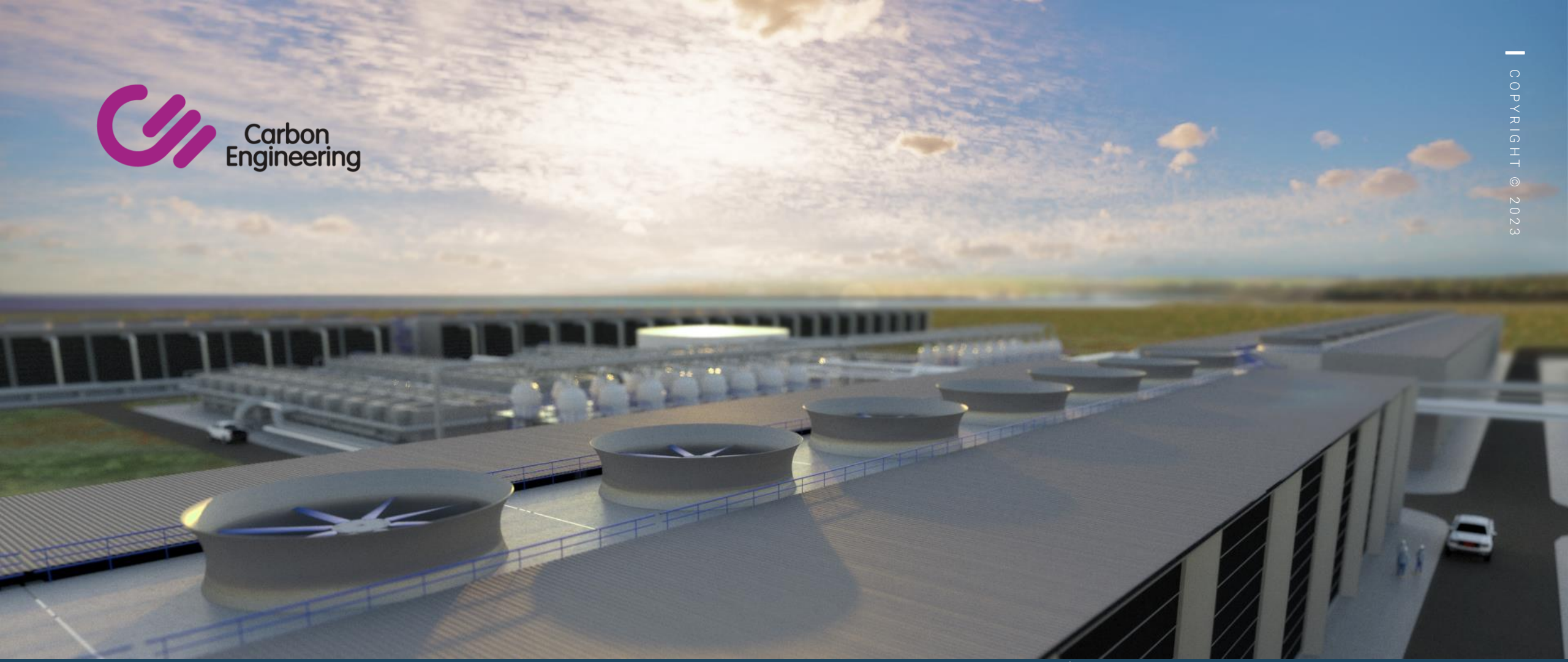


Carbon Engineering

Direct Air Capture:

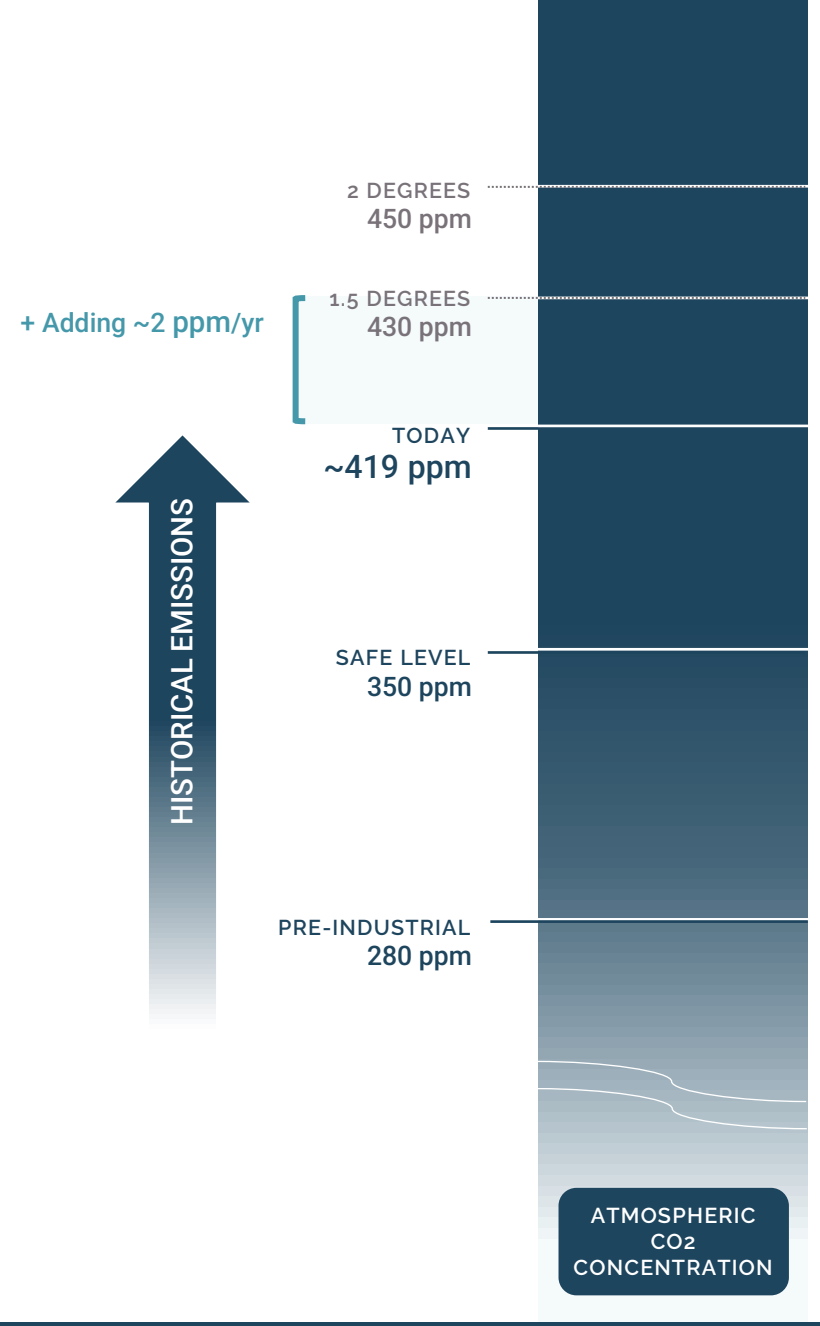
A critical tool for net zero

Pre-read for CFEE delegation

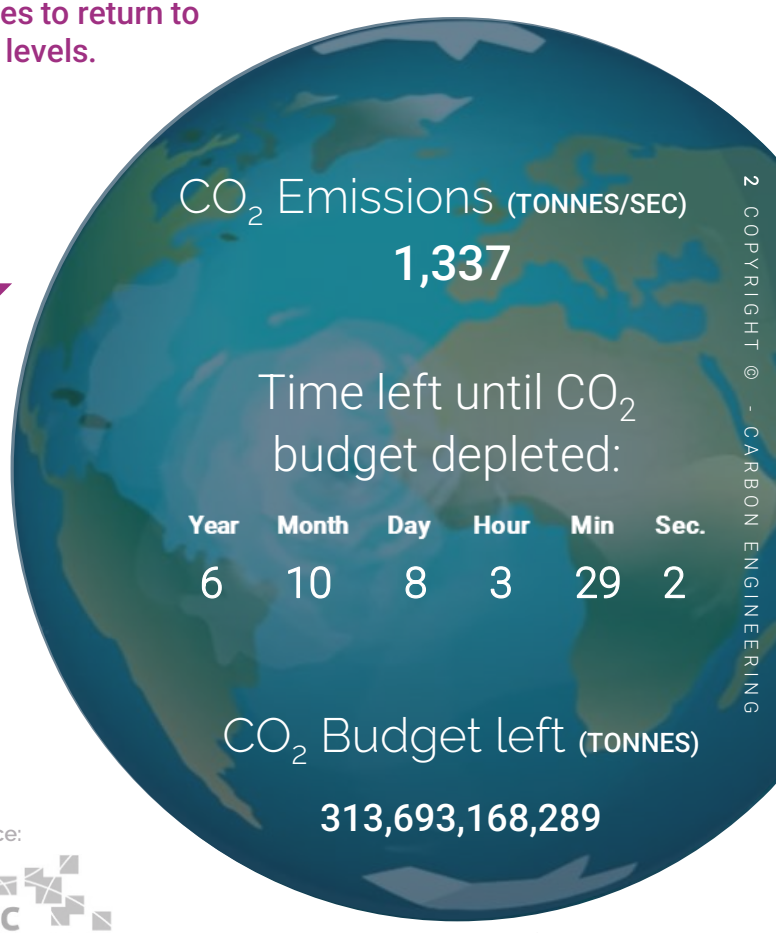
August 2023

Remaining carbon budget

We have fewer than **7.5 years left on the carbon clock** before an expected average of 1.5 degrees of warming



Remove ~1 Trillion tonnes to return to safe levels.



Source:
MCC
Mercator Research Institute on Global Commons and Climate Change

1.5-degree scenario
Data from 2022-09-14

THE CARBON CLOCK IS TICKING; THE CLIMATE PROBLEM IS URGENT

The push for net zero

What is net zero?

Net zero emissions -

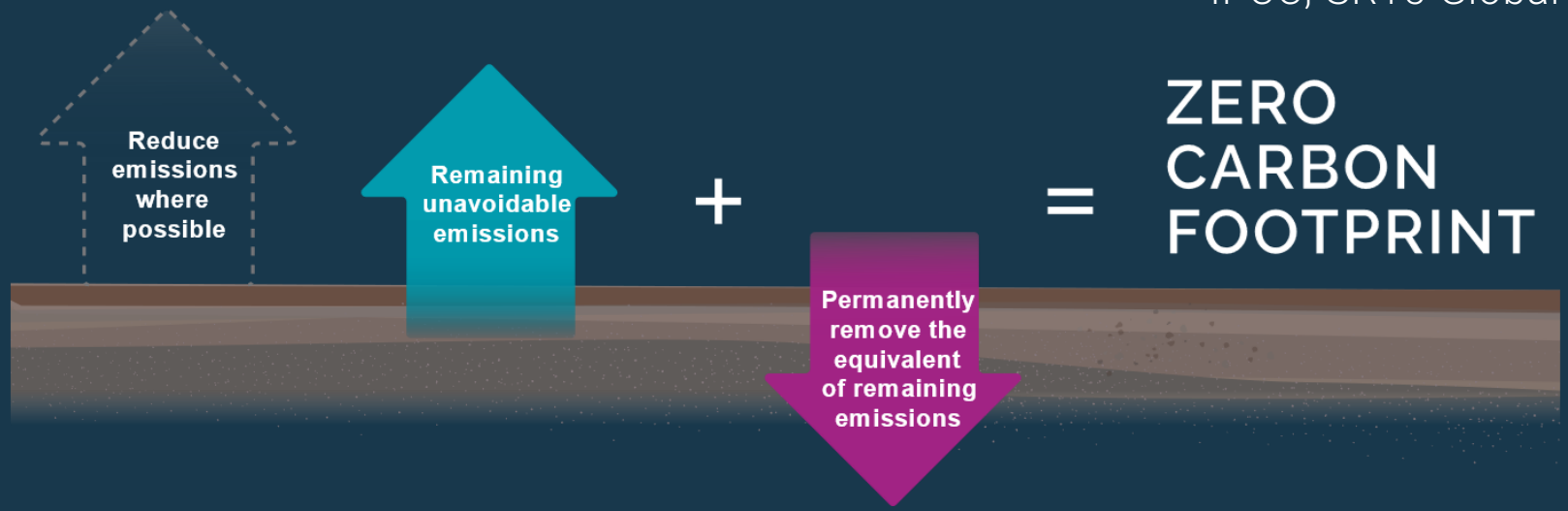
"Net zero emissions are achieved when anthropogenic emissions of GHG to the atmosphere are balanced by anthropogenic removals over a specific period."

Intergovernmental Panel on Climate Change (IPCC), SR15 Global Warming of 1.5˚C

What is carbon dioxide removal?

Carbon dioxide removal (CDR) – "Anthropogenic activities removing CO_2 from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural CO_2 uptake not directly caused by human activities."

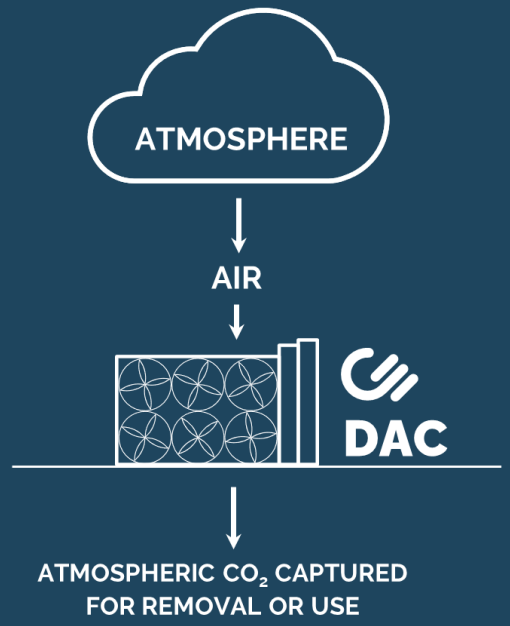
IPCC, SR15 Global Warming of 1.5˚C



Carbon Engineering

Pioneering large scale Direct Air Capture (DAC)

Can address any CO_2 emission, from any place and point in time



DEVELOPMENT

13+ years development

MILESTONES

2009 Company founded

2015 DAC pilot plant

2017 AIR TO FUELS™ pilot plant

2021 Innovation and R&D centre built

2022 FEED completed for 1st commercial DAC plant

2025 1st commercial DAC plant operational

INTELLECTUAL PROPERTY

36 issued patents & 41 applications in 19 patent families in key jurisdictions

WORLD CLASS PARTNERSHIPS, INVESTORS, AND CUSTOMERS

OXY 1POINTFIVE Chevron Cascade Asset Management Company

Large scale deployment underway

PILOT PLANT

BUILT 2015

Piloted elements of CE's DAC technology.

INNOVATION CENTRE

BUILT 2021

R&D platform for technological advancements to incorporate into commercial plants.

STRATOS PERMIAN SITE

CONSTRUCTION UNDERWAY

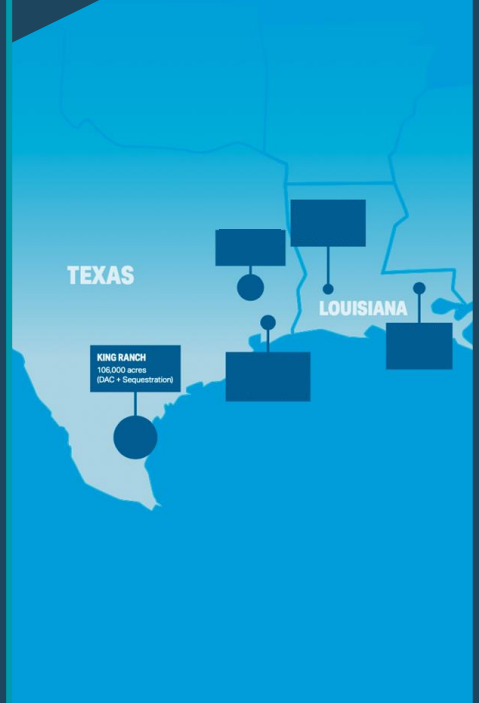
500,000 tonnes CO_2/yr once fully operational.

Expected to be largest in the world.

SOUTH TEXAS MEGA-SITE

ENGINEERING UNDERWAY

Enables potential for **30** MTPA DAC



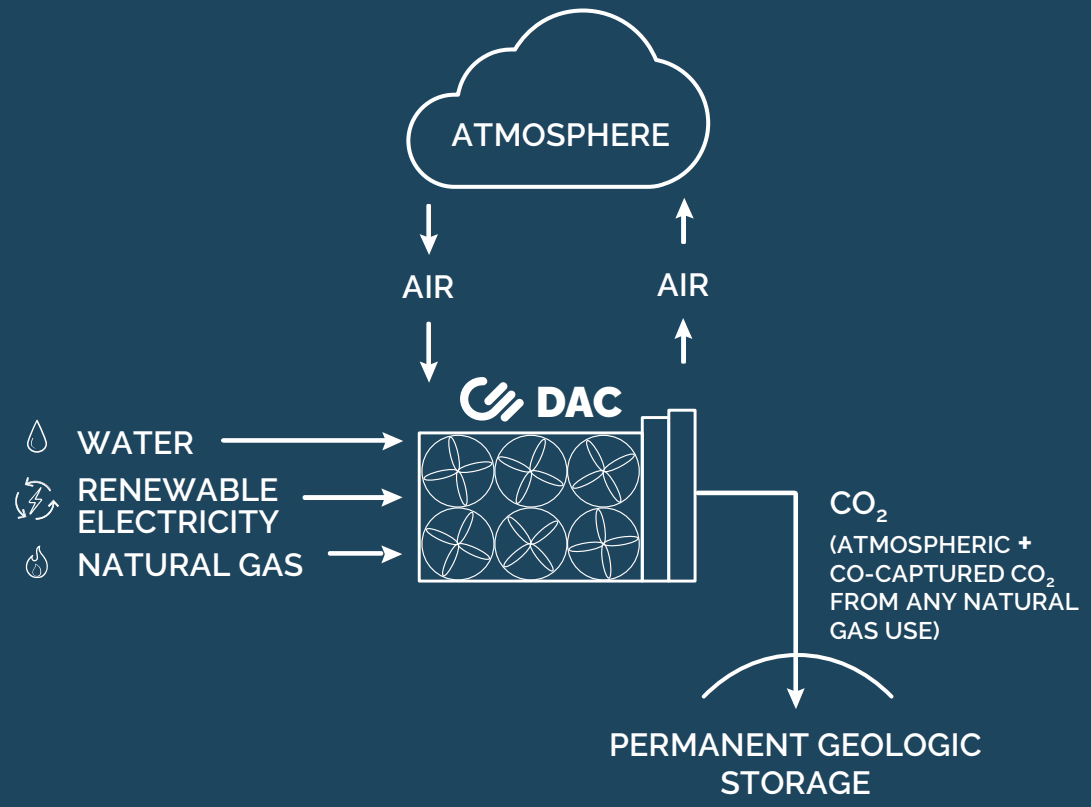
100 Mt by 2035

1POINTFIVE DEV. SCENARIO

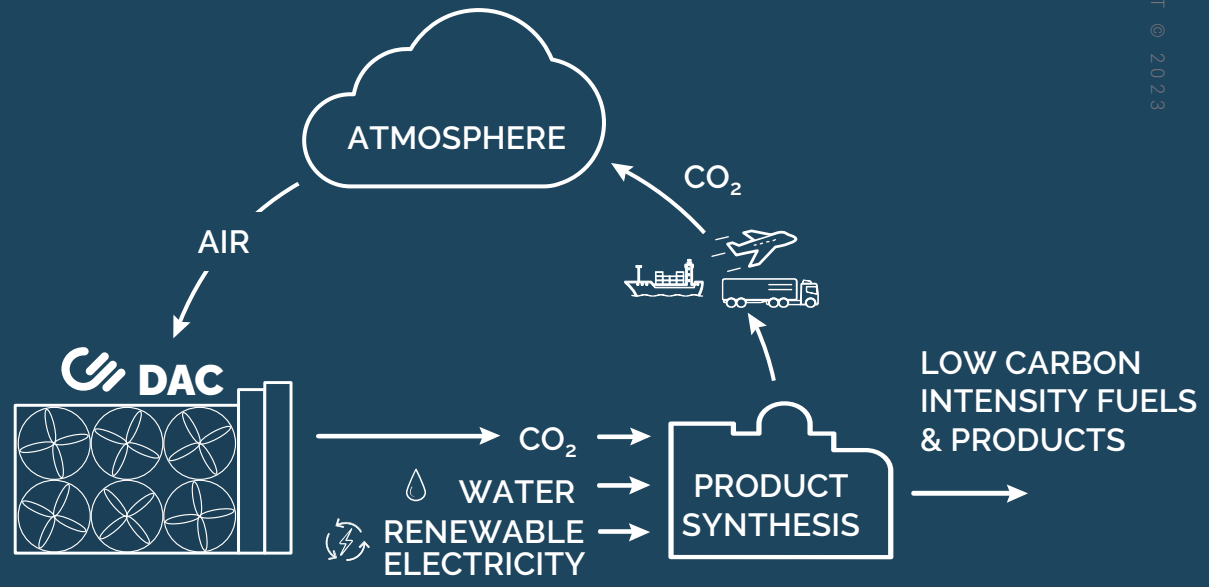
Advancing feasibility studies and plant designs in other locations across the globe

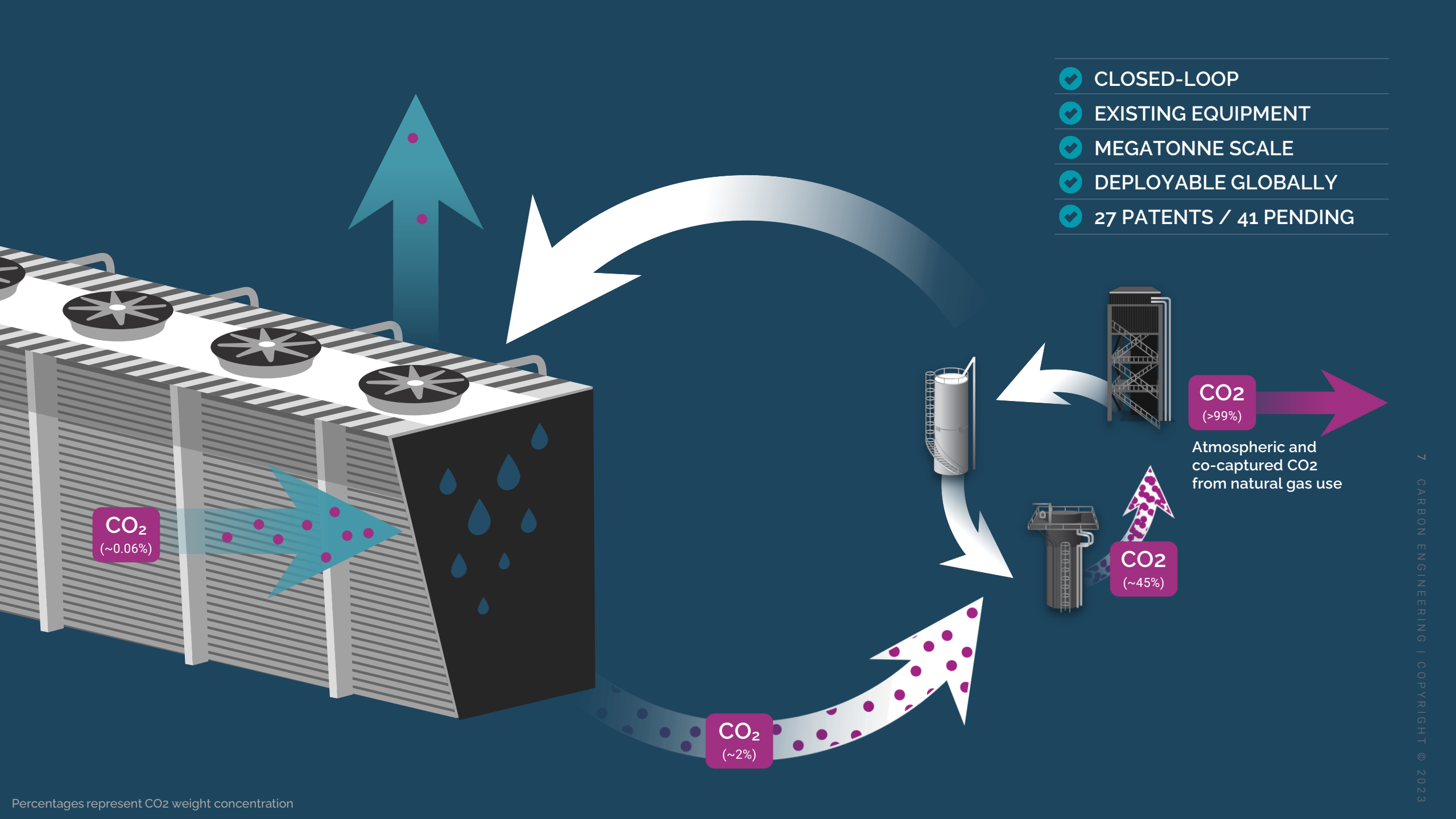
CE DAC enables complementary solutions for carbon dioxide reduction and removal from the atmosphere

CARBON DIOXIDE REMOVAL



LOW CARBON INTENSITY FUELS & PRODUCTS





Percentages represent CO_2 weight concentration

A turn-key solution

CE's process was designed to be deployed at scale

1 INDUSTRIAL EQUIPMENT WITH PRECEDENT

- A combination of pre-existing technologies adapted and combined with patented innovations and proprietary know-how
- Reduces scale up risk & improves cost estimation

2 CLOSED CHEMICAL LOOPS

- Non-volatile non-toxic chemical process
- Meets environmental health and safety standards

3 FREEDOM OF LOCATION

- Plants can be located where economics are optimum to take advantage of low-cost local energy or proximity to sequestration sites or demand centre

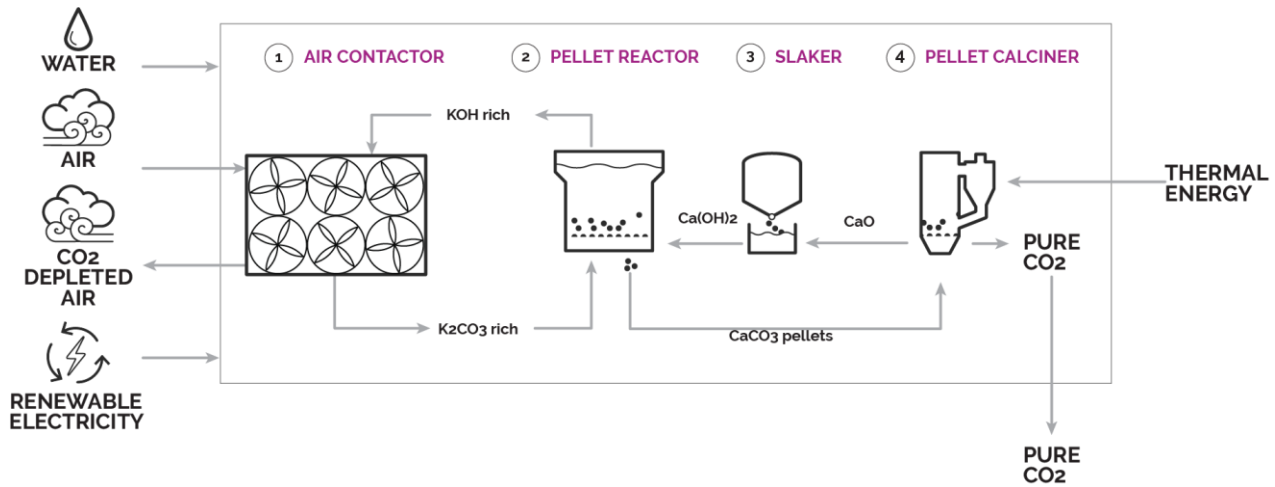
4 LICENSED PROCESS BUSINESS MODEL

- Partners with experienced plant developers and world leading EPCs
- Many partners enables faster deployment

1

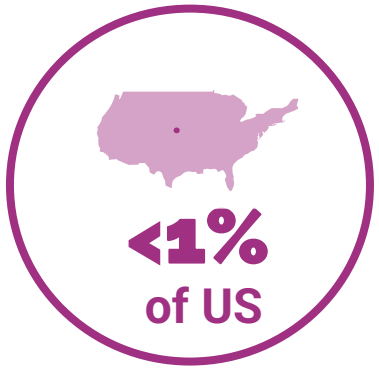
EQUIPMENT	INDUSTRIAL PRECEDENT
AIR CONTACTOR	Industrial cooling tower
PELLET REACTOR	Water treatment technology
SLAKER	Standard equipment for converting Calcium Oxide to Calcium Hydroxide
CALCINER	Refractory lined circulating fluidized bed calciners are commonly used in mining for ore processing

2



For more information, visit the Joule paper on CE's process

DAC Provides Benefits in Reduced Land Use and High Durability

	DAC	BECCS	A/REFORESTATION
LAND USE FOR 10 GT/YR CAPTURE [1,2]			
DURATION AND TYPE OF CARBON STORAGE [3]	**1,000+ yrs** (geologic storage)	**1,000+ yrs** (geologic storage)	**1-100 yrs** (stored as biomass)

1. Brack, D, King, R. (2020). Managing Land-based CDR: BECCS, Forests and Carbon Sequestration. Glob Policy, 12, 45-56,
2. DAC includes land area for renewable energy , 0.04% for DAC plant only
3. A Bergman & A Rinberg (2021) "The Case for Carbon Dioxide Removal: From Science to Justice" CDR Primer, edited by J Wilcox, B Kolosz, J Freeman
4. Dooley, K., Harrould-Kolieb, E. and Talberg, A. (2021), Carbon-dioxide Removal and Biodiversity: A Threat Identification Framework. Glob Policy, 12: 34[illegible]
5. Sabine Fuss et al 2018 Environ. Res. Lett. 13 063002

A solution for hard to abate transportation sectors

DAC enables complementary solutions for reduction and removal

1 Durable Carbon Dioxide Removal (CDR)

1POINTFIVE

2 Sustainable Aviation Fuel (SAF)

Produced through CE's AIR TO FUELS™ process.

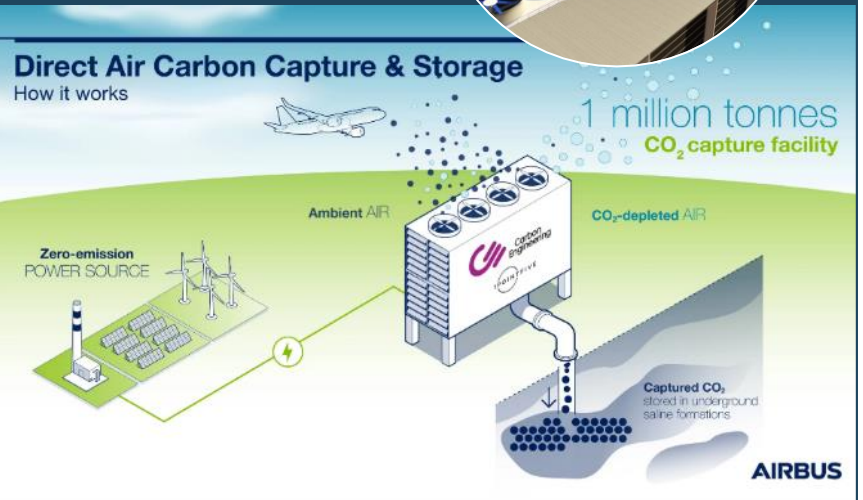
BOTH options are considered equal in existing and emerging high-integrity transportation decarbonization compliance markets like the pioneering California LCFS (and WA/BC LCFS policies)

2022 Was a Remarkable Year for Aviation and Permanent Carbon Dioxide Removal (CDR) through DAC + Geologic Sequestration

1 **March**
Airbus pre-purchased **400,000 tonnes** of CDR from 1PointFive

AIRBUS

1POINTFIVE



2 **July**
Airbus announced a CDR collaboration with seven other airlines (and airline groups) at the Farnborough airshow

AIRBUS
FARNBOROUGH INTERNATIONAL AIRSHOW
virgin atlantic
LATAM
AIRFRANCE KLM
Lufthansa
easyJet
AIR CANADA
Aer Lingus
BRITISH AIRWAYS
IAG
IAG Cargo
IAG GBS
IAG Loyalty
IAG Tech
IBERIA
IBERIA EXPRESS
LEVEL
vueling

3 **November**
Carbon Engineering announced significant R&D investments by Airbus and Air Canada

AIRBUS AIR CANADA

CE Innovation Centre

- Squamish, BC, Canada
- Built 2021
- Validation plant for pre-commercial testing of equipment (run-replace-run), ~1,000 t/y capacity
- Extensive facilities for lab and bench scale testing

Lab, bench, and fully-integrated demonstration testing

Source: Chloe Farand, Climate Change News, 27/2/2020

MORE INFORMATION CAN BE FOUND AT:

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