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## Ascon Carbon Capture Technology - A novel intervention for greenhouse gas emissions mitigation at coal power stations & coal boiler systems

Presented at the "Future Coal" Leaders Forum: Session 2 - Advanced Power Generation and End users

Fairmont Hotel, Singapore | 16 May 2023

By Nate Macmillan

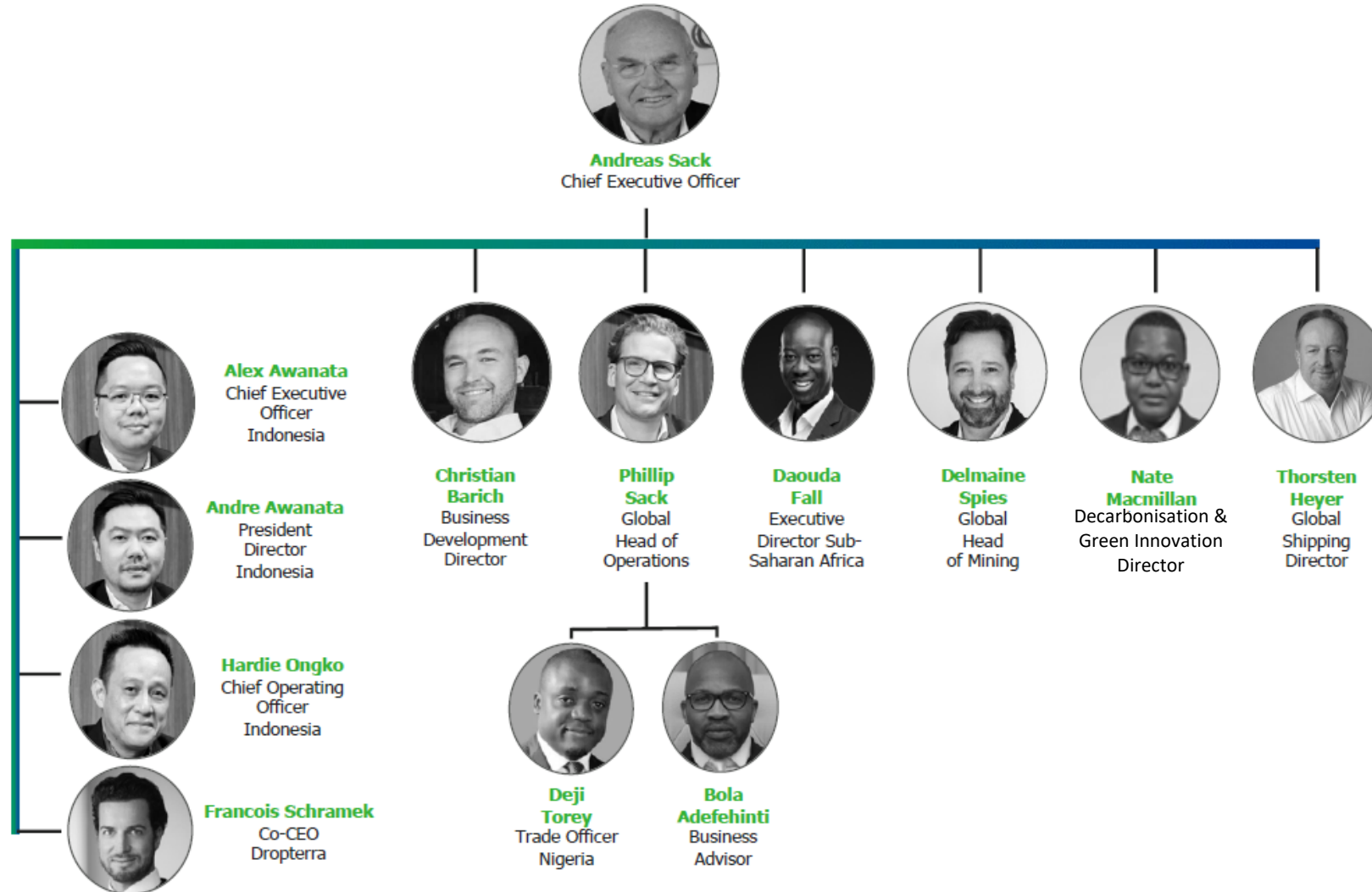
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# Ascon Group Management



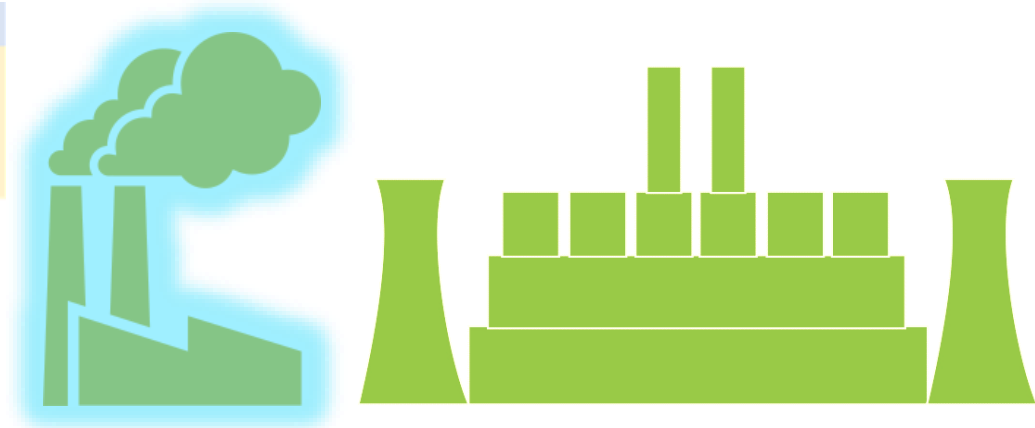
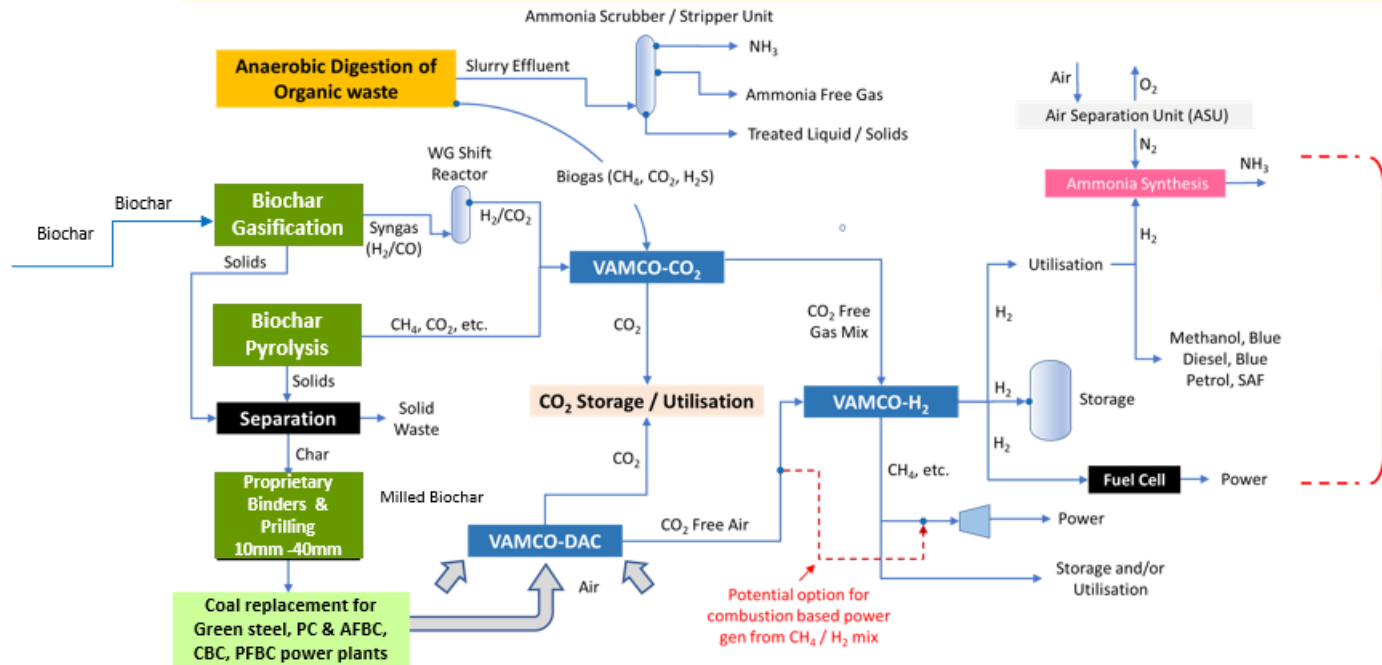


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# Rationale for Carbon Capture

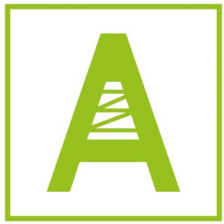
## Achieving Negative Emissions Using the VAMCO\* Family of Gas Cleaning Technologies

- \* VAMCO → **V**ersatile **A**dvanced **M**ethods of **C**leaning **O**ff-Gases
- VAMCO-CH<sub>4</sub> → A version of VAMCO for point-source capture of methane using a propriety chemical looping process
- VAMCO-CO<sub>2</sub> → A version of VAMCO for point-source capture of CO<sub>2</sub> using a propriety calcium looping process
- VAMCO-DAC → A version of VAMCO for **D**irect **A**ir **C**apture (DAC) of CO<sub>2</sub> from the atmosphere using a propriety cryogenic process
- VAMCO-H<sub>2</sub> → A version of VAMCO for hydrogen purification using a propriety membrane reactor technology



**Carbon Removal Carbon credits**  
CO<sub>2</sub> to ethanol or methanol pathways  
Carbon tax

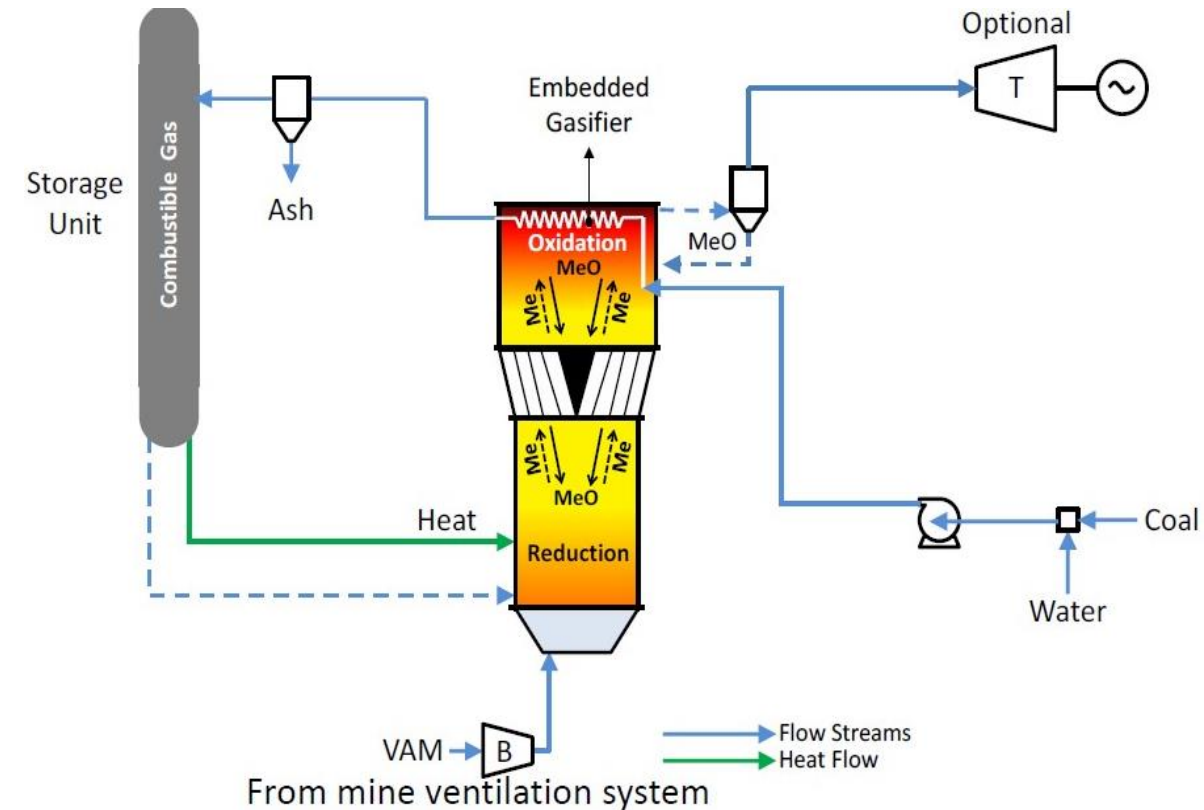
Complimentary to Bioenergy with Carbon Capture & Storage (BECCS)  
Environmental, Societal & Governance (ESG)  
**Paris Agreement and COP obligations**



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# Underground Coal Mine Fugitive Methane Emissions

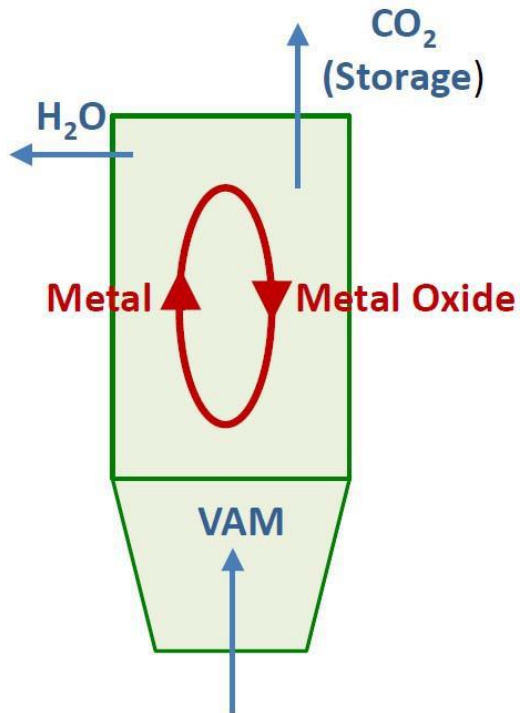
Activity	Completion	Technical Readiness Level (TRL)
Theoretical Research	2014	0
Concept Design	2015	1
Proof-of-concept (bench-scale R&D)	2016	3
1 m <sup>3</sup> /s proof-of-concept prototype	2017	4
Pilot scale cold-flow module	2017	4
30 m <sup>3</sup> /s pilot plant & field trials	2019	6
300m <sup>3</sup> /s demonstration plant	2019	7
Coal fire plant pilot CO <sub>2</sub> capture	2024	8-9



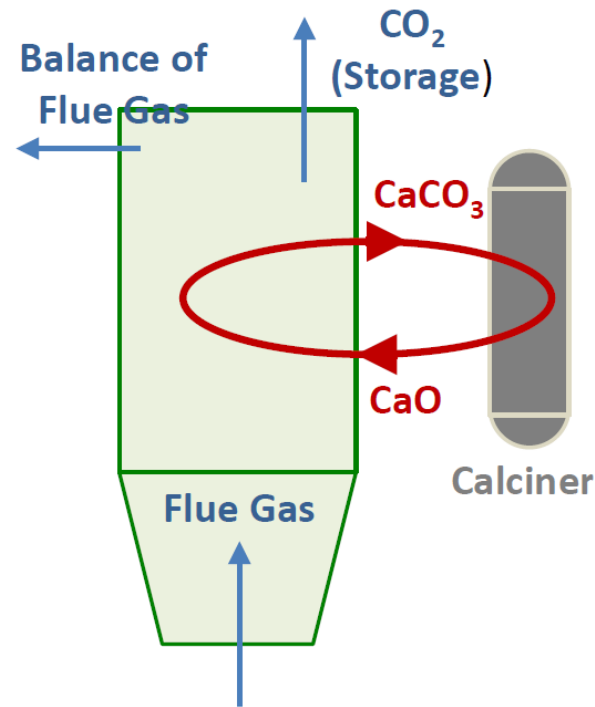


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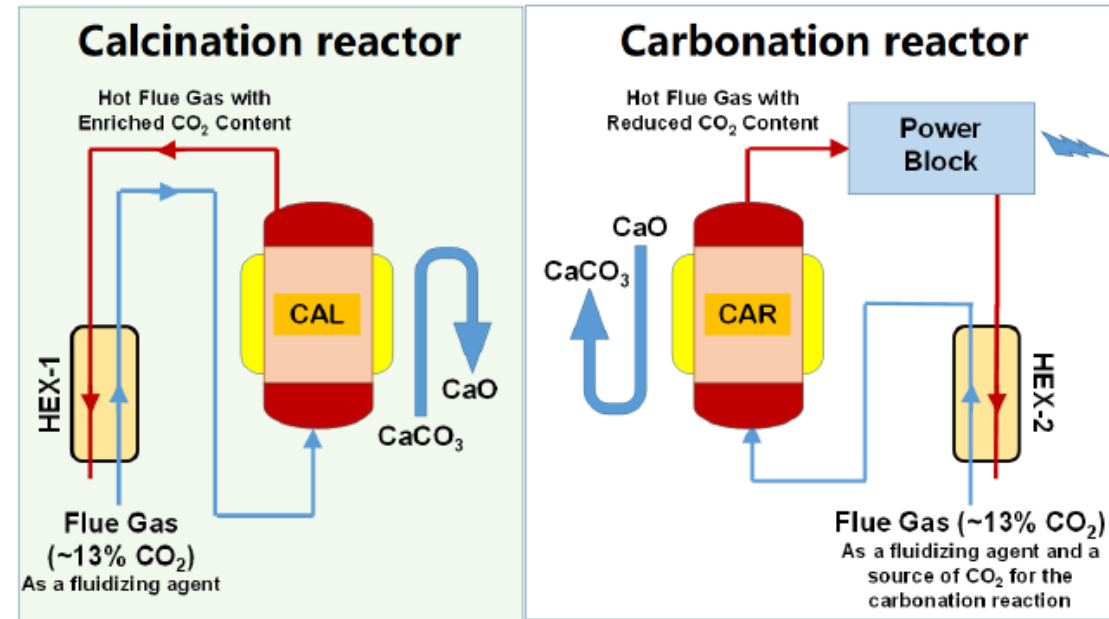
# Evolution of Fugitive Methane Gas Capture technology to CO<sub>2</sub> Capture



**UNDERGROUND COAL MINES**  
The technology is used for fugitive methane emission by converting them to CO<sub>2</sub> for reduction of Greenhouse Gas emissions by 90%



**FLUE GAS**  
The technology captures the CO<sub>2</sub> from flue gas emissions of process industries





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# Development History

Bench scale reactor



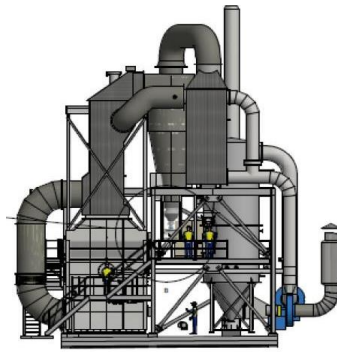
Pilot scale cold flow model



1 m<sup>3</sup>/s proof-of-concept  
prototype (2017)



300 m<sup>3</sup>/s Demonstration plant  
FEED (2019)



30 m<sup>3</sup>/s pilot plant & field trials  
(2019)





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# 30 m<sup>3</sup>/s Fugitive Emissions Pilot Plant

Methane Conversion Experiment	Bed Temperature	Flowrate 30 m <sup>3</sup> /s
1	700	23
2	660	23
3	660	33

## Methane Conversion Experiment Conclusions

No deactivation

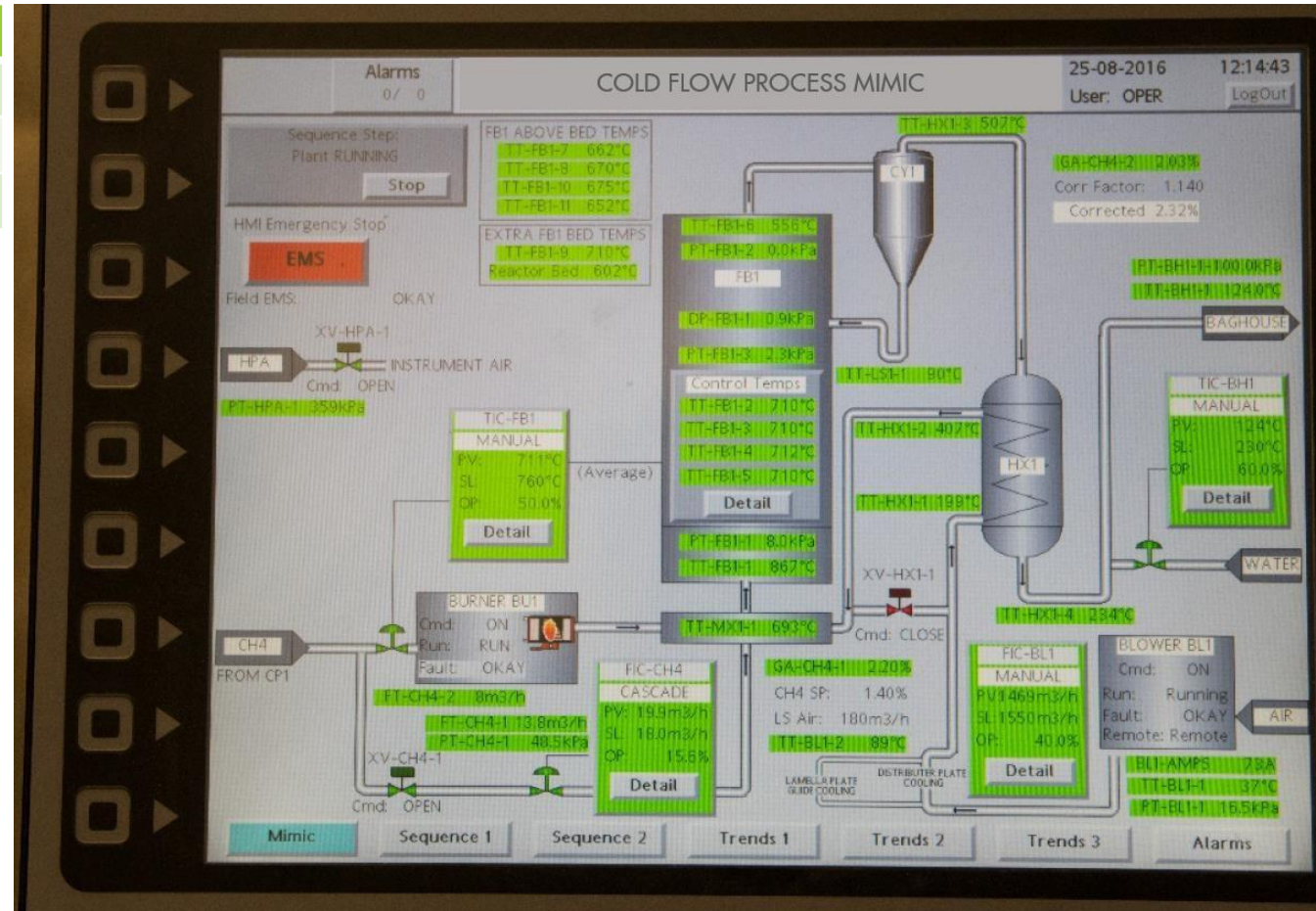
High bed temperature = higher in fluidised bed CH<sub>4</sub> conversion

Lower VAM flowrate = higher in bed CH<sub>4</sub> conversion

Full conversion of methane achieved at the top of the fluidised bed as any methane unconverted in the fluidised bed was converted in the reactor zone above the fluidised bed

Technology operates at 700° compared to other methane abatement technologies that need temperatures of 1000° where there is risk of methane autoignition due to higher fluctuation of methane levels

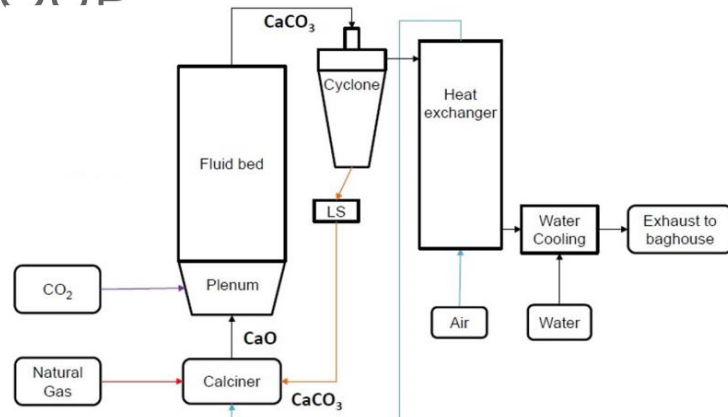
Fluid bed technology operates over a wide range of flow rates and methane concentrations including minimum rates which other current systems have their lower operating limit





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# Low CAPEX & Quick turnaround time for CO<sub>2</sub> Capture Retrofit



Fluidised Bed Temperature (°C)	Burner (%)	Air flowrate (m <sup>3</sup> /h)
600	0	1200
700	0	1200
700	0	1200
700	0	1200
Ramp to 713	0	1200
713	0	1200
713	0	1200
734	30	1200
734	30	1200
742	50	1200

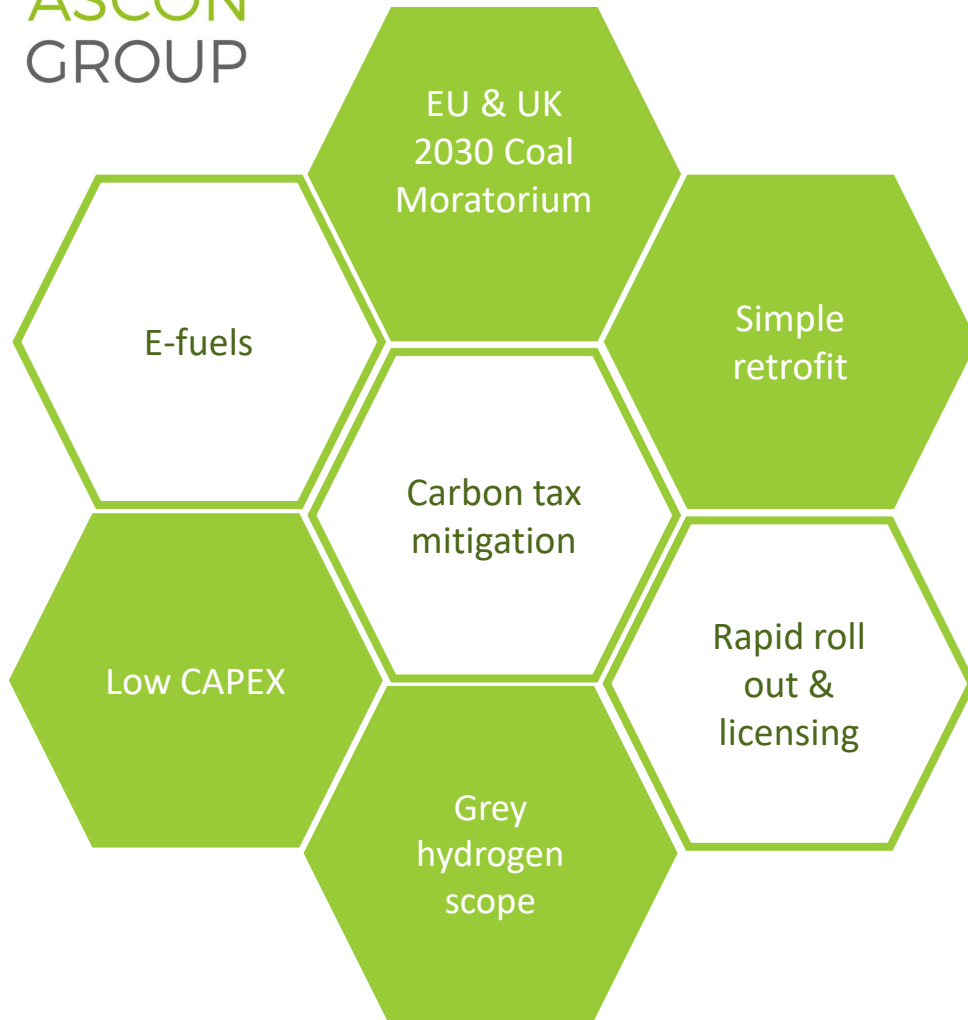
- 3.9 MJ/kg CO<sub>2</sub> experimentally achieved in comparison to 4.0 MJ/kg CO<sub>2</sub> thermodynamically
- System design required to optimised CO<sub>2</sub> partial pressure and operating temperature trade-offs







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## Takeaways

Multi-fuel sustainable energy future where fossil fuels, biofuels, e-fuels & hydrogen coexist

Ending the debate on fossil fuels

Pure CO<sub>2</sub> monetization in food & beverage industries

Pathways of Capture Carbon dioxide to ethanol/methanol

Ascon TRL 7 chemical looping carbon capture technology is non-amine based



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