
Start-Up Team

David Alonso Ph.D.
Larry Clarke CEO
Jim Dumesic Ph.D.
Jeff Fornero Ph.D.
Sikander Hakim Ph.D.

Founders

James Dumesic Ph.D. – CBiRC,
University of Wisconsin
Peter Keeling Ph.D. – CBiRC,
Iowa State
Brent Shanks Ph.D. – CBiRC,
Iowa State

Board of Managers

Victoria Gonzalez
Mich Hein Ph.D.
James Dumesic Ph.D.

Year Founded

2012

Industry

Industrial Biotechnology -
Biorenewable Chemicals

Strategic Partners

Pennakem
Flambeau River Papers
Johnson Timber
Sarawak Biodiversity Centre

Financing Sought

\$500k – Bench scale - complete
\$10M – Demonstration

Use of Funds

Pilot Phase
Demonstration unit
Engineering scale-up
Intellectual property
Additional R&D
Business development

Glucan Biorenewables LLC

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Chemicals and Advanced BioMaterials

TriVersa Process™ Produces Chemicals and Advanced Biomaterials

GlucanBio's renewable *TriVersa Process™* technology transforms woodchips and other biomass into highly valued industrial chemicals and advanced biomaterials. GlucanBio's simple chemistry uses a solvent, gamma-valerolactone (GVL), to breakdown the biomass into its three primary components: cellulose, hemicellulose, and lignin. These components are then cleanly and quickly segregated into three separate streams with very little biomass wasted in the process.

TriVersa Process™ simultaneously transforms the three components of biomass into foundational chemicals and materials used in industrial applications throughout the world. High yields and speed of process combine with impressive revenues from each of the three product streams to create projected returns in excess of 40%. With 100s of millions of tons of aggregated biomass produced each year, the ability to spread this technology across the globe is revolutionary. While industries such as sugar cane processing burn their biomass waste stream, we have the advanced technology to turn the waste into products valued at \$500 to \$7000 per ton. This environmentally friendly process is based on simple and innovative technology, trading low value uses up to high value industrial chemical and advanced materials.

Organic Liquid Phase Catalysis Technology

TriVersa Process™ biomass conversion platform uses the biomass derived solvent, GVL, to perform consistent, time-tested chemistry in a new and more effective manner. Hydrolysis and dehydration reactions within GVL are 100X and 30X faster, respectively, as compared to aqueous biomass conversion technologies. This enables milder process conditions and final product yields in excess of 75% in total. Additionally, minor GVL losses can be regenerated by producing GVL within the process, thereby making it a closed-loop system.

Development Status

GlucanBio has been continuously advancing its technology with proof of concept having been demonstrated in the lab, bench scale, and validated by peer-reviewed journals. Our team has successfully fractionated birch hardwood and palm oil empty fruit bunches at multi-kg-scale to simultaneously produce high purity cellulose, furfural, and lignin. A variety of other biomass types including woods, bagasse, corn stover, oat hulls, palm, and coconut have been successfully fractionated at lab-scale. GlucanBio is working with the University of Tennessee to increase the value of the lignin from fuel to carbon product precursors and chemical additives.

The next step of development is a pilot plant that validates the technology. The plant design is in progress with the engineering firm Advancebio, and the project duration is estimated to require 16 months. The pilot unit is sufficient in size and capability to inform the engineering for the first commercial-scale plant, which will require an additional 24-30 months to design and construct.

INTELLECTUAL PROPERTY

GlucanBio has an exclusive license agreement with the Wisconsin Alumni Research Foundation (WARF) for five patents (2011-2013), and has filed three more provisional patents with further discoveries in the pipeline.

Innovation & Differentiation

GlucanBio's *TriVersa Process*TM is able to leverage remarkable cost savings relative to competitors due to the following inherent advantages:

- 1) Spreads biomass acquisition and processing costs over three significant revenue streams
- 2) Eliminates enzymatic inputs that are susceptible to external environmental vagaries
- 3) Decreases digestion severity (combination of the time, temperature, and acid)
- 4) Lowers yield losses due to faster hydrolysis and dehydration reactions
- 5) Decreased capital expenditures due to the smaller equipment sizes enabled by faster reactions
- 6) GVL is produced within the process from by-products (levulinic acid), improving the carbon utilization

The revenue generation and cost savings greatly reduce the plant size required to obtain financial returns superior to those produced by much larger competitor facilities, and without the requirement of government price supports. Modeling for the first commercial plant shows an internal rate of return in excess of 40% for a 50k MT dry biomass per year plant, making this a promising technology for commercialization.

Biomass and Product Markets

Bagasse, palm oil empty fruit bunches, and wood are currently aggregated, globally abundant, geographically diverse, of low or no economic value, and are suitable as feed for the *TriVersa Process*TM.

The hemicellulose will be used to make furfural, a drop-in chemical. DuPont, International Furan Chemicals, and Pennakem, all have shown strong desire for a North American furfural supply, including interest in off-take agreements. GlucanBio can deliver furfural at a cost 35% lower than existing furfural plants. The cellulose fraction offers a wide variety of possible products, such as viscose pulp, high purity cellulose, and non-food glucose, each representing a billion dollar market opportunity. The cellulose can also be converted into specialty HMF derivatives, microfibers, or nano-cellulose whose markets are young, yet promising.

The GlucanBio lignin is the most attractive product. The mild process conditions retain the lignin's natural chemical structure, opening new possibilities for the lignin market. Researchers are using the *TriVersa Process*TM lignin to perform reactions at much higher yields than using lignins from other sources. The technology creates strong opportunities to extend and differentiate products. Moving forward, an extensive array of products can be made with the *TriVersa Process*TM and this product versatility will enable GlucanBio to positively respond to shifting demands in future global markets.

START-UP TEAM

The GlucanBio highly qualified team represents over 170 years of global commercialization experience, 630 publications, and 29,000 citations.

- Professors Jim Dumesic, Brent Shanks, and Peter Keeling founded the Company based on technology developed in the Dumesic Lab at the University of Wisconsin.
- Mr. Larry Clarke joined the team as CEO in May, 2015. Larry is a former Executive Vice President with Bunge and brings more than 30 years of agribusiness experience including trading, international assignments and multiple Board positions providing a broad network of connections.
- Dr. David Alonso, a visiting scholar working in Dr. Dumesic's lab, joined the Company in late 2012. Dr. Alonso is the world expert in the solvent-based system used by GlucanBio, with more than 9 patents and 43 publications.
- Dr. Jeff Fornero, a 20-year veteran of the petrochemical industry and an experienced entrepreneur, joined the team with expertise in the engineering scale-up of nascent technologies from lab to commercial scale.
- Dr. Sikander Hakim, the newest member of the team, received his Ph.D. under Brent Shanks and spent 4 years as a post-doc in Dr. Dumesic's lab studying the catalytic conversion of biomass-derived feedstocks.