



**Waste sector = 5% of global emissions in 2016
(1.6 Billion Tons CO_{2eq}/year)**

**Business as Usual
= 2.6 Billion Tons CO_{2eq}/year by 2050**



Case of **France**



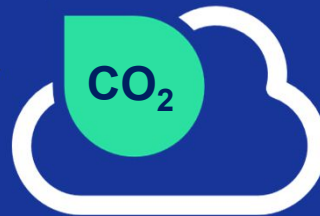
Waste to energy (incineration)

~380 kg CO_{2eq}/t of waste
(from fossil-based products)

+

~550 kg CO_{2biogenic}/t of waste
(from organic content)

42%

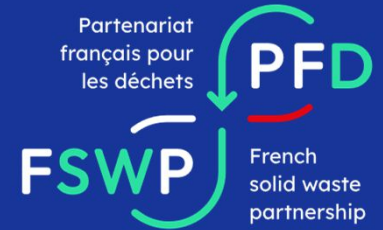


58%

Source : <https://bibliothèque.ademe.fr/energies-renouvelables-reseaux-et-stockage/4007-determination-des-contenus-biogene-et-fossile-des-ordures-menageres-residuelles-et-d-un-csr-a-partir-d-une-analyse-14c-du-co2-des-gaz-de-post-combustion.html>



Case of **France**



Waste to energy (incineration)

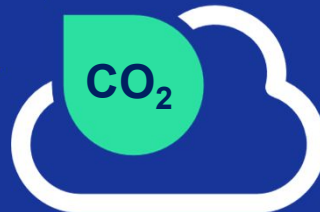
~ **0.3** MWh/ ton of waste
45% electricity
55% heat

~ **140** kg CO_{2eq} /MWh*
Emitted

* Scope 1 & 2 emissions only, fossil emissions only.

~ **180** kg CO_{2eq} / MWh**
Avoided

** Compared to the use of the French energy mix



Source : <https://bibliothèque.ademe.fr/energies-renouvelables-reseaux-et-stockage/4007-determination-des-contenus-biogene-et-fossile-des-ordures-menageres-residuelles-et-d-un-csr-a-partir-d-une-analyse-14c-du-co2-des-gaz-de-post-combustion.html>



Case of 



Biowaste methanization

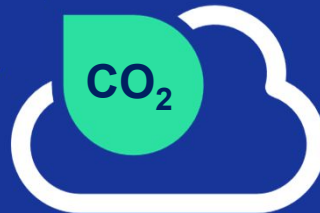
~ **1.1 MWh PCS**
biomethane / T biowaste

~ **45 kg CO_{2eq} /MWh***
Emitted

~ **240 CO_{2eq} /MWh ****
Avoided

*Scope 1 & 2 of the energy production process only.

** Compared to the use of the French mix of natural gas



Source: <https://projet-methanisation.grdf.fr/actualites/les-analyse-de-cycle-de-vie-confirment-limpact-positif-de-la-filiere-biomethane-sur-la-reduction-des-emissions-de-gaz-a-effet-de-serre>



Case of 

Partenariat
français pour
les déchets



Biogas Recovery from Engineered Landfills

Operational
practices:

Good

Bad

**Biomethane /t waste
over the lifespan of the waste**

~ 0.78 MWh/t*

~ 0.42 MWh/t*

**CO_{2eq} emitted /t waste
over the lifespan of the waste**

~ 300 kg CO_{2eq}/t *

> 900 kg CO_{2eq}/t *

**By 2025 in France,
landfill biomethane will
contribute
6 TWh
of renewable
natural gas**



* based on the French landfilled waste mix, accounting for organic fraction reduction trends as per EU Directive

Source: <https://waga-energy.com/en/ecube-study/>



Case of **France**



Biogas recovery from Engineered Landfills

Engineered landfill with
Poor Practices

> 900 kg CO_{2eq}/t of waste*

(over the lifespan of the waste)

Cost of
improvement
in France

~ 2 to 4 €/t of waste

Engineered landfill with
Good Practices

~ 300 kg CO_{2eq}/t of waste*

(over the lifespan of the waste)

* based on the French landfilled waste mix, accounting for organic fraction reduction trends as per EU Directive



Case of **France**



Partenariat
français pour
les déchets

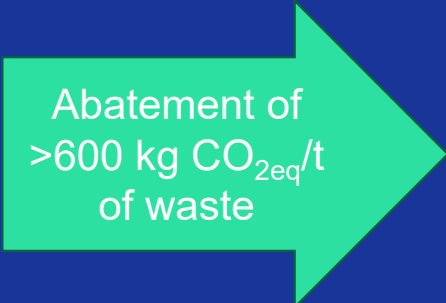


Biogas recovery from Engineered Landfills

Poor Practices

- No capture during operation
- Delay in implementing the capture system post operation
 - Semi-permeable cover
 - No bioreactor
- Poor monitoring & maintenance
 - Flaring all the biogas
 - Leakages*

*non-optimized treatment of residual CH₄
& non-preservation of cover integrity



Abatement of
>600 kg CO_{2eq}/t
of waste



Good Practices

- Capture during operation*
 - *temporary cover
 - Impermeable cover
- Bioreactor with >60% waste kept humid
- Frequent monitoring & maintenance
 - Energy valorisation of biogas
 - Minimized leakages*

*optimized treatment of residual CH₄
& preservation of cover integrity