METHANE EMISSIONS FROM NON-HAZARDOUS WASTE STORAGE FACILITIES (ISDND) IN FRANCE

Current state of knowledge, uncertainties and ongoing improvement work

Information Paper

1. Overview of current practices

Non-hazardous engineered landfills (or ISDND in French) are a recognised source of methane emissions, a short-lived climate pollutant with a high global warming potential. In France, these emissions are included in the national greenhouse gas (GHG) inventories compiled annually by Citepa for the Ministry for Ecological Transition, in accordance with international reporting obligations.

Discrepancies have been observed between the estimates produced at national level as part of the inventories and the assessments carried out at the level of individual sites or operators within the sector. These discrepancies can be explained in particular by differences in scale, scope, available data and methodological frameworks. They highlight the value of investigative work and of reconciling national models, reported data and field observations, in order to improve the robustness of the various estimates and their use in the development and monitoring of public climate policies.

According to the national GHG inventory produced by Citepa, landfills account for 75 to 81 per cent of GHG emissions from the waste sector (excluding energy recovery), amounting to approximately 12 $MtCO_2e$ per year (see attachement 1). Industry stakeholders, for their part, estimate that actual emissions are in the region of 6 $MtCO_2e$.

How can such a discrepancy be explained?

The estimates are based on different scopes, datasets and methodological approaches.

- National inventories must comply with a binding regulatory methodological framework, known as MRV, which aims to ensure temporal consistency, transparency, international comparability and the verifiability of data, parameters and methodological implementation in accordance with international guidelines.
- Field measurements and operator data provide valuable supplementary information, but they cannot always be directly extrapolated to the national level without analysing their representativeness, scope/completeness and uncertainties.

2. The main limitations and uncertainties of the estimates

Emissions are estimated differently by Citepa in the national inventory and by each site, based on the following common elements:

- Assumptions **regarding the composition of landfilled waste and its methane-generating potential**: in the national inventory, these are based on ADEME's national surveys (primarily ITOM and MODECOM). The composition of municipal solid waste (MSW) is derived in particular from MODECOM, whilst other waste streams are estimated using available national data. Operators report the quantities and types of waste streams received, but generally do not have the detailed knowledge required to fine-tune the composition assumptions used in the national inventory.
- The **decomposition model**: the national inventory estimates are based on the IPCC decomposition model (first-order kinetics), which spreads methane production over several decades. Other models used in certain studies or operational applications may employ different kinetics, leading to a more concentrated production of methane at the start of the decomposition period.
- The **volume of methane captured** for flaring or recovery: for the national inventory, Citepa estimates this based on the volumes of captured methane reported by operators, mainly as part of their regulatory reporting obligations (notably via GEREP), although some sites may fail to do the reporting for these figures, or do so inaccurately; at individual sites, these volumes are measured by the operators.

Areas for improvement to ensure more accurate national reporting:

- **Refuse from waste sorting facilities:** a better understanding of its composition would enable more accurate estimates of methane generation. Unlike other waste streams, for which specific composition assumptions already exist, sorting refuse waste still requires a more representative characterisation of its actual composition in order to better estimate its methane-generating potential. Currently, the assumption used in the national inventory is that the composition – and therefore the methane-generating potential – of sorting refuse waste is similar to that of municipal solid waste (MSW). However, sorting refuse, which accounts for around 30% of landfilled quantities, measured in mass, appears to have different methane-generating characteristics from MSW, which have yet to be established.
- The annual volumes of **methane captured** for flaring or recovery are not systematically reported for all sites, despite regulatory obligations, which may lead to an underestimation of the total volume captured at national level.

These two points affect the estimate of the **national methane capture** rate, which is based on the ratio between the volume of captured methane at the numerator, and the methane generation from landfilled waste at the denominator.

- The numerator lacks precision due to incomplete reported data.
- The denominator also remains uncertain because it is estimated from activity data and assumptions regarding the composition of landfilled waste derived from the national inventory, which may incorrectly reflect the methane generation associated

with the refuse from sorting facilities, representing approximately 30% of the landfilled waste tonnage.

These uncertainties could contribute to explaining part of the discrepancy between the estimations of industry stakeholders and the national reporting data.

3. Ongoing study: improving understanding of the composition of unsorted waste

The model used in the national inventory follows the IPCC's methodological framework and ensures temporal consistency and the comparability of estimates.

Within this framework, a study is currently being conducted by Citepa, in collaboration with ADEME, FNADE and the Ministry, to improve understanding of the composition of the refuse waste from the various sorting and treatment sectors in France.

This study specifically aims to better characterise the composition of sorting refuse waste actually sent to landfills. It does not cover all landfilled waste streams, nor does it address the IPCC model parameters relating to degradation kinetics or methods for calculating emissions, nor does it concern self-reported data on captured methane.

Key Messages

- Estimates of methane emissions from landfills are based primarily on three methodological elements: the quantity of waste landfilled, its composition, and the degradation parameters of the IPCC model.
- The discrepancies observed between national estimates and certain site-level assessments mainly reflect differences in assumptions and data levels, particularly regarding waste composition and the representativeness of certain activity data.
- The quantification of captured methane relies largely on operators' declarations under regulatory schemes (notably GEREP). This data source is an essential component of the inventory, but there is still room for improvement in terms of the completeness and consistency of the declarations.
- Measurements carried out at certain sites provide useful information on the actual performance of the facilities and show that high capture rates (up to 90 per cent) can be achieved under favourable conditions. However, these results are specific to the sites and periods studied and cannot be directly extrapolated to the entire French fleet. The gradual standardisation of measurement methods could enable these data

to be better leveraged to assess and improve the parameters of the national inventory, without replacing the modelling approach required for a consistent estimate at national level.

- Improving operational practices at landfills is a key driver for reducing methane emissions, particularly through optimising biogas management and the operating conditions of the cells.
- An ongoing study, conducted by ADEME, FNADE, Citepa and the DGEC/DGPR of the Ministry for Ecological Transition, focuses specifically on characterising unsorted waste in order to improve the representation of its composition in the national inventory.

The FSWP is working to raise awareness of the importance of improving practices at landfills worldwide as a climate action. Indeed, in addition to reducing the volumes of landfilled waste with high methane-generating potential, design and operational management practices can contribute to reduce methane emissions into the atmosphere. These practices include:

- *Biogas capture from the very first months of landfill operation,*
- *Operating in bioreactor mode*
- *The installation of an impermeable cover as soon as a cell is closed, and the addition of a layer of soil promoting the oxidation of methane escaping from older cells*

French know-how in controlling methane emissions and capturing biogas is an asset that can be leveraged abroad, particularly in the context of international tenders.

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Citepa is a non-profit organization committed to the ecological transition. It assesses the impact of human activities on the climate and air pollution.It produces reference data and develops solutions to promote the reduction of emissions, improvement of air quality, and adaptation to climate change.

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The French Solid Waste Partnership is a multi-stakeholder platform in the field of waste management, regrouping French stakeholders from State, the local authorities, the NGOs, the companies, and the research and training institutes. Its main purpose is to coordinate and amplify the voice of French waste stakeholders for international advocacy.

Attachment 1

Excerpt from « *Évolution des quantités de méthane généré et capté par période de stockage des déchets* » (SECTEN 2024, p.503)

Citepa

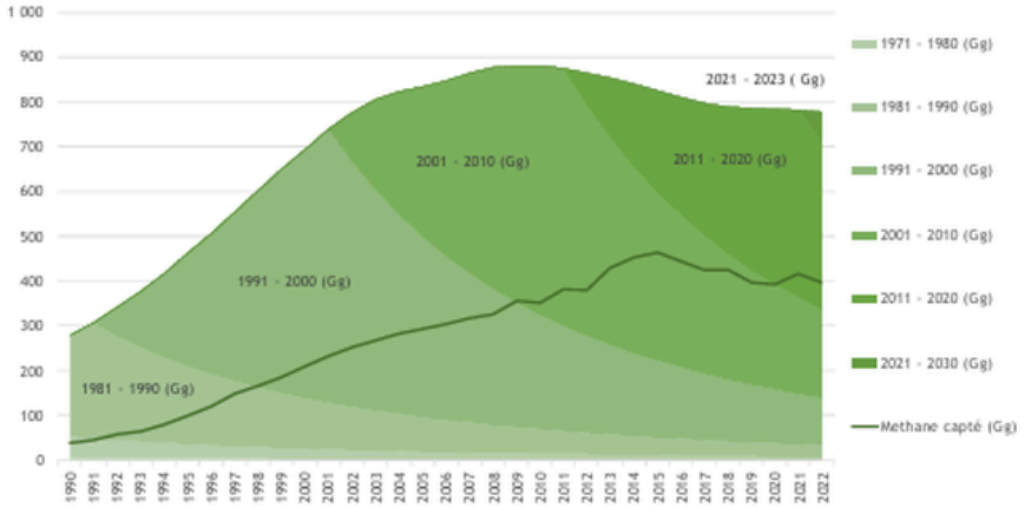
Ces émissions sont essentiellement issues des installations de stockage des déchets. L'évolution en cloche de ces émissions est liée à l'évolution des quantités de déchets stockées, dont le maximum a été atteint en 2003 et qui décroissent du fait des politiques publiques, de la hausse du taux de captage du biogaz et d'une évolution de la composition des déchets stockés.

Les mesures de prévention des déchets à destination des consommateurs, des entreprises et des collectivités, combinées à l'orientation d'une partie de ces déchets vers le recyclage matière a notamment permis de réduire les quantités stockées en ISDND et donc les émissions de CH_4 associées.

Le palier observé dans la décroissance des émissions est lié aux quantités plus importantes stockées en 2006 car les installations de stockage ont reçu les déchets des incinérateurs fermés pour leur mise en conformité avec les valeurs limites des arrêtés du 20 septembre 2002.

Le palier observé à partir de 2016 est lié à une légère augmentation des déchets stockés en 2016 issus des enquêtes ITOM. En 2018, l'enquête ITOM fait état d'une légère augmentation de la quantité de déchets mis en décharge (un peu plus de 5%). Compte tenu de cette augmentation, des cinétiques de dégradation des déchets considérées et d'une baisse de la quantité de méthane valorisé on observe une augmentation des émissions en 2019 et 2020.

Comme indiqué plus haut dans ce rapport, les émissions de CH4 issues des sites de stockage sont estimées sur la base du modèle du Giec (modèle de décomposition d'ordre 1). Ce modèle induit une décroissance des émissions atmosphériques pendant plusieurs décennies. Ainsi, il est possible de modéliser la décomposition des émissions provenant des déchets stockés en fonction de la période à laquelle ceux-ci ont été stockés.



Evolution des quantités de méthane généré (Gg) par période de stockage des déchets

Le graphique ci-dessus présente à la fois les quantités de méthane généré (à ne pas confondre avec le méthane émis) par période de stockage de déchets et les quantités de méthane capté entre 1990 et 2022. Le graphique doit être interprété ainsi : en 2022, le méthane généré par le stockage des déchets provenait à 8,5% de déchets stockés en 2021 et 2022, à 48,3% de déchets stockés entre 2011 et 2020, à 25,5% de déchets stockés entre 2001 et 2010 et à 17,7% de déchets stockés avant 2001.