



*Technical contribution on the treatment of landfill-derived biomethane under Annex
VI of Directive (EU) 2023/2413 (RED III)*

ABOUT WAGA ENERGY

Waga Energy SA is a French industrial company specialised in the production of biomethane from landfill gas. The company designs, finances, builds and operates landfill gas upgrading units across Europe and North America, offering a fully integrated service to landfill operators that transforms a fugitive methane source into a grid-quality renewable gas.

At the core of Waga Energy's activity is its proprietary WAGABOX® technology, which combines membrane filtration and cryogenic distillation to purify raw landfill gas into biomethane meeting the specifications of gas transmission and distribution networks. The cryogenic stage distinguishes WAGABOX® from conventional upgrading solutions by enabling the processing of landfill gas regardless of feedstock variability and nitrogen content, which has historically been the principal technical barrier to biomethane production from landfill gas at industrial scale.

Waga Energy operates 34 landfill gas to biomethane units across France, Spain, Canada and the United States, with an additional portfolio under construction and in advanced development in further European and North American jurisdictions. The company has completed successive rounds of equity and project finance with the backing of industrial and financial investors, and has been listed on Euronext Paris since October 2021. EQT, the Swedish infrastructure fund, is now Waga Energy's main shareholder, holding 86% of the shares.

The company's operational position, working in long term partnership with landfill operators across multiple regulatory jurisdictions, grants it direct visibility on the relationship between collection practices, capture efficiency, energy valorisation of landfill gas, and residual methane emissions at site level. That position is technical before it is commercial, in the sense that Waga Energy's economic model is contingent on the quantity and quality of gas effectively captured at each partner site, which aligns the company's operational interest with the empirical reality of landfill methane abatement.

Waga Energy participates in the European and national debates on the regulatory treatment of landfill-derived biomethane, contributes to industry studies conducted in cooperation with major waste management groups, and works with the authorities in several Member States on the design of sustainability, verification and support frameworks applicable to biomethane from landfill gas. The technical contribution set out in this document rests on that operational and institutional position and is intended to inform the Commission's treatment of landfill-derived biomethane under Annex VI of Directive (EU) 2023/2413.

EXECUTIVE SUMMARY

Annex VI of Directive (EU) 2023/2413 establishes the methodology for calculating the greenhouse gas intensity of biofuels, bioliquids and biomass fuels, including biomethane. For manure-derived biomethane, the Annex recognises a default negative emissions-saved value (esca) that reflects the avoided methane emissions attributable to improved feedstock management. No equivalent treatment is provided for landfill-derived biomethane, notwithstanding that the underlying climate counterfactual is structurally analogous and empirically well documented.

This contribution proposes the inclusion in Annex VI of a default esca value of approximately $-56 \text{ gCO}_2\text{eq/MJ}$ of landfill gas used in biomethane production, derived through a calculation methodology consistent with that already applied by the Joint Research Centre to manure-derived biomethane and anchored on the central empirically documented reference values.

The proposed treatment closes a methodological asymmetry within Annex VI, aligns the Directive with the empirical evidence on landfill methane abatement, and establishes a calibrated incentive for the deployment of best-in-class landfill gas collection. The proposal is drafted to be incorporable within the text currently under scrutiny, and in the alternative through interpretative guidance or a subsequent technical revision of the Annex, without requiring amendment to the body of the Directive.

This proposal is also consistent with the Union's broader policy direction. REPowerEU identified biomethane as a strategic renewable gas and set the objective of reaching 35 bcm of sustainable biomethane production by 2030. The recently published **AccelerateEU** initiative follows the same logic, seeking to remove avoidable regulatory bottlenecks and accelerate the deployment of mature decarbonisation solutions. In that context, the present contribution does not seek additional public funding or a new support mechanism. It seeks a fair regulatory treatment under Annex VI that recognises the methane abatement value of landfill-derived biomethane which will contribute in reducing emissions from a major under-addressed methane source and **untapping the 15-20TWh¹ per year landfill gas to biomethane potential across the Union (~5% of RePower EU target).**

¹ The estimate is based on an extrapolation of the projected volumes of municipal solid waste (MSW) landfilled at EU level between 2024 and 2035, assuming a progressive reduction in landfilling in line with the EU Landfill Directive's objective of limiting Municipal Solid Waste landfilling to 10% by 2035. Methane generation factors derived from French landfill data over this period were used as a reference and extrapolated at EU scale.

I. REGULATORY GAP AND PROPOSED TREATMENT

Annex VI, Part B, recognises for manure-derived biomethane a negative *esca* of $-45 \text{ gCO}_2\text{eq/MJ}$ of manure used in anaerobic digestion. The rationale is that anaerobic digestion prevents methane emissions that would otherwise occur during unmanaged manure storage. The value operates as a default reflecting a physical counterfactual empirically established in the scientific literature and endorsed by the Joint Research Centre; it does not require site-specific demonstration of the counterfactual itself.

The same physical counterfactual applies to landfill-derived biomethane. Organic waste deposited in landfills generates methane over a horizon of twenty to thirty years following disposal. Under prevailing practice across the Union, a fraction of that methane is captured; the remainder is emitted to the atmosphere, partially oxidised through the soil cover. When a landfill operator uses landfill gas as a feedstock to produce biomethane, the operator receives a revenue for the landfill gas capture and can deploy enhanced landfill gas collection infrastructure such as extended and densified wellfields, early capture on open cells, leak detection and monitoring, vacuum optimization or high-performance final covers. This results in a measurable additional fraction of the generated methane to be captured rather than emitted. That additional captured fraction constitutes both the feedstock of biomethane production and the quantified climate benefit.

Annex VI currently provides no mechanism to recognise this avoided-emission effect for landfill-derived biomethane. The result is a methodological asymmetry within a single Annex, between two feedstocks whose physical counterfactual is analogous and whose default treatment should, on consistency grounds, also be analogous.

The proposal is to introduce in Annex VI a default *esca* value for landfill-derived biomethane, anchored on the lower bound of the empirical range and expressed in the same unit convention as the manure case, namely per MJ of feedstock as used in the downstream production process.

II. METHODOLOGICAL BASIS

The calculation follows the structure applied by the Joint Research Centre to the manure case and uses the reference parameters adopted in Annex VI: a low heating value of 50 MJ per kg of methane and a GWP₁₀₀ of 25 gCO_2eq per g of methane, consistent with IPCC AR4.

The additional methane capture attributable to the deployment of best-in-class practices in landfill gas capture (" $\Delta\eta$ ") is taken at 10 percentage points of generated methane. The reference for this value is the Séché Environnement study (2025)², which quantified an average collection increase of 9.8 per cent across six French landfills following the rollout of a targeted action plan on monitoring, leak detection and vacuum optimisation. Higher increases have been documented in the literature, up to 30 percentage points in Duan, Kjeldsen and Scheutz (2022)³,

² Séché Environnement and Bureau Veritas (2025). *Amélioration du taux de captage du méthane à travers la surveillance et la gestion. Sectoral study.*

³ Duan, Z., Kjeldsen, P. and Scheutz, C. (2022). *Efficiency of gas collection systems at Danish landfills and implications for regulations. Waste Management*

but are not incorporated in the present proposal in order to anchor the default on the lower bound of the documented evidence base.

An oxidation factor (“OX”) of 10 per cent is applied, consistent with IPCC Good Practice Guidance for well-managed landfills in industrialised countries⁴. The avoided methane emissions attributable to the additional capture are calculated as:

$$CH_4 \text{ avoided} = (1 - OX) \times \Delta\eta \times CH_4 \text{ gen} = 0.9 \times 0.10 \times CH_4 \text{ gen} = 9\% \times CH_4 \text{ gen}$$

For the purpose of expressing the methane avoided emissions per unit of feedstock used, the baseline collection efficiency across Union landfills is taken at 80 per cent (“ η_P ”) of generated methane. This value corresponds to the high of the range of documented collections efficiencies of landfills across the EU and is therefore conservative as this number is used to divide the methane avoided emissions in the calculation. For example, the “Enhancing landfill efficiency to drive greenhouse gas reduction” study⁵ estimates that implementing best practices on landfill gas capture can increase methane capture efficiencies to around ~80% and reduce direct emissions by ~50% compared to average practice, while boosting methane available for energy recovery significantly. As another point of reference, the Duan, Kjeldsen and Scheutz (2022)⁶ study on twenty-three Danish landfills, reports collection efficiencies ranging between 50% and 68%. A range of 50 to 80% capture is also consistent with the industry analysis conducted by Suez, Veolia and Waga Energy with the support of E Cube (2023)⁷. The 80% capture rate is used here as an empirical reference point for the baseline scenario, not as a regulatory threshold.

The captured landfill gas (feedstock) in the project case is calculated as:

$$\text{Landfill gas captured} = \eta_P \times CH_4 \text{ gen} = 80\% \times CH_4 \text{ gen}, \text{ expressed in MJ of landfill gas.}$$

Accordingly, avoided methane per unit of landfill gas captured is calculated as:

$$9\% \times CH_4 \text{ gen} / (80\% \times CH_4 \text{ gen}) = 0.1125 \text{ MJ of methane emission avoided per MJ of landfill gas captured}$$

This result is then converted into the appropriate unit: applying the reference parameters of 50 MJ low heating value per kg of methane and a GWP100 of 25 gCO₂eq per g of methane, the resulting avoided emissions value is calculated as follows:

$$\begin{aligned} & - 0.1125 \text{ MJ CH}_4 / \text{MJ of landfill gas captured} \times 25 \text{ g CO}_2\text{eq} / \text{g CH}_4 \times 1000\text{g/kg} / 50\text{MJ/kg} \\ & \text{CH}_4 = -56\text{gCO}_2\text{eq/MJ of landfill gas} \end{aligned}$$

The per-feedstock convention is retained to preserve methodological consistency with the manure case, which expresses esca per MJ of manure used rather than per MJ of biomethane produced.

⁴ IPCC (2007). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

⁵ *Enhancing landfill efficiency to drive greenhouse gas reduction: A comprehensive study on best practices and policy recommendations*, A. Lair, M. Mansuy, C. Romand, O. Oberti, C. Pradels, G. Barina, T. Denoun, M. Venturini and C. Trommsdorff, 2024.

⁶ Duan, Z., Kjeldsen, P. and Scheutz, C. (2022). *Efficiency of gas collection systems at Danish landfills and implications for regulations*. Waste Management

⁷ Suez, Veolia and Waga Energy, with the support of E Cube Strategy Consultants (2023). *Contribution of non-hazardous waste landfills to the achievement of GHG emission reduction targets in the EU. Industry study*.

The value is anchored on the empirically collection efficiency of 80 per cent, which corresponds to the high range of documented reference across Union landfills (conservative as used for division in the calculation). The capture gain of 10 percentage points reflects the lower bound of the range documented in the literature; gains of up to 30 percentage points are documented in peer-reviewed studies and would yield a substantially higher default value. They are not incorporated at this stage to anchor the proposed default on the most replicable and least contested segment of the empirical evidence base. The proposed value is therefore positioned to facilitate adoption rather than to maximise the recognised abatement effect and remains open to future upward revision as the evidence base matures and harmonised methodologies for landfill gas capture monitoring become available.

Operational data from a Waga Energy project in operation, kept on file by the company and available on a confidential basis upon request, has documented an increase in landfill gas collection of approximately 19 per cent following the deployment of the upgrading unit. This empirically corroborates the incentive mechanism on which the proposed default rests. The default itself is calculated using the literature-based reference values described above, anchored on the lower bound of the documented range.

III. CONSISTENCY WITH THE RED III FRAMEWORK

The proposal is drafted to fit within the architecture of Directive (EU) 2023/2413 without requiring amendment beyond Annex VI itself. The reason it does so rests on three operational points.

First, the sustainability and greenhouse gas saving criteria of Article 29 apply unchanged to landfill-derived biomethane. The proposed esca affects only the calculation of the total emissions figure under the Annex VI methodology; it does not alter the thresholds that biomethane must satisfy to be counted towards the renewable energy targets of the Union or to qualify for financial support under Member State schemes. The interface with Article 29 is therefore neutral.

Second, the verification of the practices that justify application of the default value does not require a new regulatory vehicle. Article 30 already establishes the voluntary schemes as the mechanism through which sustainability and emissions criteria are verified across the Union. Those schemes operate audit protocols for feedstock provenance, chain of custody and greenhouse gas performance. Certification of landfill gas collection practices against a defined set of criteria, measurable on the basis of operational parameters available and verifiable at site level, would be a natural extension of their existing function. The technical specification of the criteria is a matter that can be developed in cooperation with the Joint Research Centre and the voluntary schemes, drawing on the methodologies already deployed by industrial operators.

Third, the proposal is consistent with, and non-overlapping with, the measurement, reporting and verification obligations established by Regulation (EU) 2024/1787 on methane emissions reduction in the energy sector. The proposed esca operates on the waste-sector counterfactual; the Methane Regulation operates on the energy-sector operator. The two frameworks act on

different legal subjects and different emissions inventories, and the concurrent operation of both does not give rise to double accounting.

IV. SCOPE AND BOUNDARY CONDITIONS

The proposed esca is defined within a bounded scope that delimits its interaction with adjacent regulatory instruments and forecloses the principal avenues of unintended effect.

Relationship with Directive 1999/31/EC on the landfill of waste.

The capture of landfill gas is required under the Landfill Directive, at least on closed cells. The proposed esca does not operate on compliance with that requirement as such. Rather, it operates on the additional methane abatement associated with collection performance beyond the empirical baseline observed across Union landfills. This reflects the well documented reality that, while the regulatory framework requires gas collection, actual performance varies significantly across sites and jurisdictions. Significant volumes of methane therefore continue to be emitted under prevailing conditions that could be captured with existing technical means. The proposed esca is therefore complementary to, and not a substitute for, the implementation and enforcement trajectory of the Landfill Directive.

Conditionality of the default.

The application of the default value is conditional on certification, under a voluntary scheme recognised pursuant to Article 30, of compliance with a defined set of best-practice criteria for landfill gas collection. Those criteria — periodic site-specific leak detection and monitoring, vacuum optimisation, progressive capture on open cells, high-performance cover systems — are measurable using a combination of data routinely collected at site level under existing landfill management obligations and operational protocols already deployed by best-in-class operators. They are amenable to third-party verification under the audit protocols operated by existing voluntary schemes. The default is therefore not a universal attribution; it is a calibrated recognition of verified performance above the empirical baseline.

V. PROPOSED ANNEX VI LANGUAGE

For incorporation in Annex VI, Part B, the following language is proposed, adapted from the treatment of the manure case:

"The values for biomethane production from landfill gas include negative emissions for emissions saved through the implementation of landfill gas collection practices that go beyond the empirical baseline collection practices observed across Union landfills. The value of esca considered for landfill gas used in biomethane production is equal to $-56 \text{ gCO}_2\text{eq/MJ}$ of landfill gas. Application of this value shall be conditional on certification, under a voluntary scheme recognised pursuant to Article 30 of this Directive, that the landfill gas collection practices applied go beyond the empirical baseline, in accordance with criteria to be specified in implementing guidance."