Company Presentation

Dr Helen Atkinson
Business Development Manager
h.atkinson@c-capture.co.uk

C-Capture

designing world-leading chemical processes for carbon dioxide removal

Our Vision

Process licensor

- **for large scale projects**

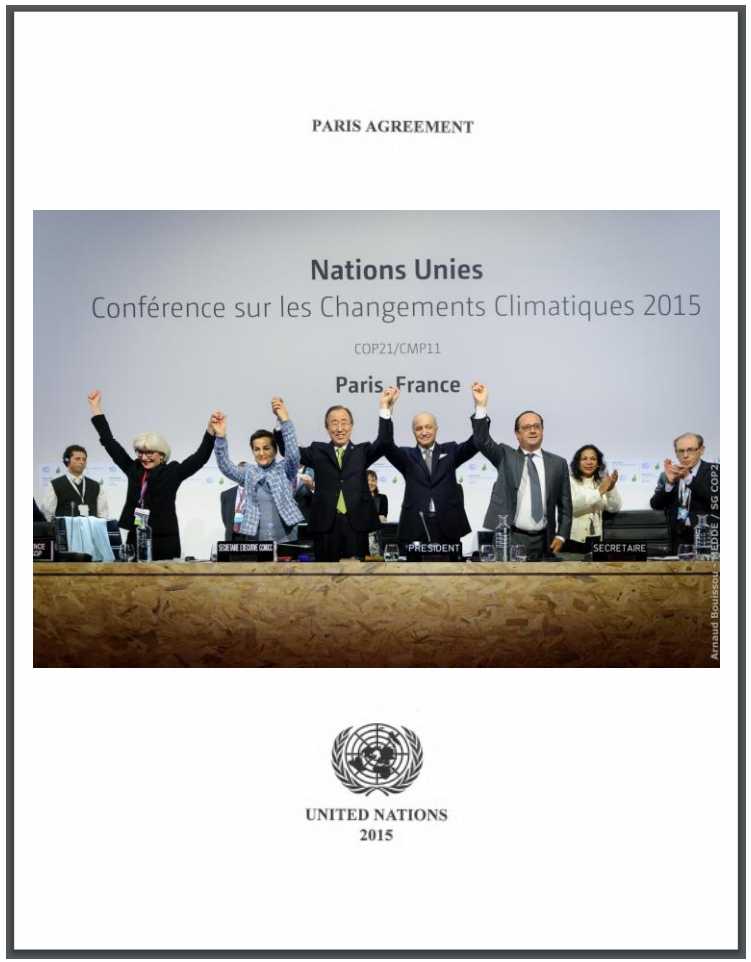
Turn-key modular containerised solutions

- **for small projects by 2025**

We will:

- Reduce the cost/energy barriers to large scale deployment
- Accelerate the growth of the global CCS market
- Help more organizations achieve their decarbonisation imperatives

Net Zero



Chris Skidmore signs legislation to commit the UK to a legally binding target of net zero emissions by 2050

Net Zero – how do we get there?

C-Capture

- We need to reduce emissions, renewables will play a huge role
- However, CCS will be required to offset emissions from sectors which are hard to decarbonize
- Negative emissions technologies such as BECCS will be required - most pathways that limit global warming to 1.5˚C rely on large-scale deployment of BECCS and afforestation

Net Zero

	2020s	2030s	2040s
ELECTRICITY	Largely decarbonise electricity: renewables, flexibility, coal phase-out	Expand electricity system, decarbonise mid-merit/peak generation (e.g using hydrogen), deploy bioenergy with CCS	
HYDROGEN	Start large-scale hydrogen production with CCS	Widespread deployment in industry, use in back-up electricity generation, heavier vehicles (e.g. HGVs, trains) and potentially heating on the coldest days	
BUILDINGS	Efficiency, heat networks, heat pumps (new-build, off-gas, hybrids)	Widespread electrification, expand heat networks, gas grids potentially switch to hydrogen	
ROAD TRANSPORT	Ramp up EV market, decisions on HGVs	Turn over fleets to zero-emission vehicles: cars & vans before HGVs	
INDUSTRY	Initial CCS clusters, energy & resource efficiency	Further CCS, widespread use of hydrogen, some electrification	
LAND USE	Afforestation, peatland restoration		
AGRICULTURE	Healthier diets, reduced food waste, tree growing and low-carbon farming practices		
AVIATION	Operational measures, new plane efficiency, constrained demand growth, limited sustainable biofuels		
SHIPPING	Operational measures, new ship fuel efficiency, use of ammonia		
WASTE	Reduce waste, increase recycling rates, landfill ban for biodegradable waste	Limit emissions from combustion of non-bio wastes (e.g Deploy measures to reduce emissions from waste water)	
F-GASES	Move almost completely away from F-gases		
GREENHOUSE GAS REMOVALS	Develop options & policy framework	Deployment of BECCS in various forms, demonstrate direct air capture of CO_2, other removals depending on progress	
INFRASTRUCTURE	Industrial CCS clusters, decisions on gas grid & HGV infrastructure, expand vehicle charging & electricity grids	Hydrogen supply for industry & potentially buildings, roll-out of infrastructure for hydrogen/electric HGVs, more CCS infrastructure, electricity network expansion	
CO-BENEFITS	Health benefits due to improved air quality, healthier diets and more walking & cycling Clean growth and industrial opportunities		

Our Journey

VOLVO VISIONARIES
Meet the brains behind the ideas changing our world

2021 GLOBAL CLEANTECH100 COMPANY
Produced by Cleantech Group

UNIVERSITY OF LEEDS
Department of Chemistry

innovation accelerator

Shell Springboard
2016 National Winner

BusinessGreen Technology Awards 2019
FINALIST

Launch 2009	Team Build 2011	Scale up 2012	EEF1 2013	EEF4 2014	Biogas 2016	EEF5 April 2017	CAPSIN 1 2018	Drax 2018	Drax, BPV £3.5M, 2019	Team Build 2020	A+ £8M 2021

ipgroup plc

CARBON TRUST

ipgroup plc
Department of Energy & Climate Change
Energy Entrepreneurs Fund

Department for Business, Energy & Industrial Strategy
Energy Entrepreneurs Fund

drax

bp

CCP

CLIMIT

SINTEF

drax

BEIS Energy Innovation Programme
£5M, June 2019
Led by C-Capture, with Drax co-applicant

Department for Business, Energy & Industrial Strategy

Solvent based CCS has been around since the 1930s

Patented Dec. 2, 1930 **1,783,901**

UNITED STATES PATENT OFFICE

ROBERT ROGER BOTTOMS, OF LOUISVILLE, KENTUCKY, ASSIGNOR TO THE GIRDLER CORPORATION, OF LOUISVILLE, KENTUCKY, A CORPORATION OF DELAWARE

PROCESS FOR SEPARATING ACIDIC GASES

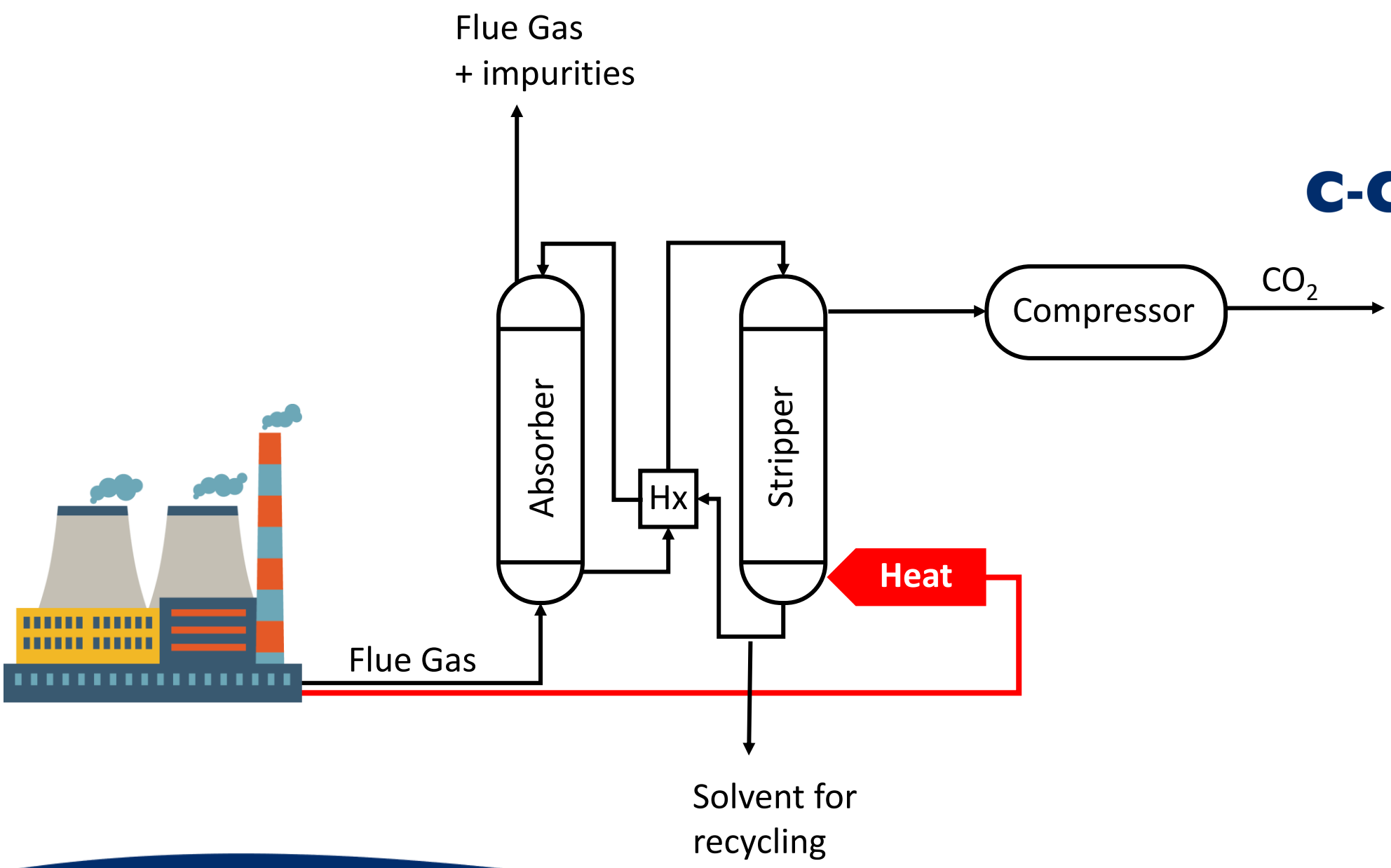
REISSUED

Application filed October 7, 1930. Serial No. 486,918.

I have discovered that certain organic nitrogen compounds of the class known as amines may be employed for this purpose. An amine may be considered as an ammonia substitution compound in which one or more of the hydrogen atoms of the ammonia are replaced by a group containing carbon and hydrogen.

There are challenges associated with the amine- based systems which our technology has sought to overcome

Our solvent is amine free & N free: no danger of increased reactive N in surrounding environment. We must ensure that as we deploy CCS technology on a large scale, we don’t negatively impact farmland & the health of people who near CCS plants


Flue Gas
+ impurities
Absorber
Hx
Stripper
Compressor
CO_2
Heat
Flue Gas
Solvent for
recycling

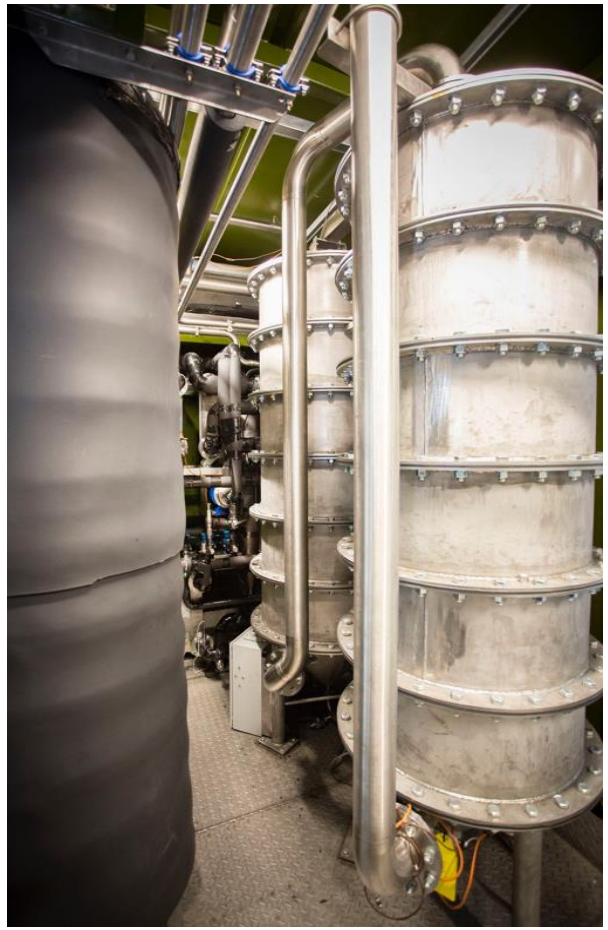
Scale up of C-Capture's technology

grams CO_2/day - lab

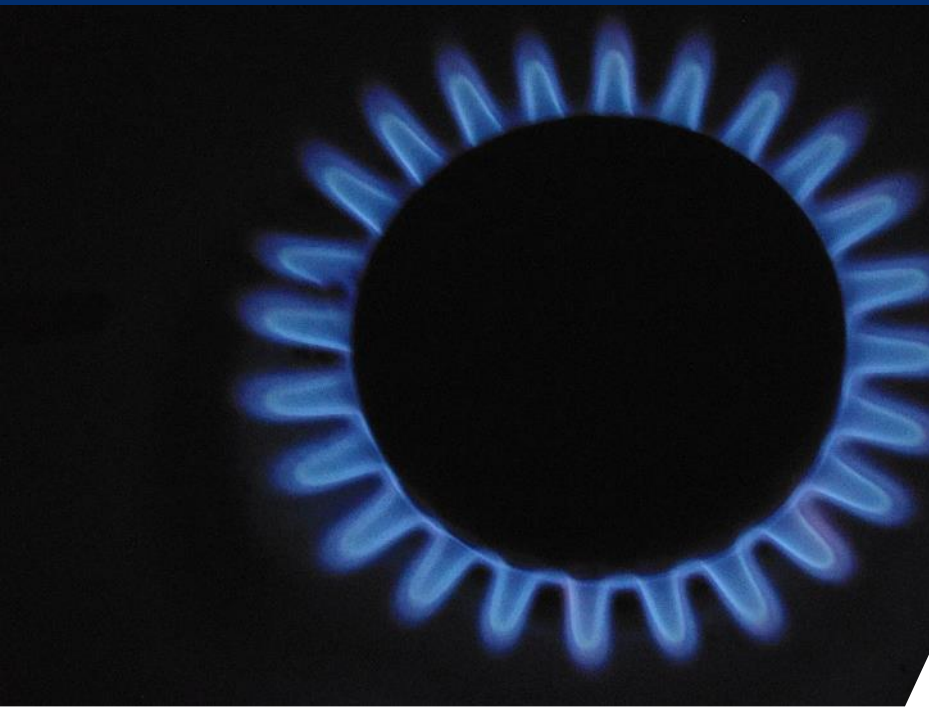
kgs CO_2/day - miniplant

100s kgs CO_2/day - biogas trials

1 tonne CO_2/day - biogas trials



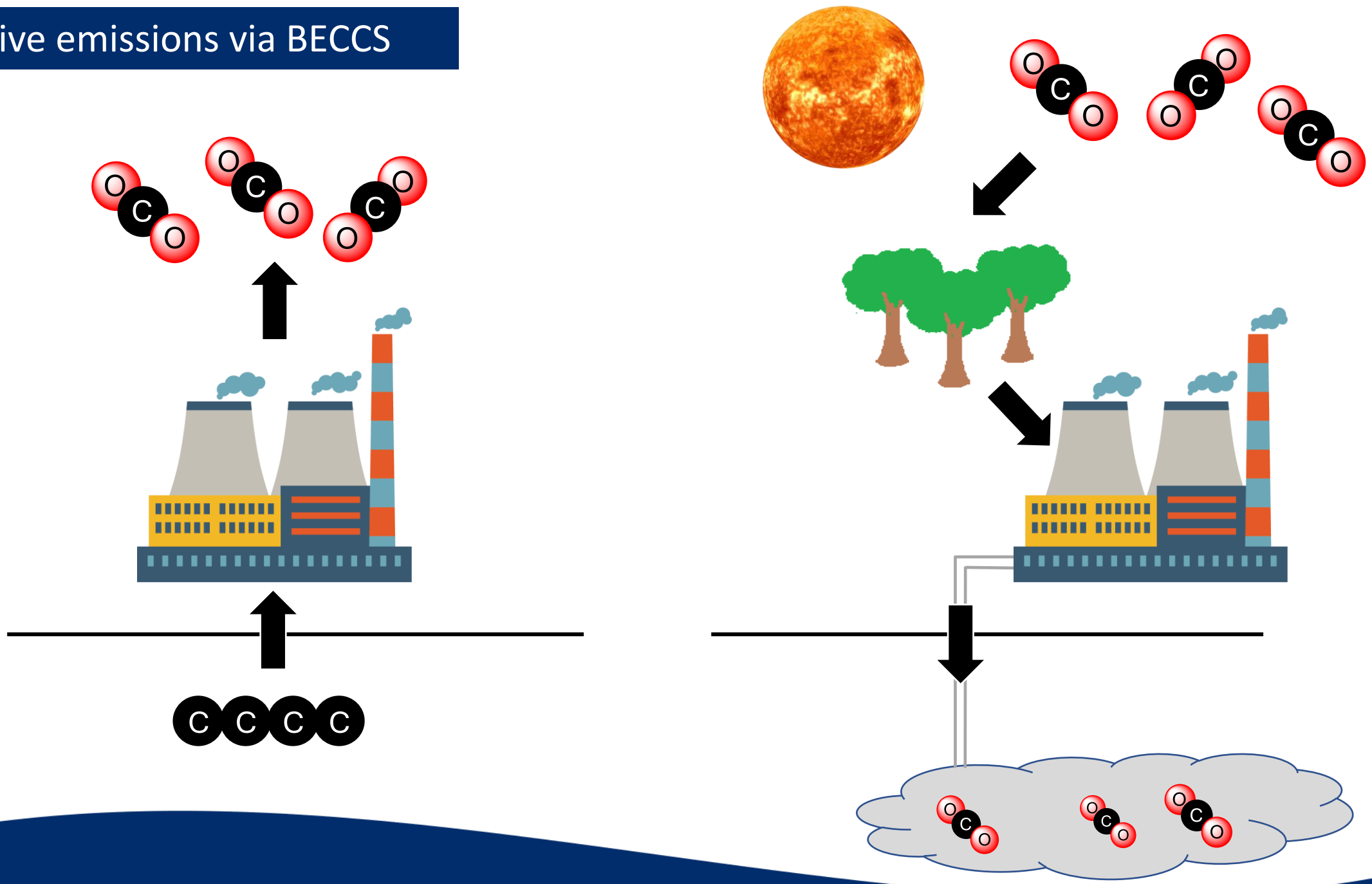
One application is biogas upgrading from AD plants where CO_2 is removed & the upgraded biomethane injected into the national grid or compressed and used as a fuel



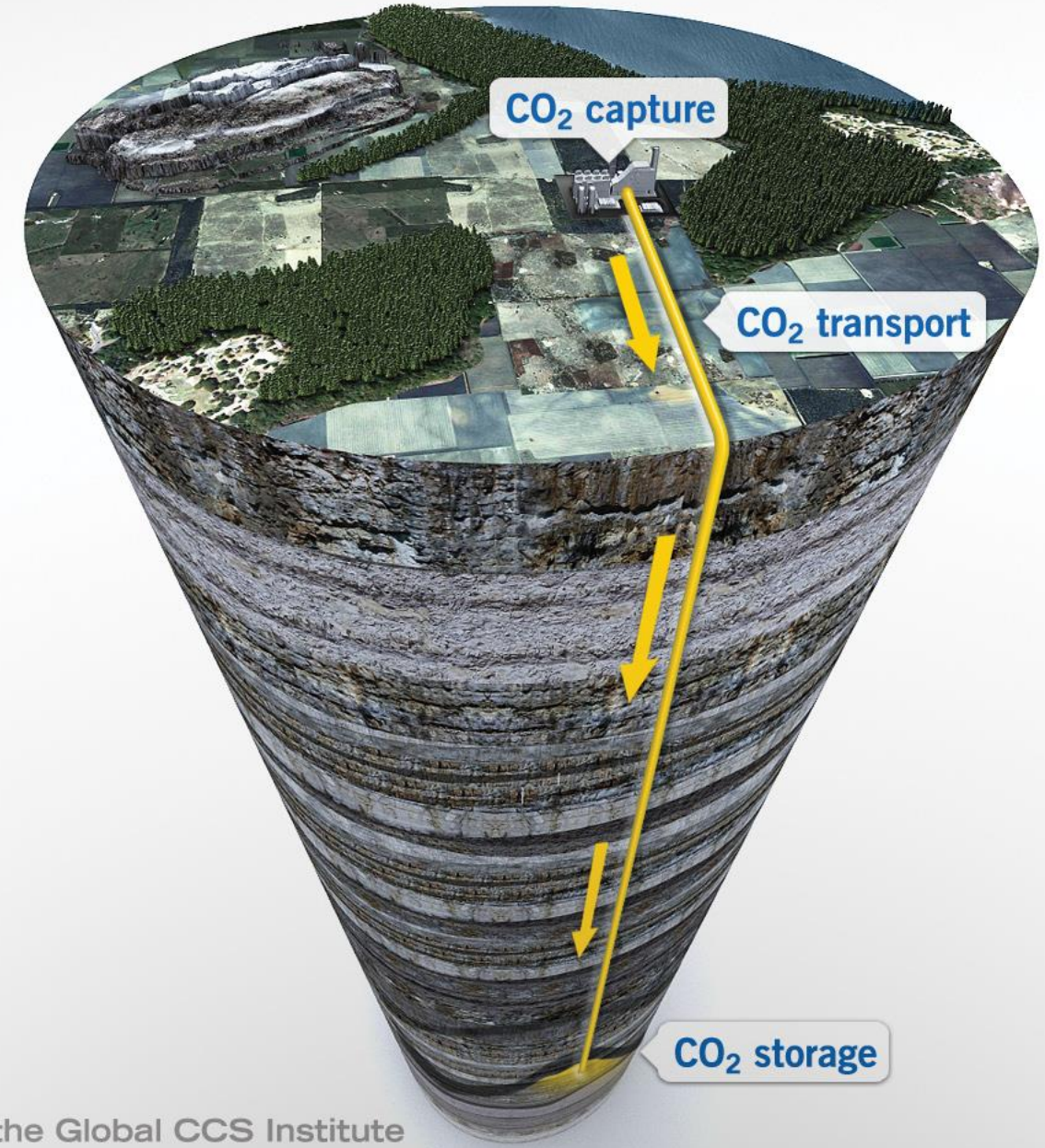
C-Capture

This shows the inside of the shipping container during the biogas trials. In these trails we used a bubble absorber which can be seen in the background

Negative emissions via BECCS



THE CARBON CAPTURE AND STORAGE PROCESS



Provided by the Global CCS Institute

C-Capture is working with Drax as it scales up CCS technology to become the UK's first negative emissions power station

New 10 column absorber allows more flexibility and accessibility in the system as we carry out our tests

Independent validation of technology

SINTEF

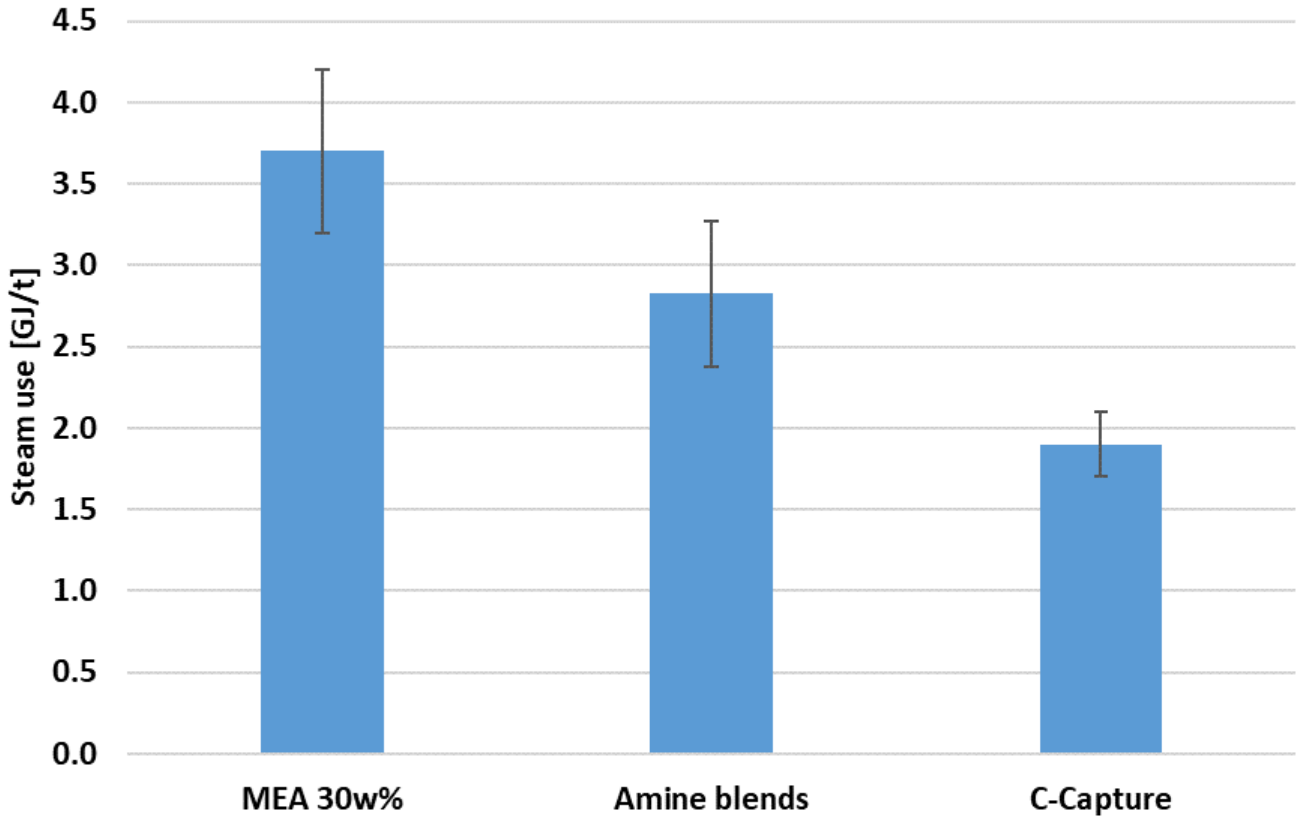
TECHNOLOGY CENTRE MONGSTAD

C-Capture’s unique solvent

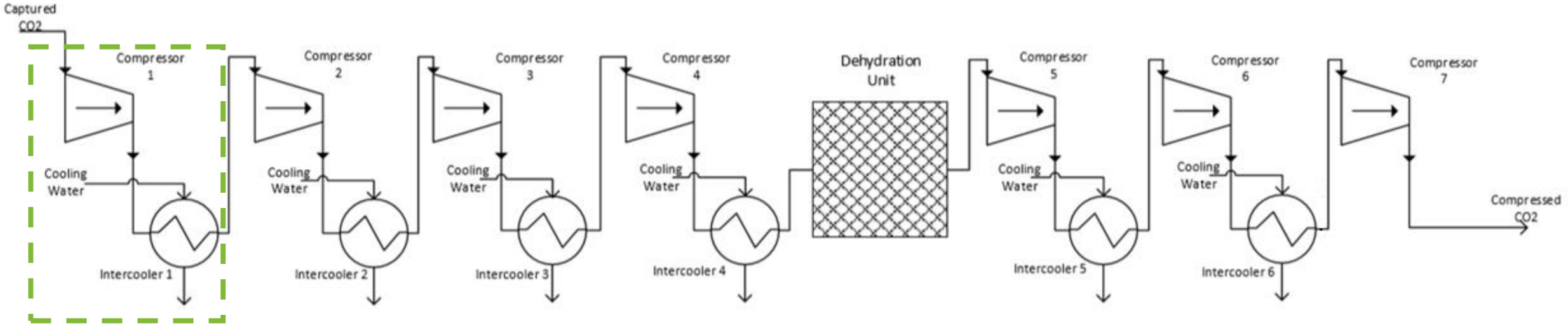
Low corrosivity avoids having to replace equipment frequently, reduces maintenance time, reduces capital expenditure and avoids ever seeing pipework like this

Less volatile than amine alternatives, less likely to react with any particles that pass through the absorber, leading to reduced emissions

Lower energy penalty, lower parasitic load on the power station. Heat of reaction is lower, heat capacity of the solvent is lower, there are lower heat losses in overall system

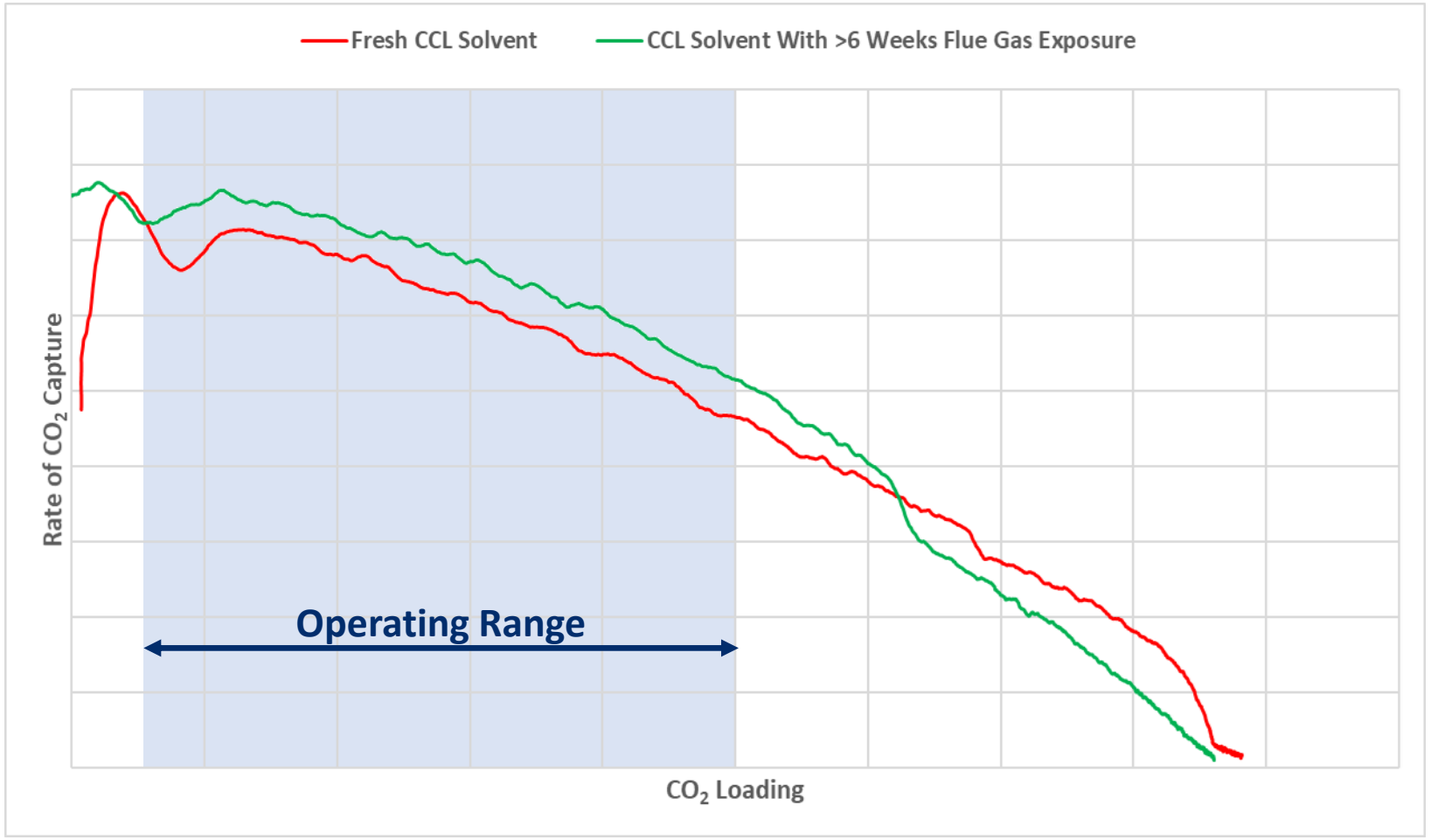


Vapour pressure is lower, higher CO_2 release pressure reducing the energy needed for compression. Fewer compressors are needed therefore less cost involved



Eliminated Compression Stage

Minimal aging demonstrated via rate of CO_2 capture vs loading with a fresh solvent vs one that had been exposed to flue gas at Drax for 6 weeks



Accelerated aging rigs used to demonstrate resistance to degradation and oxidation

Thermal degradation
+ High SO_x
+ High NO_x
+ High O_2

Minimal degradation observed, providing high confidence of stability in challenging applications

STEEL

BECCS

GLASS MANUFACTURE

NATURAL GAS UPGRADING

BIOGAS UPGRADING

37 billion tonnes CO_2 emitted per annum

5,200 plants emit > 1 million tonnes per annum CO_2

The Global CCS Institute estimate 2000 CCS plants need to be operational by 2040 if we are to achieve net zero by 2050

CEMENT

WASTE TO ENERGY

OIL REFINERIES

SHIPPING

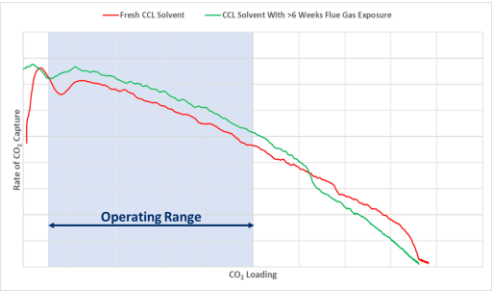
HYDROGEN

Summary

C-Capture

LOWER EMISSIONS

C-Capture have developed a completely new, innovative technology with minimal environmental impact.



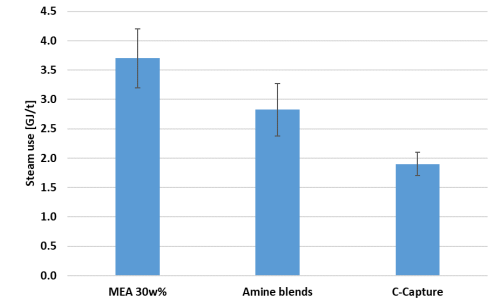
MINIMAL SOLVENT AGING

LESS CORROSIVE

Our solvent has many favorable properties, which result in low CAPEX and OPEX, reduced costs of compression, long equipment lifetime and reduced maintenance costs.

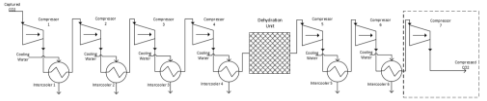
Lab data, small scale trials and Drax pilot have demonstrated the technology, and we are working with SINTEF for independent validation.

Our technology is well suited to the large-scale capture of CO_2.



LOWER ENERGY PENALTY

LOW DEGRADATION



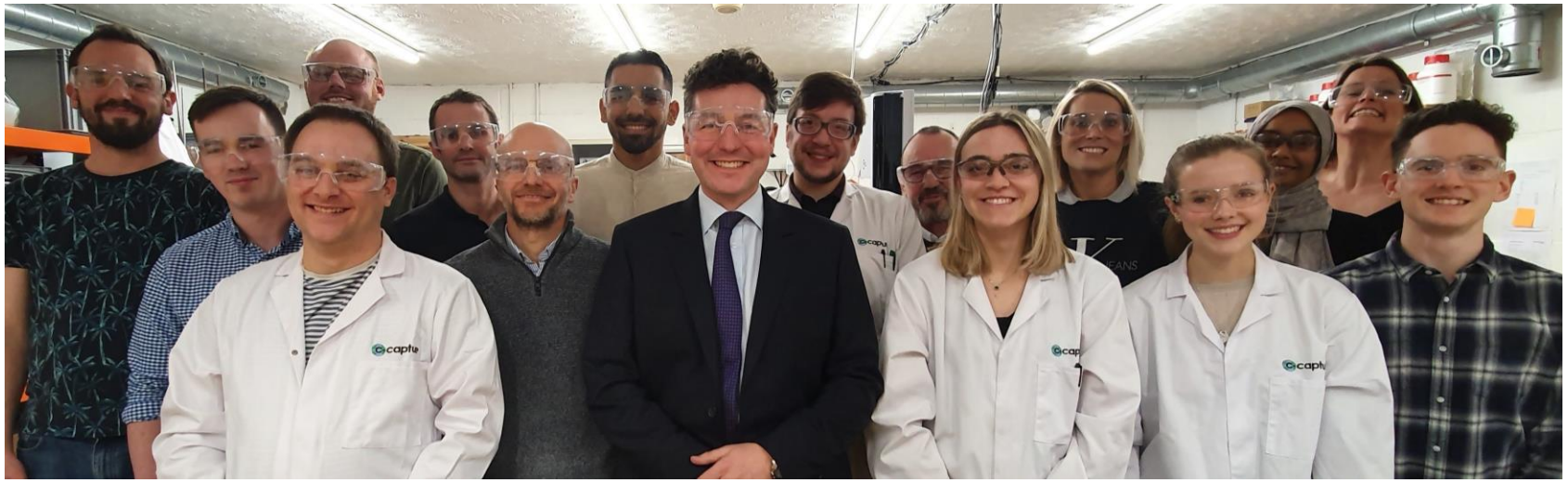
REDUCED COSTS OF COMPRESSION

drax

UNIVERSITY OF LEEDS

Department for Business, Energy & Industrial Strategy

ipgroup



bp

Thank you