



Myriant Succinic Acid BioRefinery



DOE Bioenergy Technologies Office (BETO) 2015 Project Peer Review

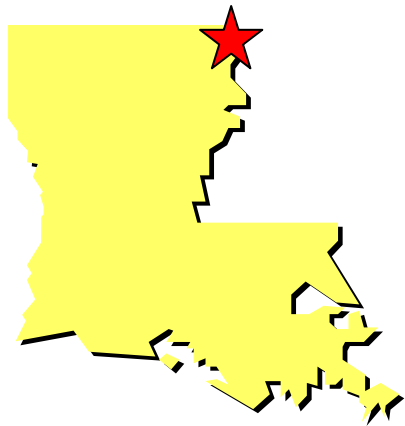
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Goal Statement

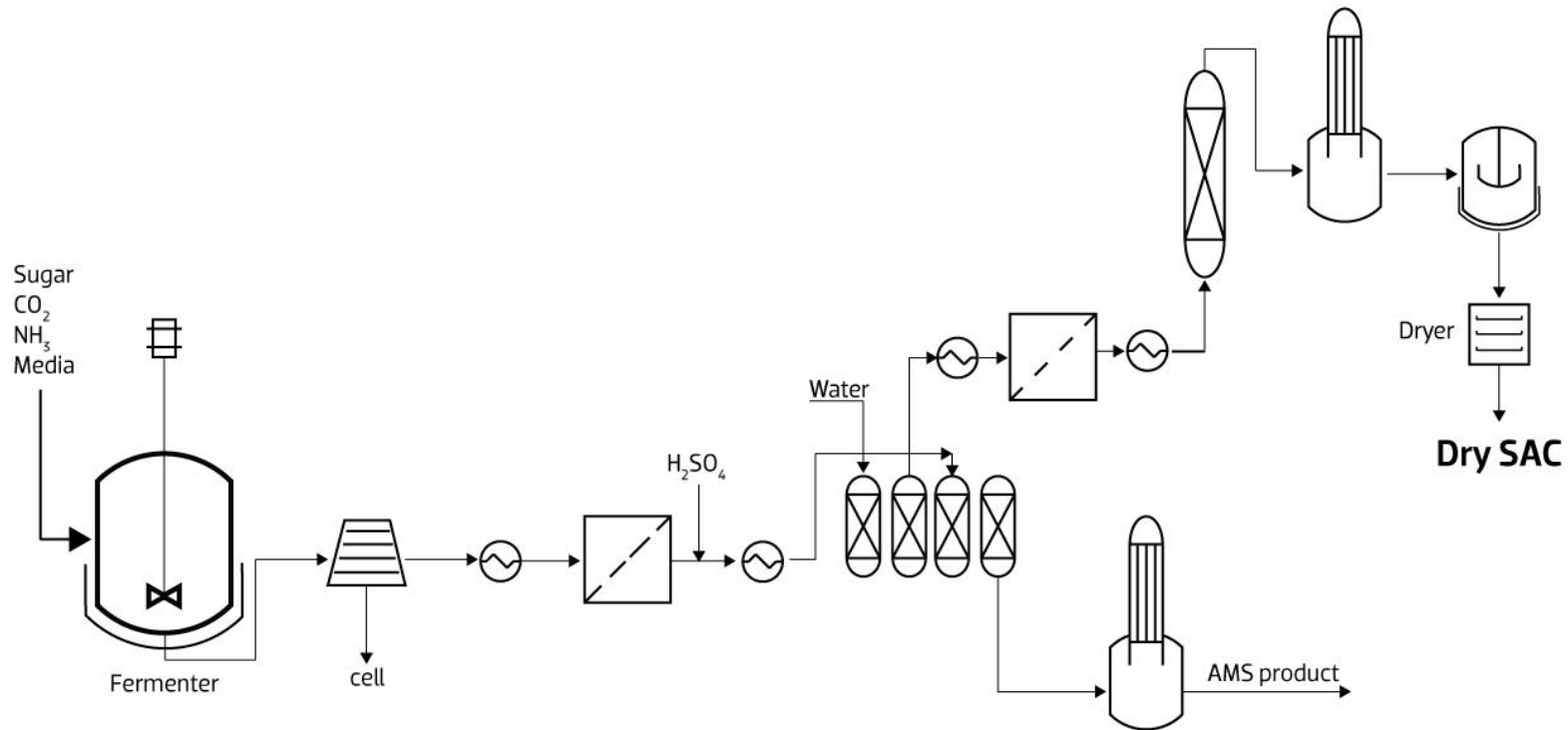
- Renewable Succinic Acid Production
 - A high value bio based chemical derived from renewable feedstocks
- Validate proposed technology at a demonstration plant located in Lake Providence, LA.
 - Nameplate Capacity: 30 million lbs/year



Myriant's Succinic Acid BioRefinery (MySAB) Lake Providence, LA



The Myriant Process



Small Footprint

Myriant's process reduces greenhouse gas emissions by 94% compared to petroleum -based Succinic Acid

- Life Cycle Analysis of Bio-succinic acid production using the IPCC 2007 (GWP) method

MySAB Quad Chart Overview

Timeline

- Project start date
 - ☞ BP1 - 3/29/10
 - ☞ BP2 - 2/1/11
- Project end date
 - ☞ Commercial Start: 2Q'13
 - ☞ Performance Test: June 2015
 - ☞ Final Reports : September 30, 2015

Budget

	Total Costs FY10 – FY 12	FY 13 Costs	FY 14 Costs	Total Planned Funding (FY 15 – Project End Date
DOE Funded	\$37,210,368	\$12,291,887		\$497,756
Cost Share	\$41,755,267	\$7,826,602		

Barriers

- Managing Federal and State funding sources and requirements, including self executed third party contracts / vendors
- Effectively executing a phased systems handover and startup approach
- Scale-up challenges and operation of first-of-a-kind integrated chemical manufacturing plant

Project Participants

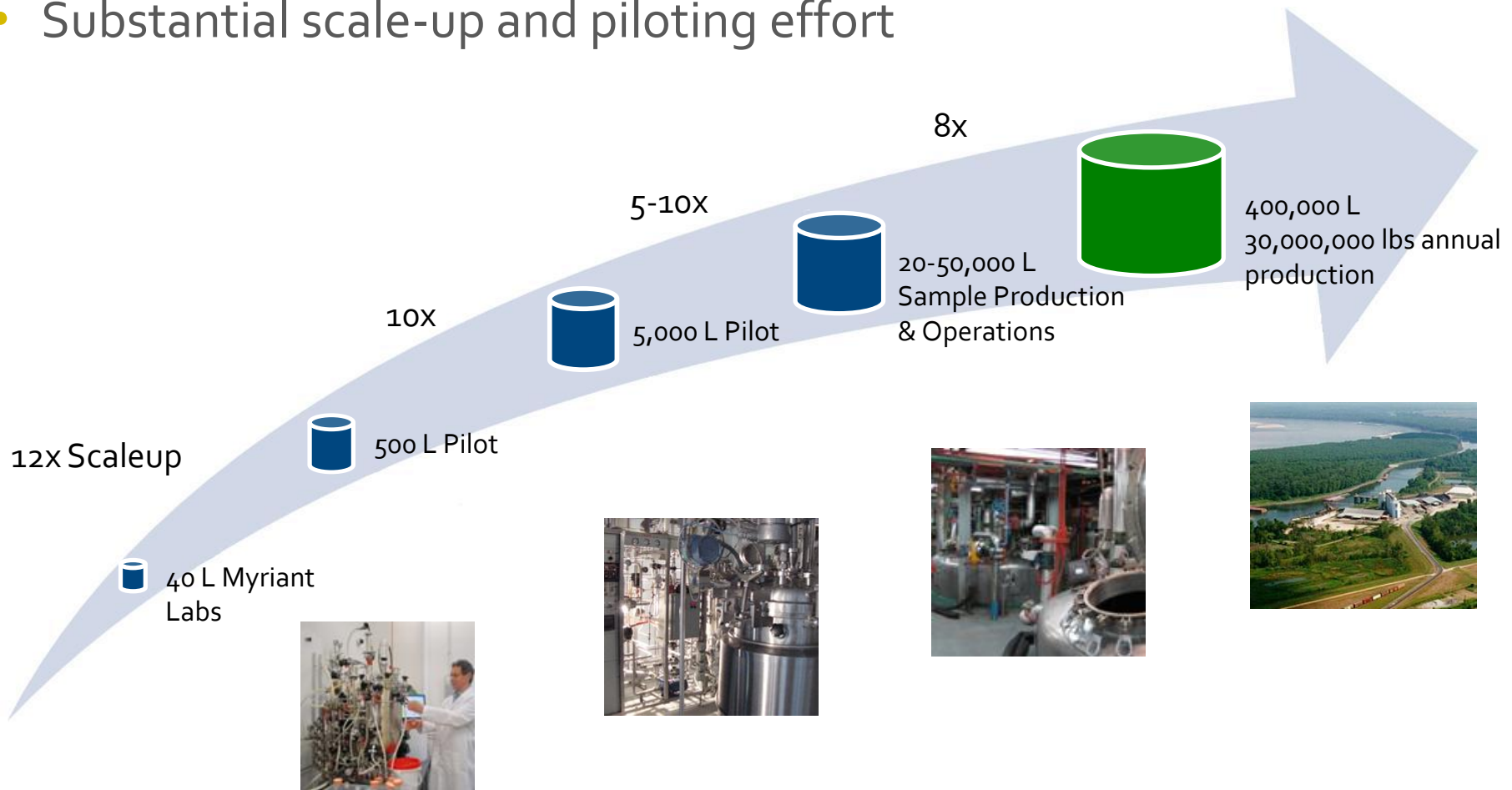
- **Site:** Port of Lake Providence
- **Technology:** Uhde Corporation of America: (Basic Eng. and Down Stream Process technology)
- **Project Management:** CH2M Hill: EPCM (Detailed Eng. and CM)
- **Construction Management:** CH2M Hill
- **Start-up and Commissioning:** Myriant and Uhde
- **Operations:** Myriant

Project Overview

- Build and operate a demonstration scale biorefinery to produce succinic acid from renewable feedstocks including grain sorghum & lignocellulosic sugars
 - Project initiated January 2010
 - Began Commercial Operation in June 2013
- Platform for scale-up and optimization
- Confirm marketplace acceptance of bio based succinic acid

Approach

- Key alliance agreements with technology and engineering partners
- Substantial scale-up and piloting effort



Approach

- Selection of well located, previously permitted site allowed achievement of key permits and NEPA approval
- Good project execution practices including project meeting schedule, significant integration of technical and engineering teams, earned value management
- EPCM contract approach

Approach

- Gantt Chart Variances
 - 2013 DOE project operations period completion vs. 2015 Actual
- Some technical / engineering hurdles
 - Typical of the first-of-its-kind start-up
- Project baseline (schedule, cost, scope) changes
 - Schedule delays mitigated by phased start-up approach
 - No major change in scope
- Substantial scale-up & piloting efforts support the economic pro-forma models, and resulted in substantial equipment process warranties from selected strategic partners.
- Myriant's Operations personnel were involved through construction completion, systems acceptance, commissioning and start-up
- Extensive pre product qualification program and understanding the customers product quality requirements per target application

Technical Accomplishments

- MySAB is producing succinic acid from 95 DE & shipping product to customers
 - ✧ Production started June 2013
 - ✧ Product quality exceeds plant design basis
- 10x Fermentation scale-up validated
- No substantive process changes
 - ✧ Integration and recycle
- Evaluated cellulosic sugars as potential feedstock
 - ✧ Positive results but sugars not commercially viable

Relevance

- Top Value Added Chemical from Biomass
 - ✧ Displaces petroleum based feedstock for commercial products
- Reduces lifecycle GHG emissions by 94% compared to Petro-based Succinic Acid
- Transformative technology, demonstrates technical and economic advantages of producing valued biochemicals
- Capable of efficiently utilizing domestically available non food feedstock crop (grain sorghum and lignocellulosics)
- Permanent job creation
 - ✧ 60+ permanent positions in operations, maintenance, laboratory

Future Work

- Sorghum Grits performance test by June 2015
 - 10-day operation on sugars derived from sorghum grits
- Final reports by September 2015

Summary

- **Key partnerships vested in the project:** from pilot plant testing through design phase, construction, start-up and operations - our partners joined our teams bringing tremendous technical and organizational expertise
- **Integrated operations:** pilot plant operations generated data to support plant design, plant operations integration occurs with closure of recycle streams, plant startup dynamics, and supporting systems and utilities key learnings
- **Fermentation scale-up and downstream recovery scale-up success:** plant operations are meeting design criteria, supports positive project pro-forma.
- **Demonstrating viability:** commercially viable production of bio-products from renewable feedstocks continues on track, project developed data and economic information for using a broad range of lignocellulosic feedstocks
- **Market demand:** Myriant has strong demand for bio-succinic acid, with long-term customer contracts in each core market applications.



ADDITIONAL SLIDES

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Responses to Previous Reviewers' Comments

Comments from last review	Changes/progress to date
Critical Factors	
<p>"Can Myriant command a "green premium" for its product, or does the marketplace view it as an undifferentiated fungible commodity".</p>	<p>Myriant's economics do not rely on a green premium.</p>
Technical Progress and Accomplishments	
<p>"Lack of integrated piloting creates and unknown on what final product quality the can achieve".</p>	<p>Product quality with integrated recycle has exceeded design basis.</p>
Coordination with other Institutions	
<p>"There does not look to be significant coordination or technology transfer to the industry". "Minimal technology from other institutions applied in this project".</p>	<p>Myriant conducted large scale fermentation performance testing of lignocellulosic hydrolysates from 35+ companies with pilot or larger scale capacity. Final report provided to DOE.</p>
Overall Impressions	
<p>"Although difficult to assess from the lack of content in the presentation, it appears that the program will be successful in transitioning the developed technology for manufacturing succinic acid from cellulotics".</p>	<p>Production of succinic acid from cellulosic hydrolysates has been demonstrated at lab scale. However sugars derived from lignocellulosics are not commercially feasible at this scale.</p>

Publications & Patents

Myriant Technologies LLC, (predecessor to Myriant Corp.) filed four patent applications under Patent Cooperation Treaty.

Metabolic evolution of Escherichia coli strains that produce organic acids

PCT/US2010/057111 (Filing Date: November 17, 2010)

International Publication No.: WO 2011/123154 (October 6, 2011)

National Stage Entry in Australia, Brazil, Canada, China, European Patent Office, Indonesia, India, Japan, Korea, Malaysia, Mexico, Philippines, Singapore, United States and Vietnam.

Engineering microbes for efficient production of chemicals

PCT/US2010/057119 (Filing Date: November 17, 2010)

International Publication No.: WO 2011/063055 (May 26, 2011)

National Stage Entry in Brazil, China, European Patent Office, Japan, Korea, Thailand and United States.

Production of organic acids from xylose rich hydrolysate by bacterial fermentation

PCT/US2011/032803 (Filing Date: April 16, 2011)

International Publication No.: WO 2011/130725 (October 20, 2011)

National Stage Entry in Brazil and United States.

Improved fermentation process for the production of organic acid

PCT/US2011/046047 (Filing Date: July 30, 2011)

International Publication No.: WO 2012/018699 (February 9, 2012)

National Stage Entry in Canada and United States.