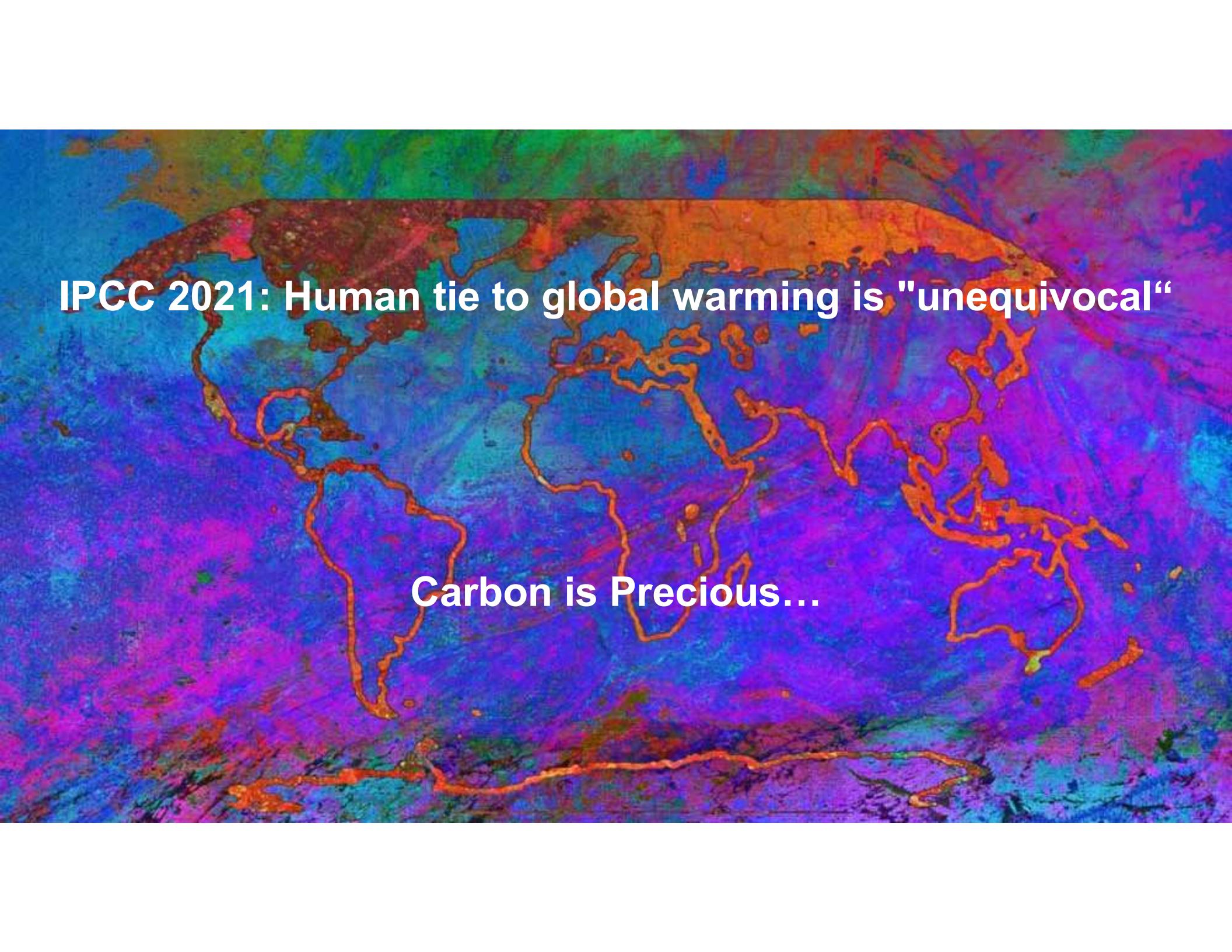




**12<sup>th</sup> World Renewable Energy Technology Congress**  
**Energy Transition: Solar for 24x7 Power**  
**Dr. Preeti Jain, LanzaTech**





**IPCC 2021: Human tie to global warming is "unequivocal"**

**Carbon is Precious...**



**Energy can be  
Carbon free**

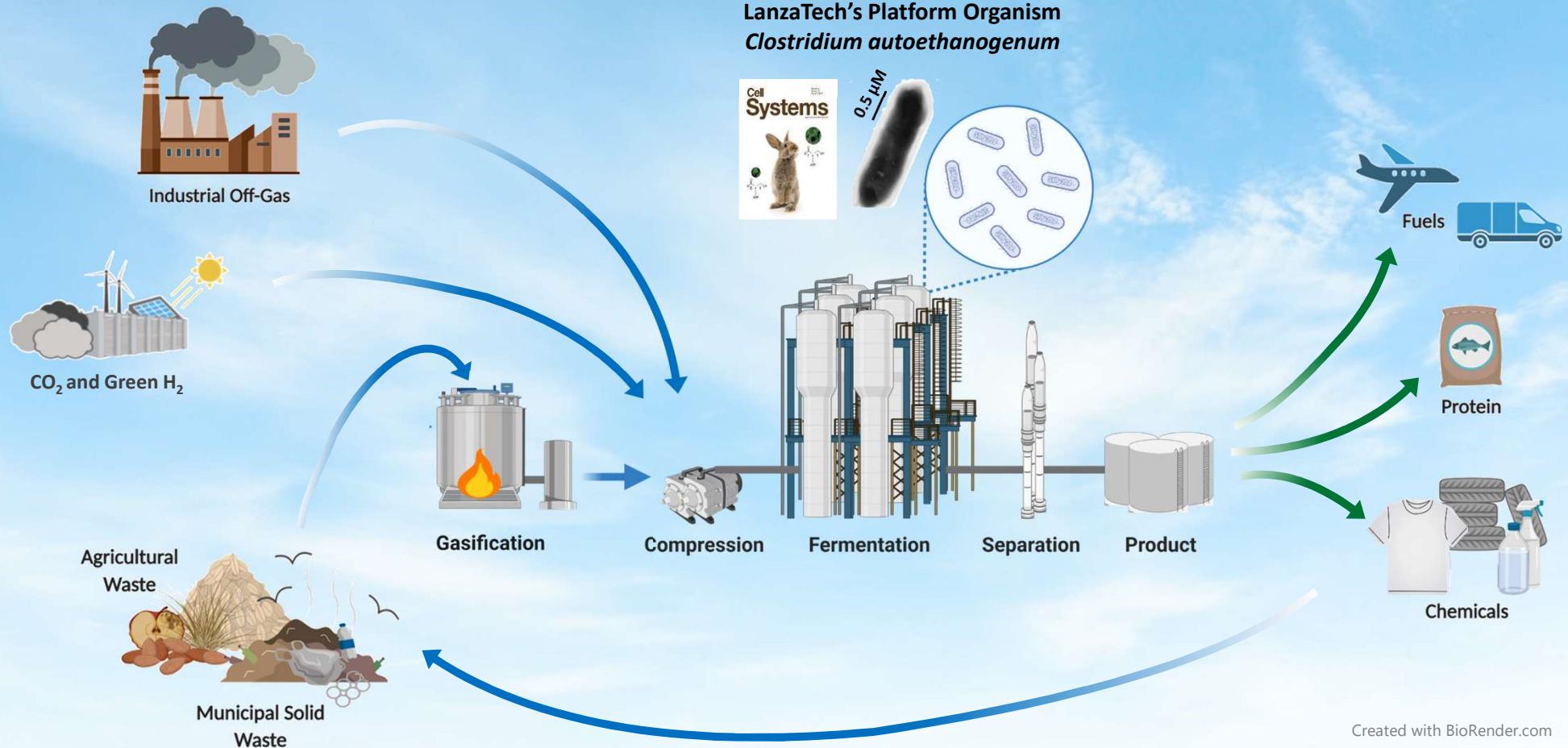


**Chemicals & Fuels  
need Carbon**



**Where that Carbon comes from  
will Define our Climate Future**

# LanzaTech's Gas Fermentation Platform Technology



Fackler, [...] Kopke (2021) *Ann Rev Chem Biomol Eng* 12: 439-470  
Kopke & Simpson (2020) *Curr Opin Biotechnol* 65: 180-189

## Technology De-risked: Operating at Commercial Scale

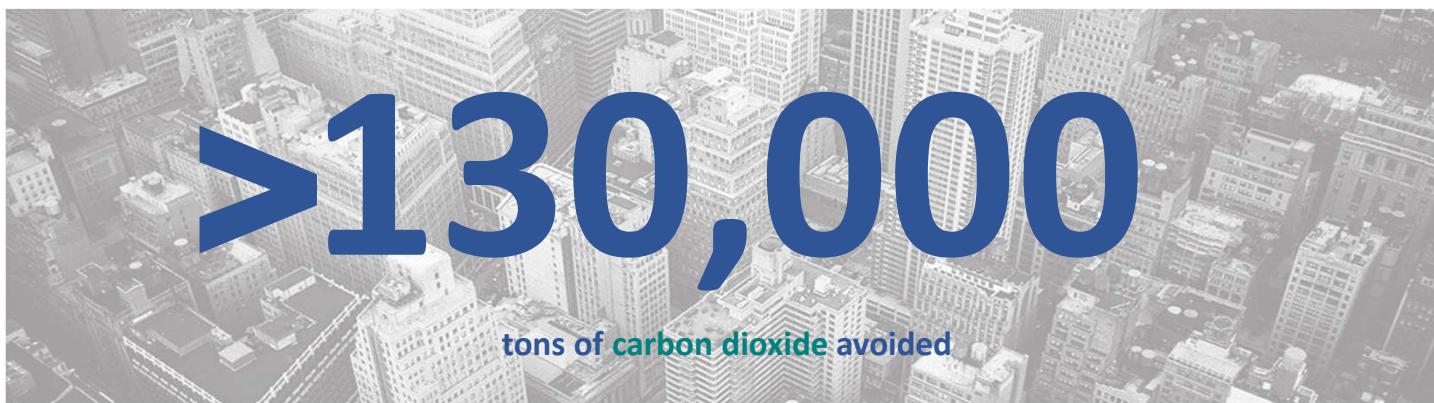


World's First Commercial  
Gas Fermentation Plant



Operational since May 2018  
>22 million gallons/year

- Industrial emissions to ethanol
- Second commercial plant operating since April 21
- Payback 4-6 years



Fackler, [...] Köpke (2021) *Ann Rev Chem Biomol Eng* 12: 439-470  
Köpke & Simpson (2020) *Curr Opin Biotechnol* 65: 180-189

## Diffusion of Technology



**Accessing all global carbon waste  
~2T liters ethanol**

## Enabling A Circular Model



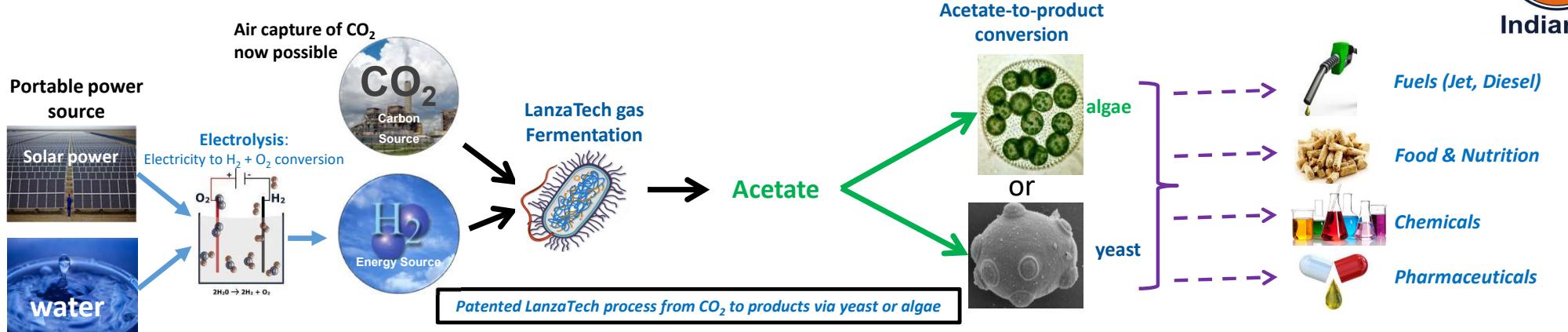
Fackler, [...] Köpke (2021) *Ann Rev Chem Biomol Eng* 12: 439-470  
Köpke & Simpson (2020) *Curr Opin Biotechnol* 65: 180-189

## Consuming CO<sub>2</sub>

		H <sub>2</sub> :CO Ratio	Carbon Efficiency	Energy Efficiency
CO	$6 \text{ CO} + 3 \text{ H}_2\text{O} \rightarrow \text{EtOH} + 4 \text{ CO}_2$	0:1	33.3%	
CO + H <sub>2</sub>	$3 \text{ H}_2 + 3 \text{ CO} \rightarrow \text{EtOH} + \text{CO}_2$	1:1	66.7%	
CO + H <sub>2</sub>	$4 \text{ H}_2 + 2 \text{ CO} \rightarrow \text{EtOH} + \text{H}_2\text{O}$	2:1	100%	80%
CO + H <sub>2</sub> + CO <sub>2</sub>	$5 \text{ H}_2 + 1 \text{ CO} + 1 \text{ CO}_2 \rightarrow \text{EtOH} + 2 \text{ H}_2\text{O}$	5:1	100%	
CO <sub>2</sub> + H <sub>2</sub>	$4 \text{ H}_2 + 2 \text{ CO}_2 \rightarrow \text{Acetate} + 2 \text{ H}_2\text{O}$	N/A	100%	

*Carbon efficiency changes with different feedstock but  
energy efficiency remains relatively constant*

# From CO<sub>2</sub>, Power and Water to Food, Fuels and Chemicals

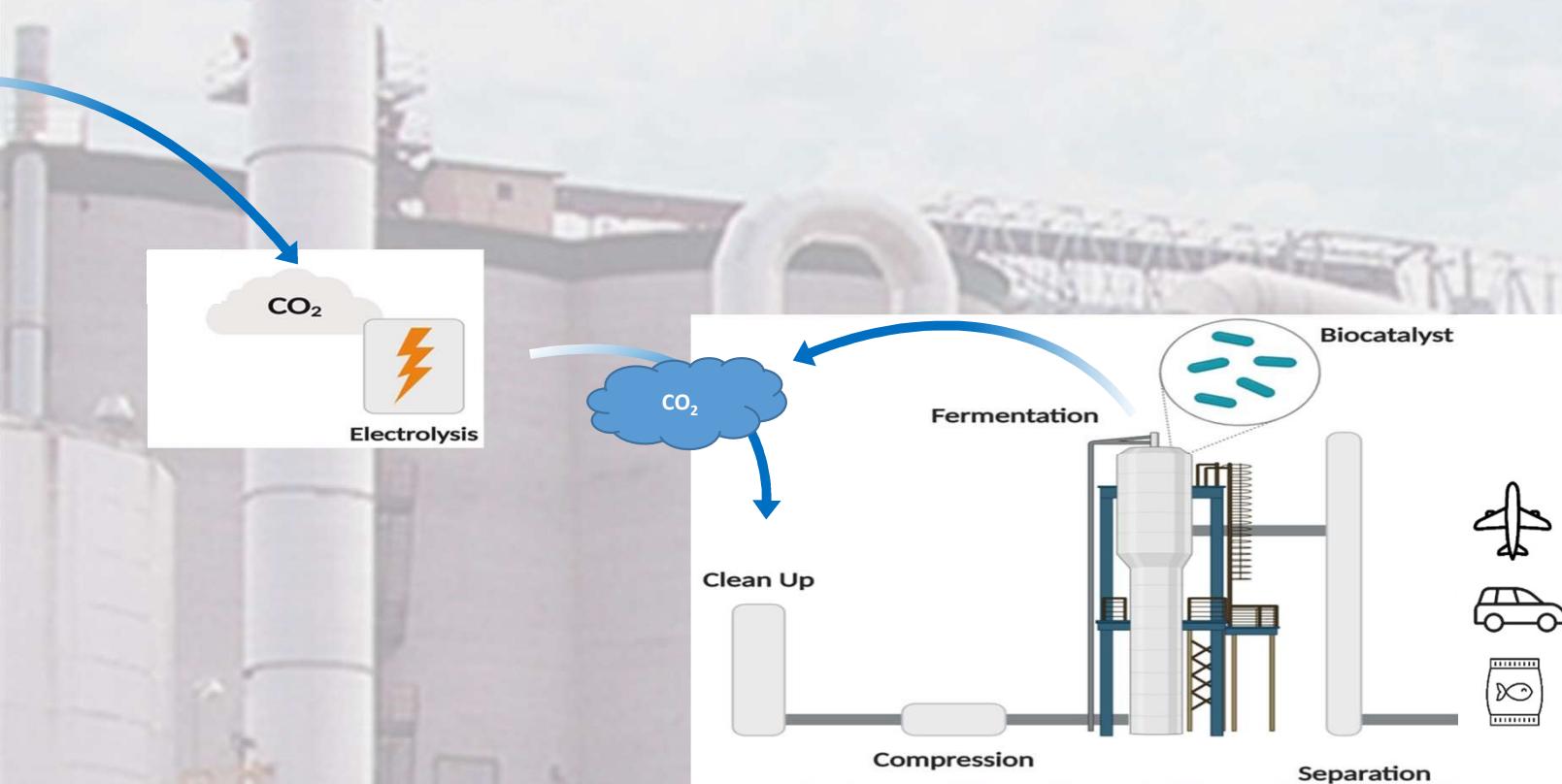


- Gas fermentation can produce Acetate from CO<sub>2</sub> & H<sub>2</sub> continuously at high rates and yields
- Many algae and Yeast can use Acetate as a carbon & energy source for product synthesis

*Sustainably produced Acetate can replace sugars as the carbon source for an electron-driven bio-economy*



# CO<sub>2</sub> and Electrolysis: Retrofit to Corn Ethanol Facilities



**14.5B gpy  
Ethanol**

**~100% carbon utilization**  
**> 800 facilities in the U.S., Brazil, India, EU and China**

# Ethanol: Building Block of the Future



# Living CarbonSmart

## Purified Ethanol



COTY



## Glycols and Surfactants



INDIA GLYCOLS LIMITED



## PET Resin



## PET Fibers



lululemon

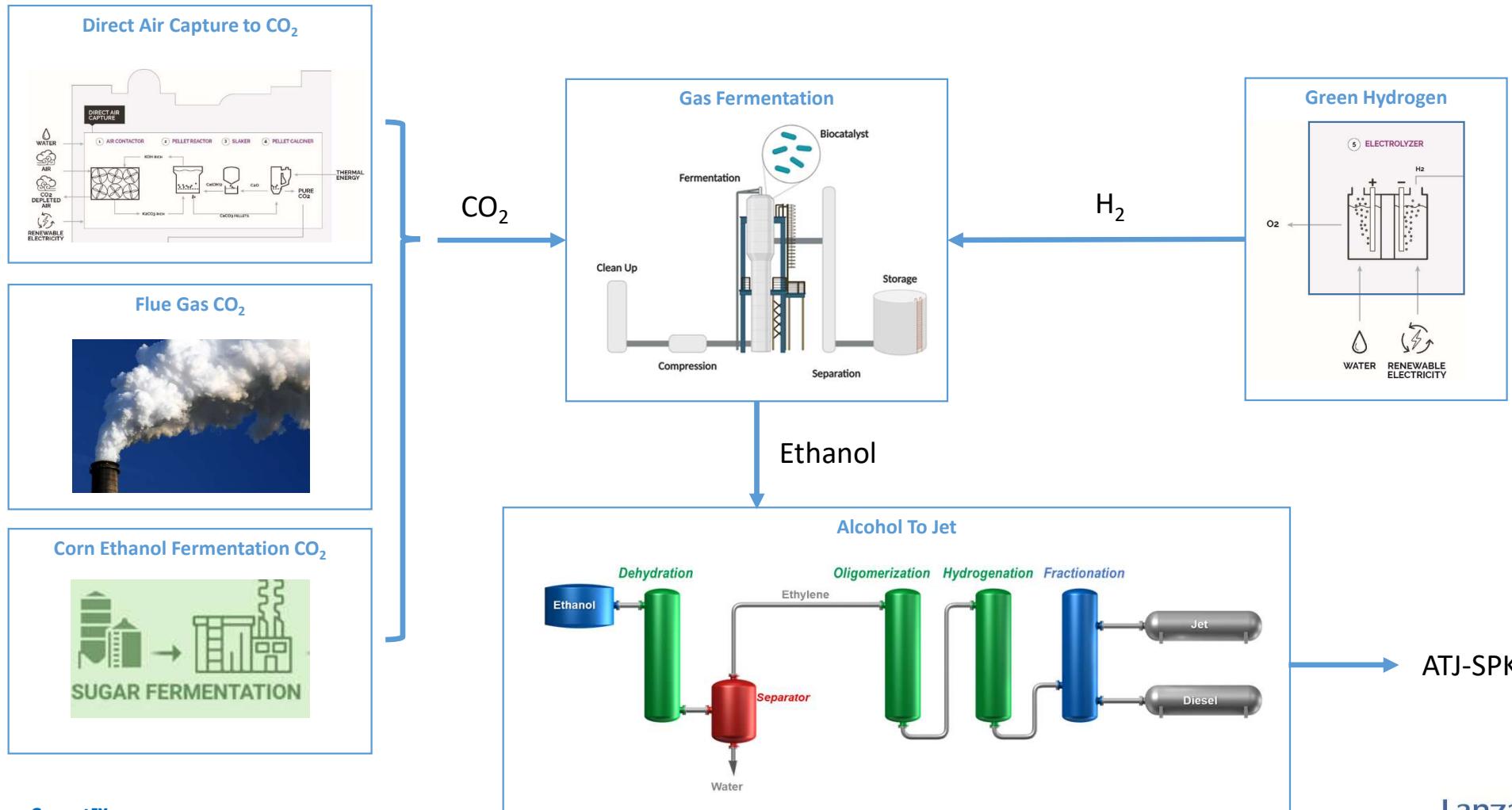
## Polyethylene



L'ORÉAL  
PARIS



# CO<sub>2</sub> to SAF via ATJ



# Getting Sustainable Aviation Fuel (SAF) to Scale

Mandated SAF  
Demand of Over  
**\$50B** by 2030

## Small Supply

70M liters SAF produced  
globally in 2020



## Huge Demand

Mandates and  
commitments expected  
to generate market of over  
40B liters SAF by 2030<sup>1</sup>

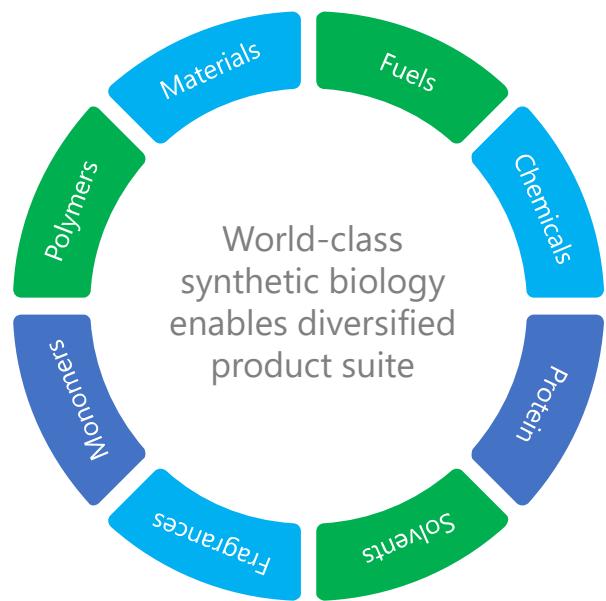
## Global Consumption

360 B liters for commercial  
airlines in 2019



<sup>1</sup> Assuming 10% SAF market share, jet fuel market CAGR of 2.5% from 2024 onwards using 2019 baseline, and SAF price of \$4.75/gal; <sup>2</sup> Volume estimates based on growth from 2019 jet consumption baseline.

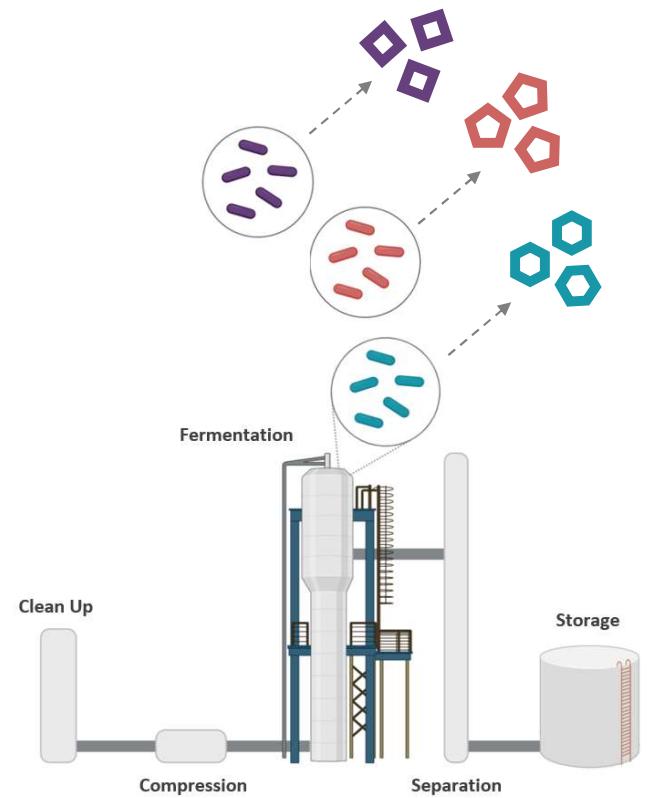
# Unlimited Flexibility



Same reactor  
Same feedstock  
Same process



Change production to  
meet market demand  
and maximize revenue



A wide-angle aerial photograph of a forest fire. The flames are visible as bright orange and red areas, with thick plumes of smoke billowing upwards and spreading across the landscape. The surrounding terrain is a mix of green and brown, indicating burned and unburned areas. The overall scene is one of significant environmental impact and destruction.

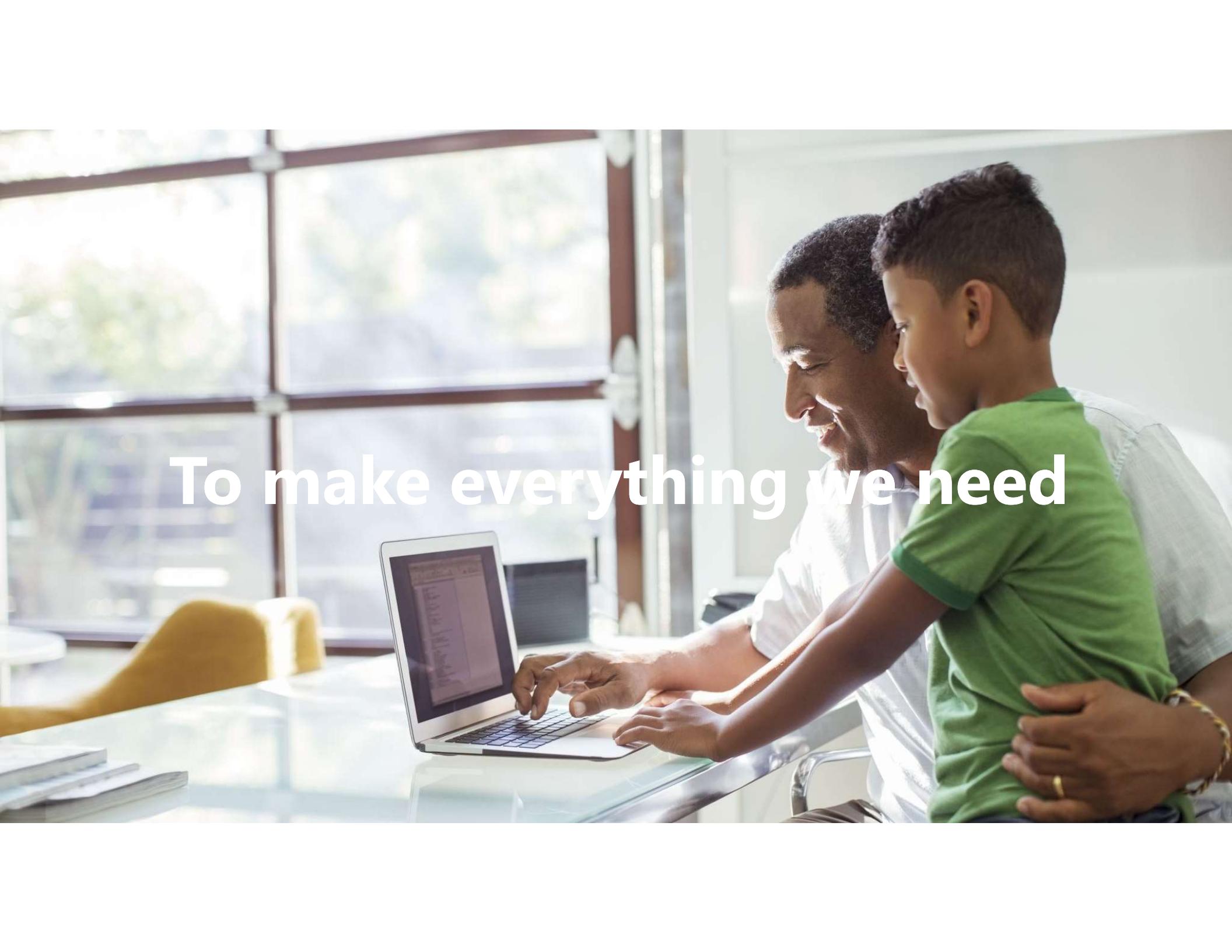
**It's time to rethink carbon**



**Harness clean power**

A photograph of two female scientists in a laboratory. The scientist on the left, wearing a white lab coat and safety glasses, is looking towards the right. The scientist on the right, wearing a red lab coat and safety glasses, is holding a clear plastic tray with multiple small containers, possibly for cell culture or testing. They are both wearing black gloves. The background shows laboratory equipment and shelves.

and biology

A photograph of a man and a young boy sitting at a desk, looking at a laptop screen. The man is on the left, wearing a white shirt, and the boy is on the right, wearing a green t-shirt. They are both smiling and looking at the laptop. The laptop screen shows some text and numbers. In the background, there are large windows and a yellow chair.

To make everything we need

