

LanzaTech

Nasdaq: LNZA

Recycle carbon with Biology

Steellanol Project

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About LanzaTech



Technology Pioneers

With over 1,400 patents and 20 years of R&D and scale up, LanzaTech is the industry leader in recycling carbon.



Certification Expertise

Extensive experience certifying via Roundtable on Sustainable Biomaterials (RSB), International Sustainability Carbon Certification (ISCC), CORSIA, Kosher, Vegan, Natural, and REACH Registration.



Advantageous Partnerships

LanzaTech has a strong network of investors and partners, including Mitsui, Fluor, Dow, and more. In 2022, Brookfield Renewables committed \$500 million to the co-development of commercial scale projects.



Regional Supply, Global Footprint

With production facilities around the world, LanzaTech provides regional commercial supply chains alongside world-class logistics expertise.



Purification Dexterity

LanzaTech can deliver base product graded to match applications in home or personal care, textiles and beyond.



World-Class Customer Base

Global brands such as Zara, Coty, and adidas have reduced their carbon footprints by incorporating recycled carbon materials into their portfolios.

2025

by the numbers

500,000

tonnes CO2 annual abatement capacity

300,000

tonnes EtOH annual production capacity

1,400+

scientific patents

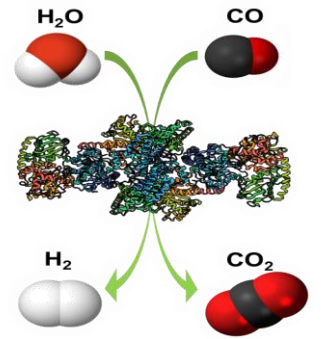
~350

employees worldwide

Feedstock flexibility

Gas Composition		H ₂ :CO Ratio	Energy Efficiency
CO	$6 \text{ CO} + 3 \text{ H}_2\text{O} \rightarrow \text{C}_2\text{H}_5\text{OH} + 4 \text{ CO}_2$	0:1	72.8%
CO + H ₂	$3 \text{ H}_2 + 3 \text{ CO} \rightarrow \text{C}_2\text{H}_5\text{OH} + \text{CO}_2$	1:1	78.5%
CO + H ₂	$4 \text{ H}_2 + 2 \text{ CO} \rightarrow \text{C}_2\text{H}_5\text{OH} + \text{H}_2\text{O}$	2:1	80.6%
CO + H ₂ + CO ₂	$5 \text{ H}_2 + 1 \text{ CO} + 1 \text{ CO}_2 \rightarrow \text{C}_2\text{H}_5\text{OH} + 2 \text{ H}_2\text{O}$	5:1	82.1%
H ₂ + CO ₂	$6 \text{ H}_2 + 2 \text{ CO}_2 \rightarrow \text{C}_2\text{H}_5\text{OH} + 3 \text{ H}_2\text{O}$	1:0	85.2%

Organism making H₂ on demand through **Biological Water-Gas-Shift**



CODH Enzyme

Multiple avenues to reach **maximum carbon utilization** by flexibly adding **Green H₂**

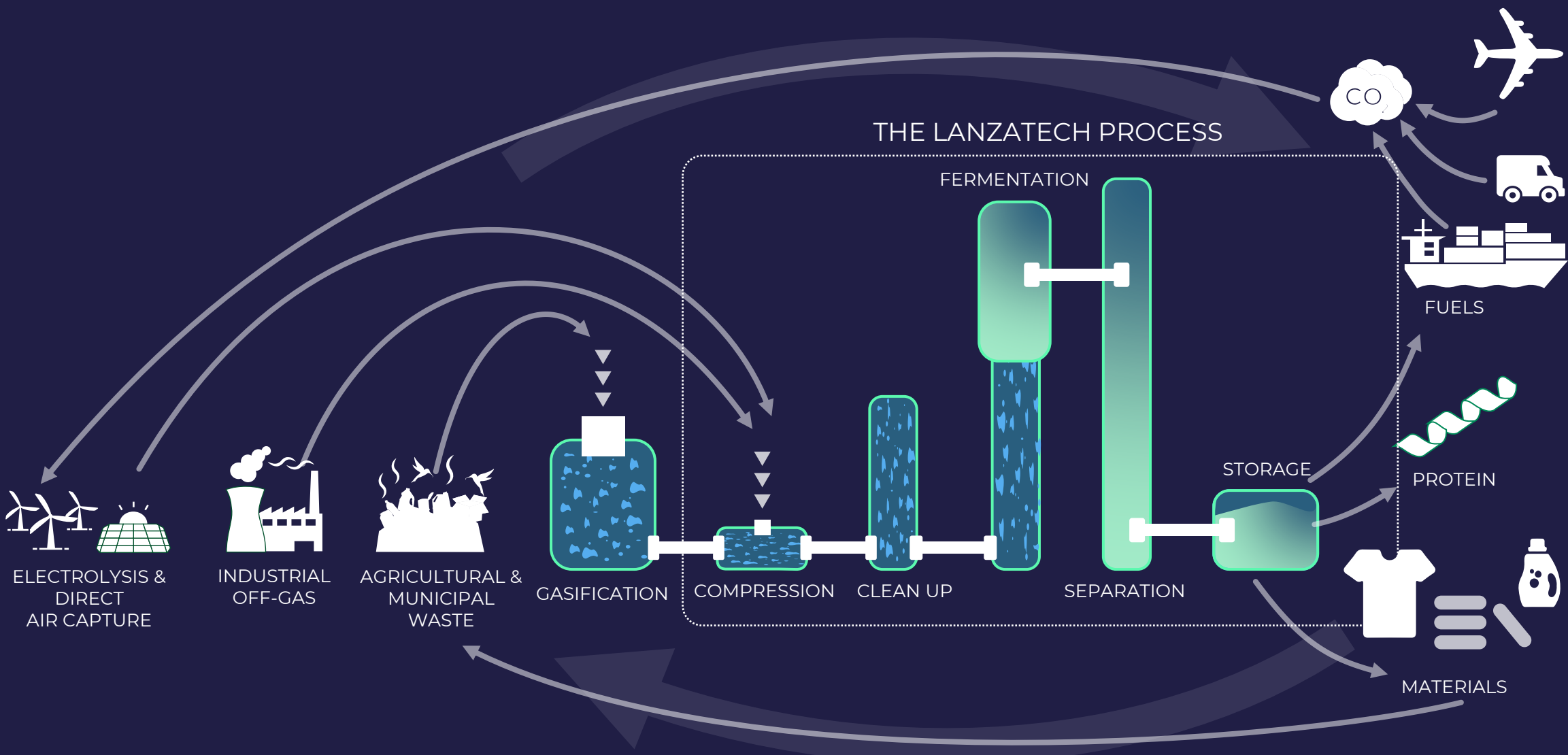


LanzaTech Microbe – *Clostridium autoethanogenum* LZ1561

- Acetogenic (gas fermenting) Clostridia utilize gases: CO, CO₂, H₂
- Classified as WHO/ABSE **risk group 1**
 - Lowest risk rating, same as Baker's yeast
 - No or low individual and community risk
- *Clostridium autoethanogenum* discovered by Abrini et al. in 1994
- Strain LZ1561 created by LanzaTech
 - Result of several rounds of natural selection in LanzaTech labs
 - High gas uptake and ethanol productivity
- Can be synthetically engineered for alternative products such as isopropanol



TECHNOLOGY DESCRIPTION: A novel circulation solution, recycling waste carbon into valuable products



DEGREE OF MATURITY - 15+ YEAR SCALE UP JOURNEY



2005

Laboratory Scale – 10L



2008

Pilot Scale – 600L

50x



2012

Demonstration Scale

1 – 2 Bioreactors

33x

30x



2018+

Commercial Scale

2 – 8 Bioreactors

DEGREE OF MATURITY - Globally licensed and commercially operational footprint

Global Reach

Diverse Feedstocks

Unique Regulatory Regimes



Start Up Year: 2018
Carbon Source: Steel Mill Emissions
Ethanol Production Capacity: 46,000 tons per year
Location: China








Start Up Year: 2021
Carbon Source: Ferroalloy Emissions
Ethanol Production Capacity: 46,000 tons per year
Location: China



Start Up Year: 2022
Carbon Source: Ferroalloy Emissions
Ethanol Production Capacity: 60,000 tons per year
Location: China







Start Up Year: 2023
Carbon Source: Ferroalloy Emissions
Ethanol Production Capacity: 60,000 tons per year
Location: China



Start Up Year: 2023
Carbon Source: Refinery Emissions
Ethanol Production Capacity: 33,500 tons per year
Location: India



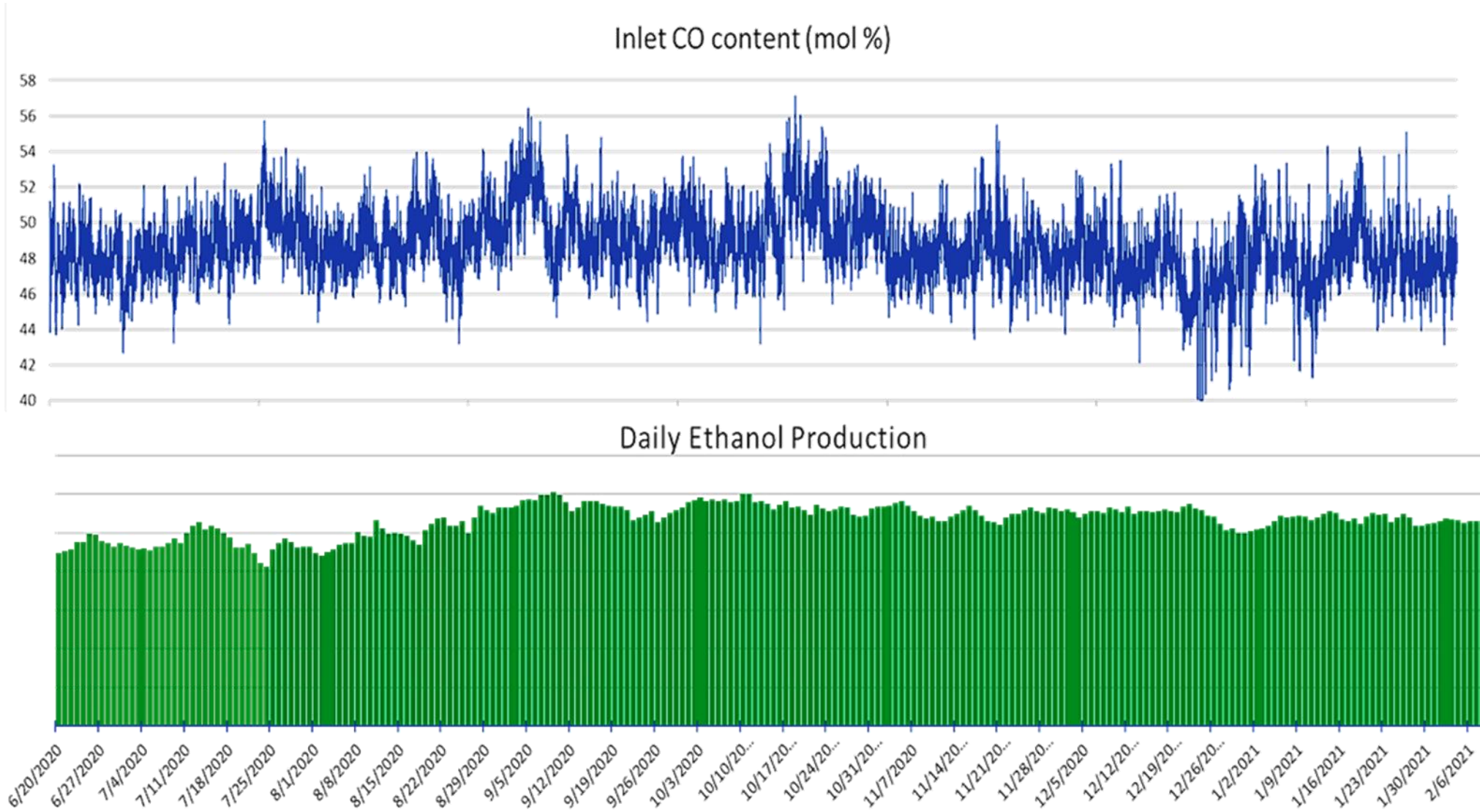


Start Up Year: 2023
Carbon Source: Steel Mill Emissions
Ethanol Production Capacity: 64,000 tons per year
Location: Europe



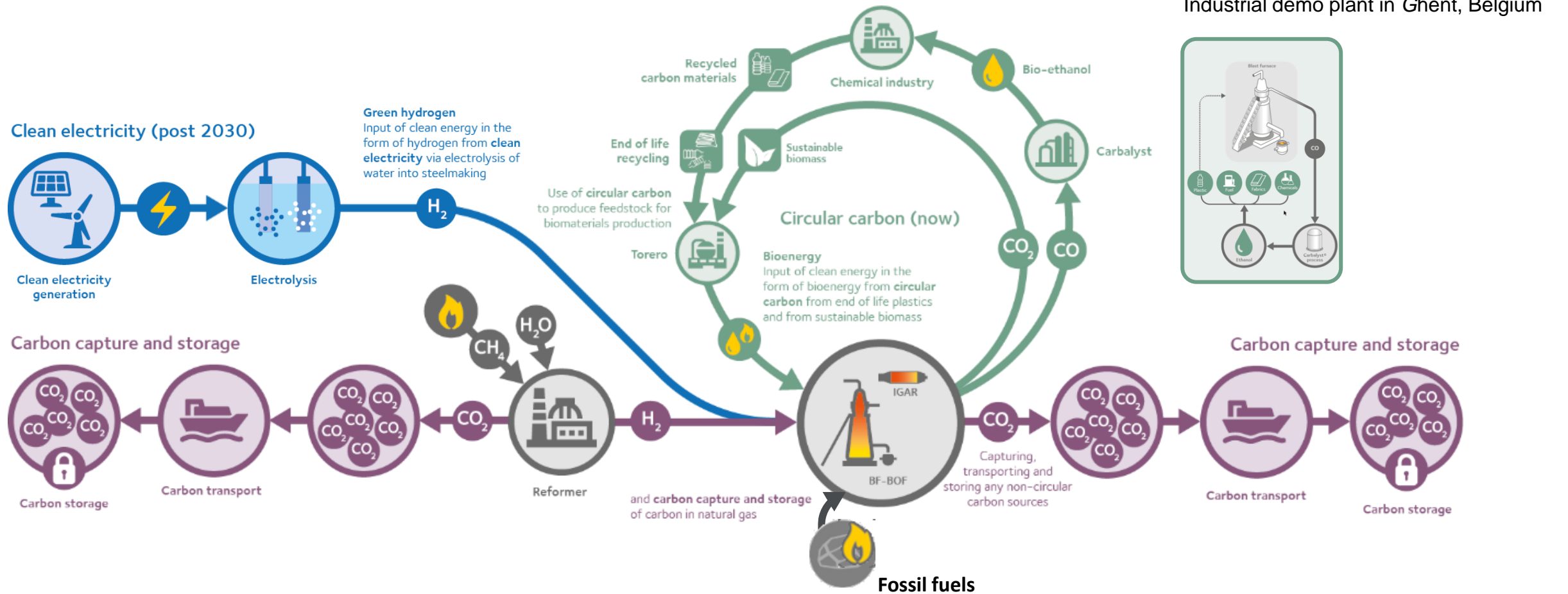

Total of **6** commercial-scale gas fermentation facilities operating at full-scale will bring cumulative **annual nameplate capacity to 300,000 MT of ethanol**

MATURITY: 1ST Commercial – year 3, total daily ethanol

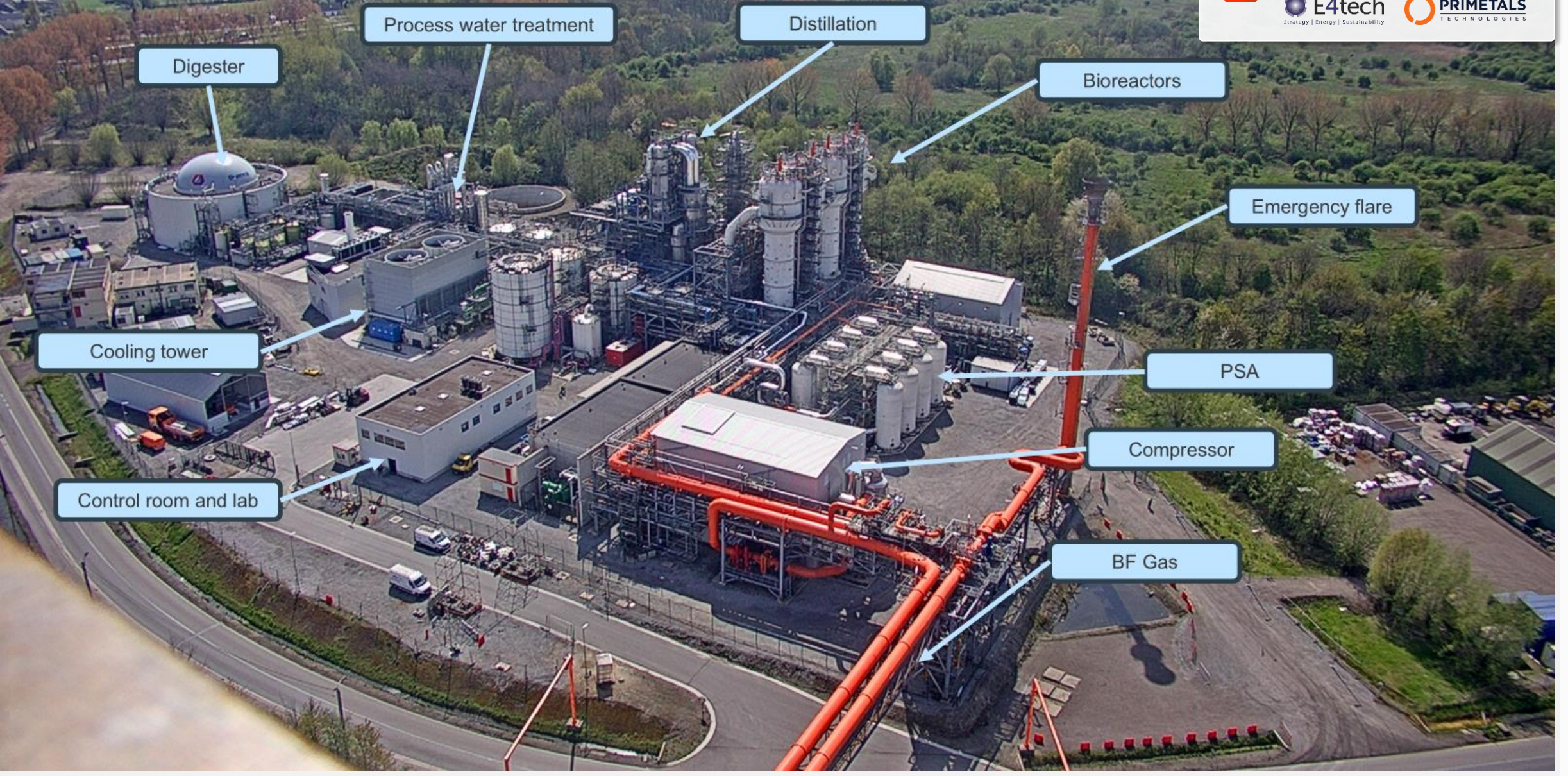


Campaign end: Yearly steelmill maintenance period, no substrate available

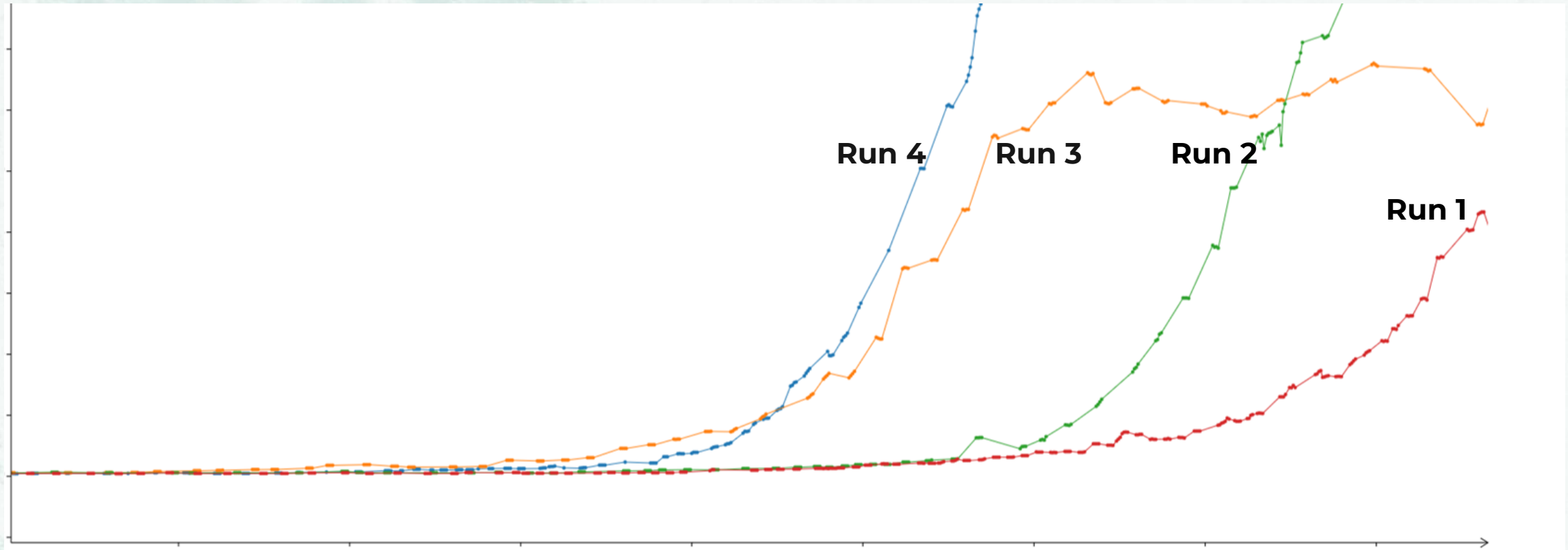
Steelanol: integral part of the ArcelorMittal Smart Carbon technology roadmap



ArcelorMittal 'Steelanol' plant : First gas fermentation plant in Europe; leading example in the CCT space for others to emulate



MATURITY: Startup Time at Steelanol



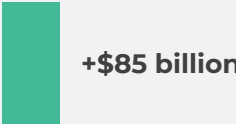
TOTAL END MARKETS FOR PRODUCTS ENABLED BY THE LANZATECH PLATFORM

\$1T Addressable Market

Potential for **>1 billion** tons/year of product from waste feedstocks

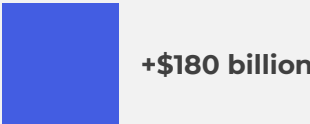
Ethanol¹

LanzaTech ethanol may be sold into fuel markets



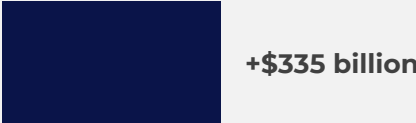
Jet fuel via ethanol²

LanzaJet™ Alcohol-to-Jet process can convert LanzaTech ethanol to SAF



Materials via ethanol³

LanzaTech ethanol can be converted into a wide range of materials, such as plastics, polymers, and textiles.



Other chemicals and materials⁴

Synthetic biology enables the production of other chemicals, which can be upgraded to materials.



Fuels Materials Polymers Monomers Fragrances Chemicals Solvents

¹ Ethanol (\$89.1B, 2019, Grand View Research), ² Jet fuel (\$179.2B, 2018, Allied Market Research), ³ Ethylene (\$222B, 2019, The Business Research Company), Ethylene Oxide (\$45B, 2020, Research and Markets), PET (\$43.8B, 2019, The Business Research Company), MEG (\$26B, 2018, Market Research Future), ⁴ Acetone (\$4.6B, 2019, Grand View Research), Isopropanol (\$2.7B, 2019, Grand View Research), Isoprene (\$2.6B, 2019, Technavio), Polypropylene (\$116B, 2019, Grand View Research), Methyl Methacrylate (MMA) (\$12.6B, 2019, Fortune Business Insights), Specialty chemicals (\$630B, 2019, Grand View Research),

ECONOMICS: Blast Furnace off-gas (BFG) to ethanol

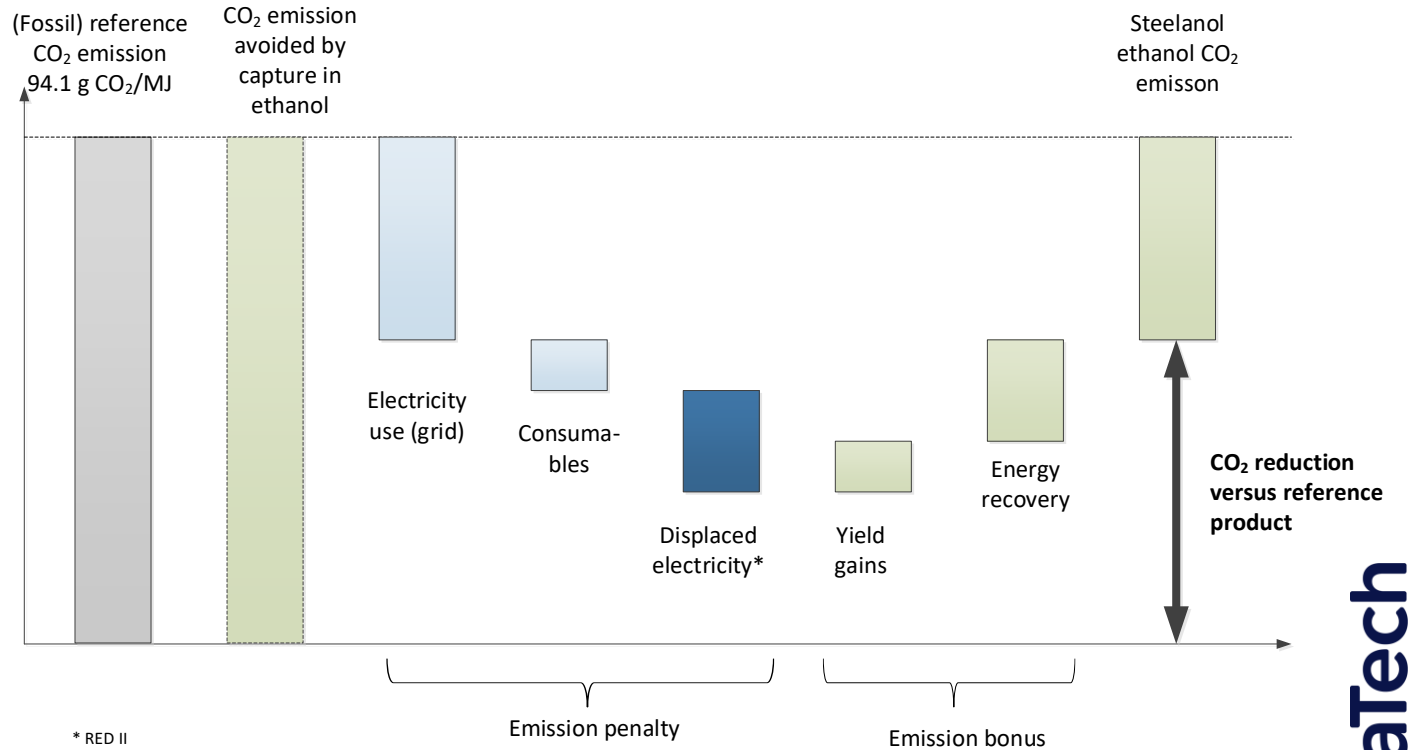
		Case 1	Case 2	Case 3
Inputs	BF Gas flow (KNm3/hr)	90 - 125	200 - 250	300 - 350
	Other inputs	Utilities (Power, Steam, Water), Chemicals, LT Microbes & Media		
	Capex (\$ Mn)	150 ± 50%	200 ± 50%	250 ± 50%
Outputs	Ethanol Production (KT per year)	60	120	150
	Project IRR (Capex - base case) Ethanol sale @\$1000/MT	14%	21%	23%

POTENTIAL BARIERS FOR IMPLEMENTATION

CCU is not very well supported within the EU-legislation:

- **RED II:** recent changes introduced C12/14 measurements, accounting of displaced electricity, ...
- **CCU is not eligible for ETS reductions**, except for carbon capture > 100 years (whereas still allowed for fossil sources)
- **Circularity is not integrated** under ETS. Circular use of fossil waste is not recognized as GHG reduction.

Illustration RED II: displaced electricity impact

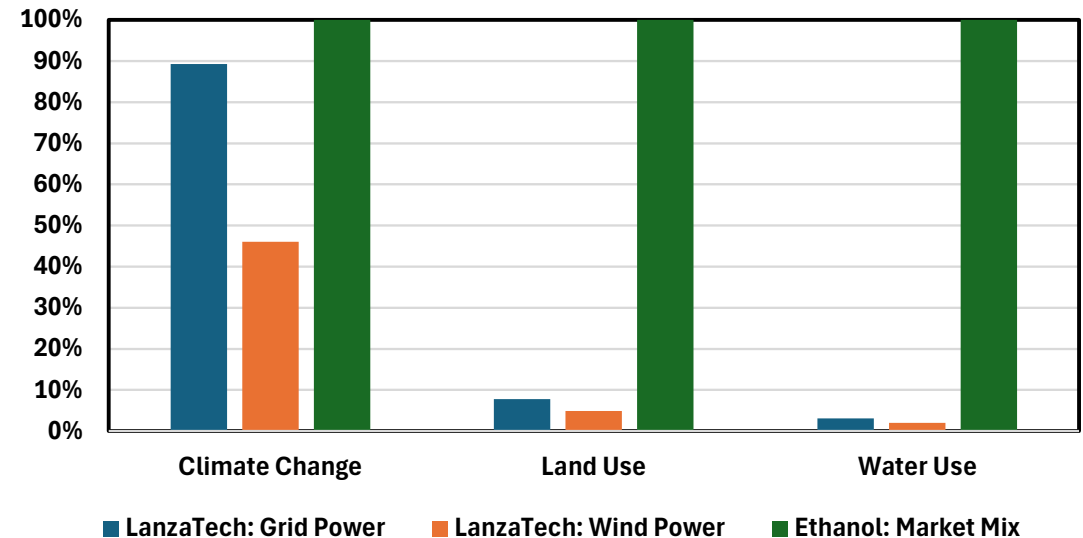


ENVIRONMENTAL BENEFITS

GHG / LCA / Energy & water consumption / circularity aspects

- **Low Water Use:** compared to conventional ethanol sources
- **Low Land Use** per unit of ethanol production
- **Chemicals:** all chemicals are sourced locally
- **Biocatalyst:** tested and proven to have no negative consequences
- **Climate Change and Global Warming Potential (GWP)** is highly sensitive to electricity grid mix and can be comparable or lower than conventional ethanol

Environmental Benefits of LanzaTech Ethanol



Ethanol produced from industrial off-gases in China. Environmental impacts are normalized to a market mix of ethanol produced from sugarcane, corn, and sugar beet in multiple locations.

TRADE OFFS

- Implementing LanzaTech technology requires no trade-offs and no obligation to keep Blast Furnaces operational. The technology seamlessly adapts to CO and CO₂ emissions from any industrial source, including Direct Reduced Iron processes.



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RECYCLE CARBON WITH BIOLOGY

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