Company Profile

- Founded in January 2005
- Corporate Headquarters in Chicago, IL, R&D in New Zealand, Operations and BD office in China
- Funding
  - Series B: Qiming Ventures - $US 18M in 2010
  - Series C: Burrill MLSF - $US 56M in 2011
- Team
  CSO/Founder: Dr. Sean Simpson
  CEO: Dr. Jennifer Holmgren
  - Over 140 staff
    - Synthetic Biology
    - Analytical
    - Engineering
- IP Portfolio
  - >160 Patents filed
  - 6 proprietary microbe families
The LanzaTech Process

Gas feed stream

- Gases are sole source of energy
- Production of fuels and chemicals
- Potential to make material impact on the future energy pool (>100s of billions of gallons per year)
- Completely outside of the food value chain
- Biofuel, carbon capture and energy efficiency technology solution
Accessible Feedstock Pool

- Pet Coke: ~90M MTA
- Natural Gas: 3300B M³
- Flue Gases
- Municipal Waste: >2B MTA
- Biomass: >1B MTA US Alone

CO₂ + H₂ → CO + H₂

*2010 production data – IEA, UNEP
LanzaTech Gas to Liquid Platform

Resources
- **CO**
  - Industrial
- **CO**
  - Syngas: Biomass, Coal, Methane
- **H₂**
  - COG, Chemical
- **CO₂**
  - Power

Customized Catalysts
- Native
- Synthetic

Product Suite
- **C₂**
  - Ethanol
  - Acetic acid
- **C₃**
  - i-propanol
  - Acetone
- **C₄**
  - BDO
  - n-Butanol
  - i-Butanol
  - Succinic acid
- **C₅**
  - Isoprene
- **Other**
  - PHB
  - ……..

Thermochemical Approaches
- Hydrocarbon Fuels (diesel, jet, gasoline)
- Chemical Intermediates
- Olefins
- Chemicals

Industrial Syngas: Biomass, Coal, Methane COG, Chemical Power

Native
Synthetic
Getting to Scale

Commercial Production by 2013
On a Fast Path to Commercialization

2008
Pilot
BlueScope Steel Mill

2012
Operational

2012
Groundbreaking
February 27
China

2012
In Design
US

Freedom Pines
Biorefinery

LanzaTech
BAOSTEEL
SHOUGANG GROUP
Freedom Pines Biorefinery

125 tpd Infrastructure in Place
LanzaTech process used with biomass syngas

Syngas from two biomass gasification technologies successfully tested

Real biomass syngas used in all process demonstrations

- Tolerant of gas contaminants
- Flexible to H2/CO ratio
- Commercial production rates achieved
Data showing microbial **biomass syngas** consumption under two different process operation modes during a single continuous reactor run using biomass syngas.

**Syngas composition:** 30% CO, 55% H₂, 10% CH₄, 5%CO₂

*Enables Optimization of Process Economics*
A Hybrid Catalytic Route to Fuels from Biomass Syngas

**Project Objectives:**
Develop a cost-effective hybrid conversion technology for catalytic upgrading of biomass-derived syngas to jet fuel and chemicals to meet the price, quality and environmental requirements of the aviation industry.

**Integration Diagram:**
- Gasification & Syngas Conditioning
- Fermentation & Alcohol Recovery
- Catalysis

Sources:
- Wood
- Stover
- Switchgrass

Products:
- Gasoline
- Jet Fuel
- Diesel
- Butadiene
- MEK
- EOH
- 2,3BDO

**System Integration, Optimization and Analysis**

**US Government (Department of Energy) support to Improve Economics and Process Sustainability**
Waste Gases and Biomass to Jet Fuel

Basic Alcohol to Jet Conversion Pathway

- Dehydration
- Oligomerization
- Hydrogenation

Jet Fuel

Water

ATJ Pathway Collaborations with PNNL and Swedish Biofuels
**2,3 BDO: A Route to Platform Chemicals**

2,3-Butanediol

- **Catalytic Dehydration**
- **Catalytic or Acid Dehydration**
- **Reductive Elimination**

1,3-Butadiene

- **~11M MPA**
  - **>$20B**

Butenes

- **1-Butylene** (But-1-ene)
- **2-Butylene** (But-2-ene)
- **Isobutylene** (2-Methylpropene)

- **~19.5M MPA**
  - **>$21-28B**

Methyl Ethyl Ketone (MEK/Butanone)

- **~1.5M MPA**
  - **>$2.3B**

**Preliminary Screening Demonstrates Technical Feasibility**
Flexible Product Slate from Biomass Syngas

• **Today**
  - Ethanol
  - 23 Butanediol

• **Near Term:**
  - C4 chemicals from 23 BDO (MEK, 1,3-butadiene, butylenes)
  - Acetic Acid
  - Drop-in jet, diesel, gasoline

• **Longer Term:**
  - C3, C4 alcohols
  - Acetone
  - Isoprene
2012 & 2013 Global Recognition

2012

MIT technology review

LanzaTech was named by Technology Review to the 2012 TR50, the third annual list of the world’s most innovative technology companies.

2012 & 2013 Global Recognition

TiE50 has named LanzaTech as one of the top Energy/CleanTech technology start up companies for 2012. TiE50 is TiE Silicon Valley’s premier annual awards program keenly contested by thousands of technology startups worldwide.

LanzaTech has been named as one of 10 New Energy Pioneers at the fifth annual Bloomberg New Energy Finance Summit. This award recognizes LanzaTech as a world-leader in energy innovation.

LanzaTech has been named to the 2012 Global Cleantech 100. One of the companies best positioned to solve tomorrow’s clean technology challenges.

Richard Pearse Award for Innovation Excellence in the NZ Aviation Industry

LanzaTech has won the Richard Pearse Award for Innovation Excellence in the NZ Aviation Industry.

2013

WORLD ECONOMIC FORUM

LanzaTech has been selected as a World Economic Forum Technology Pioneer 2013. Recognition is for companies involved in the design, development and deployment of new technologies and hold promise of significantly impacting the way business and society operates.

Recognized as Thought Leader in Sector
Thank You.