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9 reasons why Carbon Capture should be prioritized in the Waste to Energy sector

17 May 2022

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Introduction: key take-away of 6th IPCC report conclusions (April 2022)

- Beside the common mitigation options*, other measures are recognized to be **critical** to meet net zero:
    - Carbon capture and storage
    - Carbon capture and utilisation
    - Carbon dioxide removal
    - Reduce methane emissions from solid waste

Sixth Assessment Report
WORKING GROUP III – MITIGATION OF CLIMATE CHANGE
ipcc

** i.e. renewable energy, electrification of transport, energy efficiency in building or material efficieny in industry, nature based solutions…)*

Introduction: key take-away of 6th IPCC report conclusions (April 2022)

- Carbon capture and storage
- Carbon capture and utilisation
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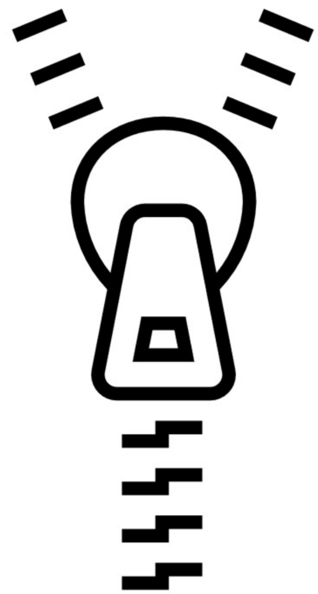
Waste to Energy

Carbon Capture Storage/Utilisation



9 reasons why Carbon Capture should first be deployed in the Waste to Energy sector

WtE plant in Bao An, China

1. The low hanging fruit: methane

- Today, humankind produces 2 bio tonnes of municipal solid waste per year.
- 70% of it is still landfilled: 1,4 bio tonnes per year, or 45 000 kg per second
- Landfilling produces methane*
- Methane is 80X more harmful to the climate than CO_2 in its first 20 years in the atmosphere

** Besides other dramatic consequences like air pollution, water contamination, soil degradation, plastic dissemination, disease/virus propagation, and definitive loss of the materials that are landfilled*

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1. The low hanging fruit: methane

1 ton waste in **landfill** = 4+ ton CO_2 equivalent*

1. The low hanging fruit: methane

1 ton waste in **landfill** = 4+ ton CO_2 equivalent

CO_2 ÷ 4+

WtE plant in Fangshan, China

1 ton waste in **WtE** = 1 ton CO_2

1. The low hanging fruit: methane

924+ Mt CO_2 eq/y

equivalent CO_2 reduction from avoided methane emissions between 2020 and 2030*

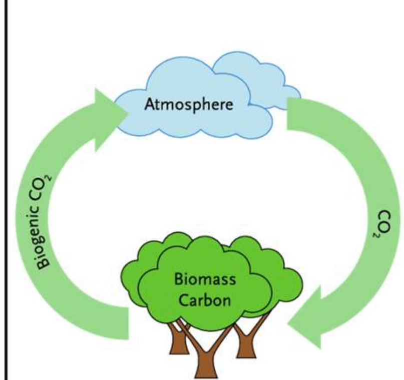
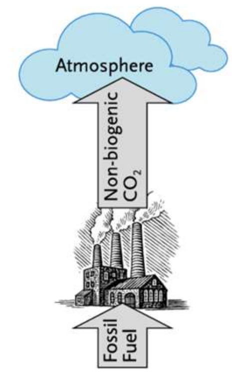
**note. 231 Mt waste should be diverted from landfill to WtE between 2020 and 2030*

2. WtE + CC = CDR * = negative CO_2 emissions

- 50-60% of municipal solid waste is from biogenic source (wood, paper and food waste)

- WTE integrated with CC is uniquely positioned as one of the few negative CO_2 emissions technologies

- As a negative emissions technology, WTE integrated with CC will be able to off-set the emissions of other more challenging CO_2 emitters

	Biogenic	**Non-biogenic**
Source		
WTE	Net zero emission	Net positive emission
WTE + CC	Net negative emission	Net zero emission

* *WtE = waste to energy*
CC = carbon capture
CDR = carbon dioxide removal

3. CC integration in WTE is proven

Project	Operation start	Technology	Scale	Status
Klemetsrud WTE in Oslo, Norway 	2026	Amine	400 000 tCO_2 per year	Starting construction
Duiven WTE, Netherlands 	Q3 2019	Amine	100 000 tCO_2 per year	Operational
Twence WTE, Netherlands  	2014	Amine	2-3 000 tCO_2 per year	Operational
	Q4 2023	Amine	100 000 tCO_2 per year	Construction to commence in 2022

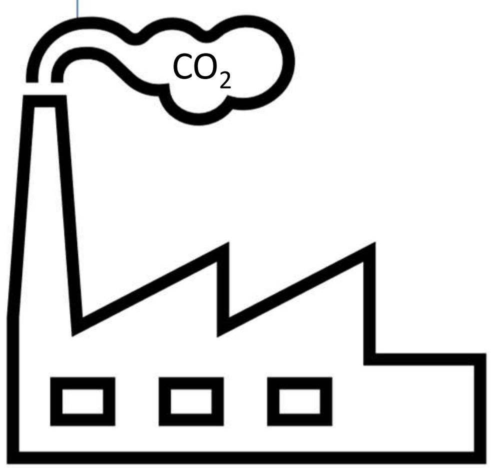
4. Material CO_2 reduction potential

649 Mt CO_2/y

90% CO_2 captured

584 Mt CO_2 /y captured

Global WtE
emissions by 2030*



WtE

+ 292 Mt CO_2 /y
net negative emissions potential to offset emissions of other emittors

* *Source Ecoprog 2022*

5. 24/7

- WTE plants run continuously
- Availability > 8000 hours/year
- Planned yearly shutdown

➔ Continuous delivery of:

- steam
- electricity
- CO_2

WtE plant in Singapore

6. Longevity of WtE

- WtE plants are backed up by long term contracts for waste supply and energy offtake

- WtE plants are local: close to the waste source and to the energy offtake

- No risk of delocatisation

- Some examples:

  - *ISVAG in Belgium: built in 1989 and still operating smoothly*
  - *French WtE fleet: 127 plants with a average age of 27 years.*

WtE plant in Antwerp, Belgium (ISVAG)

7. Synergies between WtE and CC

WtE produces:
- Heat
- Power
- Cooling
- Other utilities

Synergies save:
- CAPEX
- OPEX
- Space

CC consumes:
- Heat
- Power
- Cooling
- Other utilities

Other potential synergies:
- Flue gas cleaning
- Carbonated residues for bricks
- Sodium bicarbonate for flue gas cleaning


Bricks based on carbonated bottom ash


Bicar Production site in Twence WTE using captured CO2 of the WTE

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8. Cost competitiveness

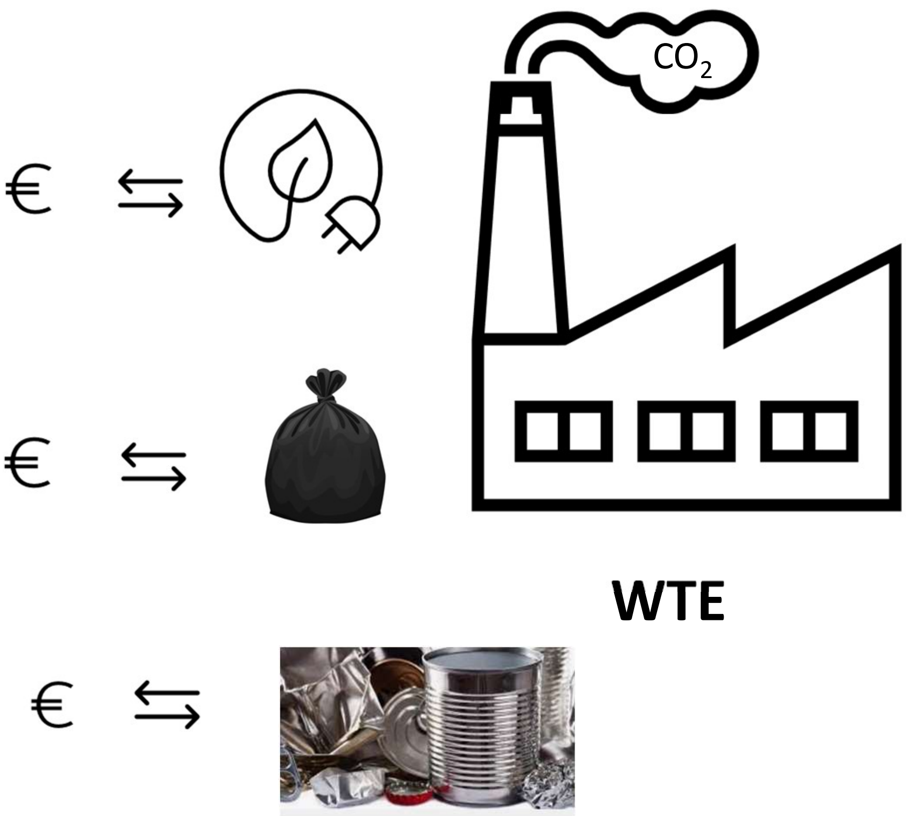
Sector	Estimated £/t CO_2
Waste to Energy	66-110 £/t CO_2
Iron production & other metal processing	80 £/t CO_2
Cement & lime	80-140 £/t CO_2
Other Non-metallic Minerals	140 £/t CO_2

Comparison of CCUS Costs by Industrial sector
Source: Eunomia report CCUS development pathway for the WtE sector

Factors influencing the total CC cost:

- Energy penalty ⇔ level of synergy with WtE
- Technology
- Solvent
- Distance from source to storage/utilisation site

9. New financial incentive for project development



Actual economic model of a WtE plant

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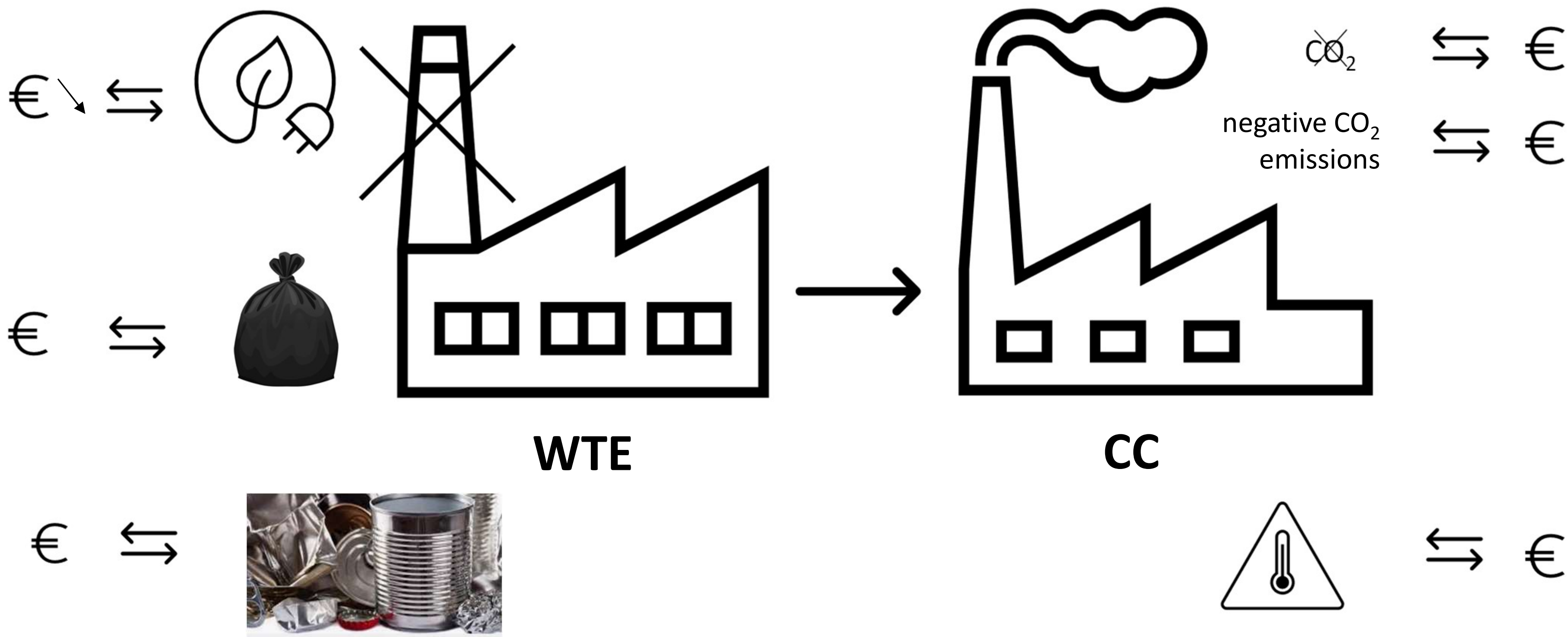
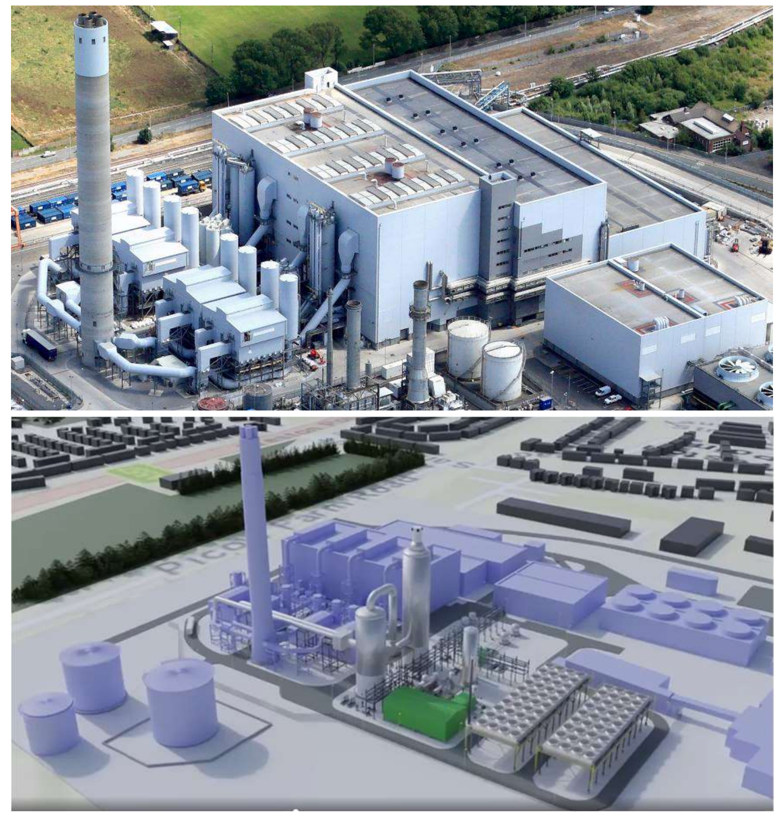
9. New financial incentive for project development



New economic model of a WtE plant combined with CC

Keppel Seghers and carbon capture

- Feasibility study of the integration of CC plant in the Runcorn ERF / 3 different technologies (1mio ton CO_2/y)
- Multiple CC feasibility studies in WTE in the pipe Asia/UK
- Confidential dialogue with CC technology suppliers (amines, hot potassium, solid sorbents, etc...)
- Discussing pilot plant scale projects
- Chairing CCUS working group in Industry Association ESWET (European Suppliers of Waste to Energy Technologies)



WtE plant combined with CC in Runcorn, UK

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