Opportunities from Carbon Capture and Usage

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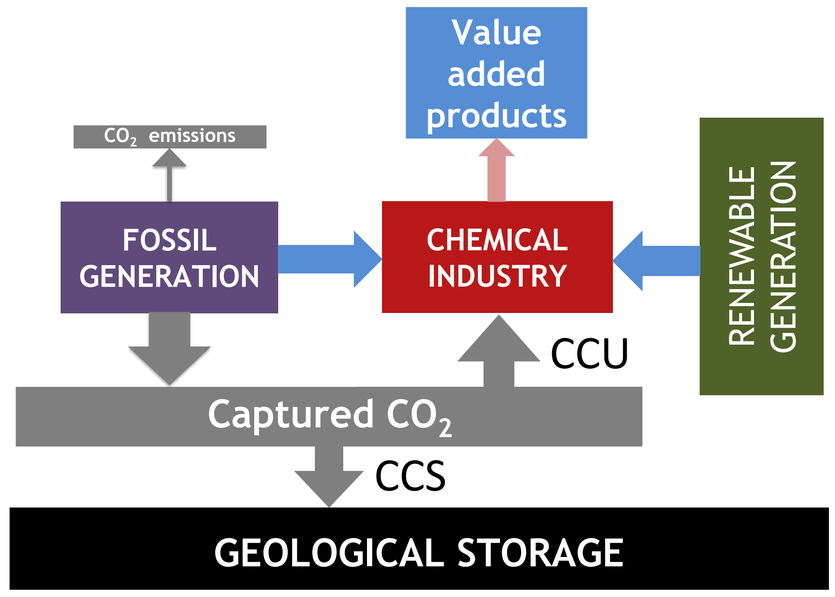
Could CO_2 be a *resource* rather than an *environmental hazard*?

Treating CO_2 as an environmental hazard by sequestering it underground has received a lot of attention. CCU is an alternative approach in which captured CO_2 is used as a feedstock to decarbonise industrial processes (CCU).

CCU is an example of a circular economy, as resource consumption and CO_2 waste streams are reduced to deliver existing products using new processes. It is necessary to take a different perspective on the energy system to understand the possibilities of CCU.



CCU

- Uses captured CO_2 to produce new value-added products.
- Reduces resource use in and emissions from electricity generation and heavy industry.
- Not considered in most long-term modelled scenarios.

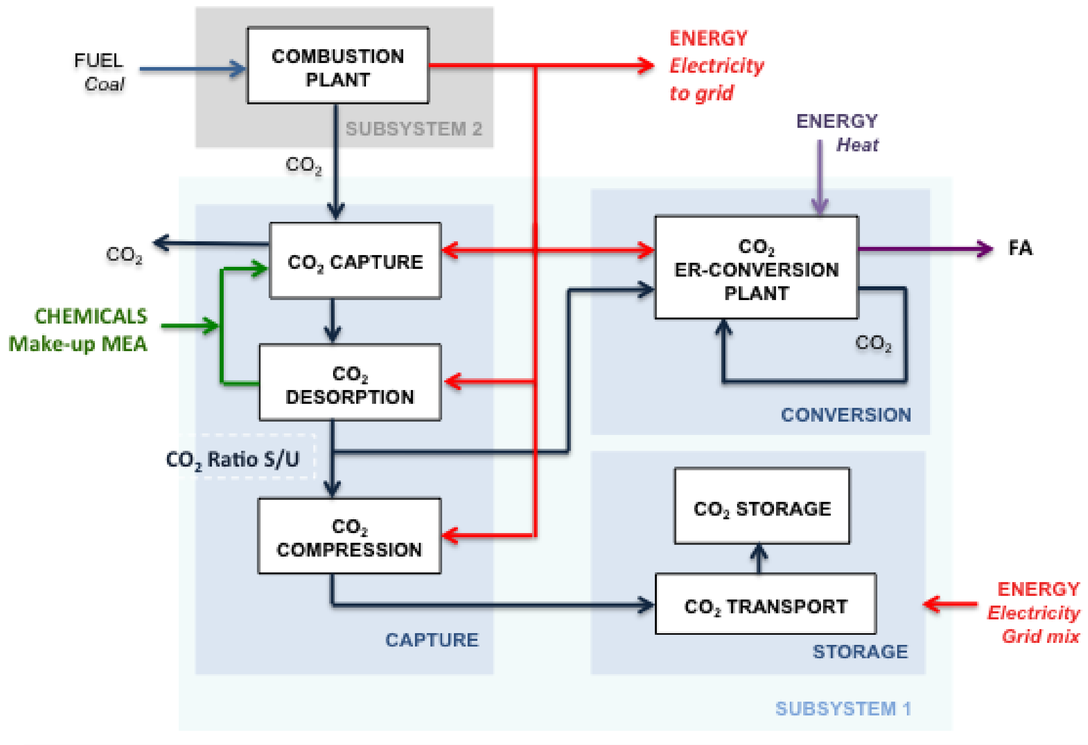
CCS

- Stores captured CO_2 in permanent geological storage.
- Substantial emission reduction for power and heavy industry, but industry is a net source of CO_2.
- A key component in most long-term modelled scenarios.

CCU case study: formic acid production

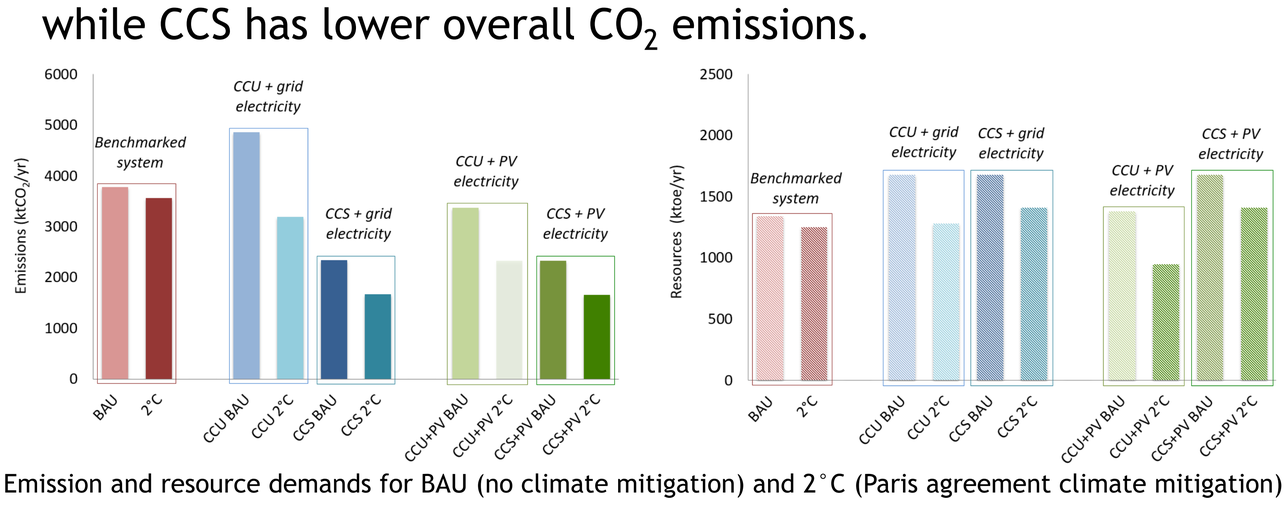
Framework

350 kT of formic acid is produced in Europe each year by hydrolysis of methyl formate. It could instead be produced from captured CO_2 using a novel electro-reduction process. In this case study, we examined the environmental and cost implications of this CCU process and compare it to CCS.



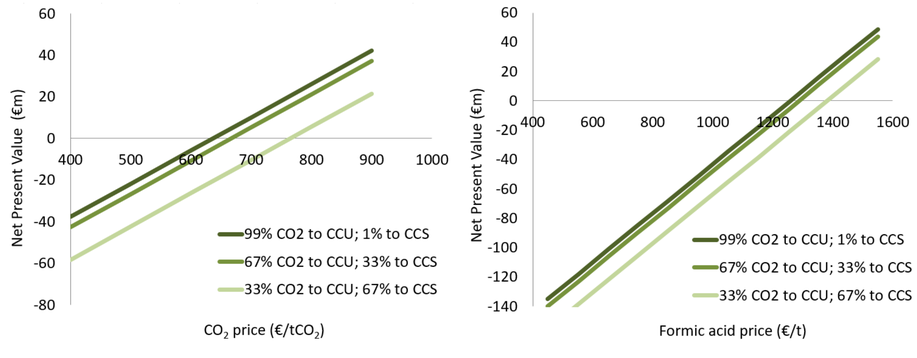
Results

- Environmental trade-offs between CO_2 emissions reduction and resource consumption: CCU is less resource intensive, while CCS has lower overall CO_2 emissions.



Emission and resource demands for BAU (no climate mitigation) and 2°C (Paris agreement climate mitigation)

- Costs: CCU has better economic potential than CCS.



Positive NPV requires formic acid prices of €1200-1400/t (equivalent to CO_2 revenues of €640-720/tCO_2), which is much higher than the current formic acid price of around €650/kg.

There is much potential to reduce production costs of this novel electro-reduction route through innovation.

Could CCU underpin a transition to CCS?

The Clean Growth Strategy identifies CCUS as a potentially large economic opportunity for the UK in the long term, but the high costs of building CCS infrastructure are an impediment.

- CCU offers a market for CO_2 that does not require large investments in CO_2 transport and storage infrastructure.
- Innovation, through learning-by-doing, is required to reduce capture costs. By creating a market for CO_2, CCU could facilitate innovation and drive down capture costs.
- This means that CCU offers an opportunity to underpin the early stages of a transition to CCS.
- A broader view of industrial processes and energy generation is required to fully understand the potential of CCU.

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This work was funded by the NERC "Comparative assessment and region-specific optimisation of GGR" project (NE/P019900/1) and the Madariaga Programa (PRX18/00027).