Reducing Methane Emissions in Waste Management

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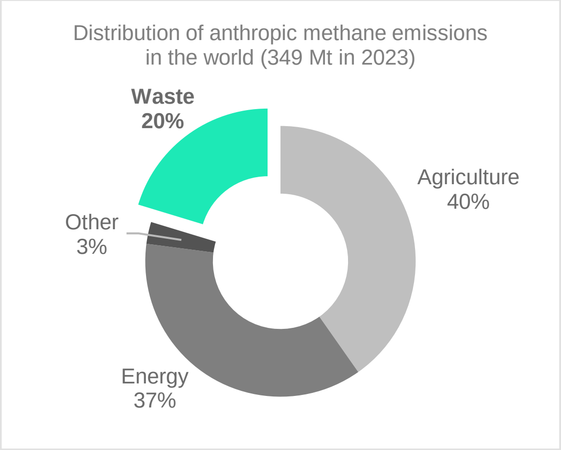
Overview of methane emissions in waste management

Methane, emitted notably by waste management, is a major contributor to climate change

Methane is the 2nd highest greenhouse gas contributing to global warming, after carbon dioxide

- According to the European Environment Agency, methane contributes about 0.5 °C (or nearly half) of the observed 1.1 °C present-day warming above the pre-industrial temperature.
- Methane has a much shorter atmospheric lifetime than CO_2 – 12 years compared with centuries – but **absorbs much more energy** while it exists in the atmosphere.
- The **Global Warming Power** (GWP) of methane is **81 times that of CO_2**, over a 20-year period.
- **Methane also affects air quality**, leading to ground level ozone, a dangerous air pollutant.
- The concentration of methane in the atmosphere is currently **2.5 times greater** than its pre-industrial levels.
- Methane emissions can be **natural (40%) or due to human activities (60%)**. The anthropic emissions are distributed as followed.

Worldwide, waste management emits 71 Mt of methane per year



In Europe, waste management represents even a greater proportion of anthropic methane emissions

35%

of anthropic methane emissions, representing about :

9 Mt

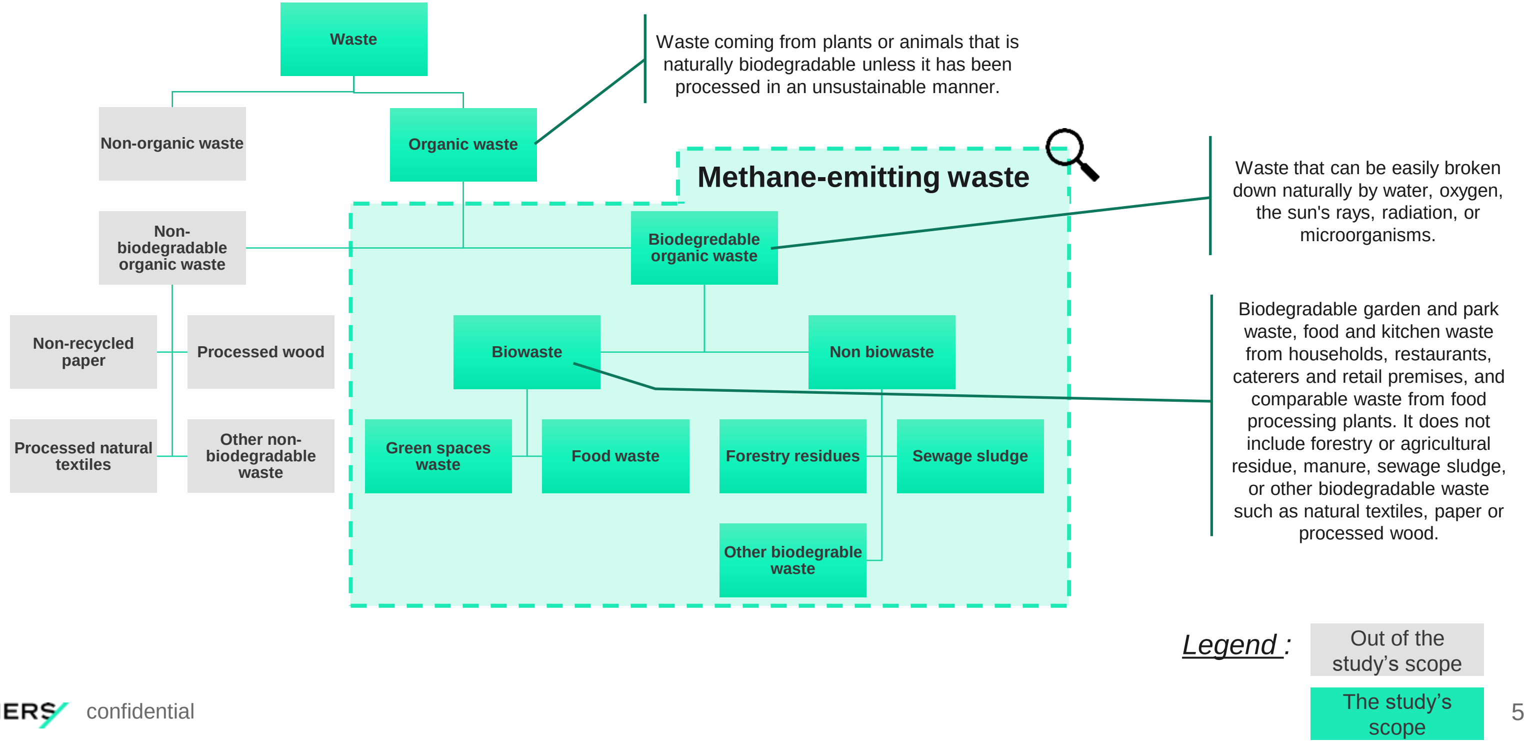
In 2023

Given the significant warming power of methane and its limited lifetime in the atmosphere, **reducing methane emissions represents one of the best near-term opportunities to contribute to climate change mitigation**. Waste methane emissions can be reduced thanks to **several levers** that can be implemented locally.

Source : European Environment Agency, International Energy Agency

Sia Partners study on waste methane emissions

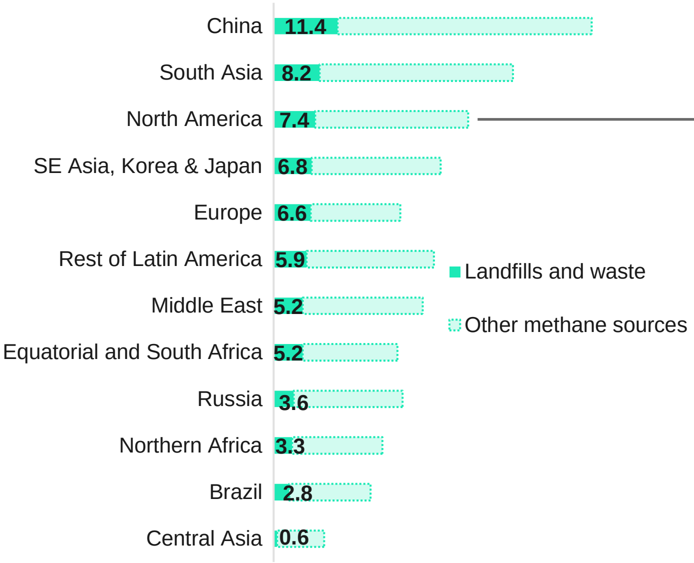
In this study, Sia Partners focused on methane emitting waste which includes a diverse range of sources, typically classified as **biowaste** and **non-biowaste**. In its comprehensive analysis of methane emissions, Sia Partners has also explored the challenges associated with **emissions from the energy sector** and is specifically addressing the impacts of **agriculture** in a separate study.



Methane emissions related to waste vary widely across the world

Disparities in methane emissions by region

Estimated annual methane emissions in million of tonnes



United States Example

By type of waste:

Wastewater

CH_4 emissions from wastewater account for 11.6% of total CH_4 waste emissions in the US.

Food waste

Landfilled food waste contributes to 58% of fugitive methane emissions from municipal solid waste landfills in the US.

Other biowaste

One tonne of decomposing paper emits up to 90 kg of methane.

By type of treatment: Landfills

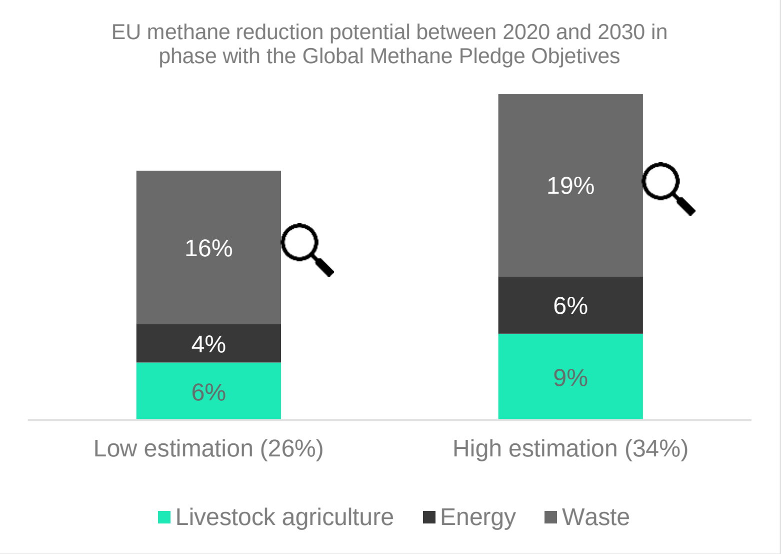
83% of US anthropogenic **methane emissions from the waste sector** in 2021 were **due to landfills**. Remaining emissions are due to wastewater treatment, composting and anaerobic digestion at biogas facility.

GHG emissions in the waste sector **mainly stem from methane emissions** resulting from the degradation of organic matter in non-hazardous waste landfills. **84-91%**

Source : UNEP, cross-referenced with IAE data ; EPA ; University of British Columbia

Methane emissions from the waste sector is the greatest methane reduction potential in the EU

In a business-as-usual development with current EU policies, EU methane emissions are estimated to decline by **13.4%** between 2020 and 2030. This reduction potential remains weak compared to the COP28 Global Methane Pledge's goal of reducing methane emissions by 30% between 2020 and 2030. If we combine measures in line with the Global Methane Pledge ambition, we estimate to achieve a reduction of **26 to 34%** with a higher reduction potential in the waste sector compared with the energy and livestock agriculture sectors.



Sector	Included reduction measures
Waste	• Separation and use of organic waste • Mitigation at wastewater treatment plants (WWTPs)
Energy	• Leak detection and repair (LDAR) • Reduction of venting and flaring in oil and gas production • Coal mine methane management
Livestock agriculture	• Healthier consumer diets, with 10% of EU consumers making the switch • Anaerobic digestion of manure • Other manure management

Source : CE Delft - independent research and consultancy organisation, 2022, Methane reduction potential in the EU between 2020 and 2030

Regulations on methane emissions from waste remain however limited

The legislative landscape lacks specific regulations directly targeting methane emissions from waste. Most policies impact methane emissions indirectly by focusing on organic waste, food waste, and landfilling. These regulations improve waste management and contribute to limiting waste production, which subsequently affects methane emissions. In Europe, such regulations are quite developed.

EU regulations indirectly impacting methane emissions

Limiting landfilling

- **European Landfill Directive:** limits the share of municipal waste landfilled to 10% by 2035.
- **European Decree 2021-1199:** Objective of a total absence of recoverable waste in disposal facilities by 2030.
- **Sweden law - Organic waste ban:** Since 2005, organic waste can no longer be landfilled.

Reducing food waste

- **Italian law "legge Gadda":** Encourages food donation, through simplification and harmonization of the legislative framework that regulates this sector.
- **Spanish regulation on food waste:** introduces fines for supermarkets discarding unsold food, and restaurants must be able to provide 'doggy bags' for leftovers.

Encouraging circular economy

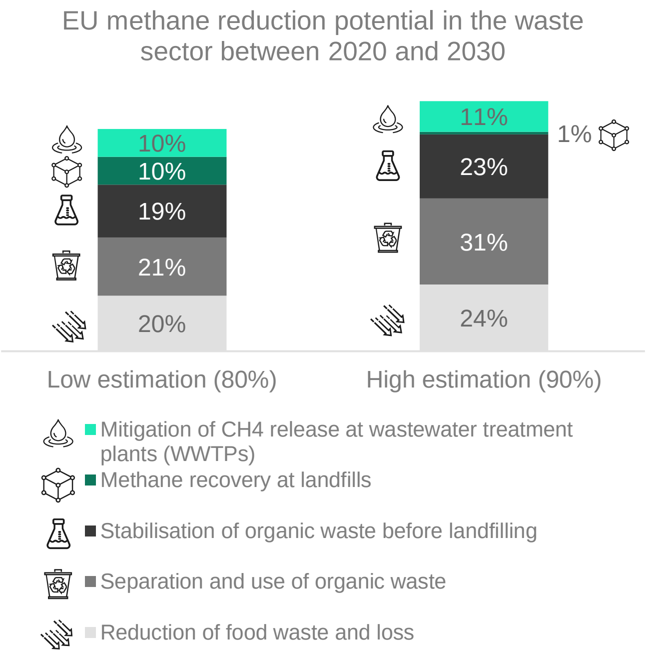
- **Kreislaufwirtschaftsgesetz - German law:** sets priorities for the reduction, reuse, recycling and recovery of waste prior to disposal.
- **French law – AGEC:** aims to reduce waste and promote recycling and reuse, notably by banning certain single-use plastic products and imposing recycling and information obligations on producers.

Regulations directly addressing methane emissions

California's Landfill Methane Regulation: requires owners and operators of certain landfills to install and optimally operate gas collection and control systems, monitor surface methane concentration and other performance parameters, repair emission exceedances and other performance issues.

Source : European Union ; Ministère de la transition écologique et de la cohesion des territoires ; Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz, California Air Resources Board

The EU methane reduction potential in the waste sector between 2020 and 2030 varies from 80% to 90%



This emission reduction potential has been analyzed through five measures ranked by their priority in waste management:

1. Reduction of food loss and waste

About a third of all food produced is lost or wasted worldwide. In the EU, about 20% of all food produced is wasted along the food value chain, not counting food waste that is used as animal feed.

2. Separation and use of organic waste

Organic waste can be collected separately from municipal solid waste (MSW) and industrial waste, followed by utilization of this organic waste.

3. Stabilization of organic waste before landfilling

The stabilization of organic waste is a treatment that significantly reduces the amount of materials emitting methane in organic waste. This process minimizes pollution and saves landfill space.

4. Methane recovery at landfills

Methane recovery at landfills represents a set of specific measures in which landfill gas is collected and used, for example for biomethane production or electricity and heat generation, or flared.

5. Mitigation at wastewater treatment plants (WWTPs)

Different wastewater treatment methods lead to different methane emission levels. If well managed aerobic or anaerobic treatment steps are used, methane emissions can be restricted to a negligible level.

Source : CE Delft - independent research and consultancy organisation, 2022, Methane reduction potential in the EU between 2020 and 2030

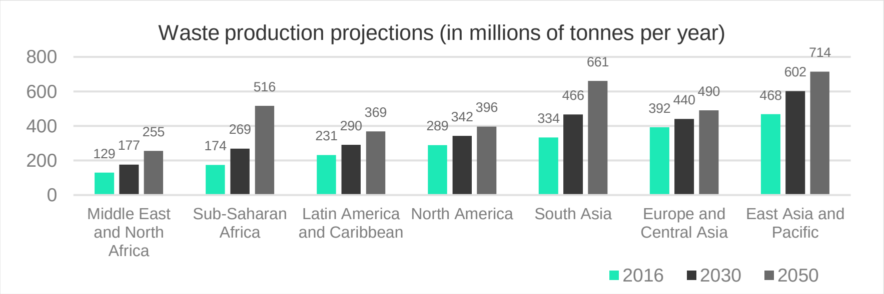
Presentation of several major reduction levers

Focus on – Limiting landfill storage

Waste production rise is leading to a rise of methane emissions

The annual production of municipal solid waste worldwide stands at **2.01 billion tonnes**. Projections suggest that global waste will surge to **3.40 billion tonnes by 2050**, surpassing the rate of population growth during the same timeframe.

An increase in waste production is likely to be equal to more waste ending in landfills which would **increase methane emissions**. Methane emissions from waste are expected to increase by 13 megatons a year over the next decade alone.



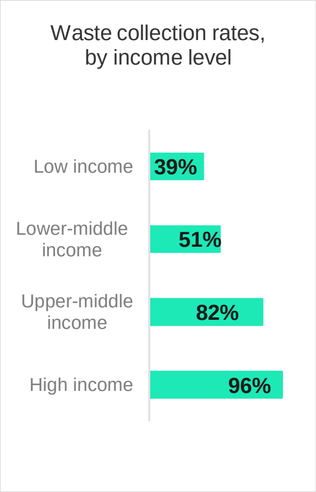
Reducing Methane Emissions Through Composting

Composting reduces methane emissions by decomposing organic waste aerobically, resulting in **more carbon dioxide but less methane** than through anaerobic decomposition in landfills. This is beneficial since methane has a much higher global warming potential than carbon dioxide. **Separate collection of organic waste and treatment is estimated to reduce methane emissions by 62%.**

Waste management: a significant challenge, particularly in low-income countries.

Despite progress in waste management globally, at least **33 percent of the 2.01 billion tonnes of global waste are still not managed in an environmentally responsible manner**. As waste production is projected to increase, the imperative to improve waste sorting becomes even more pressing.

This challenge is particularly acute in low-income countries, where open dumping accounts for 93 percent of waste disposal methods. Moreover, by 2050, these countries are anticipated to **produce more than three times their current waste output.**

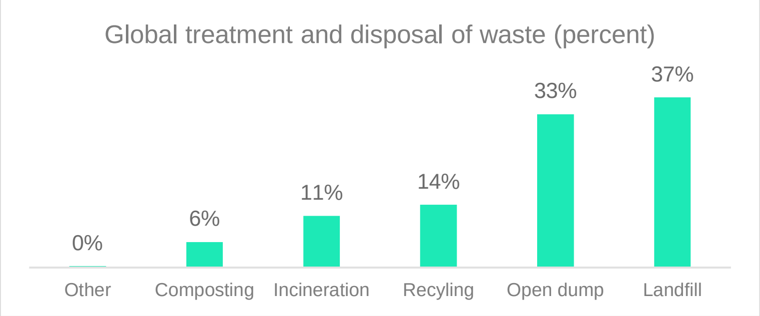


Sia Partners can help you to:

- Identify major waste sources and main levers to limit waste production
- Implement systems to monitor and track waste production
- Set regulatory watch: environmental and waste management regulations

Focus on – Limiting waste production and improving waste sorting

Landfills play a **vital role in waste management systems** by offering a disposal solution for non-recyclable materials. However, they offer a **propitious environment for anaerobic decomposition** of organic materials leading to methane emissions. As such, landfills contribute significantly to methane emissions. Therefore, reducing the amount of waste landfilled is crucial.



The potential of limiting landfilling – The German case

In 40 years, Germany **divided by more than 4 times the methane emissions from its landfills**, due to a drop in their number (from 50k to 300). In parallels, they **increased the capacity of their waste-to-energy plants** to deal with non-recyclable waste. The energy produced contributes to 1% of the German final energy consumption.

Long-term methane emissions reduction through landfill waste limitation

The anaerobic decomposition of organic materials, the process through which methane is produced, **persists for decades due to the slow breakdown of waste.**

Therefore, methane production at landfill sites spans several decades, steadily rising during operation and **peaking a few months after the final waste deposition**. Subsequently, it diminishes over several years or even decades, especially with significant waste volumes, until complete organic material degradation.

Therefore, even after a landfill reaches capacity and ceases operations**, methane emissions continue for 25 to 100 years.** Thus, limiting landfill waste is a lever to curb global methane emissions in the **long-run.**

Sia Partners can help you to:

- Map a waste stream to identify levers to reduce landfilling
- Improve waste collection round by implementing our tool OptiWise
- Support municipalities and other relevant organizations to implement composting and recycling systems

Source : Word Bank ; GAIA

Focus on – Solid Recovered Fuels (SRF)

Solid Recovered Fuels (SRF) refers to waste that is burned to **make energy**, whether in **electricity power plants**, or in another form such as **cement plant** or industrial boiler room.

- In Europe, the waste used in SRF must **not be dangerous and be non-recyclable**.
- In France, SRF are classifed in 5 categories, according to their LHV (**economic criteria**), their chlorine rate (**technical criteria**), and their mercure rate (**environnemental criteria**).

As a rule, CSR is **prepared directly on waste sorting and recovery sites**, an additional activity that creates more jobs on these sites.

→ CSR preparation lines process the material in various stages: crushing, mechanical sorting by air flow or size (trommel sieve), separation of ferrous metals, fine grinding according to the needs of the end user (e.g. cement plant), etc

The use of SRF therefore offers **two environmental benefits**:

- By preventing waste from being landfilled, it **limits soil pollution and methane emissions** during waste degradation.
- By offering an alternative energy source, SRF can **avoid the use of fossil fuels**.

Nevertheless, these gains must be analyzed with care, to **avoid rebound effects**, and must not overshadow the **essential actions of waste reduction and energy sobriety**.

Currently, 30% of non-mineral, non-hazardous waste is landfilled

- In Europe, this represents a potential annual source of nearly 70 million metric tons of RDF(1)
- According to French regulations, the LHV of SRF is at least 12MJ / kg(2)
- In Europe, SRF represents a **potential energy source of 233 TWh, equivalent to Great Britain's electricity production in 2023** (3)

In this way, **SRF transforms costly waste into high-value energy.**

Sia Partners can help you to:

- Identify waste deposits that could be included in SRFs
- Carry out technical and economic studies to assess the relevance of SRF
- Support local authorities and manufacturers in setting up RDF facilities

Source : Veolia ; Journal officiel, French legislation ; RTE, French TSO

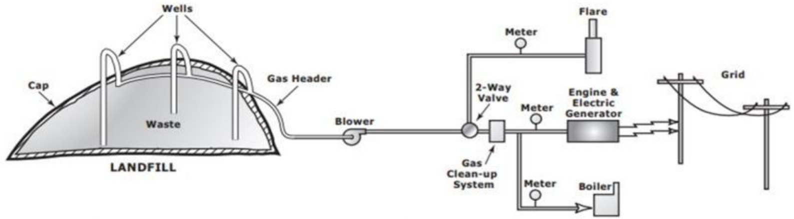
Focus on – Equipping landfills with methane recovery systems

Methane is emitted during **the decomposition of organic waste**.

Landfills therefore emit methane, not only during operation, but also for many years after decommissioning.

The advantage of this source of methane emissions is that it is **localized: methane recovery is therefore easy and economically viable**.

The diagram below shows a typical landfill gas recovery project (1):



Landfill methane capture offers **two environmental benefits**.

- By capturing methane before it is emitted into the atmosphere, it **limits the amount of gas contributing to climate change**.
- By offering an alternative energy source, biogas **avoids the use of fossil fuels**.

At the Laogang landfill site in China, over **90,000 tonnes of methane is captured**, processed and recovered every year. The production unit attached to the facility generates **100,000 MWh of energy** every year.

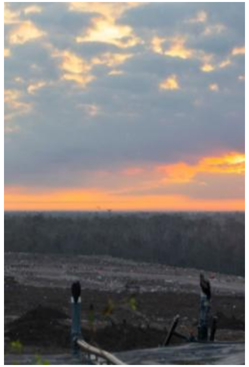
Nevertheless, landfills have many other **drawbacks, such as soil and water pollution**. This is why we need to keep in mind the **essential actions of waste reduction and energy sobriety**.

Landfill methane capture enables local authorities to reduce the cost of waste treatment by **producing electricity and/or heat from landfill gas**.

For example, Veolia has set up a biogas capture system at the Plessis-Gassot non-hazardous waste landfill in France, which is then valorized in a cogeneration plant.

The plant produces 130,000 MWh of electricity per year, **generating over €7 million for the operator**.

The plant also produces thermal energy for around 3,000 households (approx. 30,000 MWh), enabling users connected to the network to see their **bills cut by over 90%**. (2)



Sia Partners can help you to:

- Carry out technical and economic studies to assess the feasibility of equipping landfills with methane recovery systems.
- Support waste facilities in managing their landfill equipment projects
- Identify co-benefits, in a territorial ecology approach

Source : Global Methane Initiative ; Veolia

Focus on – Transfer of emitting waste *to methanizers in France*

Anaerobic digestion involves **processing organic matter** from a variety of sectors: agricultural, industrial, catering waste, municipal waste, and so on. By **fermenting this material in the absence of oxygen** ("anaerobically"), biogas is obtained which, once purified, becomes biomethane. This biomethane can be **re-injected** into the gas network, **used as a fuel** for **vehicles** or as a **combustible** in **power or cogeneration plants**, or as **a source of heat** in certain industrial processes.

The methanization process also creates residues called **digestates**. These are **effective organic fertilizers** for crops. However, this process raises questions about the **quality of this digestate**.

In **France** for example, for **each ton** of methanized waste, an **average of 930 kilograms of digestate** is produced. This natural fertilizer is **valorized in different ways**, depending on its composition. Most digestate is used as **agricultural fertilizer**. However, digestate quality is crucial. Inputs of fertilizing elements such as nitrogen (N), phosphorus (P) and potassium (K) are high, but little is known about their content due to the heterogeneity of substrates. In areas of high environmental pressure, digestate treatment may be necessary to absorb excess nutrients.

In **France**, in all anaerobic digestion sectors**,** the average **margin on investment is 5.1%** for **cogeneration projects** and **9.5% for injection projects**. **Methanization** also enables better waste management at lower cost (**almost 2x lower treatment cost than incineration or landfill**).

- Approximately **16 million tons** of biodegradable waste is processed through anaerobic digestion annually in **Europe** alone**.**
- The energy produced from biogas derived from biodegradable waste can power around **3.5 million European households annually**.
- Anaerobic digestion of biodegradable waste can reduce up to **60 million metric tons of CO2 equivalent emissions per year** globally**.**
- There are over **4,500 anaerobic digestion plants** dedicated to biodegradable waste processing worldwide.
- **The biodegradable waste sector in methanization supports approximately 40,000 jobs in Europe.**
- The anaerobic digestion of biodegradable waste generates around **5 billion cubic meters of biogas** each year.

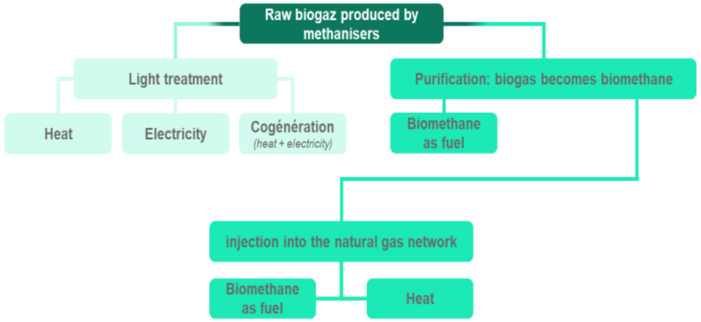
Sia Partners can help you to:

- Conduct a market research to identify opportunities and trends in this industry.
- Integrate advanced technologies for monitoring and optimization.
- Assess the viability and profitability of your project.
- Optimize your supply chain processes for the collection and processing of waste.

Source : MethaFrance ; FranceAgriMer ; Ademe ; European Biogas Association (EBA) Report 2023 ; International Energy Agency (IEA) Bioenergy Report 2022 ; European Commission - Energy, Climate change, Environment statistics 2023 ; World Biogas Association (WBA) Report 2023

Focus on – Methane cogeneration vs grid injection

There are **4 ways to valorize biomethane produced by anaerobic digestion plants**. The **focus** here is on the most common: **cogeneration and injection**



Positive environmental impacts:

- The **carbon content** of biomethane is **8 to 10 times lower** than that of **natural gas**.
- **Injected biomethane** emits **80% less CO2** than **natural gas**, considering the entire value chain.

Negative environmental impacts:

- **Cogeneration:** Water consumption (cooling) and pollutant emissions (nitrogen oxides (NOx) and fine particles for example)
- **Grid injection:** Fugitive methane

Both **cogeneration** and biogas **injection** into the gas grid are **mature processes**.

- **Economically**, **injection** is **more profitable** than cogeneration since **95% of the gas produced is valorized**, compared to **70% for cogeneration**.
- **Injection projects are also simpler** as they do not require **heat recovery**, unlike cogeneration which relies on heat recovery for economic balance.
- **Advancements in purification techniques** have **lowered injection costs** and improved profitability.

In short, **injection** makes it possible to technically, economically and geographically **decorrelate biomethane production and consumption**.

Cogeneration does, however, offer the **advantage** of being able to **recover waste that cannot be injected**, such as industrial waste from paper mills, washing water and transformation processes, sewage sludge and certain waste from the food industry.

Sia Partners can help you to:

- Conduct feasibility studies and cost-benefit analysis of both options
- Understand regulatory and compliance requirements.
- Assess the technical requirements and select the most appropriate technologies for either cogeneration or biomethane integration.
- Create financial models and assist you in securing funding and investment for the chosen option.

Source : Enea, Qantis, 2017 report ; Entraid, unités de méthanisation : cogénération ou injection ?

Focus on – Methane conversion to biofuels

Biofuels are substitute fuels obtained from biomass. They are generally incorporated into fossil fuels.

There are **three generations of biofuels**, depending on the origin of the biomass used and the associated conversion processes. Today, the first generation has reached the industrial stage, while the second and the third generation is in the development phase.

Second-generation biofuels are derived from the transformation of lignocellulose contained in **agricultural and forestry residues**, in plants from **dedicated crops** or from the recovery of **industrial waste**.

It offers an advantage over first-generation biofuels in terms of **greater availability and non-competition with food**. This technology can be used to produce so-called **second-generation bioethanol, biodiesel, biohydrogen or biogas**.

Third generation biofuels works by using **algae** to convert sunlight, carbon dioxide, and water into bio-oils.

Positive environmental impacts:
- GHG **emissions reduction**
- Utilization of **waste**
- Improved **air quality**

Negative environmental impacts:
- **Energy consumption**
- **Water use and soil contamination**
- **Biodiversity loss and deforestation**

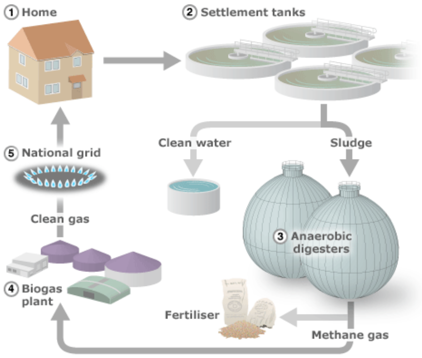
- Methane has the potential to produce approximately **20 exajoules (EJ) of energy per year** if fully utilized for biofuel production. (1EJ = 277,778 TWh)
- Converting methane to biofuels can reduce global greenhouse gas emissions by up to **500 million metric tons of CO2 equivalent annually**.
- The **efficiency** of converting methane to biofuels can reach up to **60-70%**, depending on the technology used.
- The **global production of biofuels from methane** is projected to reach **30 billion liters by 2030**.
- The methane-to-biofuels industry supports over **100,000 jobs worldwide** and generates annual **revenues exceeding $15 billion**.
- There are currently **over 1,000 facilities** globally dedicated to **converting methane into biofuels**, with significant growth expected in the next decade.

Sia Partners can help you to:
- Develop long-term strategies and detailed roadmaps for biomethane-to-biofuel conversion projects.
- Conduct feasibility studies and cost-benefit analyses to assess project viability.
- Evaluate and select the most suitable technologies for converting biomethane to biofuel.

Source : International Energy Agency (IEA) Bioenergy Report 2022 ; World Biogas Association (WBA) Report 2023 ; Environmental Protection Agency (EPA) Report 2023 ; International Renewable Energy Agency (IRENA) Biofuels Report 2023 ; Global Bioenergy Partnership (GBEP) 2023

Focus on – Wastewater treatment

15% of EU methane emissions are coming from sewage sludge, a bioproduct of wastewater treatment, a share which is expected to increase over next years. By breaking down wastewater sludge or solid waste, anaerobic digesters produce **methane-rich biogas** in the process. Efficiently **centralizing and capturing** this biogas allows you to either use it locally through a **cogeneration process or inject** it in the grid.



Compared to landfilling sewage sludge and allowing the produced methane to be released in an uncontrolled manner, enclosing it in an anaerobic digester can provide the following environmental benefits:

- Limit greenhouse gas emissions.
- Create renewable natural gas to be injected into the grid.
- Generate heat and power locally through a cogeneration process.

At the municipal level, drinking water and wastewater **plants** can represent up **to 40% of total energy consumed**. Knowing that **40% of operating costs** for drinking water systems can be attributed to **energy**, mitigating these costs by capturing and using emitted gases offers significant economic opportunities. In some cases, such energy efficiency measures can cut up to **30% of energy costs**. Additionally, methane reuse helps **diversify the power sources** of wastewater plants, making them more **resilient** to shocks and stresses, and allowing them to function partially **off-grid**.

This naturally comes with a positive impact on GHG emissions. In total, it is assumed that a country such as the US could reduce annual **CO2** emissions by **2.3 million metric tons** by using the resulting biogas, which is equivalent to the emissions of 430k vehicles.

Sia Partners can help you to:

- Carry out technical and economic studies to assess the feasibility of equipping wastewater plants with anaerobic digesters and methane capture facilities.
- Define a roadmap and progressive targets.
- Manage existing wastewater equipment projects, increasing the benefits of methane-related projects while maintaining exploitation.
- Identify co-benefits, in a territorial ecology approach.

Source : EEA, Jacob (2020) & EPA

Landscape of projects to reduce waste-related methane emissions

CH4 emission reduction projects are rapidly emerging all over the world

Waste reduction

Sybert waste reduction roadmap (France)
Implement **dynamic pricing for collection of municipal waste**, reducing it by **42%** in 14 years and enabling **biowaste sorting**

Bornholm zero-waste island project (Denmark)
Set measures to treat **100% waste** as resources by 2032, leveraging on **sorting and recycling**

NPS waste diversion projects (USA)
Managing 36m of tons of waste across 400 US sites, reducing waste being sent to landfills by 32%.

Wastewater management

Malabar biomethane injection project (Australia)
13M€ project to **collect and upgrade the biogas** produced from the AD process to biomethane for **thousands of households**

Bottrop wastewater treatment plant (Germany)
Extract methane from sewage sludge to meet the full **35m kWh** energy requirements of one of the **largest EU plant**

Reverto's biogas cogeneration plant (Austria)
Combine fermentation of wet waste, OFMSW*, and oil-free microturbines to **supply 90%** of the plant's **energy requirements**

Conversion to biofuels

Energy recovery from MSW** (Malaysia)
Leverage the **3.3% annual increase** of MSW** to produce biofuel injected into the Malaysian grid (20 MW)

Novo Gramacho Biogas Project (Brazil)
Upgrade collected methane to produce vehicle biofuel and **avoid 1.4 million metric tons of CO2eq/year**

Akouédo Landfill Gas Recovery Project (Côte d'Ivoire)
Produce **biogas**, **70% composed of captured methane** in the major landfill of the capital

Solid Recovered Fuels

SUEZ x Humens SRF Production Facility (France)
Convert non-reusable waste into energy to feed a **55 MW SRF-based** power plant, based on the recovery of 140k tons/year

Veolia SRF Production & Usage (France)
Replace coal-fired boilers with SRF units, using **350k metric tons** of SRF/year and cutting **half** of the site's fossil **CO2** emissions

SRF Guidelines and Quality Standards (Taiwan)
Reduce the reliance on imported energy (97%) by ensuring the manufacturing quality of SRFs

Focus dans slide suivante

* Organic Fraction of Municipal Solid Waste
** Municipal Solid Waste

Zoom-in on a set of representative projects across Europe

	Sybert waste reduction roadmap	Bottrop wastewater treatment plant	SUEZ x Humens SRF Production Facility
Context & Objectives	**Engage in waste reduction actions to increase the profitability and sustainability of a French recycling center**	**Cover most of the energy needs of one of the largest EU sewage treatment plant**	**Turn commercial and industrial waste into SRF to feed the whole energy needs of a sodium bicarbonate plant in France**
Key activities	To allow the phase out of one of their furnaces, Sybest incinerator proceeded to the following actions: • Implement dynamic, weight-based pricing to reduce municipal waste • Drive waste sorting, reducing incineration cost • Cause a decrease in waste tax for sorted material	In the world's largest digestion towers, the Emscher treatment plant decided to: • Capture sewage gas from the 190k tons of annual sewage sludge • Isolate and extract methane from the sludge • Use the extracted methane to generate electricity on-site, and to produce biogas and green methanol-based fuels	In its facilities, SUEZ operates to the following activities: • Collection – capacity above 30t/hour • Pre-sorting/separation - remove metals and other non-combustible • Shredding – reduce the material to 0-30mm SRF • Baling – compress SRF to maintain quality (moisture content & cal. value) • Burning – generate heat used to produce chemicals and agrochemicals
Results	✓ 37% drop in waste production in 14 years ✓ 7% reduction of incineration cost ✓ Shut one of the two furnaces, leading to €70 million savings ✓ Waste tax 19% lower than the national average	✓ Complete solar, wind and hydropower production to meet the plant energy requirements (35 million kWh/y) ✓ CO2 emissions reduction: 70k tons of CO2eq/year	✓ Total investment: €130 million ✓ Total waste recovery rate: 48.5% (140k tons/year) ✓ CO2 emissions reduction: 60% by 2026

Sia Partners Expertise

Sia Partners expertise to tackle methane emissions in the waste management sector

Methane, a major contributor to climate change

Methane **contributes significantly to global warming**, but reducing methane emissions is a **good opportunity to fight climate change**, considering that the **half-life of methane is only 12 years**.

That must be captured as close as its source as possible

Considering that methane is currently **very difficult to capture** once in the athmosphere, it is essential to **reduce methane emissions**, or to **capture it as close as possible to its source** of emission.

And which can be turned into a profitable source of revenue

Even if methane capture is often **regarded as a costly process**, it **can be turned into a consistent source of revenue**, if sold as a source of energy. The lack of projects on the subject make it a **good opportunity** for investors.

Sia Partners can **help you reduce methane emissions** in the waste sectors in many ways, from leading technical-economic studies, to launch and lead complex projects, as shown previously. **Some of our capabilities are detailled in the next page.**

Did you know it?

Sia Partners can also help you to tackle methane emissions in the **energy and the agricultural sectors**.

How Sia Partners can help you to tackle methane emissions

	Building Strategy	Establishing processes	Leading Expertise
General Management / Strategy	• Carrying out sector benchmarks • Project business plan • Feasibility studies and cost-benefit analysis	• Construction of a strategic plan • Techno-economic feasibility study	• Industrial and territorial ecology approach • Partnership with start-ups
Operations Department	• Carrying out inter-site benchmarks • Identifying quick wins • Identification of waste sources • Technical requirement assessment	• Co-building of action and progress plans • Project management to implement actions plan	• Circular economy approach • Eco-design approach
Purchasing Department	• Sourcing forecast • Financial model	• Responsible purchasing approach	• Working with subcontractors to limit landfill
Finance / Legal Department	• Compliance assessment	• Regulatory monitoring (methane emissions, waste, etc.)	• Risk analysis • Drafting and reviewing contracts • Compliance audit
IT Department	• Assessment of project impacts on the IT	• Implementation of environmental reporting • Deployment of Waste Tracker, our tool to track waste	• Development of digital solutions / adhoc AI bot • Optimization models applied
HR / CSR Department	• Training/awareness • Estimation of methane emissions	• Support for internal initiatives • Change management	• Audits on internal processes • Employer Brand Initiatives

Sia Partners' main expertise and previous work

At Sia Partners, we have helped many companies to better manage their waste and methane emission strategies.

Client	Assignement title
CITEO	Study of the national deposit of abandoned waste
GRTgaz	Analysis and mapping of addressable input potential for biomethane production
Microsoft	Cost-effective operational model for waste management
TotalEnergies	Analysis and mapping of addressable input potential for biomethane production
CLER	Economic study on the costs and benefits of an energy renovation plan
Equity fund	Strategic due diligence for a player designing waste sorting centers
Idex	Benchmark for renewals of public service contracts for heating networks and incinerators
TotalEnergies	World market study of biowaste and biodegradable plastic packaging
GRTgaz	Support of global methane emisions strategy

At Sia Partners, in order to offer the best service to our clients, we conduct studies on subjects of interest.

Subject	Link
Circular economy: chemical recycling of plastics	Here
Reduce methane emissions from your production activities	Here
Reducing Methane Emissions in the Energy Sector	Here
The waste performance of CAC 40 groups	Here

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Glossary

Glossary

Term	Definition
Anaerobic decomposition	Decomposition and degradation of organic matter in a medium containing no dissolved oxygen.
Biodegradable waste	Waste that can be easily broken down naturally by water, oxygen, the sun's rays, radiation, or microorganisms.
Bio-gas	Gas produced by the fermentation of animal or vegetable organic matter.
Bio-waste	Biodegradable garden and park waste, food and kitchen waste from restaurant, household, food processing plants, … It does not include forestry or agricultural residues, manure, sewage sludge, or other biodegradable waste such as natural textiles, paper or processed wood.
Food loss	Loss of food that occurs in the food supply chain from harvest up to the retail level.
Food waste	Food loss occurring at retail level and consumption levels.
Fugitive methane	Uncontrolled emissions of gas escaping from an industrial process, mainly due to untimely leaks.
Global Methane Pledge (GMP)	Voluntary framework helping nations to take action to collectively reduce methane emissions by 30% below 2020 levels by 2030.
Global Warming Power (GWP)	Warming power of a gas, relative to the warming power of the same mass of carbon dioxide. It is a conversion factor used to compare the relative impact of different greenhouse gases on global warming, based on their cumulative radiative forcing over a given period.
Lower heating value (LHV)	Amount of heat released by the complete combustion of a unit of fuel, assuming the steam is not condensed, and the heat is not recovered.
Organic waste	Waste that is biodegradable and comes from either a plant or an animal.
Recoverable waste	Waste that can be collected, processed and transformed into new products.

About Sia Partners

Sia Partners has 350 consultants dedicated to the challenges of our Clients’ energy transition

Our expertise

Low-carbon energies

- Hydrogen
- Biogas, LNG
- Wind & Solar
- Hydro, Nuclear

Low-Carbon Strategy

- Strategic analyzes
- Due Diligence
- Benchmarks and roadmaps
- CSR strategy

Infrastructure & networks

- Basic & flexible production, Storage
- Intelligent T&D networks
- Automated gas infrastructure

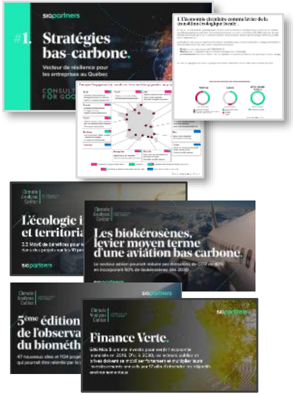
Sustainable Cities

- Electric mobility
- Heat and cold networks
- Energetic efficiency
- Microgrids
- Smart homes & Cities
- Water & Waste

Publications: studies and observatories

Items

Studies



Climate Analysis Center | CONSULTING FOR GOOD

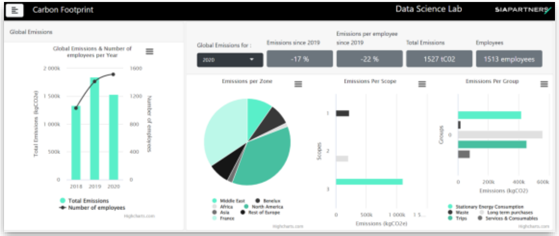
The Sia Partners study "Carbon neutrality in 2050: major European groups are committed" reviews the strategies and action plans of 24 European groups.

- Low carbon strategies are becoming essential on strategic, environmental and economic levels
- Strategies are poorly structured or scattered
- Carbon neutrality objectives are set by a very large majority of companies.
- The emissions perimeters do not always cover the three carbon perimeters in their entirety.

Bots & automation

Our carbon footprint bot supports you in your efforts to contribute to carbon neutrality over time:

- Data entry
- Carbon footprint visualization
- Reduction scenarios
- Monitoring progress
- Continuity of monitoring in a single tool
- Consistency between the balance sheet and the KPIs



Sia Partners: end-to-end Climate expertise: leveraging our +800 Experts

Our expertise covers all sectors …

- Financial Industry
- Energy & Utilities
- Automotive
- Technology
- Retail
- Aerospace & Defence
- Healthcare
- Travel & Transportation
- Media & Entertainment
- Real Estate
- Resources
- Telecomm.

And many more

…with extended consulting capabilities…

Environmental

- Net zero trajectories
- Climate Vision and strategy definition
- GHG Calculation and Assessment
- Low and Net-zero strategy
- Climate Business Model Transformation
- Climate Risk management
- Green IT
- Internal Carbon Pricing
- SBTi Certification
- Biodiversity
- Water pollution
- Waste management
- EV strategies

Social

- HR & Change management
- Organizational awareness
- DEIB
- Stakeholder Communication
- Value Chain assessment
- Accessibility
- Workforce
- Human Rights
- Health and Safety

Governance

- Strategic studies and benchmarks
- Reporting and Transparency
- Regulation and Compliance
- Governance strategies
- Business Conduct
- Gap Analysis
- Ethics and Integrity
- Policies review

Project & program management

…dedicated to ESG

CONSULTING FOR GOOD

Management Consulting
Dedicated to create impacts
ISO, GHG,
CDP, Ecovadis & SBti net-zero

SIAXPERIENCE

Corporate Communication
ESG/CSR -Sustainability Reports
Design and marketing

greenly

A carbon Management platform leveraging Technology and AI to manage your GHG emissions

HEKA

Data Science department helping companies with data-related challenges

NIKE · ENGIE · SOLVAY · transdev · L'ORÉAL · EDF · VEOLIA EAU · Pernod Ricard · ABInBev · UK Power Networks · VINCI · ADEME · NESTE · CONDUENT · LV · BNP PARIBAS · PEPSICO · Rte · encevo · WELLS FARGO · Pfizer · ABN·AMRO · SOCIETE GENERALE · AXA · Shell Ventures · elia · amazon · GRDF · LA POSTE · econocom · citrix

We are a next-generation consulting firm

We are a global firm that has grown steadily over the past 20 years

3,000+ Consultants

50 Offices across **20** countries

455M€ in revenue for FY22/23

We invest heavily in tech and design to stay on cutting-edge and meet our clients' evolving challenges

8 AI centers

10 Design Centers

1000 Clients
92% returning

We cultivate expertise stemming from R&D activities and our proximity with our clients' industries

4% Of our revenue invested in R&D

300K+ Followers on LinkedIn

We are business experts focused on delivering superior results

90 **Partners**

Global coverage across **50** **offices**

16 **Business Units, working in an integrated manner**

SECTORS	SERVICES
Agriculture	Actuarial Sciences
Automotive & Aerospace Defense	Business transformation
Banking & Capital Markets	Compliance
Consumer Goods & Retail	Corporate Strategy
Energy, Resources & Utilities	CSR
Government	Cybersecurity
Health	Data management
Insurance	Data Science
Luxury goods and beauty	Digital transformation
Manufacturing	E-commerce
Pharmaceuticals	Financial Performance
Real Estate	Growth & Innovation
Software & platforms	IT Strategy
Technology	Marketing & Customer Experience
Telecommunications & Media	Organization effectiveness
Transportation & Travel	People
	Pricing & Revenue Management
	Procurement & Sourcing
	Restructuring
	Supply Chain & Logistics

Sia Partners is a next-generation consulting firm focused on delivering superior value and tangible results to its clients as they navigate the digital revolution.

Our global footprint and our expertise in more than 30 sectors and services allow us to enhance our clients' businesses worldwide. We guide their projects and initiatives in strategy, business transformation, IT & digital strategy, and Data Science. As the pioneer of Consulting 4.0, we design AI-powered, enterprise solutions.

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