



**Municipal waste is expected to rise
to ~ 4 B Ton /y by 2050
a 73% increase* compared to 2020**

*** with high variability between geographic zones.**

Source: *What a waste, World Bank*



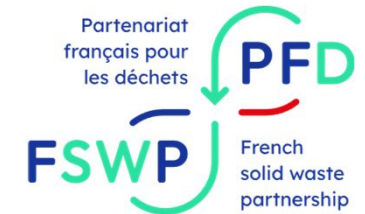
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**Waste sector = 5% of global emissions in 2016
(1.6 Billion Tons CO_{2eq}/year)**

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



Pathways for waste to address the climate urgency :

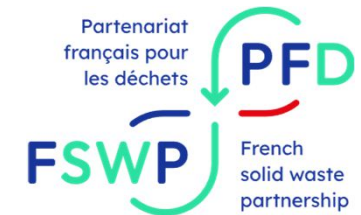
1 - Reduce waste volumes*

* reduces emissions associated to production of goods, transport and treatment



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Pathways for waste to address the climate urgency :

2 - Improve waste collection to reduce flooding risks* & pollution

* prevents drainage blockages

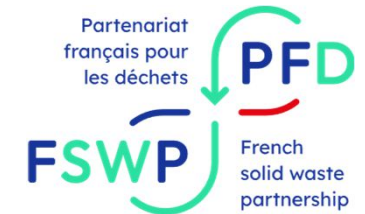




Pathways for waste to address the climate urgency :

3 - Improve waste collection routes to reduce transport emissions





Pathways for waste to address the climate urgency :

4 – Reuse* and recycle**

*reduces production of goods

**low-carbon raw materials





Pathways for waste to address the climate urgency :

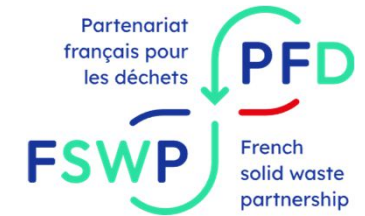
5 – Transition* to engineered landfills with methane recovery

* Rehabilitate dumpsites and controlled landfills



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Pathways for waste to address the climate urgency :

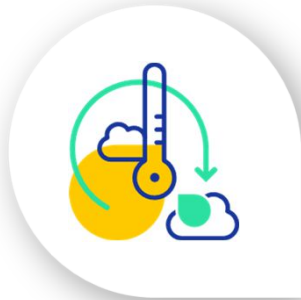
6 – Recover* the energy from waste

*while avoiding methane leakage



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WASTE & CLIMATE
CHANGE

WASTE TO
RESOURCES



FRANCE - Limay



Recycled PET production

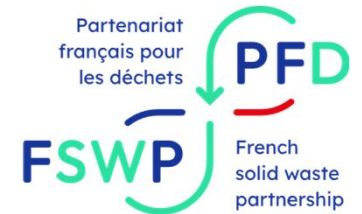
France Plastique Recyclage



Production of recycled plastic (rPET) as a substitute for primary PET

- 45,000 t/year of PET bottles from selective collection processed
- 41,000 t/year rPET produced

➔ [France Plastiques Recyclage : dernière ligne droite pour les travaux d'extrusion - Paprec](#)



CLIMATE BENEFIT:

- > rPET generates 70% less CO₂ than primary PET
- > 50 kTon CO₂eq avoided by 2022 by using rPET in place of primary PET

CO-BENEFIT:

- > Increases the sustainability of the bottled water industry.



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WASTE TO ENERGY/
METHANE REDUCTION

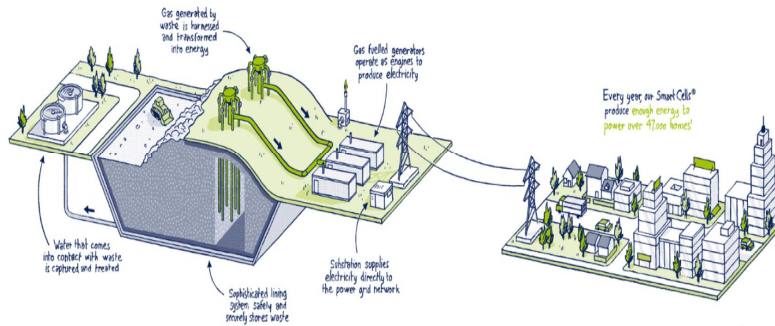


AN INTERNATIONAL MODEL



Green landfill to energy

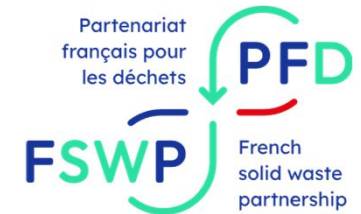
Integrated infrastructure to replace dumpsites



An innovative financing model for waste treatment in developing economies

- Produce biomethane, produce electricity
- Improve waste management from open dumpsites to environmentally controlled landfills
- The case of Meknes, Morocco:
 - 200 kTon/ y of waste safely managed
 - 70% reduction in emissions by 2033
 - 5,500 MWh/y production capacity

➔ [A waste recovery centre in Meknès combines the fight against global warming with social innovation - SUEZ Group](#)



CLIMATE BENEFIT:

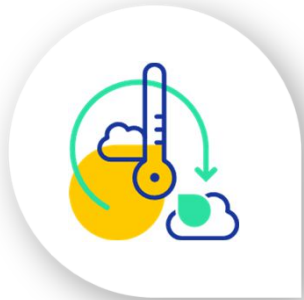
- > Methane capture
- > Production of renewable energy

CO-BENEFIT:

- > Land value enhancement
- > Reduced pollution through leachate treatment
- > Improved energy autonomy

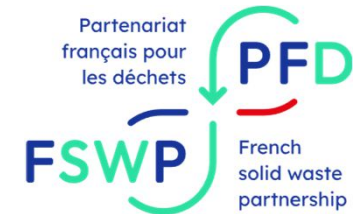


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WAGABOX[®] technology

A benchmark solution for landfill gas purification for recovery



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WASTE TO ENERGY/
METHANE REDUCTION



EUROPE AND NORTH AMERICA



Coupling membrane filtration and cryogenic distillation to upgrade landfill gas into grid compliant biomethane

- Improvement in energy yield compared with cogeneration
- Optimized methane capture as there is no limitation in air concentration in landfill gas
- Example: WAGABOX[®] in Claye-Souilly, France
 - Capacity: 130 GWh/y
 - 21,000 kg CO₂eq avoided/y
 - 20,000 households supplied with biomethane

➔ [Technologie - Waga Energy \(waga-energy.com\)](https://waga-energy.com)

CLIMATE BENEFIT:

- > 142 kTon CO₂eq avoided (since 2017) compared to former landfill operation scenario
- > Green fuel for transport and industry
- > Methane emissions reduction

CO-BENEFIT:

- > Improving landfill operation



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WASTE FOR ALL
SDG

HOLISTIC WASTE
MANAGEMENT



OMAN - Muscat



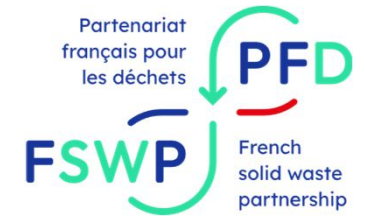
Barka Landfill

A landmark of the Omani journey from open dumpsites to 100% controlled solid waste treatment



2,500 t/day are highly compacted and readily covered with soil to reduce emissions

- Biogas is recovered; the installation of a gas engine is in planning; the capture of biogas from open cells is evaluated
- Leachate is treated; the permeate reused to cover the landfill operation needs; no discharge
- Tyres are processed in chips to fuel a nearby cement plant



CLIMATE BENEFIT:

- > Methane emissions are significantly reduced
- > Green energy from biogas about to be harnessed

CO-BENEFIT:

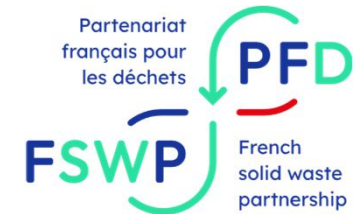
- > More than 1M people benefit of an improved environment
- > Water and soil pollution from open dumps is avoided
- > Multiple use of fossil carbon: from tyres to energy





Non-recyclable waste into green energy

Heat and power production as an alternative to landfilling



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WASTE TO ENERGY



The Sète waste-to-energy plant:

- 55,000 t/y of non-recyclable waste processed in an 18.1 MW oscillating furnace to produce
 - 15.7 GWh of electricity
 - 23 GW of steam

CLIMATE BENEFIT:

- > Energy production

CO-BENEFIT:

Energy autonomy :

- > Produces electricity for 4,000 to 6,000 households
- > Produces steam for an oil seed industry

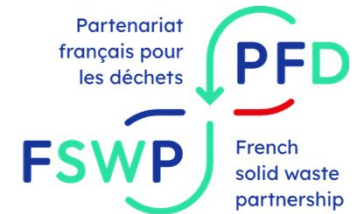
➔ [L'éco-centre Ikos Fresnoy-Folny, pionnier de la méthanisation \(paprec.com\)](https://www.paprec.com)





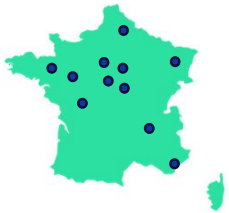
MASSBio₂ the CO₂ Dashboard

Assessing biogenic and fossil carbon fractions in incineration flue gas, waste and energy

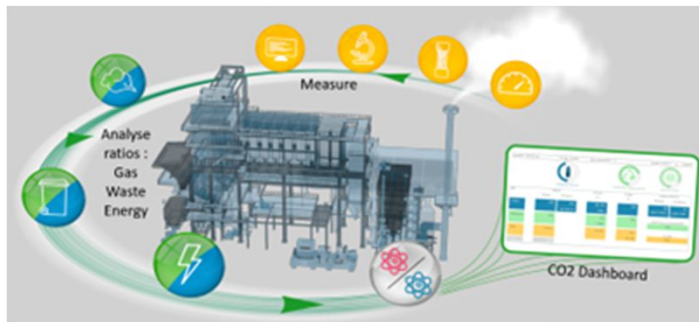


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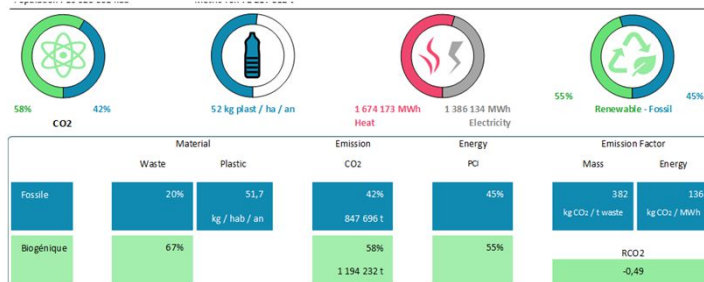
WASTE TO ENERGY



FRANCE - 11 locations



From flue gas to waste composition... by measuring the origin of CO₂ (¹⁴C analysis)
An algorithm assesses biogenic and fossil CO₂, the waste composition, and the renewable energy fraction.



➔ [Nos innovations -R&D | Groupe Merlin \(cabinet-merlin.fr\)](https://www.cabinet-merlin.fr)

CLIMATE BENEFIT:

➤ Measure CO₂ emissions to understand waste composition and identify levers driving mitigation actions.

CO-BENEFIT:

- Citizens and decision-makers awareness to reduce waste production
- Metrics on waste composition to drive action





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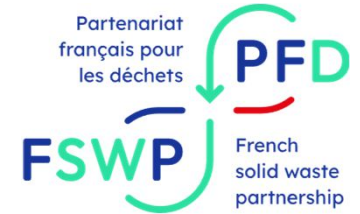
WASTE TO ENERGY



TÜRKIYE- Istanbul

Istanbul Waste-to-Energy Plant

Istanbul Metropolitan Municipality - İSTAÇ A.Ş



Treatment capacity of 1.1 M/t waste per year

- Europe's largest waste to energy facility
- Electricity production by an 85 MW turbine = meets the needs of 1.4 million inhabitants
- Objective of carbon neutrality by 2053

➔ [Décarbonation: Veolia devient l'opérateur du 1er site de production d'énergies à partir de déchets de Turquie | Veolia](#)

CLIMATE BENEFIT:

- > 1,4 M Ton CO₂eq/y of carbon emissions are reduced (through reduced landfilling and transportation)
- > Green electricity production

CO-BENEFIT:

- > Improve the environment for citizens
- > Improved energy autonomy



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WASTE TO RESOURCES



United Arab Emirates-
Abu Dhabi



MAGMA
ENVIRONMENTAL SERVICES
operated by VEOLIA

Oil & Gas Waste Recovery

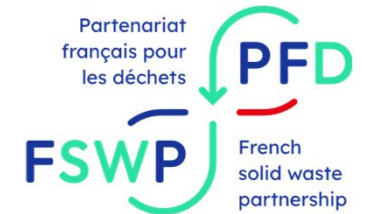
The ecological transformation of the oil industry in the Middle East



Hazardous waste treatment at Al Ruways: the largest oil refinery in the Middle East

- Maximize resource recovery (water and oil) from oil and gas industrial waste, for reuse on nearby OpCo's (ADNOC Operational subsidiaries) industrial sites (recovery and reuse of petroleum resources).
- Increase the green energy production capacity through an upcoming solar power plant

➔ [Magma Corporate presentation](#)



CLIMATE BENEFIT:

- > Reduced consumption of petroleum raw materials
- > Promoting a green economy

CO-BENEFIT:

- > Reducing the environmental impact of industrial activities
- > Meet people's energy needs



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Geothermal CO₂ capture

Leveraging CO₂ dissolution capacity in cold versus hot water



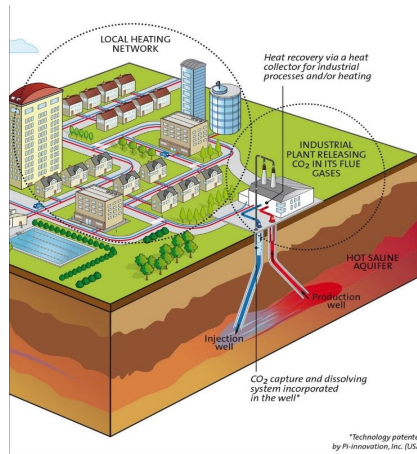
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CARBON SINK



FRANCE – Greater Paris

R&D project to combine a deep geothermal plant with permanent CO₂ storage of incineration flue gases.



The project aims to:

- Store 300,000 tons of CO₂ (40% fossil) in a deep aquifer
- Recover heat from the geothermal aquifer to supply district heating
- Reduce the amount of the future European tax on waste-to-energy emissions.

CLIMATE BENEFIT:

- > 300 kTon CO₂ to be captured
- > Harnessing renewable energy (heat)

CO-BENEFIT:

- > Research partnership
- > Innovation can benefit others



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WASTE TO
ENERGY



FRANCE - Cordemais



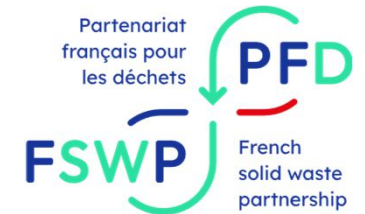
Ecocombust II

Black pellets from wood waste as a substitute for coal



Wood waste conversion into black pellets
to fuel the Cordemais coal-fired power plant

- Transformation of wood waste by steam cracking to produce 160,000 t of black pellets/year as an alternative fuel to coal.
- The plant uses 250,000 t/year of B-wood and 40,000 t/year of Solid Recovered Fuels.



CLIMATE BENEFIT:

- > 6 million Ton CO₂eq avoided over 20 years compared to fossil fuel
- > Fossil fuel substitution by renewable energy

CO-BENEFIT:

- > Energy autonomy
- > Existing coal-fired power plant infrastructure can be leveraged to produce green energy



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