The role of CCUS in Climate Change

CCUS in Action" – A Deep Dive into the Future of Carbon Capture and Utilization

Online Webinar-22/05/2025

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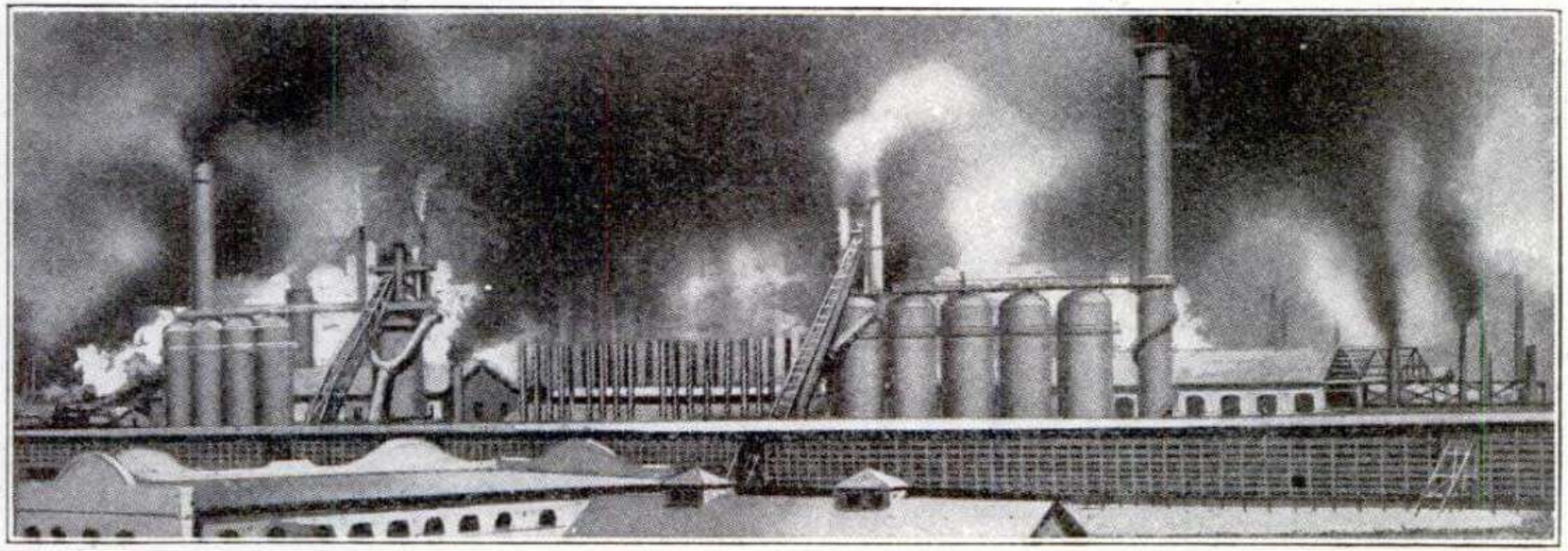
Reuse

Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101172954. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union.

The Greenhouse Effect and Global Warming

March, 1912 POPULAR MECHANICS 341

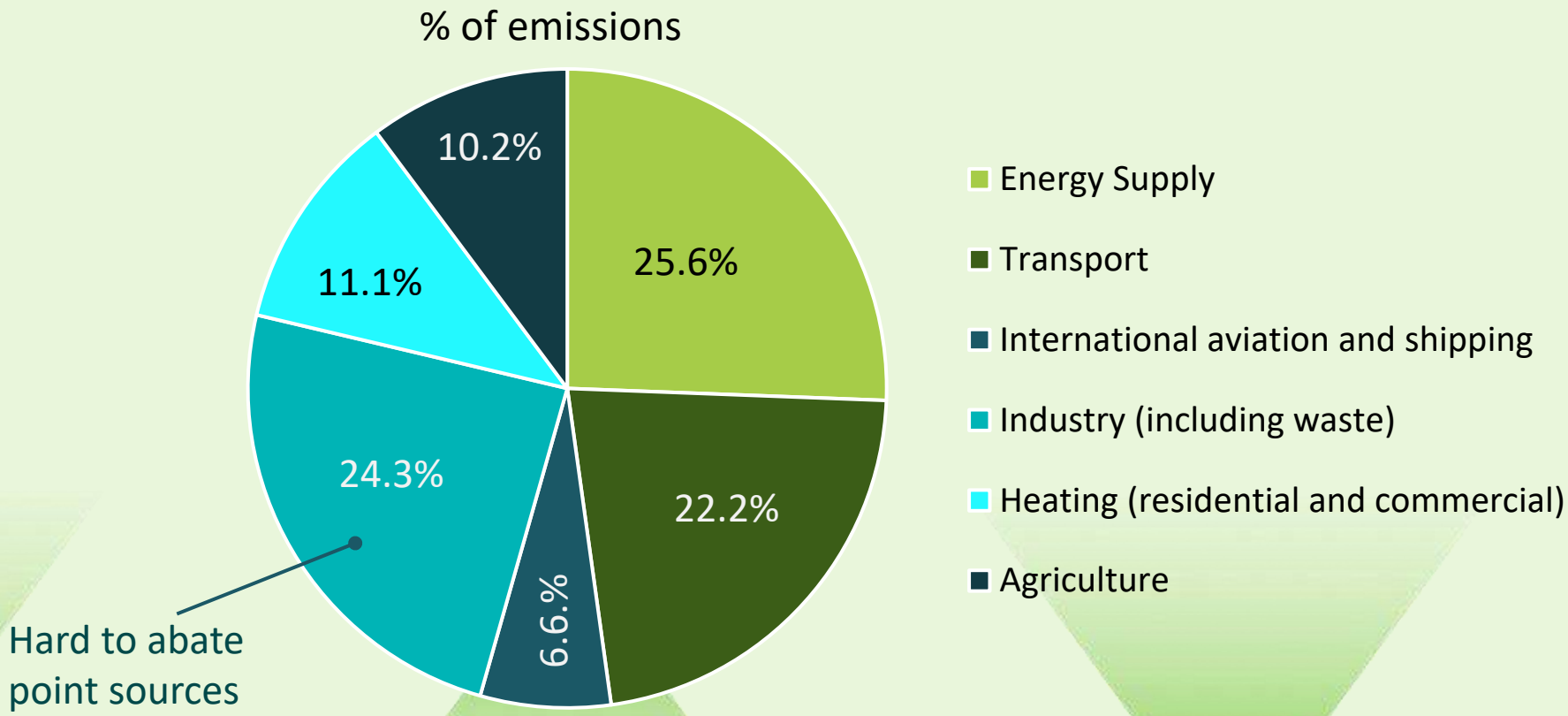


The furnaces of the world are now burning about 2,000,000,000 tons of coal a year. When this is burned, uniting with oxygen, it adds about 7,000,000,000 tons of carbon dioxide to the atmosphere yearly. This tends to make the air a more effective blanket for the earth and to raise its temperature. The effect may be considerable in a few centuries.

Slide courtesy of Dr Greg Mutch, School of Engineering, Newcastle University

CO_2 emissions - Facts

- In 2022 Europe emitted 3.6 Giga tonnes of CO_2 equivalent (CO_2, methane, nitrous oxide, fluorinated gases).



https://www.europarl.europa.eu/topics/en/article/20180301STO98928/greenhouse-gas-emissions-by-country-and-sector-infographic

CO_2 emissions – Industrial Sources

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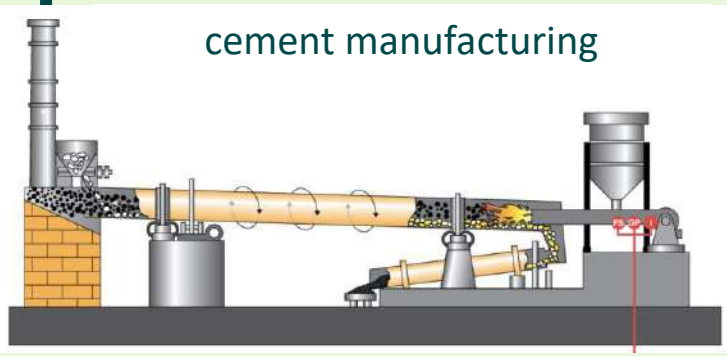
Flue gas (~18 vol% CO_2)

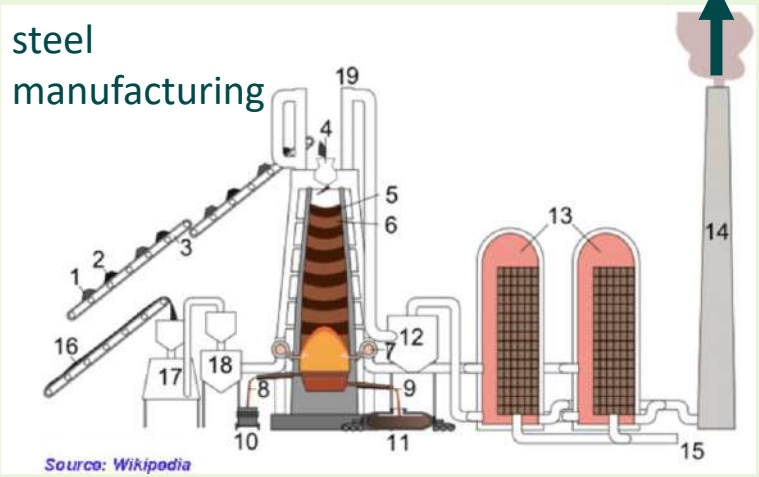
cement manufacturing



$E_{min} = 0.15\ GJ/tonne_{CO_2}$

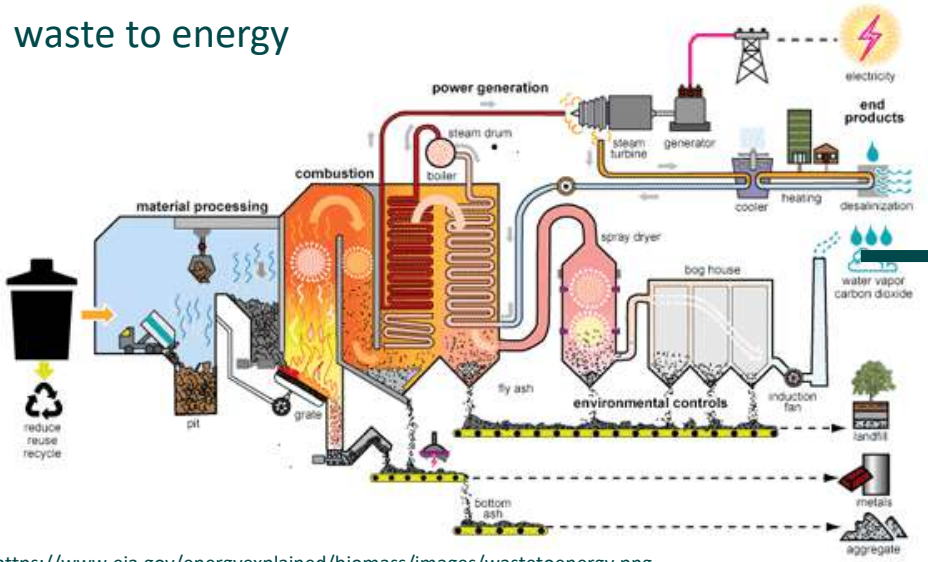
Flue gas (~22 vol% CO_2)

steel manufacturing



$E_{min} = 0.14\ GJ/tonne_{CO_2}$

waste to energy



https://www.eia.gov/energyexplained/biomass/images/wastetoenergy.png

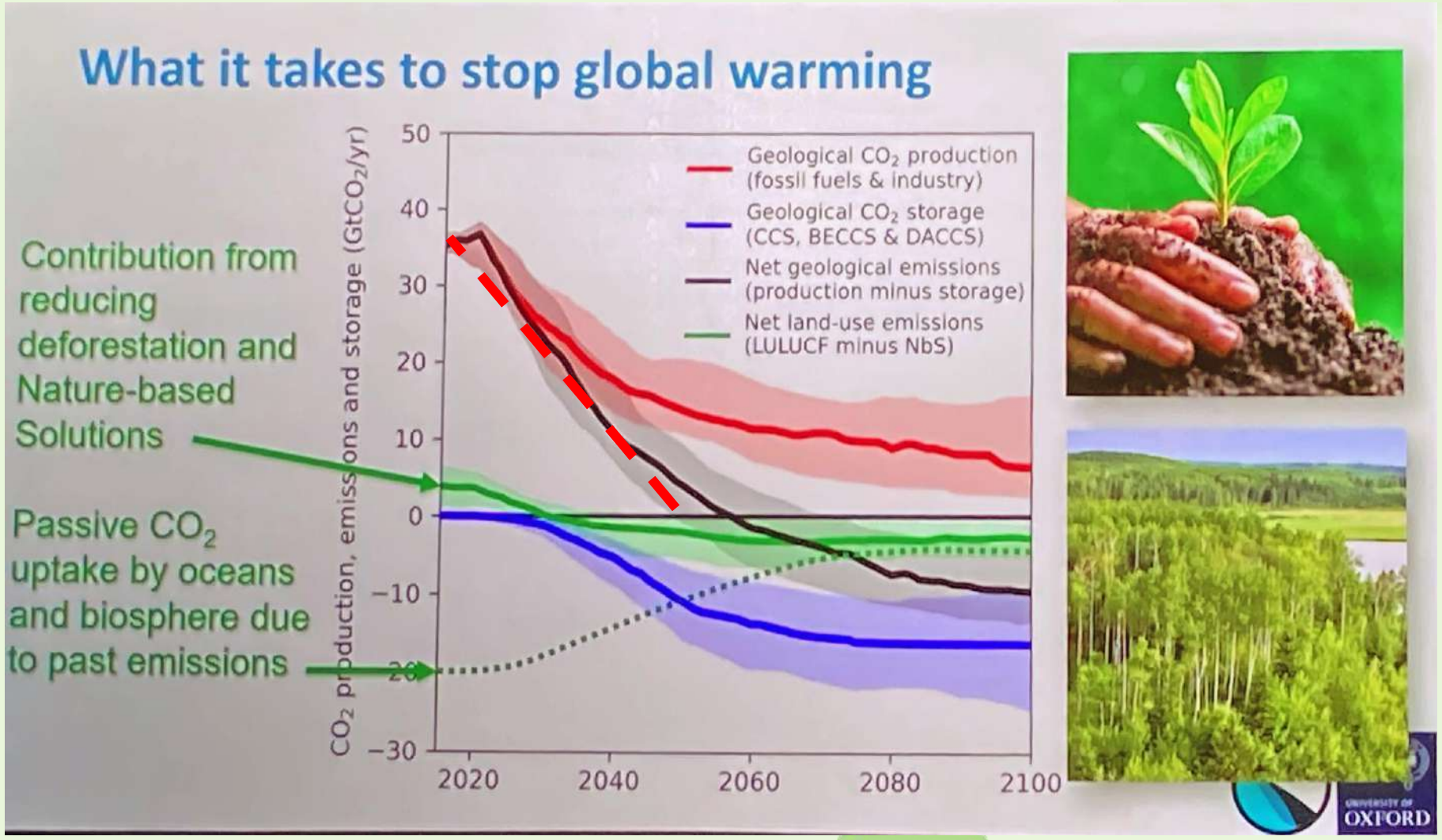
$E_{min} = 0.19\ GJ/tonne_{CO_2}$

Flue gas (~10 vol% CO_2)

Direct air capture

$E_{min} = 0.5\ GJ/tonne_{CO_2}$

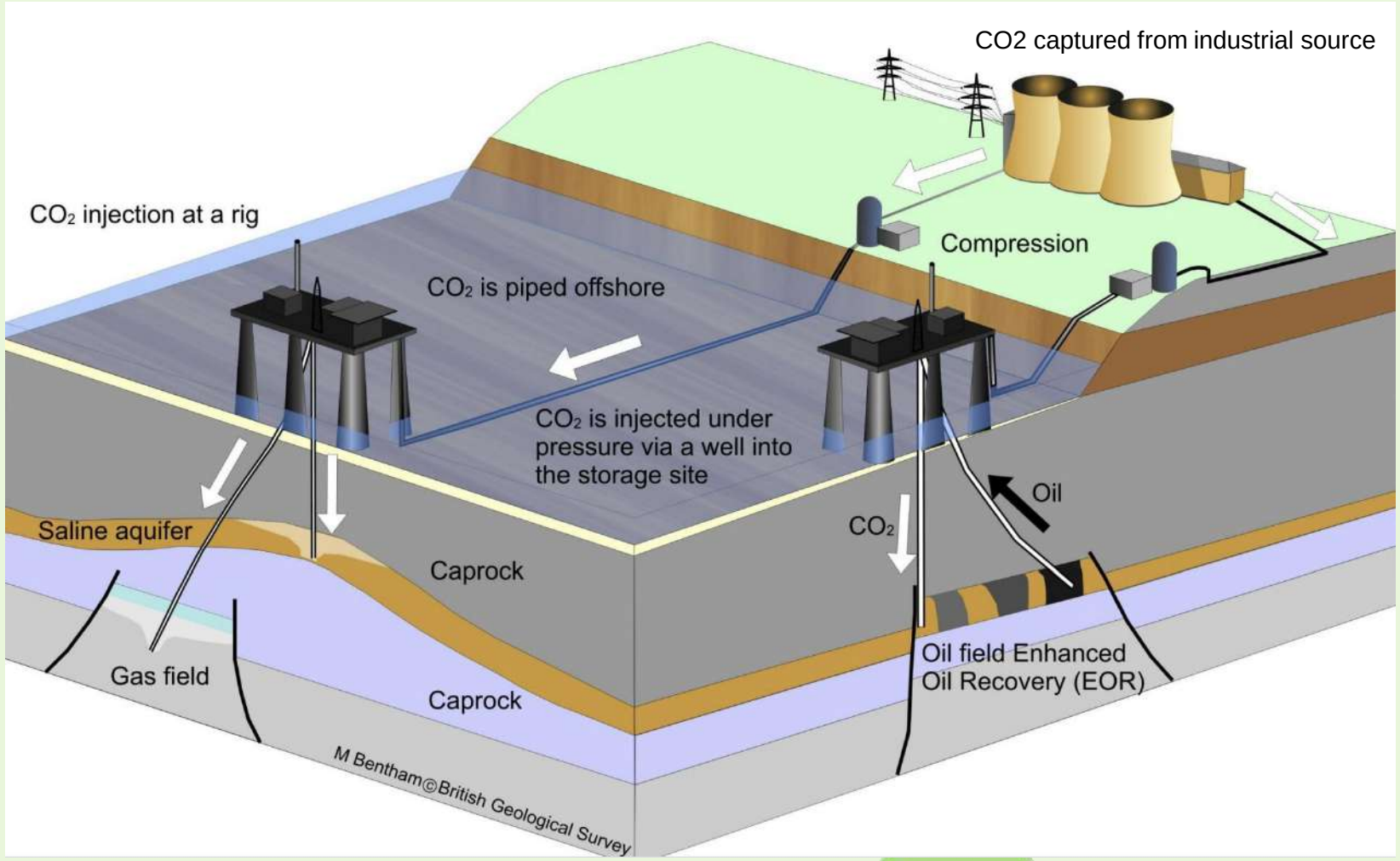
CO_2 emissions - Facts



Dashed red line is the Geological CO_2 production trajectory required for Paris agreement targets

Slide from a presentation by Professor Miles Allen, University of Oxford, at GHGT-17, 21st October 2024, Calgary.

CO_2 Capture and Storage – Full Chain

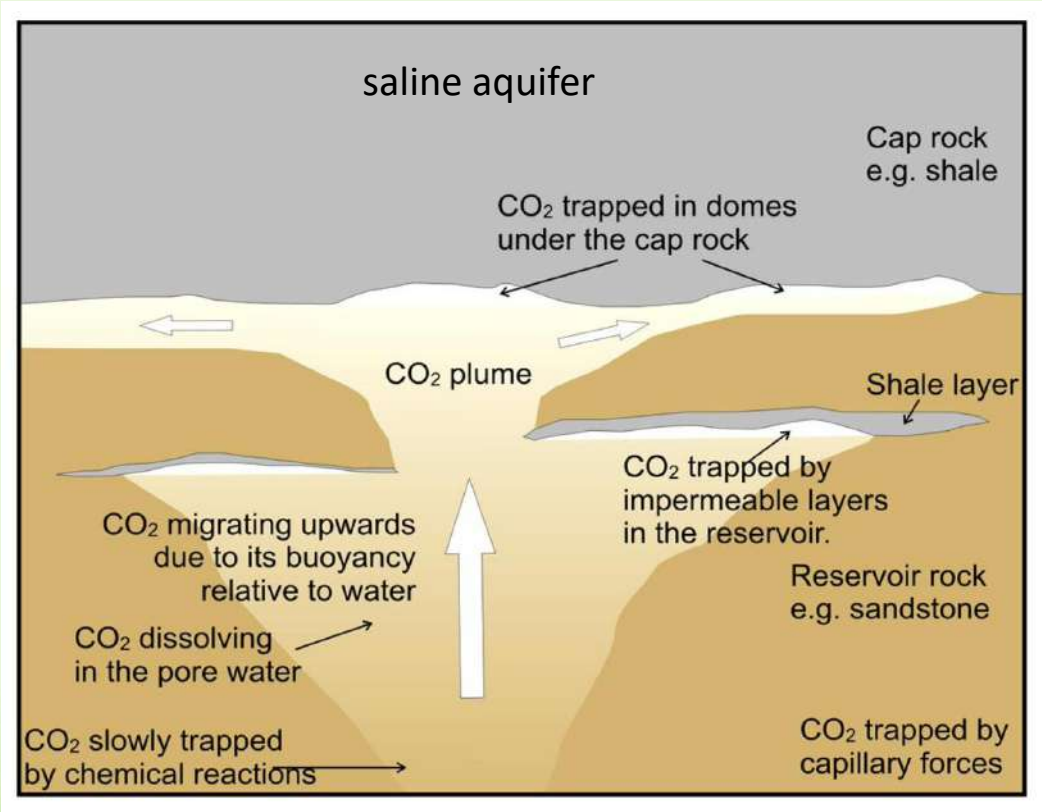


Most optimistic cost is €131 per tonne CO_2 for offshore storage.

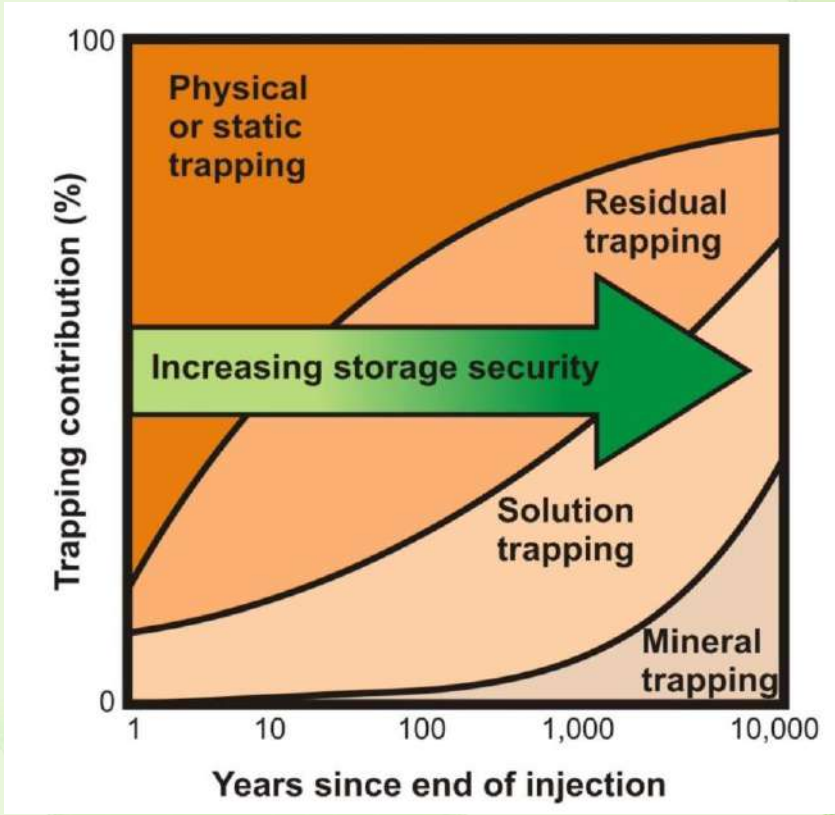
Source: https://committees.parliament.uk/writtenevidence/38365/pdf/

Enhanced Oil Recovery is **not** storage

CO_2 Capture and Storage – Full Chain



Source: British Geological Survey (2010)



Source: IPCC (2005)

CO_2 Capture and Storage – Full Chain

Reuse

Boundary Dam Coal Fired Power Station - 2015

115 MW_e

2400 tonnes per day of CO_2 capture

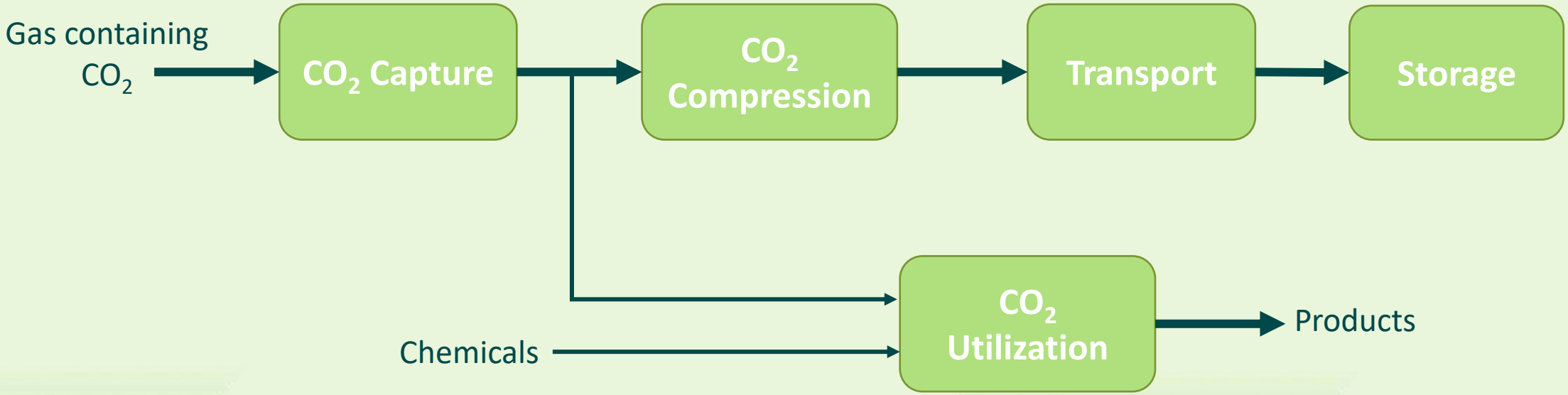
Some storage but CO_2 is mainly used for enhanced oil recovery

Comparison of post combustion capture methods

Capture Method	Cost - € per tonne CO_2	Energy consumption GJ/tonne CO_2	Comments
Solvent Based	34 – 85	2.8 – 3.4	Cost end energy consumption depend on the solvent used to capture CO_2
Adsorption onto solid	13 – 106	0.4 – 3.2	Cost depends on price and lifetime of adsorbent. Energy consumption depends on pressure.
Membrane	35 – 70	0.7 – 2.1	Cost depends on price and lifetime of membrane. Energy consumption depends on pressure
Chemical looping	20 – 30	1.7 – 3.0	A reactive adsorption process that uses a low-cost adsorbent.
Micro algae	618 – 1400	0.8	High cost of microalgae cultivation.

Solvent based capture is widely deployed because it has been proven to work at the scales required

Carbon Capture and Utilisation



- CO_2 from fossil fuel sources must be converted in products with a significant lifetime.
- Building materials and some plastics are good examples.
- Fuels should not be produced from fossil CO_2 sources.

Carbon Capture and Utilisation

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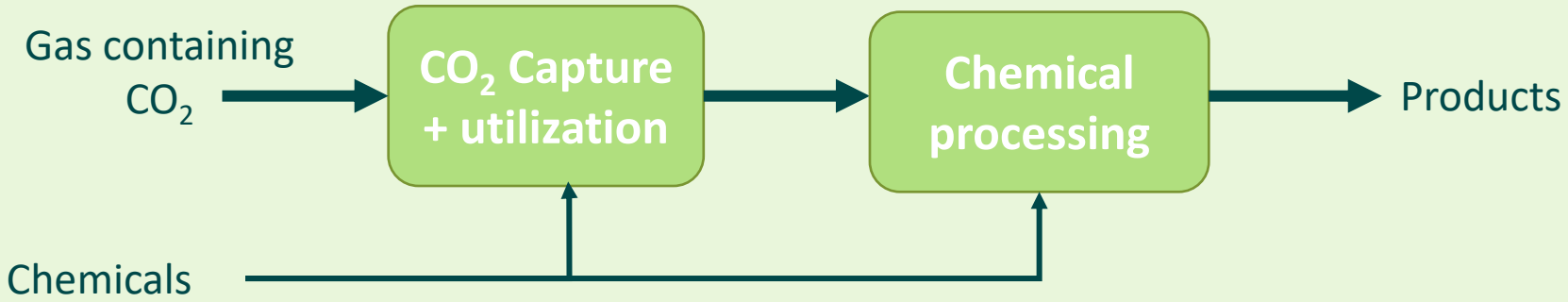
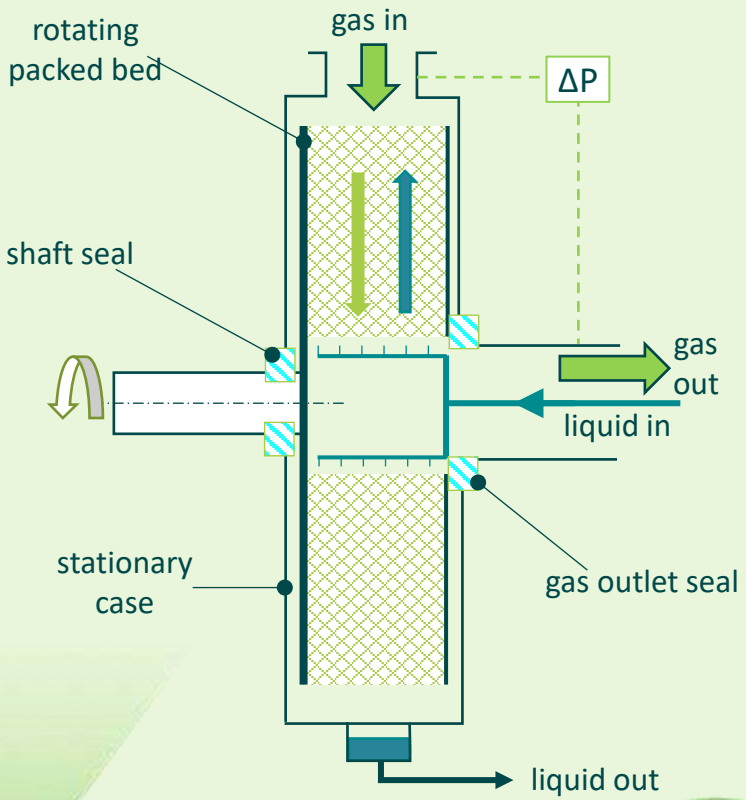
REUSE Project



- REUSE project is “intensifying” CO_2 utilization by combining the capture and utilization processes.
- Using the rotating packed bed as a key technology

Carbon Capture and Utilisation



packing

- The volume of the packed bed is reduced by a factor of 20-50
- Capital cost saving of 40%

CO_2 emissions – Industrial Sources

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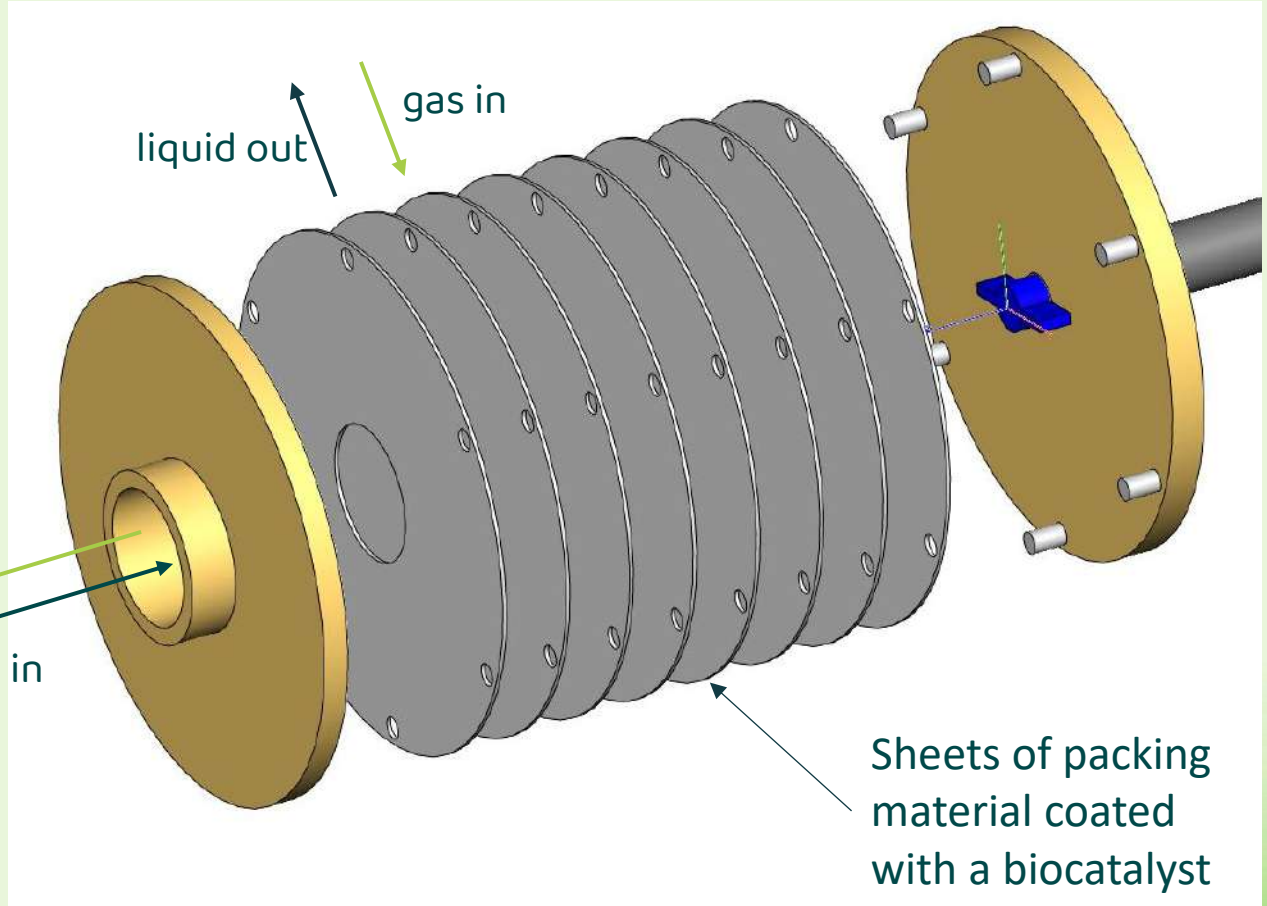
Rotating Packed Bed for the REUSE Project



Convert CO_2 into carbonate and bicarbonate ions

CO_2 emissions – Industrial Sources

Reuse

CarboNation Project – detergent powder ingredients from CO_2

- Using spray dryer off gas to produce solid carbonate in a one step process.
- Demonstrated at 1 TPD scale in February 2025

Thank you for your attention

Any Questions?

Reuseproject.eu

REUSE - Horizon Europe Project

info@reuseproject.eu

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