



Imperium/Lanzatech Syngas Fermentation Project – Biomass Gasification and Syngas Conditioning for Fermentation Evaluation

**Cooperative Research and
Development Final Report**

CRADA Number: CRD-12-474

NREL Technical Contact: Esther Wilcox

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Cooperative Research and Development Final Report

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

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CRADA Title: Imperium/Lanzatech Syngas Fermentation Project - Biomass Gasification and Syngas Conditioning for Fermentation Evaluation

Parties to the Agreement: LanzaTech, Inc.

Joint Work Statement Funding Table Showing DOE Commitment:

Estimated Costs	NREL Shared Resources
Year 1	\$ 644,398.00
Year 2	\$ 299,748.00
TOTALS	\$ 944,146.00

Abstract of CRADA Work:

LanzaTech and the National Renewable Energy Laboratory (NREL) will investigate the integration between biomass gasification and LanzaTech's proprietary gas fermentation process to produce ethanol and 2,3-butanediol. Using three feed materials (woody biomass, agricultural residue and herbaceous grass) NREL will produce syngas via steam indirect gasification and syngas conditioning over a range of process relevant operating conditions. The gasification temperature, steam-to-biomass ratio of the biomass feed into the gasifier, and several levels of syngas conditioning (based on temperature) will be varied to produce multiple syngas streams that will be fed directly to 3 liter seed fermenters operating with the Lanzatech organism. The NREL gasification system will then be integrated with LanzaTech's laboratory pilot unit to produce large-scale samples of ethanol and 2,3-butanediol for conversion to fuels and chemicals.

Summary of Research Results:

LanzaTech set up a small bench scale fermentation system in which experiments were run using a mixture of bottled gases to mimic biomass derived syngas. A larger fermentation skid was then setup and commissioned using the same bottled syngas mixture. The ThermoChemical Process Development Unit (TCPDU) at NREL was used to produce biomass generated syngas. The syngas was sent to the LanzaTech fermentation skid for use in their proprietary process. Multiple feedstocks were used to produce the syngas, one of which led to operational difficulties of the TCPDU system. Analysis was conducted to determine the feedstock components which led to increased tar formation in the system.

During tests, using the TCPDU generated syngas, it was determined that the syngas contained low levels of a chemical incompatible with the LanzaTech fermentation process. Syngas cleaning methods were

developed. During a subsequent run, the TCPDU condensate collection drum ruptured. Extensive corrective actions were implemented. This delayed the project substantially, and it was decided to end the work at NREL.

Subject Inventions Listing:

N/A

Report Date:

7/21/14

Responsible Technical Contact at Alliance/NREL:

Esther Wilcox

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