Contribution of non-hazardous waste landfills to the achievement of the GHG emission reduction targets in the EU

Final report - Slides

2023

Executive Summary

Slide #3

Currently achievable best operating practices allow operators to reduce by ~50% the total direct and indirect emissions generated with "average" operating practices…

Slide #4

8 practices can be declined as "good and bad practices": capturing the methane during operation, delay in capturing post operation, cover type, implementation of a bioreactor, performance of the bioreactor, monitoring, valorisation, and treatment post 30 years

Slide #5

Considering the overall changes required to transform SWDS in France from the "current mix of practices" towards a "generalisation of good practices", the average estimated cost would amount ~€3-4/t_{waste}

Slide #6

Such improvement would be achieved at a reasonable cost of ~20€/tCO2e, partly financed by the additional energy recovery

Slide #7

Avoided emissions using valorisation installation reach 110kg_{CO2eq}/t_{waste} in the case of Biomethane injection and 30kg_{CO2eq}/t_{waste} for cogeneration… and to increase biomethane production, corresponding to an increase of avoided emissions by + ~50%

Slide #8

The generalisation of "good practices" could increase by ~+26% the potential of biomethane production in France, enabling to benefit from methane that is available yet unexploited

Slide #9

N.B. In France, landfill biomethane could contribute to ~10% of the 2030 biomethane injection targets (~2-3TWh depending on production practices); extrapolated at the EU level, it could represent ~15-20TWh, or ~5 to 10% of the 2030 production target of RePower EU

Slide #10

Putting in place "Good practices" ensures landfilling to be environmentally competitive with incineration benefitting from lower direct and indirect emissions and a similar level of avoided emissions in 2020

Main findings

> Best landfill gas practices can achieve a significant reduction of methane emissions: ~50% / -66%

> The abatement cost of methane emissions is very competitive: ~20€/tCO2e or ~€3-4/twaste

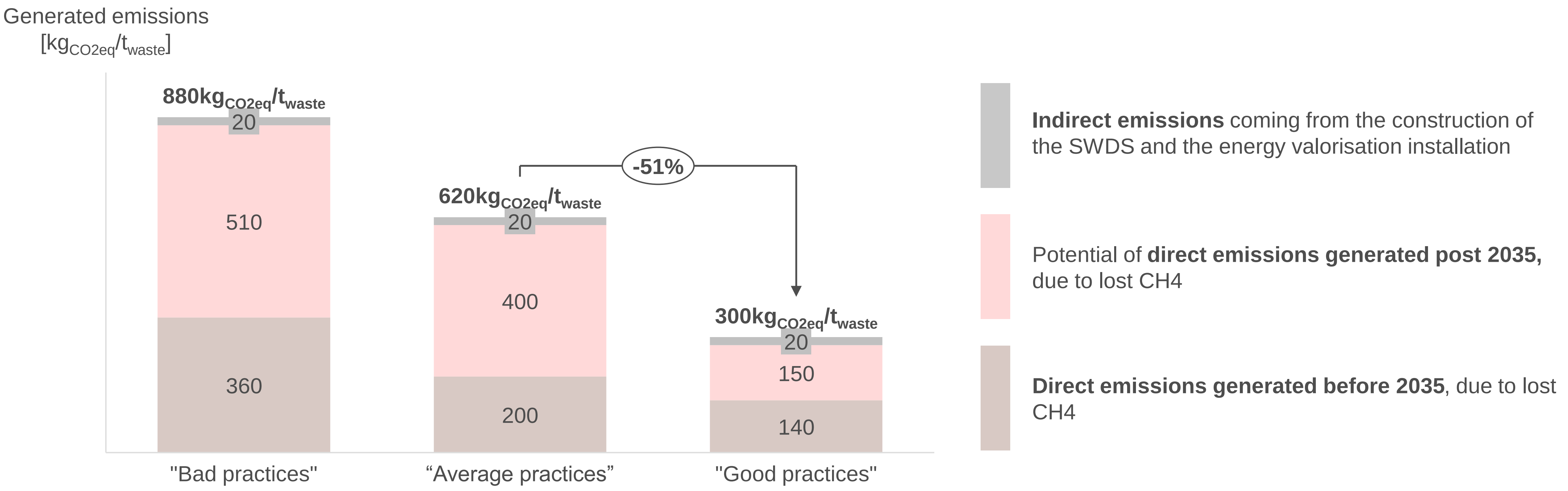
> Improved landfill gas capture would generate significant potential of renewable natural gas (biomethane): 15 to 20% of *Repower EU* target

> Financial resources generated by RNG and (if applicable) Carbon Credits would finance the scheme

> In addition « Green Landfills » can bring positive environmental externalities

Currently achievable best operating practices allow operators to reduce by ~50% the total direct and indirect emissions generated with "average" operating practices…

COMPARISON OF THE EMISSIONS GENERATED FOR A TON OF WASTE TREATED WITH "GOOD", "AVERAGE" OR "BAD PRACTICES" IN 2020 IN SWDS [kg_{CO2eq}/t_{waste}]



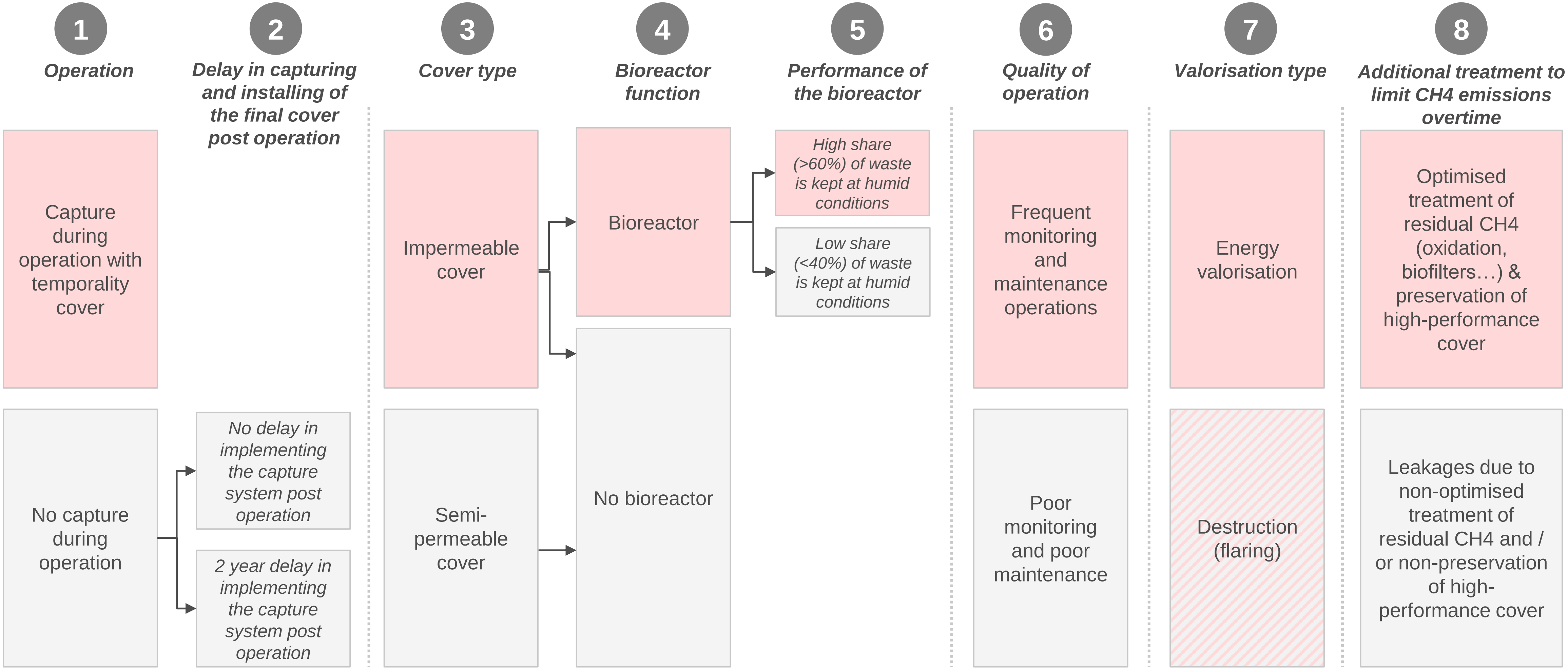
Assumptions

- "Average practices":
  - Geomembrane cover, 90% capture rate
  - Bioreactor is not efficient, leaving waste at "dry" temperature conditions for its degradation
  - Degradation of the cover (3% p.a.) causing leakage post 30 years.
  - Good quality monitoring and maintenance decelerating degradation
- "Good practices":
  - No delay implementing the capture system post operation
  - Geomembrane cover, 90% capture rate
  - Bioreactor keeps 60% of waste « humid » temperature conditions
  - Degradation of the cover (1% p.a.) causing leakage post 30 years.
  - High quality monitoring and maintenance decelerating degradation

Source : IPCC model, Interviews from Suez Veolia & WAGA, ADEME, E-CUBE Strategy Consultants analysis

8 practices can be declined as "good and bad practices": capturing the methane during operation, delay in capturing post operation, cover type, implementation of a bioreactor, performance of the bioreactor, monitoring, valorisation, and treatment post 30 years

OPERATIONAL & TECHNICAL CHOICES THAT WILL DETERMINE "BEST" AND "BAD" PRACTICES IN THE MANAGEMENT OF A LANDFILL INSTALLATION



1) Low and high limit could be precised later on

Source: Interviews (Suez, Veolia, Waga), E-CUBE Strategy Consultants analysis

In between which every choice is possible — Identified as a "good" practice

Considering the overall changes required to transform SWDS in France from the “current mix of practices” towards a “generalisation of good practices”, the average estimated cost would amount ~€3-4/t_{waste}

ASSESSMENT OF THE COST NEEDED TO SWITCH FROM "BAD" / "AVERAGE" TO ‘AVERAGE” / "GOOD" PRACTICES

Switching from a practice to another in a SWDS

At one SWDS scale :

- The cost to **switch from « bad » practices to « average »** practices is **~1-2€/twaste**
- The cost to **switch from « bad » practices to « best »** practices is **~5-6€/twaste**
- The cost to **switch from « average » practices to « best »** practices is **~4-5€/twaste**

Assumptions:
- *Calculated for each practice switch for one SWDS with a capacity of 100 000t of waste per*

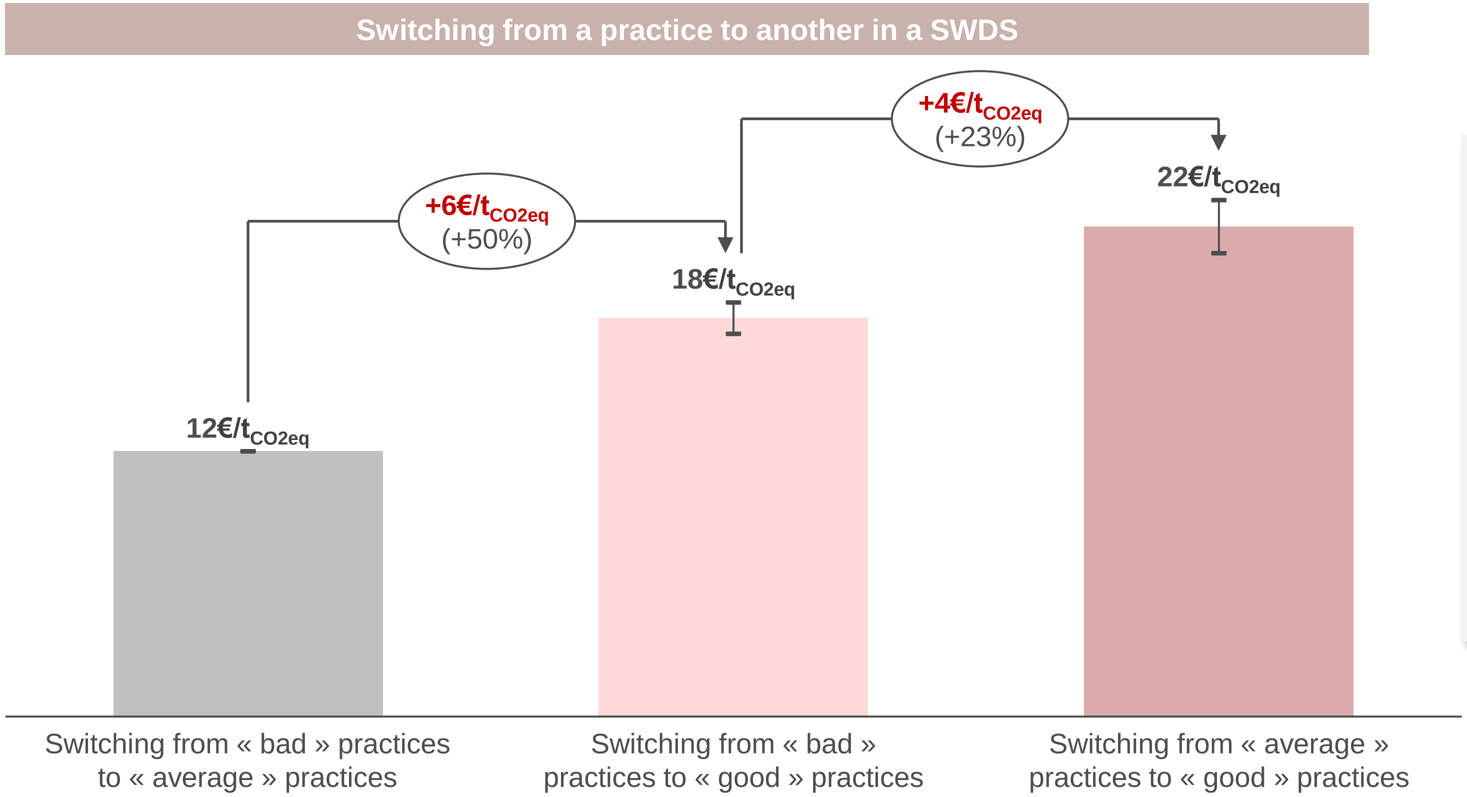
Sources : E-CUBE Strategy Consultants analysis

At one SWDS scale, and according to the initial a,d reached practice, the abattment cost varies from ~12€/t_{CO2eq} to ~ 22€/t_{CO2eq}

ABATEMENT COST LINKED TO THE IMPLEMENTATION OF AVERAGE OR BEST PRACTICES IN ONE SWDS [€/tCO2eq]

Abatement cost (€/tCO2eq) = total cost to treat the waste tons landfilled in one SWDS (€) / avoided emissions (tCO2eq), with:

- Total cost to treat the waste tons landfilled in one SWDS : net present value at 5% of : [CAPEX + OPEX] for each concerned practices
- Emissions avoided : net present value at 5% of emissions avoided



At one SWDS scale :

- The abatement cost to **switch from « bad » practices to « average »** practices is **~ 12€/t_{CO2eq}**
- The abatement cost to **switch from « bad » practices to « best »** practices is **~ 18€/t_{CO2eq}**
- The abatement cost to **switch from « average » practices to « best »** practices is **~22€/t_{CO2eq}**

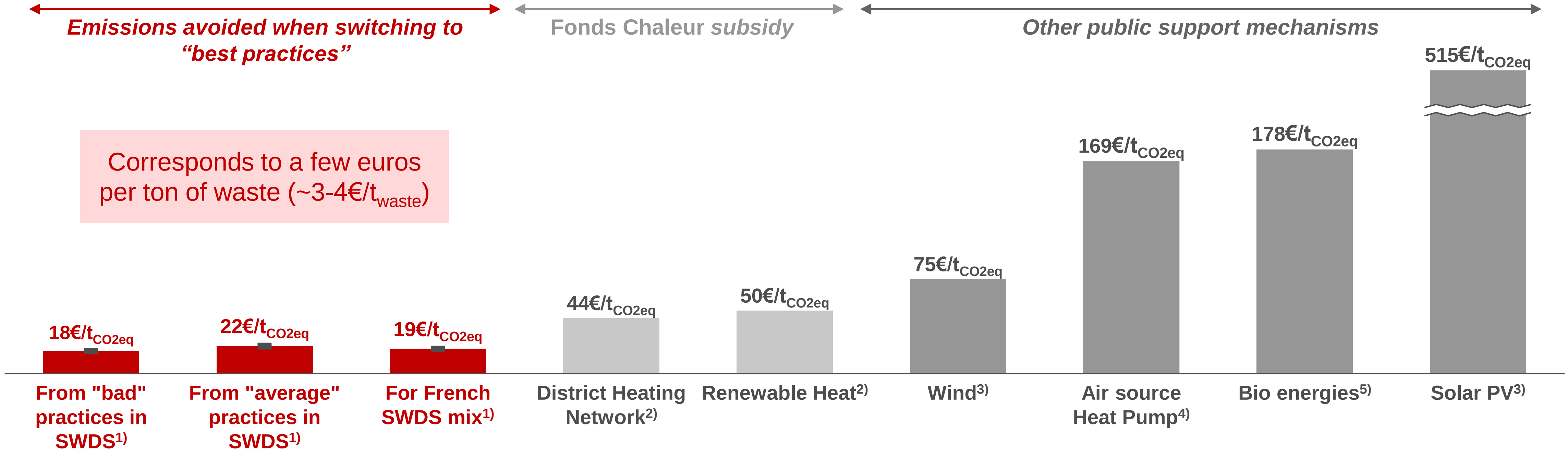
Assumptions:

- *Calculated for each practice switch for one SWDS with a capacity of 100 000t of waste per*

Sources : E-CUBE Strategy Consultants analysis

Such improvement would be achieved at a reasonable cost of ~20€/tCO2e, partly financed by the additional energy recovery

ABATEMENT COST OF RENEWABLE ENERGY DEPLOYMENT FOR THE PUBLIC SERVICES [PUBLIC EXPENSE (€) / AVOIDED EMISSIONS (tCO_2e)]



N.B. Additionally, the cost of energy recovery makes it one of the most competitive sources of green gas on the market, with a large share of assets already competitive with long-term projections of natural gas prices associated with EU-ETS carbon prices

1) Average value. Minimum and maximum value calculated from Suez and Veolia data differ from ~1-2€/tCO2eq.
2) Average abatement cost for Fonds Chaleur supported projects: total subsidy / avoided emissions in the project life (source: ADEME; Direction Générale du Trésor, « Les énergies renouvelables : quels enjeux de politique publique », Trésor-Eco n°162 03/16)
3) Abatement cost as the average public charge (purchase obligations 2012-2020, source: CRE) divided by avoided emissions (22 $MtCO_2e$/yr avoided, according to RTE 'Bilan prévisionnel 2019)
4) Average Heat Pump (~4 MWh/yr) as a substitute to an old gas boiler (90% efficiency) in an individual housing, with ~€3.5k subsidy from MaPrime Rénov, for a 20-year duration (source: FEDENE; MaPrime Rénov 1st semester 2022)
5) Purchase obligations and investment support (average abatement cost according to Direction Générale du Trésor, 2016)

Source: E-CUBE Strategy Consultants analysis based on operators technical and economical data

Avoided emissions using valorisation installation reach 110kg$_{CO2eq}$/t$_{waste}$ in the case of injection and 30kg$_{CO2eq}$/t$_{waste}$ for cogeneration

AVOIDED EMISSIONS GENERATED BY INJECTION OR COGENERATION WITH “GOOD PRACTICES” IN 2020 IN SWDS [kg$_{CO2eq}$/t$_{waste}$]

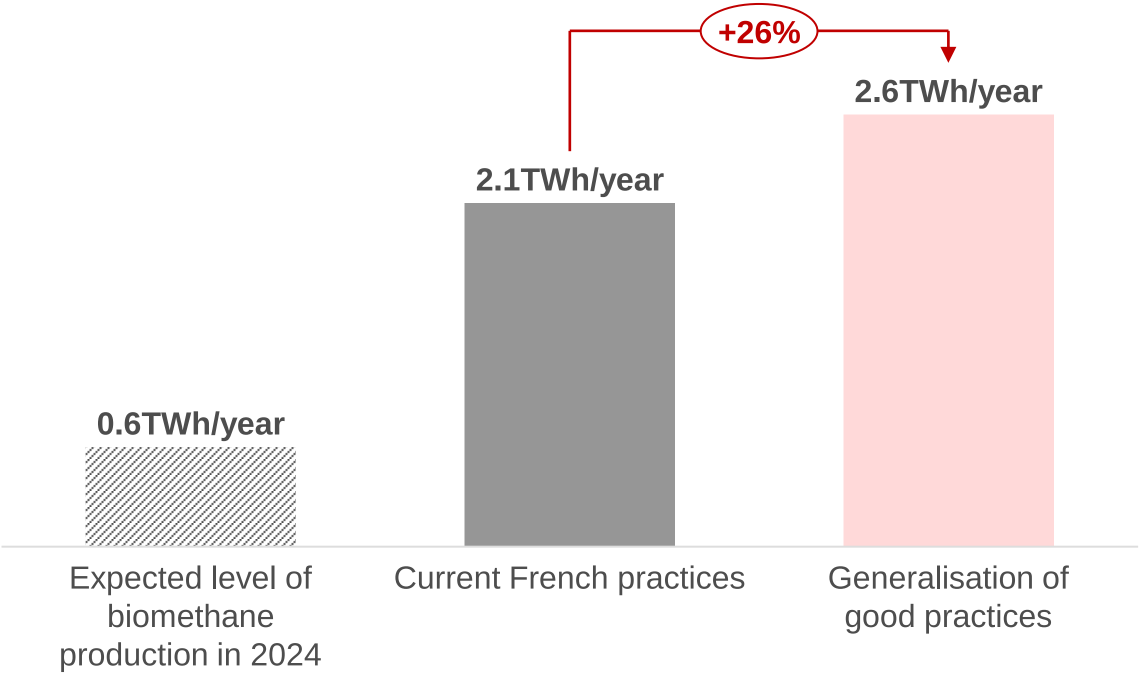
Landfilling enables energy valorisation through injection or cogeneration, which generates avoided emissions that can reach a comparable level with incineration in case of injection

Assumptions
- Estimation of CH4 emissions for 30 years post-operation
- Capture during operation
- No delay implementing the capture system post operation
- High quality monitoring and maintenance decelerating degradation
- Geomembrane cover, 90% capture rate
- Bioreactor keeps 60% of waste « humid » temperature conditions
- Degradation of the cover (1% p.a.) causing leakage post 30 years.
- Yield heat landfill = 35%, yield electricity landfill = 25%

Source: GIEC 2019 Refinement to the 2006 IPCC Guidelines; Yield study Gourc and Staub, WAGA Energy; analyse E-CUBE Strategy Consultants

The generalisation of "good practices" could increase by ~+26% the potential of biomethane production in France, enabling to benefit from methane that is available yet unexploited

PROJECTION OF BIOMETHANE PRODUCTION THAT COULD BE TARGETED IN 2030 WITH THE CURRENT FRENCH PRACTICES VS THE GENERALISATION OF GOOD PRACTICES IN FRANCE



N.B. In France, landfill biomethane could contribute to ~10% of the 2030 biomethane injection targets (~2-3TWh depending on production practices); extrapolated at the EU level, it could represent ~15-20TWh, or ~5 to 10% of the 2030 production target.

Assumptions:

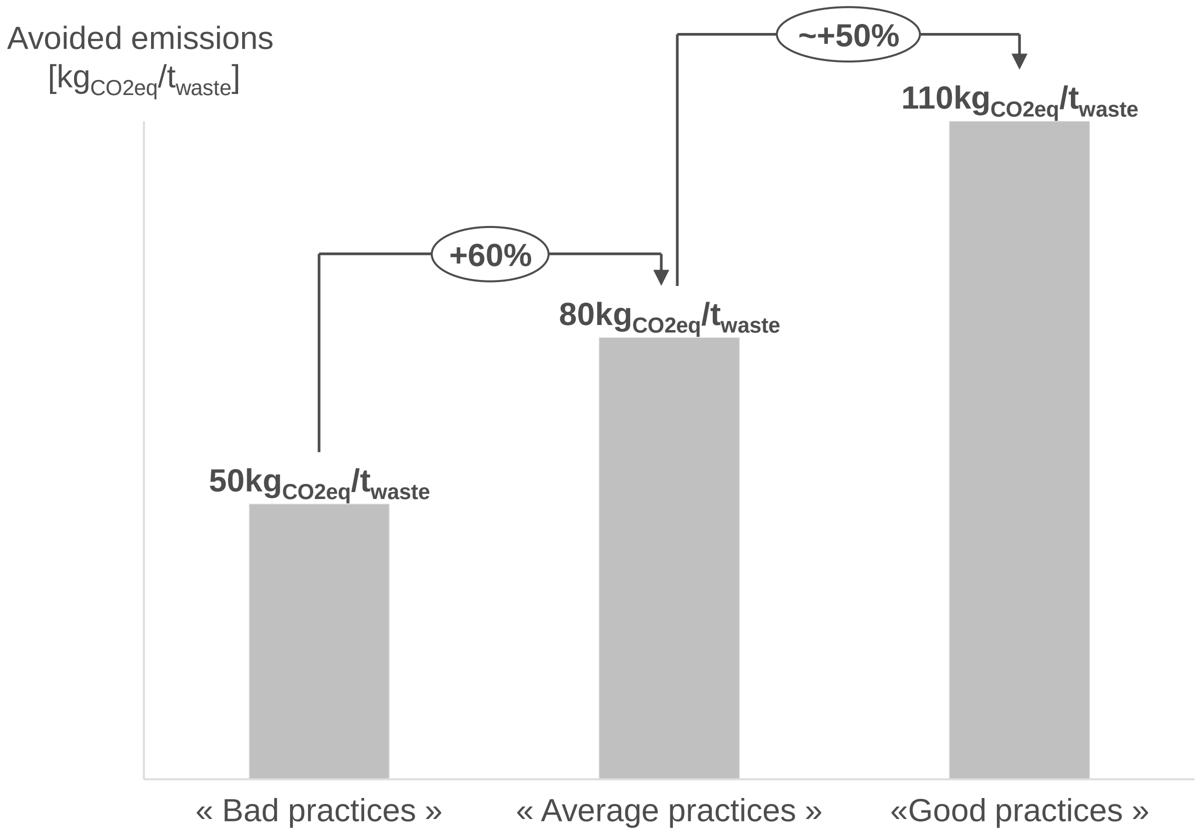
- The current production potential has been built taking into account that 16 SWDS are injecting in 2023, and ~27 SWDS will be equipped with injection by 2024[1)], projecting ~600GWh biogas production in 2024. It is assumed that this increase will continue at 2017-2024 pace (~25%p.a.), up to ~65 SWDS in 2030[2)].
- To build the "future production potential due to the generalisation of good practices":
- It is assumed that biomethane production would increase only due to the switch from "bad" to "average practices" and from "average" to "good practices",
- It is assumed that 100% of the bad practices that will switch to "average practices" will choose injection rather than cogeneration.

1) Data from WAGA ENERGY and GRDF
2) GRDF estimates that ~50 SWDS could be equipped with an injection system by 2025

Sources : E-CUBE Strategy Consultants analysis based on operators technical and economical data

… and to increase biomethane production, corresponding to an increase of avoided emissions by + ~50%

COMPARISON OF THE EMISSIONS AVOIDED FOR A TON OF WASTE TREATED WITH "AVERAGE PRACTICES" OR "GOOD PRACTICES" IN SWDS IN 2020 [kg_{CO2eq}/t_{waste}]



Source : IPCC model, ADEME, GRDF, interviews with Suez Veolia & WAGA, E-CUBE Strategy Consultants analysis based on operators technical and economical data