The Role of CCUS on Industrial Transformation

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Acorn is a joint venture, benefiting from the collective expertise of Storegga, Shell UK, Harbour Energy and North Sea Midstream Partners.

Business leaders urge backing of Acorn project

The St Fergus gas terminal in Aberdeenshire

10 March 2025

BBC NEWS

Business leaders have called on the chancellor to back the Acorn carbon capture and storage (CCS) project in Aberdeenshire.

The project at St Fergus would take greenhouse gas emissions and store it in depleted gas reservoirs under the North Sea.

The project missed out on support in 2021, which instead went to two areas in

UK Parliament Hansard

Dame Meg Hillier ›

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The path to carbon capture and storage is littered with failure: three previous projects never got off the ground, despite lots of taxpayer money going into them. What precisely are the Government going to do to ensure that this project delivers?

Sarah Jones ›

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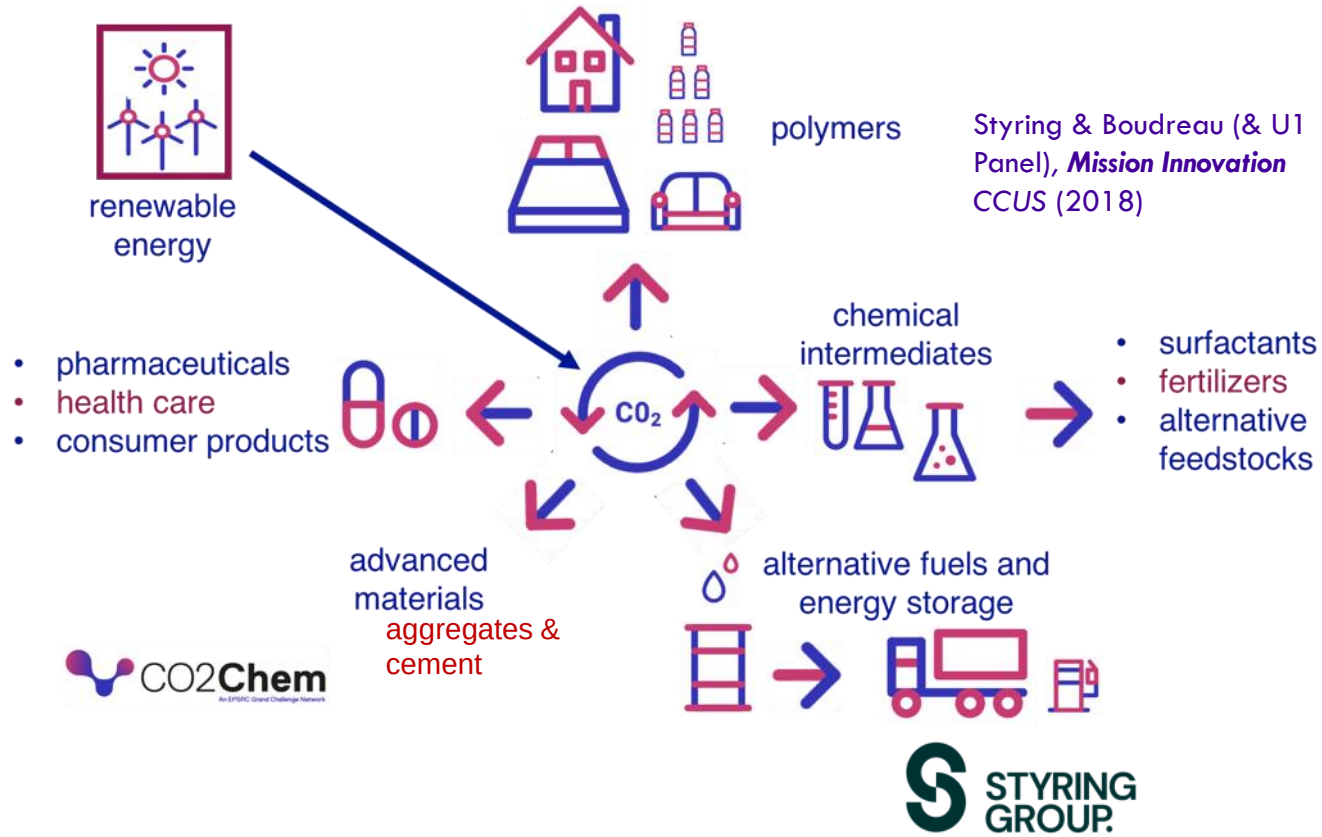
We realise that CCUS is an emerging industry, but it is also one that we can lead on internationally, thanks to the unique geography of the North sea. We will do all we can to help industry scale up in this technology, which we believe will play a crucial role in our mission towards clean power.

MISSION INNOVATION

- Established at COP21 (2015)
  - Driven by Barack Obama & Bill Gates
- CCUS Workshop (2017)
  - G20
  - EU as a block
- Report from US DOE (May 2018)
- Now UK, Mexico, Saudi Arabia



Styring & Boudreau (& U1 Panel), ***Mission Innovation*** *CCUS* (2018)

CCU–The Facts

- Impact Factor
  - 46

Please cite this article in press as: Mertens et al., Carbon capture and utilization: More than hiding CO_2 for some time, Joule (2023), https://doi.org/10.1016/j.joule.2023.01.005

Joule

CellPress

Commentary

Carbon capture and utilization: More than hiding CO_2 for some time

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Professor Jan Mertens is ENGIE's chief science officer (CSO) building ENGIE's long term vision on technologies, identifying key international research players on selected emerging technologies, and initiating research partnerships worldwide for the group.

temperature increase to maximum 1.5°C above the pre-industrial level as agreed in the Paris Agreement, carbon neutrality should be reached by 2050. Reaching that goal implies that by 2050, no net carbon emissions should occur anymore and that all carbon emitted into the air will have to be compensated

time periods, the need for molecules will remain important. Hydrogen production is the most obvious e-molecule since it can be synthesized from renewable electricity and water, either locally or anywhere in the world where cheap renewable electricity and

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Priority Commodities

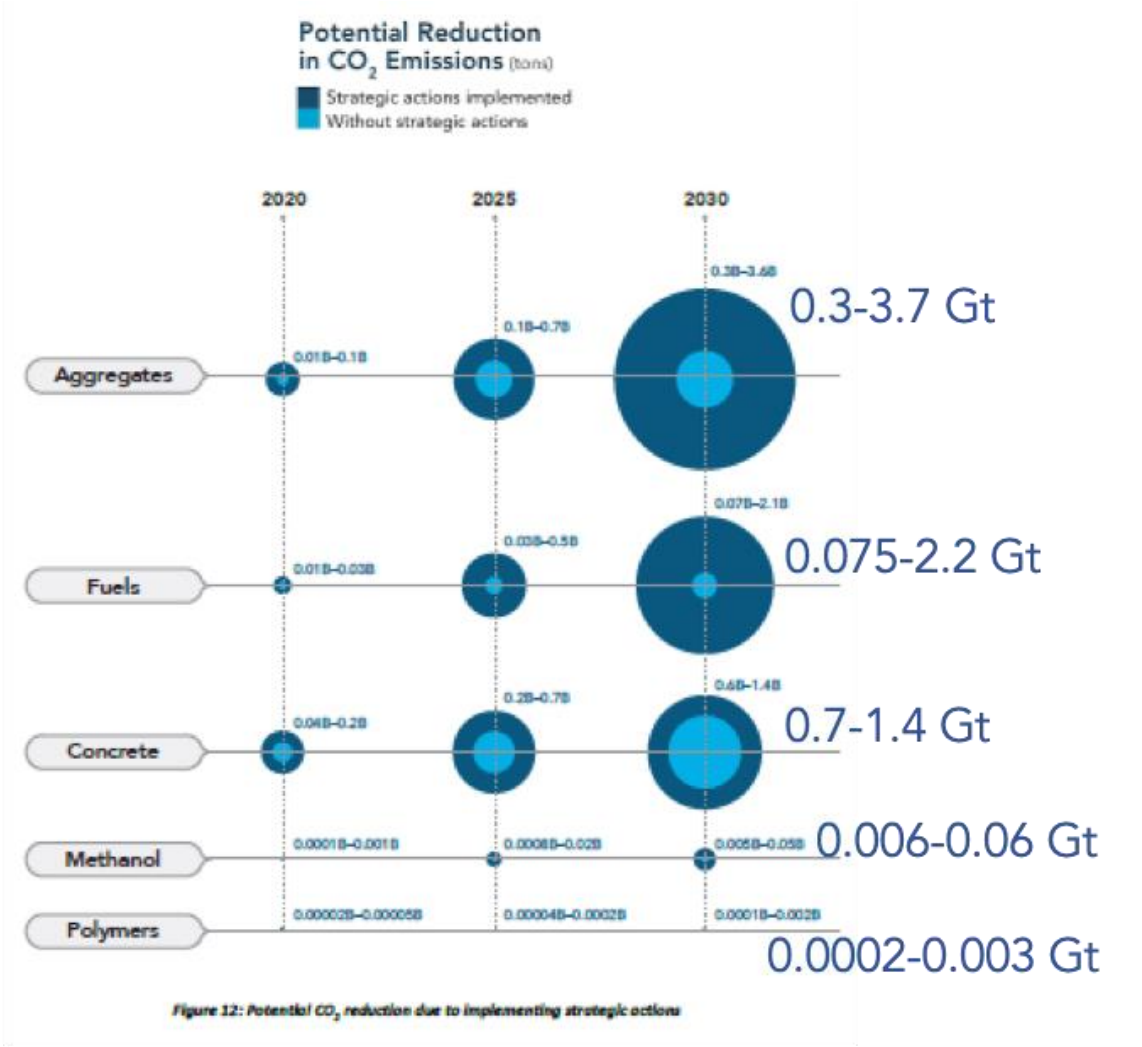


Figure 12: Potential CO_2 reduction due to implementing strategic actions

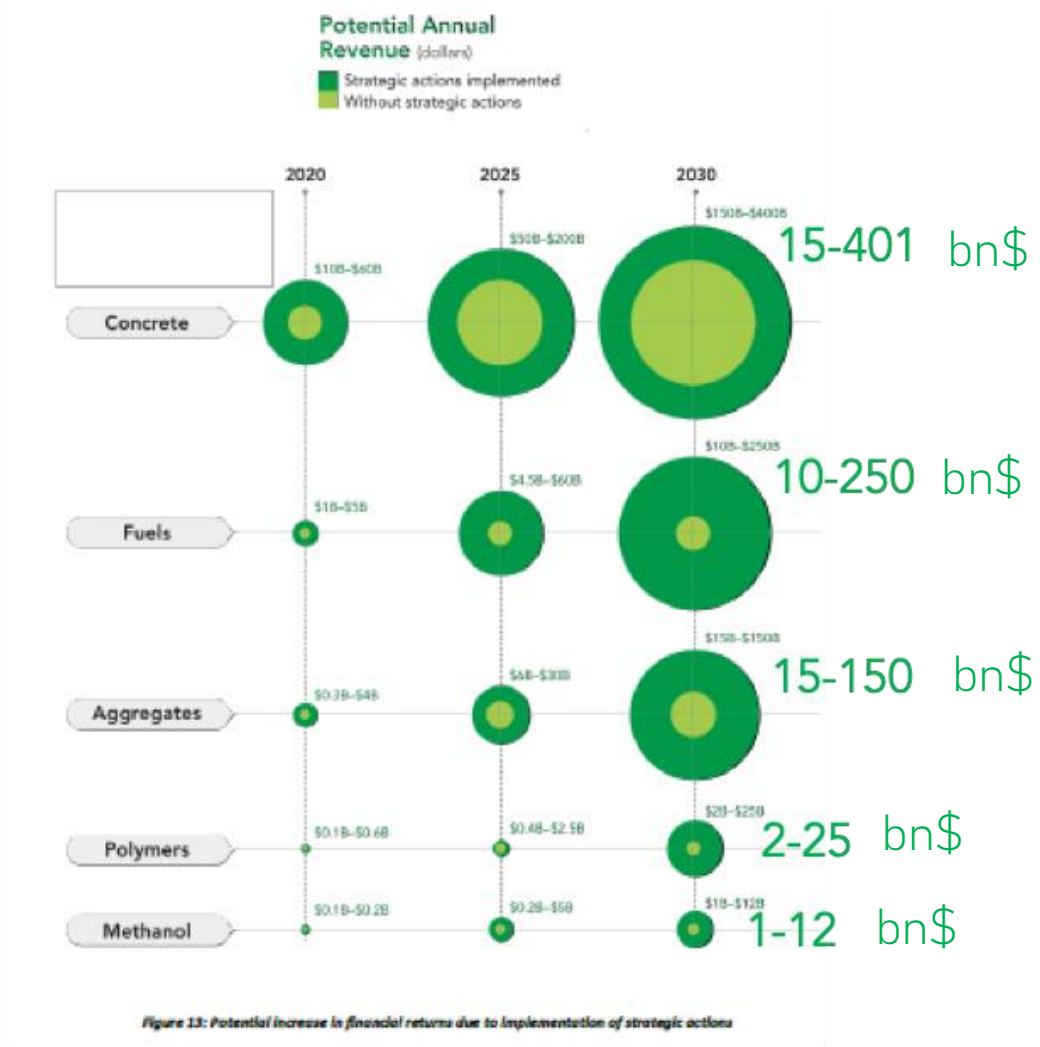
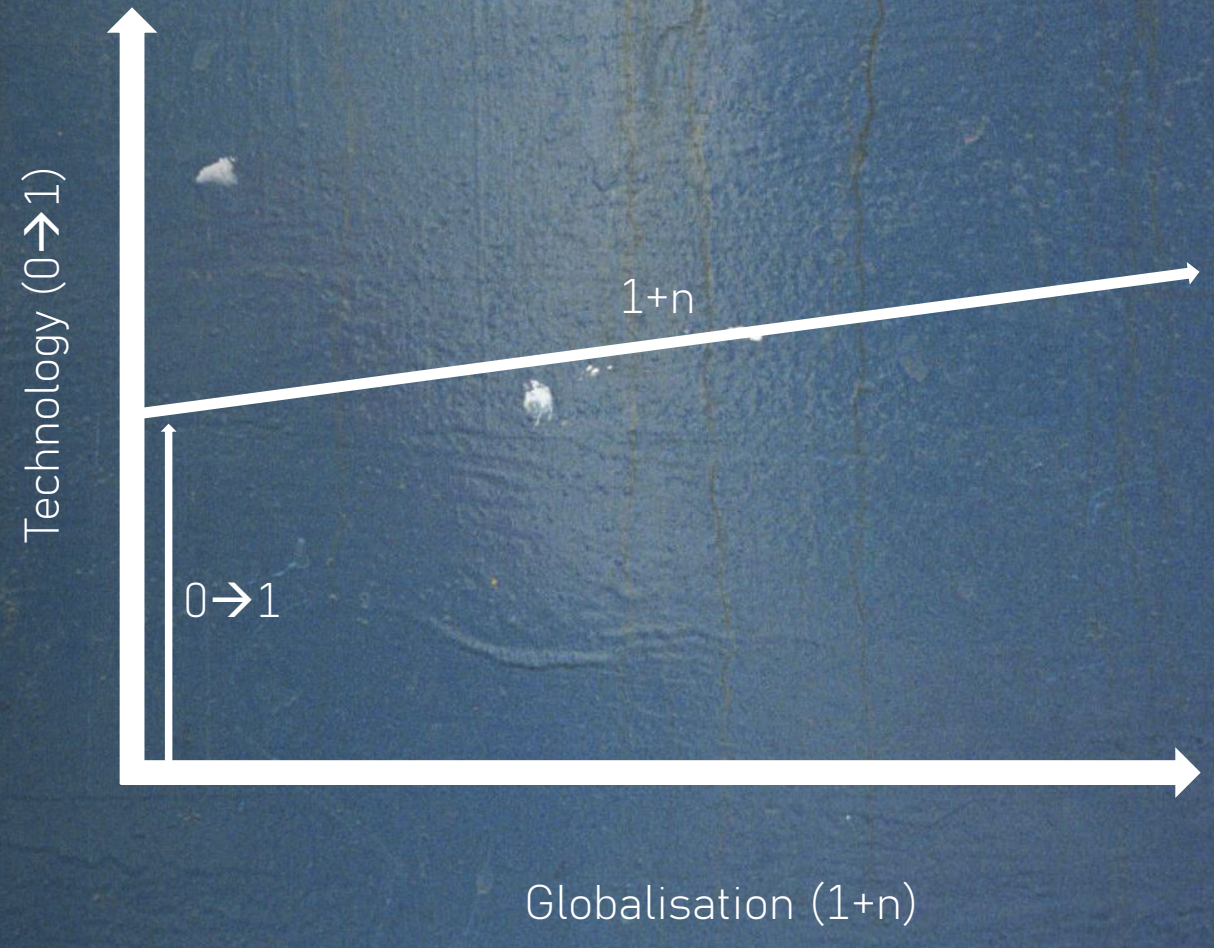


Figure 13: Potential increase in financial returns due to implementation of strategic actions

Global CO_2 Initiative/McKinsey (2016)

Zero to One



Peter Thiel with Blake Masters, Zero to One: Notes for Startups, or how to Build the Future Virgin Books (2014)

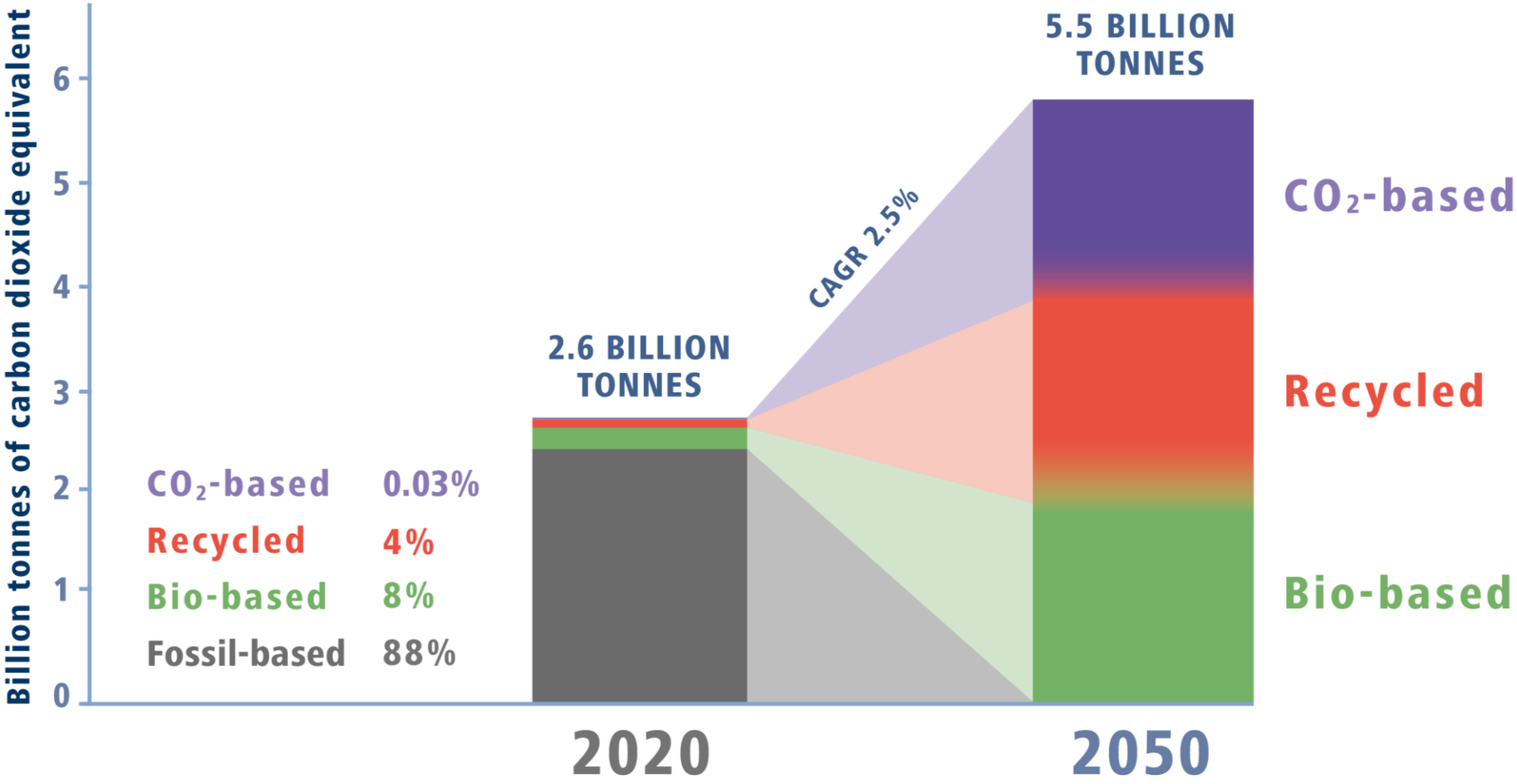
Flue2CHEM

Flue2Chem

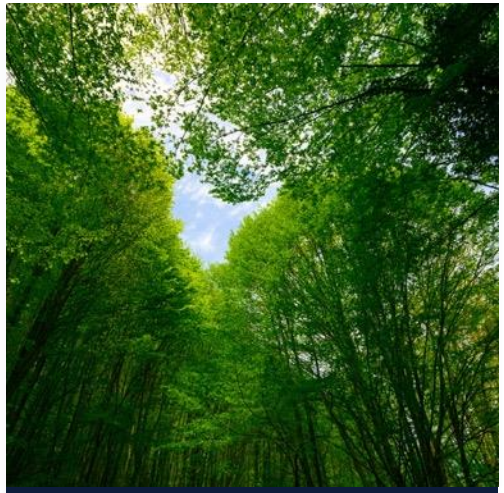
An Industry Collaboration to Create Chemicals from CO2

The Flue2Chem Team

Future sources of carbon for chemicals?



Why Flue2Chem ?



We will *not reach Net Zero* unless we find another source for carbon as a material

The science is well known, but the question is whether it can be made to work *at scale* and the *right cost*

The consumer market has the most *immediate driver for change*

Other uses of carbon as a feedstock (plastics, paints, adhesives, insulation, fabrics, textiles and so on) would be able to use similar supply chains to *move away from fossil carbon* in time

Flue2Chem: Transforming the Foundation Industries Challenge

Make sustainable materials for consumer products (Alkoxylated Surfactants) from UK emissions

Entire value chain is in scope

- Source of emissions (second use black & biogenic carbon),
- Capture and purification of emissions,
- Conversion of CO_2 to hydrocarbons and ethylene oxide,
- Manufacture and application of alkoxylated surfactants.

Consortium of 17 partners

- Evaluate the full end-to-end business & environmental impacts,
- Build the case to create a chemicals infrastructure to implement CCU in the UK.

Start 1st December 2022: 2-year project

- Unilever lead partner
- £4.4m project, £2.7m grant

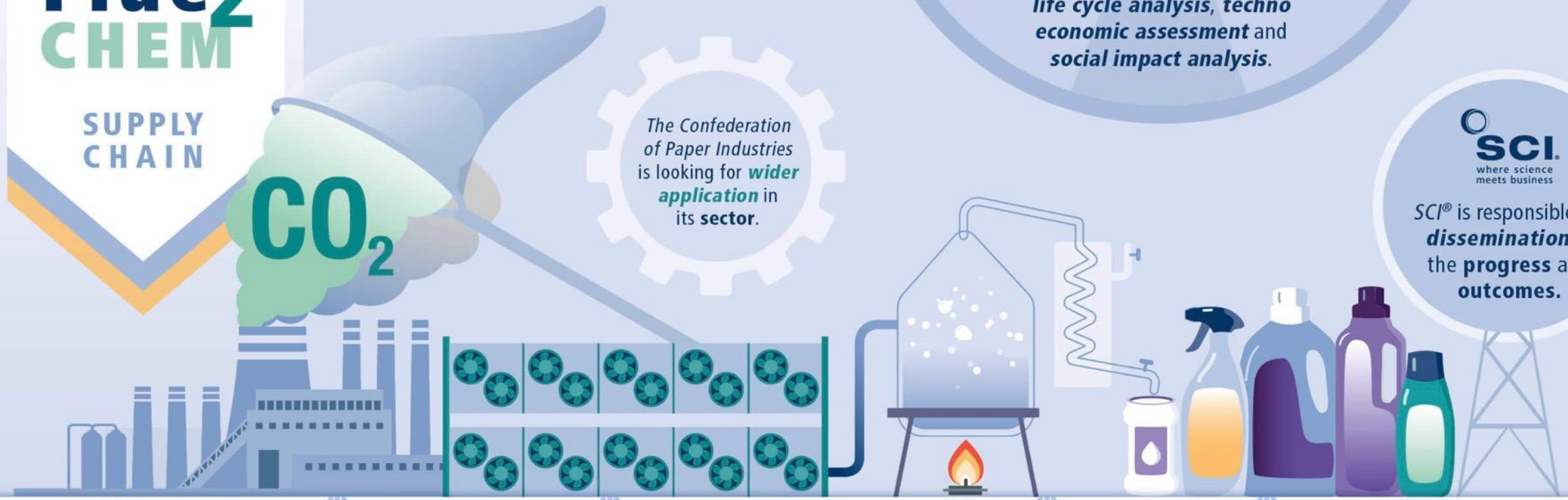
Innovate UK KTN

Why Alkoxylated Surfactants?

Global production > 6million t/yr and £10 billion | Wide range of consumer applications
Fossil Carbon increases GHG
PKO can lead to Deforestation and associated GHG increase | Generally imported to the UK

Flue2 CHEM

SUPPLY CHAIN



The University of Surrey is ***leading life cycle analysis***, ***techno economic assessment*** and ***social impact analysis***.

The Confederation of Paper Industries is looking for ***wider application*** in its **sector**.

SCI
where science meets business

SCI® is responsible for ***dissemination*** of the **progress** and **outcomes.**

Foundation Industries *emit* valuable CO_2

HOLMEN IGGESUND · UPMBIOFORE BEYOND FOSSILS · TATA STEEL

CO_2 is ***captured***

carbon clean · CCU INTERNATIONAL · University of Sheffield

CO_2 is ***converted*** into **key intermediates** used widely in the chemical industry

BASF We create chemistry · JM · University of Sheffield · cpi LanzaTech

Intermediates ***converted*** into **surfactants**

CRODA

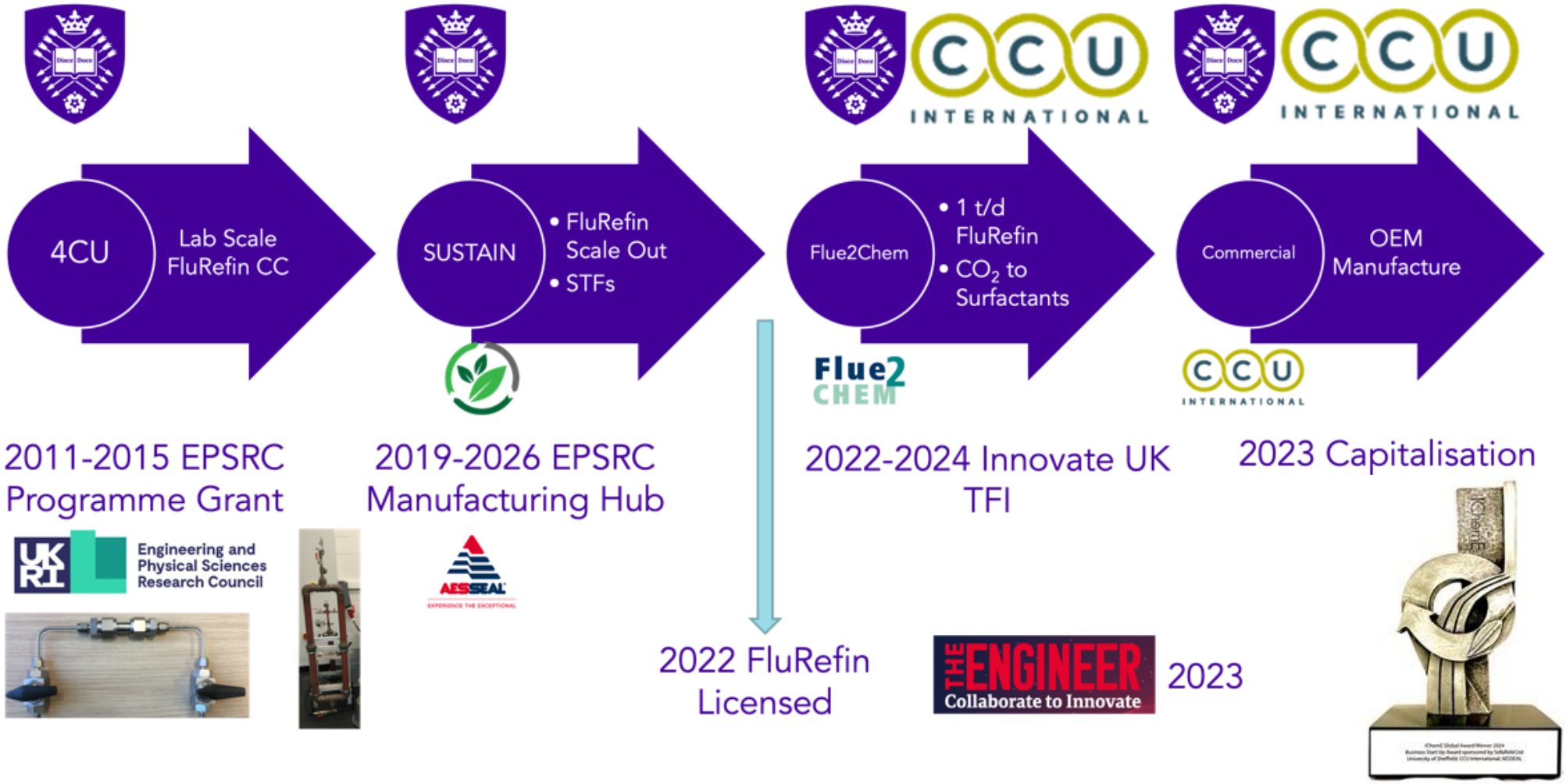
Surfactants are ***formulated*** into **cleaning products** and **coatings.**

Unilever · reckitt · P&G · TATA STEEL

New Capture Technologies are needed – but it takes time

0 → 1 then 1+n in practice

- PSA is achieved at a fraction of the expense of TSA currently used.



Industry Driven Innovation – FluRefin at Flue2Chem

Syn-diesel from syn-crude used to prepare surfactant pre-cursors

What have we learned so far?

We are going to need a lot of (green) hydrogen!

Most supply chains start with ethylene, propylene or butene.

Carbon dioxide needs reducing back to this – it will take 6 hydrogen atoms for every carbon atom!

Getting things to the right place is a challenge.

Paper mill combined heat and power boilers produce c.1,000-1,500 tonnes of CO2 a day. They are far away from places that can process it into a useful form. How will it get there? Or will we turn it into ethanol or ethylene and transport that?

Biology cannot yet make dodecanol, and thermo-catalysis cannot make lots of it

We have a lot more work to do to be able to exploit the selectivity of biological processes and/or improve the selectivity of thermo-catalytic processes

The UK is missing a lot of the necessary scale-up facilities.

Small scale work is being done in universities, but some work needs to be done in Ludwigshafen or Atlas Point because the necessary equipment doesn't exist in the UK.

Planning is good but nothing can compete with engineers on site!

Regulation and Fiscal Policy needs to be better aligned with Net Zero goals!