will increase slightly compared to the baseline scenario, as more facilities in the EU will need to measure and verify emissions from incineration when they are included in the EU ETS. At the same time, systems for measuring and verifying emissions have already been developed (see section 3.1.1), as some countries have taken the lead and already included them in the EU ETS, which would make it easier for new businesses.

At the same time, greater administrative consistency is created in the EU, which can reduce administrative costs for companies and authorities, partly because certain costs can be shared and companies do not have to deal with several different sets of regulations.

As in the baseline scenario, there is a risk that waste will end up to a greater extent in countries with weaker regulations on landfilling (including outside the EU) or that waste will be handled illegally. As more facilities will be affected by an emission price that is expected to rise in the future, this risk is considered to be greater than in the baseline scenario.

As the price of emission allowances increases, this scenario could lead to increased auction revenues from the EU ETS for countries that currently have a high level of landfill and weaker waste legislation, which over time could disadvantage countries with high levels of waste incineration.

5.3 Scenario – waste incineration in the ETS and landfill ban

In this scenario, requirements are introduced to include waste incineration in the EU ETS, while at the same time a ban on landfilling combustible and organic waste is introduced at EU level. This scenario corresponds to the approach chosen by Sweden. The consequence of this is expected to be a reduction in the risk of waste ending up in landfill instead of being incinerated, compared with the first two scenarios. This scenario is therefore more in line with the conclusion drawn in section 4.1. An increasingly high price for emission allowances will make measures earlier in the value chain more attractive, and CCUS investments in waste incineration plants may become justified. The expected effect of the proposal may be partially offset by the risk of increased illegal waste management and waste exports outside the EU.

Climate and environmental benefits

This scenario is expected to result in more waste being recycled and/or incinerated with energy recovery. A higher ETS price also creates incentives for energy efficiency measures, including more investments in combined heat and power plants within the EU, and investments in CCUS. However, no incentives are created for landfill gas capture. The expected climate and environmental benefits may be partially limited by an increased risk of illegal waste management and waste exports outside the Union.

Cost-effectiveness

A uniform price on emissions from waste incineration could increase cost-effectiveness. To a certain extent, cost-effectiveness can also be increased by a ban on landfilling organic and combustible waste. However, this is not to the same extent as in scenarios where landfilling is included in the EU ETS, as this also creates a uniform price for landfill gas emissions (see scenarios in sections 5.4 and 5.5).

Expectations that the price of emission allowances will increase as the number of emission allowances in the EU ETS decreases are expected to create favourable conditions for developing and investing in CCUS at waste incineration plants, as well as for investments higher up in the value chain, for example in material recycling.

Feasibility

As in the previous scenario, the administrative costs of waste incineration will increase as more activities are included in the EU ETS and need to measure and report their emissions in a new system. A ban on landfilling organic waste will also generate administrative costs, as the costs of supervision for designated supervisory authorities may become burdensome as the risk of illegal handling increases.

However, increased harmonisation of regulations at EU level and the stricter regulation of landfills adopted in this scenario create better conditions for costs and benefits to be distributed in a more socio-economically efficient manner throughout the EU.

From an administrative perspective, we see that this scenario would benefit countries with low landfill rates and efficient waste incineration facilities. Countries where a large proportion of waste is currently landfilled would need to introduce regulations that severely restrict this, which could have a significant impact on landfill companies in these countries. These countries would also likely need to devote significant resources to ensuring that waste is not handled illegally.

5.4 Scenario – waste incineration and landfill in the ETS

In this scenario, a requirement is introduced to include both waste incineration and landfill in the EU ETS based on measured values. This scenario creates incentives for reduced emissions from waste incineration and landfill gas capture in new landfills. Including landfill in the ETS can also be expected to increase incentives for biogas production or for the biogenic carbon atoms in organic waste to be used as a resource in other processes, as these measures become more profitable. At the same time, there is a risk that landfill owners in this scenario will not fully take into account the greater uncertainty associated with emissions from landfilling, which may counteract the effects that are desirable from a societal perspective (which also take into account the environmental risks of landfilling plastics, see section 4.1.1).

Climate and environmental benefits

This scenario is expected to result in less waste ending up in landfill and thus more waste being recycled and/or incinerated with energy recovery. A higher ETS price also creates incentives for waste incineration to make energy efficiency investments, including more combined heat and power plants, and investments in CCUS within the EU. It also creates incentives for the capture of landfill gas, as these emissions are priced in the ETS. However, these desirable effects may be limited by landfills using unreasonably low emission values to reduce their costs for emission allowances.

Cost-effectiveness

A uniform price for emissions from waste incineration and landfill creates a more equitable and uniform regulation of the climate impact of the entire waste sector. By pricing emissions in the same way, conditions are created to first reduce emissions where costs are lowest. Compared to previous cases, this creates, at least in theory, a more cost-effective management of waste from a greenhouse gas perspective. In practice, however, cost-effectiveness is limited by uncertainties surrounding the measurement and verification of emissions from landfilling. In this scenario, this risks having a major impact, as it is based on the assumption that the greater uncertainty surrounding emissions from landfilling does not need to be taken into account. In reality, the effect may therefore be that landfill companies anticipate low emission factors, as this would strengthen their attractiveness at the expense of measures higher up in the value chain, such as waste incineration. Cost-effectiveness may also be reduced as a result of the risk of illegal waste management or the export of waste outside the EU.

An expected increase in the price of emission allowances and the fact that the EU ETS is considered a long-term policy instrument mean that this scenario creates predictability and economic incentives for the development of CCUS in waste incineration, post-sorting, etc. However, this effect may be limited if the uncertainty in emission factors for landfilling is not taken into account. Incentives for measures higher up in the value chain/waste hierarchy should also be created, but this is limited by the fact that it is not the actors who have control over the generation of waste who are affected by the policy.

Feasibility

The administrative costs for waste incineration plants will increase compared to the baseline scenario, as plants will need to measure emissions when included in the EU ETS. Similarly, the administrative costs for landfill companies will increase. If the same rules apply as currently do for Sweden and Denmark, , it is the larger waste incineration plants that must carry out measurements, while the smaller ones can use a standard rate. With this arrangement, only the larger plants will face new costly requirements. In the long term, smaller waste plants should also be required to measure emissions, so that plastic is not diverted to smaller plants. Many smaller plants already have the necessary measuring equipment. However, the higher measurement uncertainty from landfills creates a particularly big challenge as there is a risk that too low emissions of landfill gas will be reported, which may be deliberate on the part of the companies but does not have to be. This creates greater demands for verification and supervision, which increases the administrative costs for supervisory authorities and verifiers.

The risk of circumvention is considered to be greater than in the previous cases, as the risk of illegal handling increases further as it also becomes more attractive to handle landfill illegally within the Union. It will therefore become more attractive to dispose of waste in landfills that do not comply with EU regulations. There may also be an increase in waste exports from the Union.

As in the scenario with a ban on the landfilling of organic waste, countries with little landfilling and efficient waste incineration plants will benefit. Countries with a lot of landfilling will be disadvantaged. Acceptance of this scenario may also be limited by the fact that the environmental integrity of the EU ETS will be impaired if more uncertain emissions from landfilling are included without this uncertainty being addressed. In this scenario, emission reductions that are easy to quantify and verify, such as reduced use of fossil fuels, are equated with uncertain emissions from landfilling.

5.5 Scenario – waste incineration and landfill with high default values in the ETS

In this scenario, there is a requirement to include waste incineration in the EU ETS based on measured values. Landfilling is also included in the EU ETS, but based on predetermined templates that take into account the degree of landfill gas capture and its use. The default values are also assumed to take into account that emissions from landfill have greater uncertainty, i.e. the emission factors per tonne of combustible and organic waste that ends up in landfill are high (see section 4.2.1). This scenario has great similarities with the previous scenario. However, the fact that landfill owners are not allowed to specify emission values for landfilling that do not take into account the greater uncertainty involved means that the outcome is likely to be more socio-economically justified. It is therefore more likely that this scenario will lead to measures that are more in line with the waste hierarchy, i.e. waste incineration plants, material recycling, biogas production, etc. will become more attractive at the expense of landfill.

Climate and environmental benefits

The use of high standardised emissions for landfill is expected to lead to widespread compliance with the waste hierarchy and thus to a reduction in the amount of organic and incinerable waste that ends up in landfill compared to if landfill owners were allowed to specify emission values.

As in the previous scenario, an increasingly high price for emission allowances creates incentives for investments that reduce greenhouse gas emissions from both waste incineration and landfills, but probably also investments earlier in the value chain that enable lower greenhouse gas emissions.

Cost-effectiveness

A uniform price for emissions from waste incineration and landfills creates increased cost-effectiveness. The use of high emission default values for landfilling is expected, at least initially, to lead to more cost-effective reductions in emissions. However, this cost-effectiveness may be offset by the risk of illegal waste management or waste being exported outside the EU.

As in the previous scenario, clearer and longer-term incentives are created for CCUS on waste incineration and measures that promote the reuse and recycling of materials.

Feasibility

The administrative costs for waste incineration plants will increase compared to the baseline scenario, as emissions need to be measured when included in the EU ETS. The same applies to the administrative costs for landfills, but the use of templates significantly limits the cost. The use of emission templates also reduces the resources needed for verification and monitoring of emissions from landfills.

The risk of circumvention is assessed to be slightly lower than in the previous scenario, as it will be more difficult for individual operators to report low emission values from landfills. At the same time, the increased costs pose a continued risk of increased illegal waste management in the EU.

This scenario is considered to have the greatest socio-economic efficiency for the EU as a whole, as the use of default emissions for landfilling contributes to a greater extent to more resource-efficient waste management and means that the costs of greenhouse gas emissions and other environmental impacts are distributed more correctly in society. As in the previous two scenarios, where landfilling becomes less attractive, this scenario is beneficial for countries with low landfill rates today. This scenario is also not considered to jeopardise the environmental integrity of the EU ETS, provided that emission factors are used that reasonably take into account the uncertainty associated with emissions.

5.6 Summary observations

Table 2 summarises the advantages and disadvantages of the policy scenarios for waste incineration and landfill analysed in this chapter. These scenarios have been selected based on the question of whether waste incineration and landfill should be included in the EU ETS.

Overall, we see the greatest advantages in including both waste incineration and waste sent to landfill in the EU ETS, but using high default values for landfill. Another alternative is to include waste incineration in the EU ETS and at the same time introduce a ban on the landfill of combustible and organic waste. Our assessment is that these two options are the ones that best comply with the principles of the EU waste hierarchy and, of the scenarios analysed, offer the greatest cost-effectiveness and socio-economic efficiency for the EU as a whole. Both options have the potential to reduce emissions from the incineration of fossil plastics and ensure a level playing field between Member States. It is also important to avoid distortions when emissions from the heating of buildings are included in the EU ETS2 from 2027. If waste incineration continues to be exempted, this could give it an unjustified cost advantage over other heating fuels.

Including waste-to-energy plants in the EU ETS and introducing a ban on the landfilling of combustible and organic waste does not create any incentives for landfill gas capture. A ban may also have lower compliance rates.

A major challenge in both of these options is the risk of illegal waste management. This is because the costs of waste management can only be passed on upstream in the value chain to a limited extent. This creates an opportunity for operators to earn significant sums from illegal waste management, thereby avoiding the costs of emission allowances. This could involve both illegal management within the EU and illegal export of waste. Another consequence of costs not being passed up the value chain is that the price of goods placed on the market does not reflect the actual cost of waste management. Since approximately 95 per cent of fossil emissions from waste incineration come from plastic, this concerns goods made of plastic. When the costs of the environmental and climate impact of plastic are not reflected in the price, this leads to unnecessarily high consumption of plastic from a socio-economic perspective.

One way to ensure that a larger proportion of the cost is shifted upstream to producers who place products containing plastic on the market is to introduce such requirements within relevant producer responsibility schemes. This could be done, for example, by requiring producer responsibility organisations to bear the emission allowance costs for waste incineration. In theory, producers who use recycled plastic should not have to pay such a cost. In practice, however, this may be difficult to implement, as it risks leading to more recycled plastic being allocated to products sold on the EU market, which could create market distortions and undermine the effectiveness of the system.

Table2 . Summary of assessment of scenarios based on criteria

Scenario	Climate and environmental benefits	Cost-effectiveness	Feasibility
1. Base scenario	Weak incentives for reducing emissions from waste incineration and landfill gas capture.	Countries will compete for waste and suboptimal solutions will be created.	Administrative as today. Low socio-economic efficiency as more waste may end up in landfill and competition with other electricity and heating alternatives is distorted. Countries that have chosen to include waste incineration in the ETS are disadvantaged.
2. Waste incineration in the ETS	Stronger incentives for reduced emissions from waste incineration, but risk of increased landfill.	Uniform price for emissions from waste incineration, but increased risk of more landfill, some of it illegal.	Increased costs for measuring emissions from waste incineration. In the long term, there is a risk that countries with high levels of waste incineration will be disadvantaged and countries with high levels of landfill will be favoured compared to today. Increased risk of illegal waste management.
3. Waste incineration in the ETS and landfill ban	Stronger incentives for reduced emissions from waste incineration and less landfilling of combustible and organic waste, but the effect is uncertain due to the risk of illegal waste management and waste exports. No incentives for landfill gas capture.	Uniform price for emissions from waste incineration and harmonised landfill legislation, but risk of illegal waste management or exports.	Increased costs for measuring waste incineration. Higher socio-economic efficiency in the EU, but countries with highly efficient waste incineration will benefit, while countries with high levels of landfill will be disadvantaged compared to today. Increased risk of illegal waste management or exports.
4. Waste incineration and landfill in the ETS	Stronger incentives for reduced emissions from waste incineration and landfills, including less landfilling of combustible and organic waste. However, the effects may be limited if low emission factors are used for landfilling and waste is handled illegally or exported.	Uniform price for emissions from waste incineration and landfill. However, this is weakened by the possibility of using low emission factors for landfill and an increased risk of waste being handled illegally or exported.	Increased costs for measurement and verification for waste incineration and active landfills. Member States with highly efficient waste incineration are favoured, while countries with high levels of landfill are disadvantaged. Increased risk of illegal waste management and export.
5. Waste incineration and landfills with flat-rate emissions in the ETS	Stronger incentives for reduced emissions from waste incineration and landfills, including less landfilling of combustible and organic waste. The effect may be offset by an increased risk of waste being handled illegally or exported.	Uniform price for emissions from waste incineration and landfill that takes into account the greater uncertainties associated with landfill. Cost-effectiveness may be offset by an increased risk of illegal waste management or export.	Increased costs for measurement and verification for waste incineration and active landfills. High socio-economic efficiency in the EU, but countries with highly efficient waste incineration are favoured, while countries with high landfill rates are

	disadvantaged. Increased risk of illegal waste management and export.

Another challenge is that large landfill companies and countries with a high level of active landfill would be disadvantaged. There are private companies with strong interests, particularly in landfills but also in waste incineration plants, which operate in several EU Member States and have a turnover of several billion euros per year. The largest is the French company Veolia, which has a turnover of over €40 billion per year, comparable to large steel companies such as ArcelorMittal and Thyssenkrupp, and which operates in almost all EU countries.

Some resistance can also be expected from waste incineration plants located in countries that have not included them in the EU ETS. This was also the case in Sweden before the plants were included, as the plants' costs increase when they need to purchase emission allowances corresponding to their emissions. In order to enable a smoother transition, free allocation of emission allowances to waste incineration plants may therefore be necessary initially, with a gradual phase-out. This could be justified, for example, by the fact that the plants deal with a socially important waste problem and that the raw material is associated with a real risk of carbon leakage. Compared with other electricity and heat production, which always has to take place locally and cannot be imported from third countries (apart from certain border areas on the EU's external border), there is a risk that the waste will be exported to third countries and handled illegally. It may therefore make more sense to allow waste incineration plants to benefit from free allocation compared to other electricity and heat producers. To achieve this, a new benchmark for waste incineration would need to be introduced in the EU ETS.

The analysis also shows that the baseline scenario, where no change occurs or where only waste incineration plants in the EU ETS are included, is least compatible with the EU waste hierarchy and has lower cost-effectiveness and socio-economic efficiency for the EU as a whole. We therefore see a major advantage in harmonisation within the EU, as the current policy instruments, where much depends on the Member States, are not considered capable of leading us to net-zero emissions within the Union by 2050.

We also see advantages in combining a ban on the landfilling of combustible and organic waste with the inclusion of landfilling in the EU ETS. This would create greater clarity and ensure compliance with the waste hierarchy. The ban could apply to small landfills so that they can be exempted from the ETS. It would also allow for actual emission values from landfilling in the long term, once the technology for this has been developed.

One option for achieving harmonisation is a levy or trading system (or alternatively a tax) that targets the fossil fuel industry or products containing non-recycled plastic based on the plastic's emissions throughout its life cycle, while at the same time setting clear targets for reducing greenhouse gas emissions from waste incineration.[48] This could also take into account other negative effects beyond

[48] Another alternative is to impose a tax on producers of plastic raw materials. These facilities are currently included in the EU ETS. A disadvantage of this alternative is the risk of carbon leakage. This creates a need for a mechanism similar to CBAM, which in the long term also needs to be

greenhouse gas emissions, such as littering and microplastics. The revenue from this levy or trading system could then be used to finance measures to increase material recycling in the first instance, and investments in CCUS on waste incineration in the second instance.[49] It may be politically challenging to impose costs directly on products, but it is worth noting that since 2021, the EU already has a "plastic tax" of €0.80 per kg for plastic packaging that is not recycled.

In addition to generating revenue for the EU budget, the plastic tax aims to create incentives for increased material recycling and a reduction in the amount of plastic on the market. However, it has had limited effect so far, as many Member States have chosen not to introduce a corresponding plastic tax, but have simply paid the tax out of their own national budgets. Revenue from the plastic levy amounts to just over €7 billion per year, which is roughly double what the revenue would be if waste incineration plants in the EU had to pay an emission allowance price of €100 per tonne of CO_2 .

A practical alternative, justified by the fact that the price of plastic products does not fully reflect their environmental and climate costs over their life cycle, could therefore be to increase the plastic tax and possibly introduce a tax on other product streams that contain plastic and are difficult to recycle but administratively easy to monitor. A plastic tax that generates revenue could also be combined with the inclusion of waste incineration plants and landfills in the EU ETS, or alternatively a ban on the landfilling of combustible and organic waste, as this would effectively motivate the necessary investments without increasing the risk of illegal handling or export of plastic waste.

downstream. The Swedish Environmental Protection Agency has stated in a report that this is relatively challenging compared to the goods already included in CBAM (Swedish Environmental Protection Agency, 2025).

[49] For more discussion on this, see, for example, the Swedish Energy Agency (2023), SOU 2024:67, Swedish Environmental Protection Agency (2025).

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