



LanzaTech 

Gas Fermentation: A carbon recycling pathway

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Carbon Smart™

LanzaTech 



Energy can be
Carbon Free



Chemicals for
Everyday Products
need Carbon

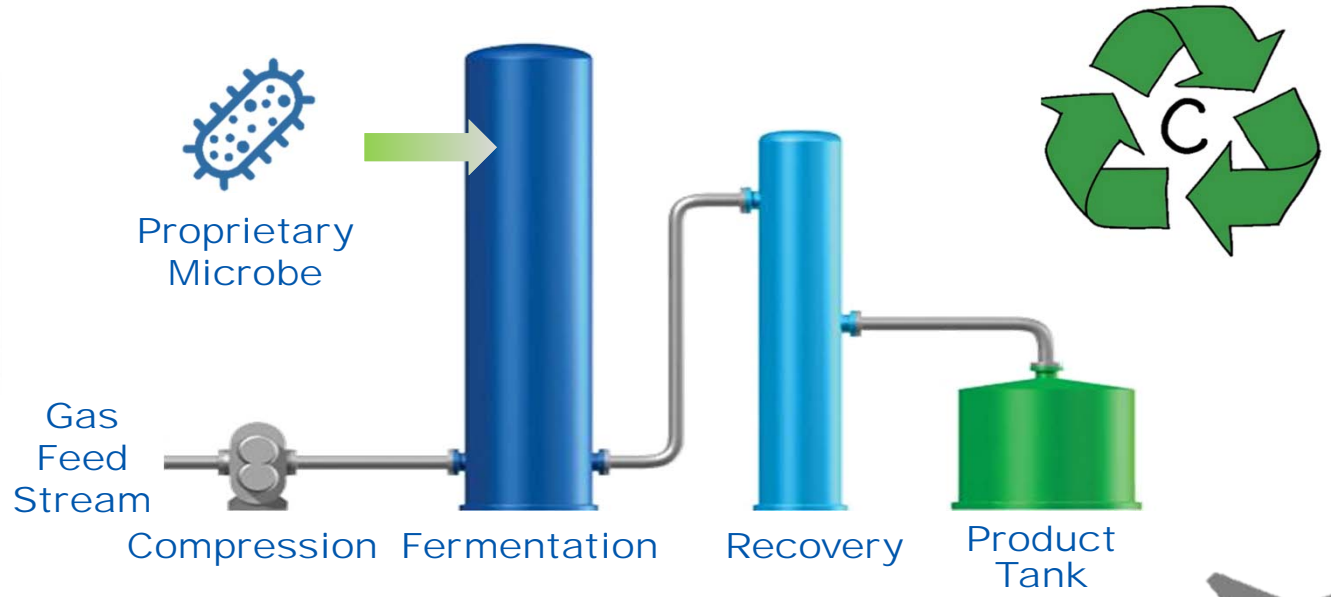


Aviation Fuel
needs Carbon

Recycling Carbon



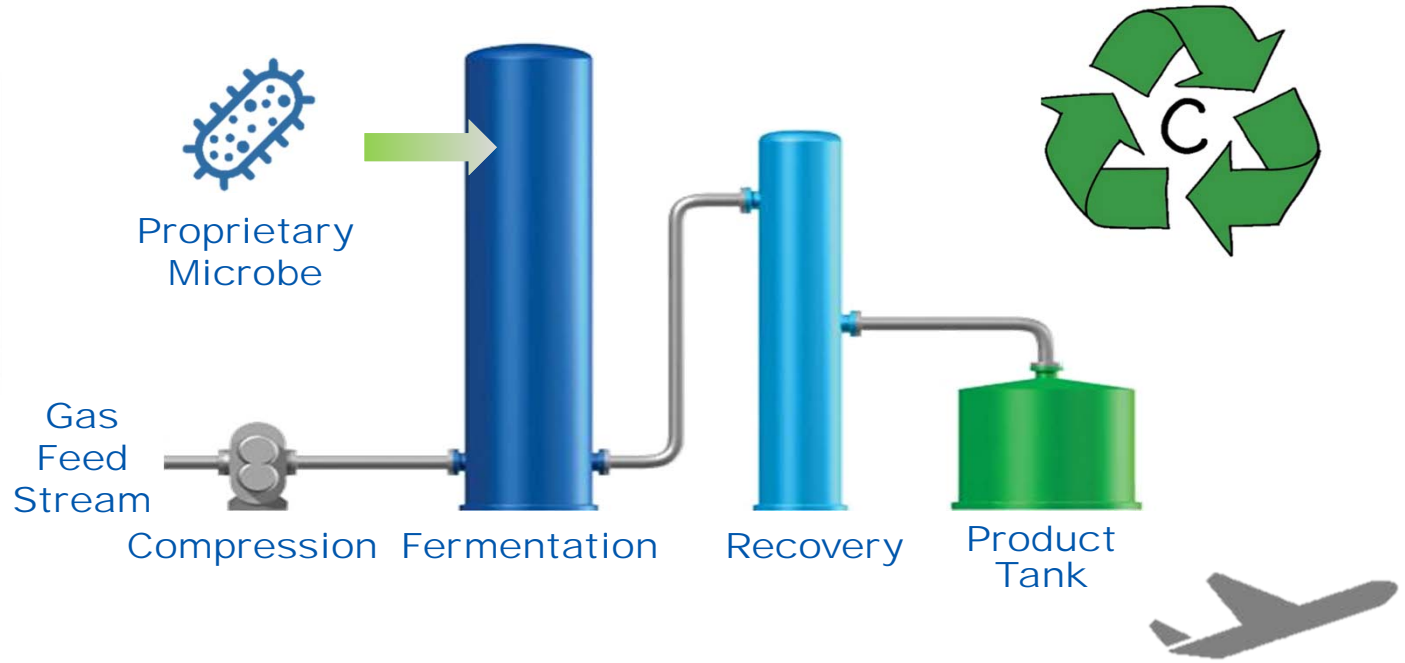
Industrial Off Gas
Biomass, MSW Syngas



Recycling Carbon



Industrial Off Gas
Biomass, MSW Syngas



Fuel, Chemicals & Food





August 2016
Ground Breaking



May 2017
Reactor Construction



May 2018
Start-Up

Compelling Project Economics at 1st Commercial Plant



**Production Levels
that Enable
Profitability**



**CapEx per Gallon
of ~\$3.25**



**Gas
BTU Value**



**Payback Period
~3 Years**

Crossing the Valley of Death



Ease of funding ↑



Discovery

Applied R&D



Engineering Development



Pilot and Demonstration
\$\$



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First Commercial



Diffusion



Adapt and adopt from others



Continuous improvement at scale

Evolution →

Path to Commercial Scale



Multiple demo plants at various scales; over 80,000 operating hours



Steel Pilot Plant 1
Nov. 2008
Auckland, NZ





BAOSTEEL

Steel Demo Plant 1
March 2012
Baoshan, China





首钢朗泽
Shougang LanzaTech

Steel Demo Plant 2
Dec. 2012
Caofeidian, China



Carbon Smart™ Behind™



Steel Pilot Plant 2
March 2014
Kaohsiung, Taiwan



SEKISUI

MSW Pilot Plant
Nov. 2014
Yorii, Japan



Freedom Pines
Biorefinery



IndianOil Corporation (IOC): Refinery Off Gas Project Summary



>50% C in Ethanol from CO₂



China
48k MTA
2018



Belgium
62k MTA
2019



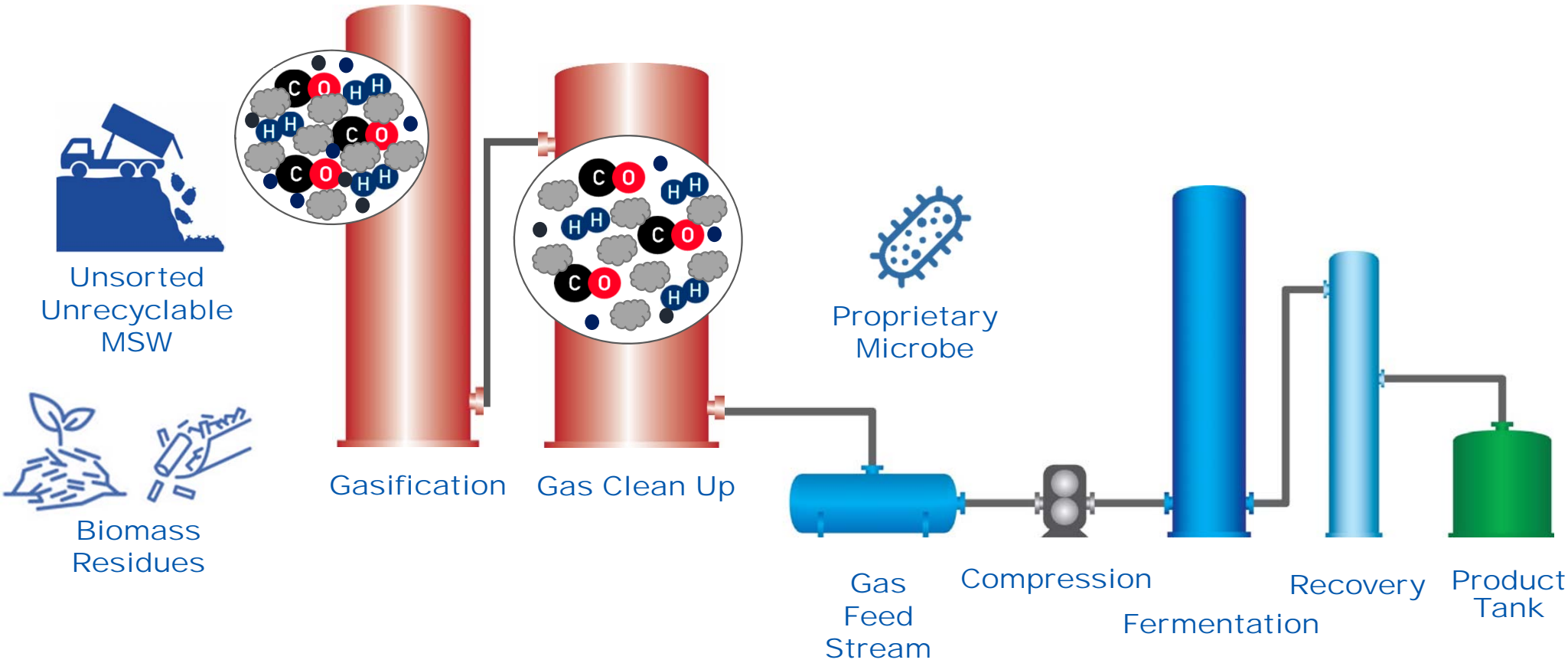
India
34k MTA
2019



South Africa
52k MTA
2019

Industrial Off Gases

Gasification and Fermentation



Variety of Feedstocks Successfully Demonstrated with Integrated Gasification Unit



35k MTA

California
Biomass Syngas

2019



20k L/A

Demonstration

Japan
Unsorted MSW Syngas

2013-2017



Waste Biomass to Ethanol

Integrated Demonstration Unit

Plasma gasifier directly connected to LanzaTech fermentation unit.

24/7 continuous production, 120 days

Biomass gasification

Syngas catalytic treatment

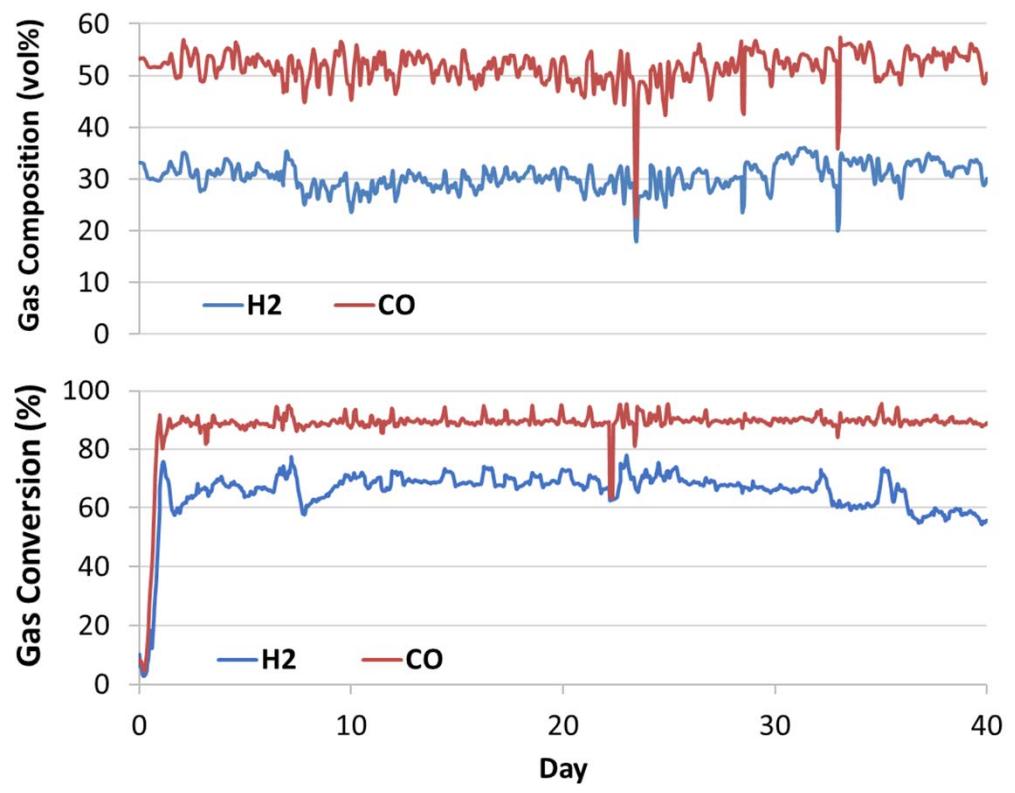
Gas fermentation to ethanol

Validated expected commercial performance

Yield of > 100 gallons per bone dry metric tonne



Integrated, Stable Production over 40 Days



Feedstock Flexibility

Proven Feedstocks

Integrated Demonstration Unit



Almond Shell



Almond Wood



Pistachio Shell



Walnut Shell



Walnut Wood

Small Scale Integration



Pine



Guayule



Corn stover



Flooring Waste

Proven Integration Using a Variety of
Waste and Residue Feedstocks



SEKISUI

LanzaTech-Sekisui
MSW → Ethanol
Demonstration
2014-2017

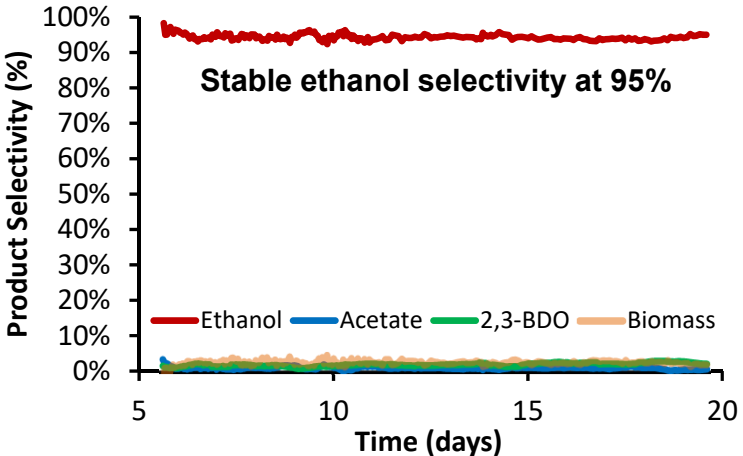
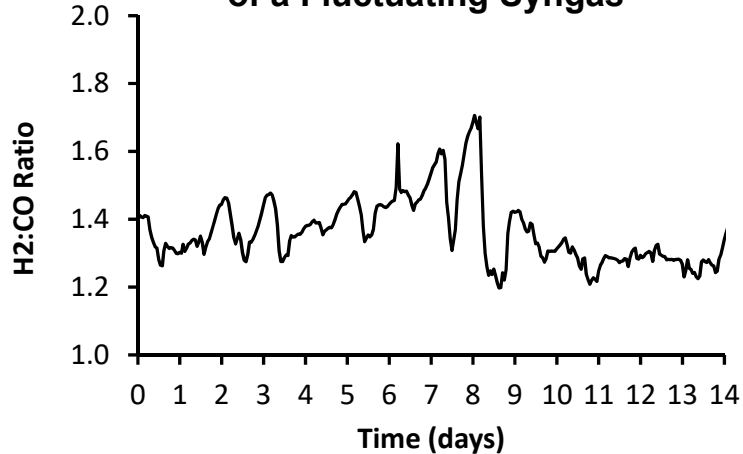


15 MTA

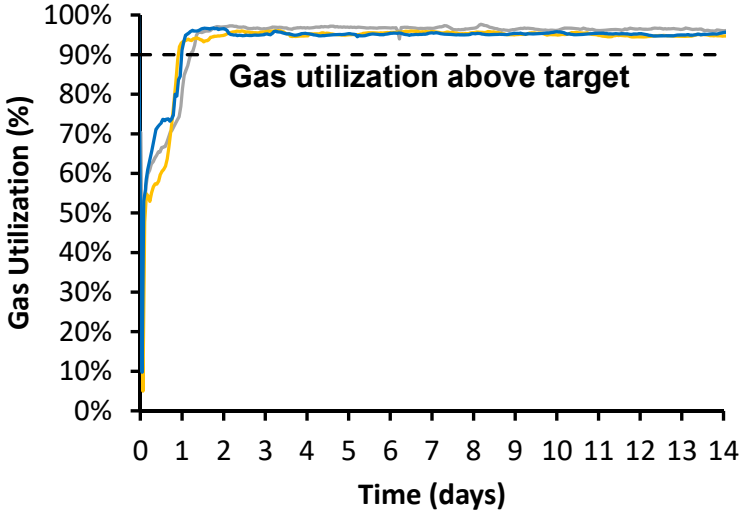
Slip stream of commercial, gasifier operated to produce syngas for electricity production

Consistent Performance Through Sequential Campaigns at MSW Pilot Plant

Highly Robust Process in Face of a Fluctuating Syngas



Highly Consistent Ethanol Production Performance Within and Across Campaigns



Demonstrated 90% water recycle → Low environmental footprint

Potential Impact, Gas Fermentation

Steel
Ferro-Alloy
50B tons/year

Biomass
Residues
400B tons/year

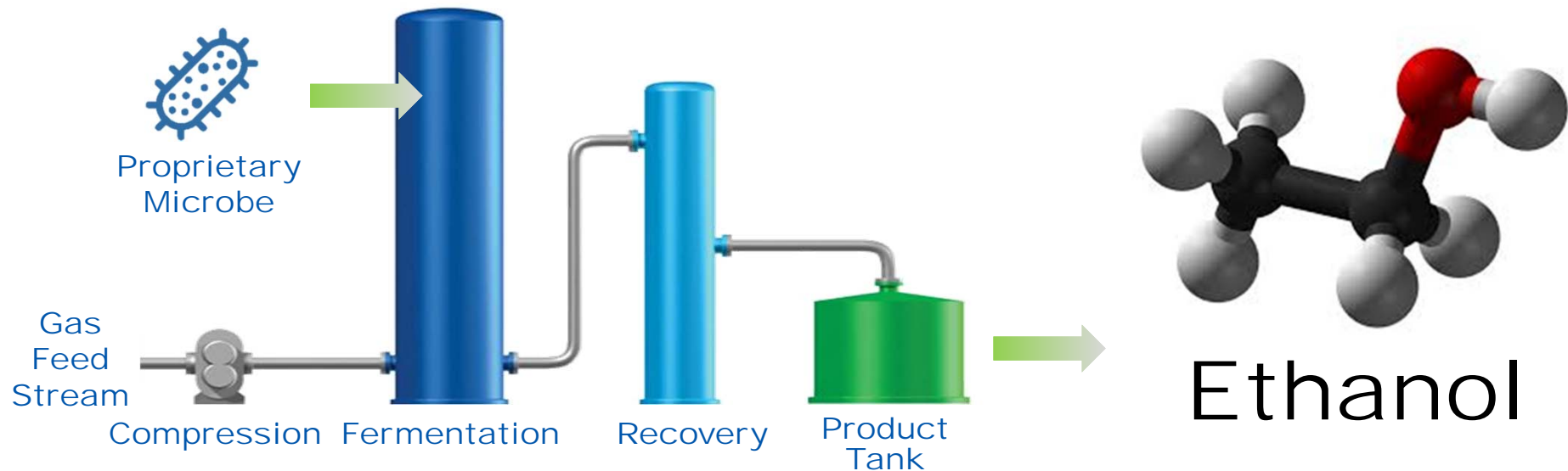
Local Input
Global Impact

Totals/year	Relative to Today
480B Gallons	~35% of transport fuel
705M Cars off the road	~75% of passenger cars
2.6M mt CO ₂	~7% of Global CO ₂



Significant Global Potential

Recycling Carbon to Ethanol



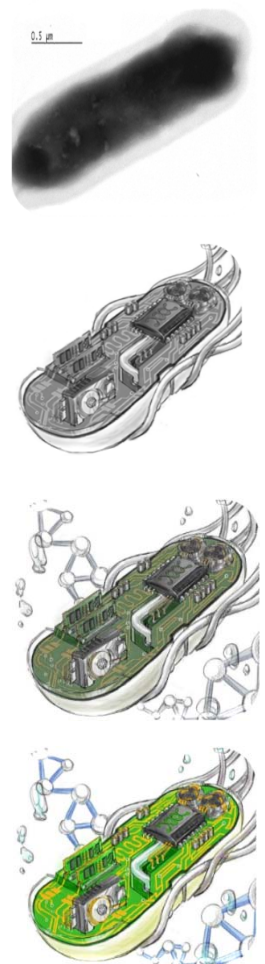
Excellent Substrate
Building Block of the Future

Making Chemicals

“hardware”



“software”



Microbe 1.0
(Native microbe)

- ✓ Ethanol & 2,3-BDO

Microbe 1.1
(Improved microbe)

- ✓ Ethanol only
- ✓ Improved efficiency & stability

Microbe 2.0
(Enhanced microbe with existing pathways)

- ✓ New product: Acetone
- ✓ New product: IPA
- ✓ New product: etc

Microbe 3.0
(Synthetic microbe with designer pathways)

- ✓ New product: Higher alcohols
- ✓ Any product



Optimize strain performance

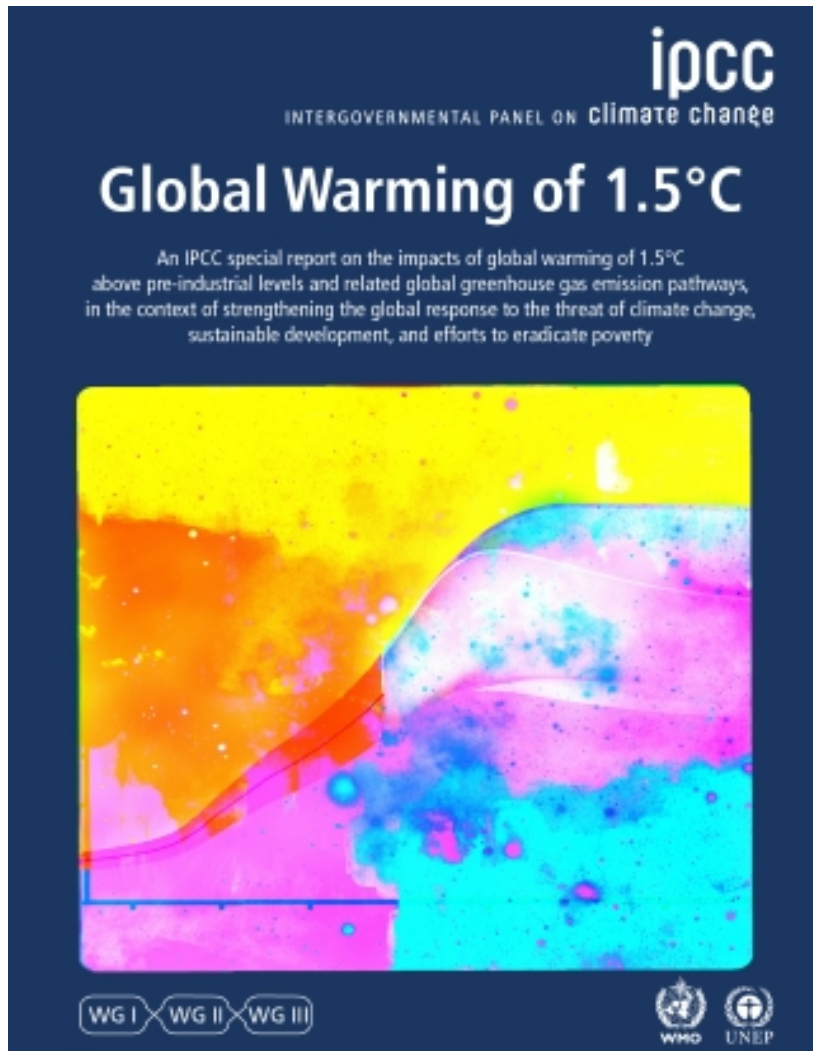


Expand product range



Carbon Smart™





“...we are already seeing the consequences of 1°C through more extreme weather, rising sea levels and diminishing Arctic sea ice...”

Panmao Zhai, Co-Chair of IPCC Working Group I.