

Data, Data, Everywhere ...

Perspectives on the Life Cycle of Bio Energy Technology Development and Commercialization ... Including the Creation, Valorization, and Disposition of Bioenergy Data Assets

**DOE Leveraging Existing Bioenergy Data Workshop
July 21, 2020**



Accelerating the Commercialization of Sustainable Technologies

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Overview

Introduction The Changing Landscape Of Technology Commercialization

Speaker & Next Rung Introduction –

Perspectives Of The Practitioners, Executers, Developers, Owners

Technology & Development Life Cycle

Data Types And Data Assets

Checking Back In On Bioenergy Technology Life Cycle

Doe Foundational Programs

Closing Thoughts



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Introduction & Background

Changing Definition of Sustainable Technologies



By its nature technology development & innovation is both disrupting what once was, and is itself at all times experiencing disruption from innovation as well as macro world forces - political, economic & black swan events

“Sustainable Technology” Programs from 1990’s

- MTBE Processes Development
- Bitumen and Oil Sands Upgrading Processes
- Syncrude Development & Processing



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Introduction & Background

Changing Landscape of Sustainable Technologies



Low Carbon Fuels & Products Have Tracked a Series of Goals

“10% by 2010, 20% by 2020, 30% by 2030, <3\$/GGE, NetZero by 2050....”

“Sustainable Technology” Programs from 2000’s

- **BioFine - Cellulose to Levulinic & Biodiesel**
- **The Commercialization & Buildout of 1st Gen Biofuels, Corn Based Ethanol**
- **Mascoma Cellulosic Ethanol**



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Introduction & Background

The Changing Targets of Sustainable Technologies



Dramatic Crash of Energy Prices and Costs, Acceleration of Climate Change and Global Warming, Realization That All Sectors Must Seek Zero Carbon Solutions

“Sustainable Technology” Programs from 2010’s

- **Conventional Renewable and 2nd Gen Bioplastics, High Value Products**
- **Crop Improvements, Pretreatments Technologies, Thermochemical Pathways, New Products & Coproducts, Anaerobic Digestion, Gas Fermentation, Fuels Optimization, Algae, true Biorefineries, Foods / Materials etc.**
- **Carbon Negative Processes**



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Speaker Introduction

Next Rung Technology / John Ellersick



John Ellersick, P.E. PMP Founder

Chemical engineer, entrepreneur and organizational leader with over 25 years of experience of taking technologies from concept to full scale execution. With this team we founded Next Rung Technology to collaborate with our clients and accelerate the commercialization of sustainable technological that address the urgent global climate, energy, water, materials and food challenges facing current and future generations.

PI – Myriant Lake Providence, DOE Lead – Mascoma Rome Phase 2

Clients & Partners – Multiple SBIR's, NYSERDA & State Grants, DOE Reviews

Myriant, Mascoma, Oasys Water, AECOM, BioMetics, Raytheon Eng & Constructors



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Speaker Introduction

Next Rung Technology / Core Team

Herve Garant, PhD – Gingko BioWorks, Greenlight BioSciences, Joule, Mascoma, SNC Lavalin, BioMetics
Linda Rauch, PE – Joule, Greenfuel Technologies, Cambrian, Biogen, Lonza, CH2MHill
Leah Stahmann, PE – Oasys Water, Next Rung, Wave to Energy & Water Treatment SBIR's
Lauren Staples PhD – Myriant, Kennesaw State, DOE Grant Compliance & Design of Experiment
Phil Ahl – Next Rung Technology, Water Treatment SBIR's
John Charest – Oasys Water, Next Rung Technology

Cumulatively & With Our Clients – 10+ Significant DOE grants, 50+ SBIR's, 100+ Technologies

PhD Biochemical Engineer, PhD Statistics, Chemical Engineers & Chemists ...
the Scaleup and Commercialization of These Assets is "What We Do"



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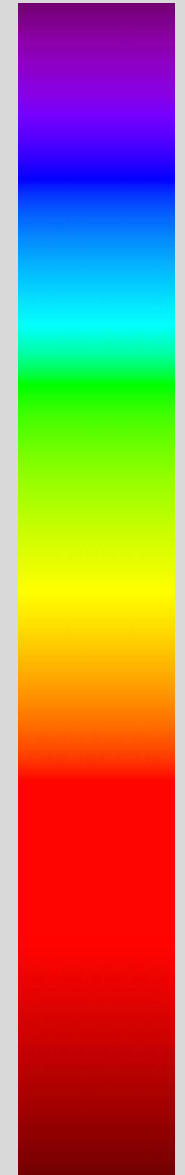


Perspective on Life in Technology & Bioenergy Commercialization

The Technology Developers Perspective & Experience....

- Let there be science ...
- Let there be IP, Patents ... < = > Let there be funding (SBIR?)
- Let there be progress, a business case, engineering, and an opportunity (FOA?)
- Let there be more funding
- Let there be a pilot plant, data generation, hours of operation, closed recycle loops
- Let there be more funding, customer discovery, product development
- Let there be scaleup & projects execution
- Let there be economic modeling and evaluations
- Let there be there be commissioning & startup
- Let there be operations, market and product development & demonstration
- Let there be learnings, process optimization
- Let there be development of a truly commercial scale and configuration plant
- Let there be an IPO, acquisition, next generation of technology to develop ...

Is There Light at the End of The Tunnel?



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The Technology & Development Life Cycle



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Data Types and Data Assets

PMC123_1-Budget_Justification_Budget_Period_2_MyriantLakeProv...c Ammended V6.xlsx

PMC123.1 - Budget Justification for SF 424A Budget

Instructions and Summary

Award Number: DE-EE0002878/004 Date of Submission: 12/7/2010 (Rev 1/5/11)
 Award Recipient: Myriant Lake Providence Inc Form submitted by: Myriant Lake Providence Inc
 E6 (May be award recipient or sub-re

**Please read the instructions on each page before starting.
 If you have any questions, please ask your DOE contact. It will save you time!**

On this form, provide detailed support for the estimated project costs identified on the SF-424A form (Budget).

- The dollar amounts on this page must match the amounts on the associated SF-424A.
- The award recipient and each sub-recipient with estimated costs of \$100,000 or more must complete this form and a SF-424A form.

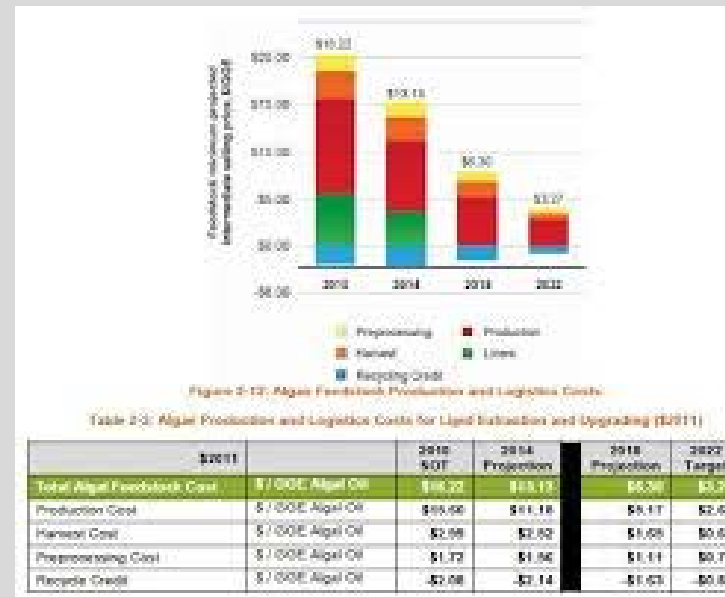


Figure 2a: Temperature and Percentage Full Factorial at La

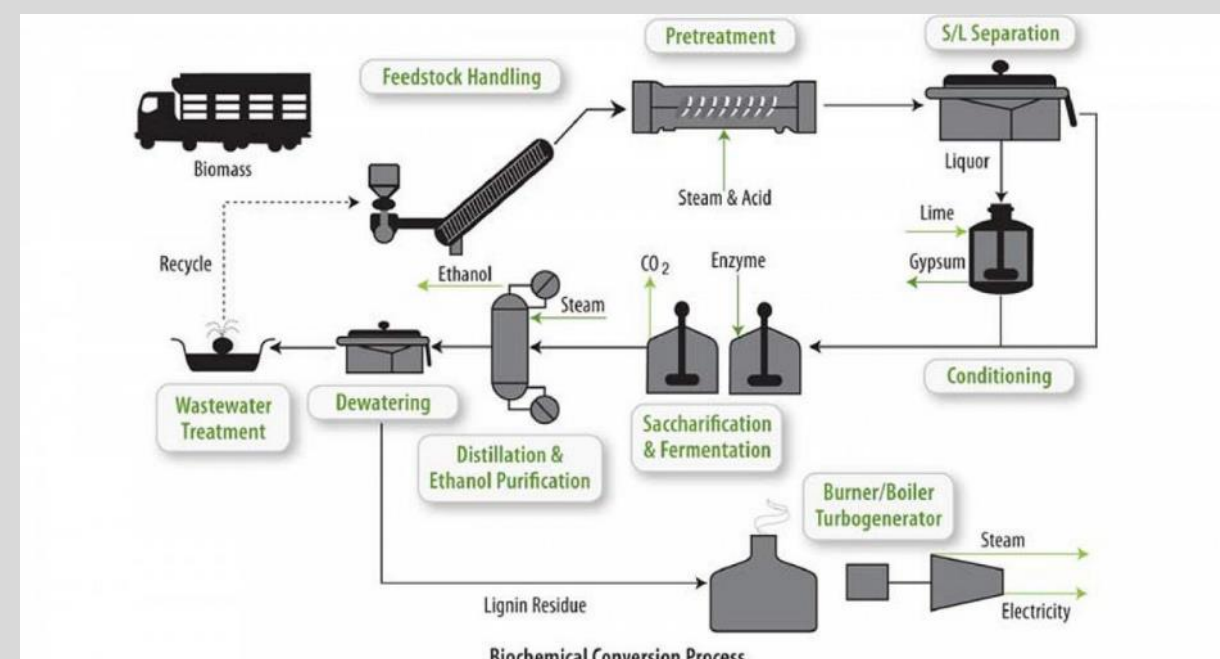
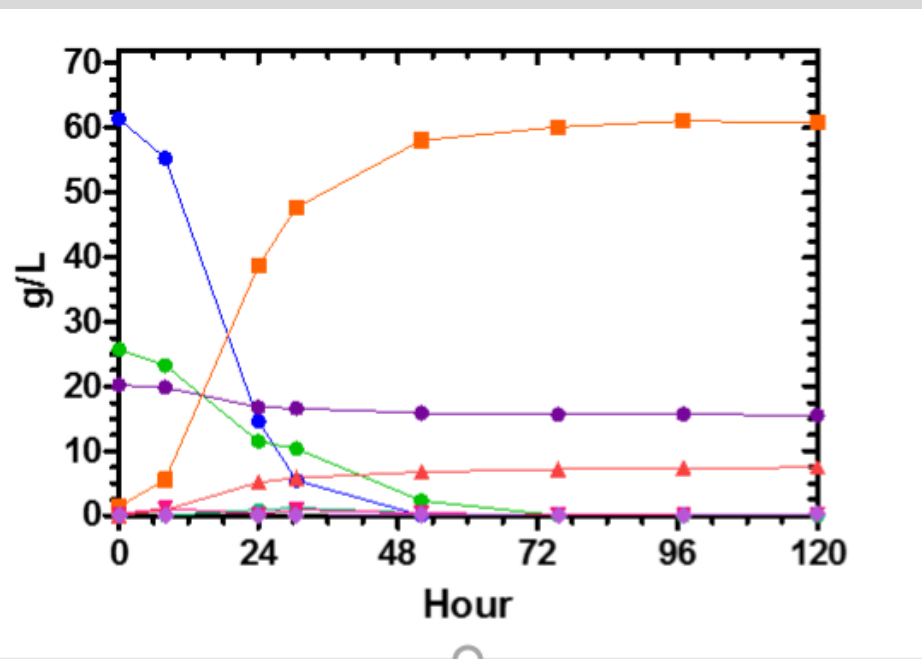
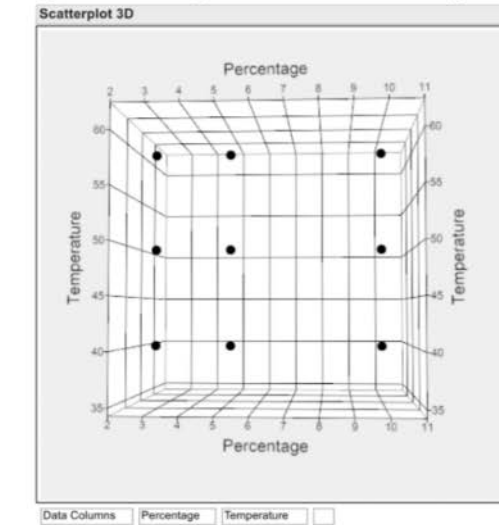
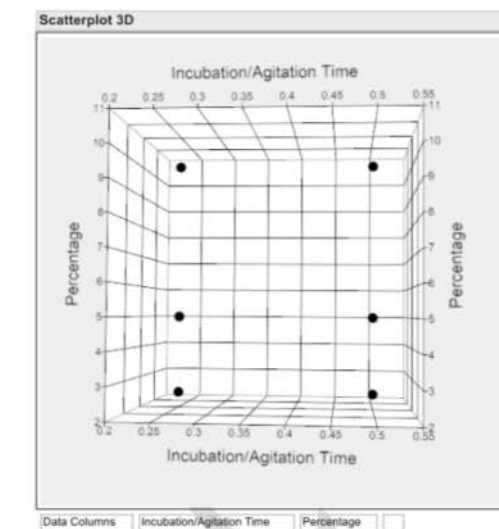


Figure 2b: A Quick Check to Investigate Reduction of Carbon



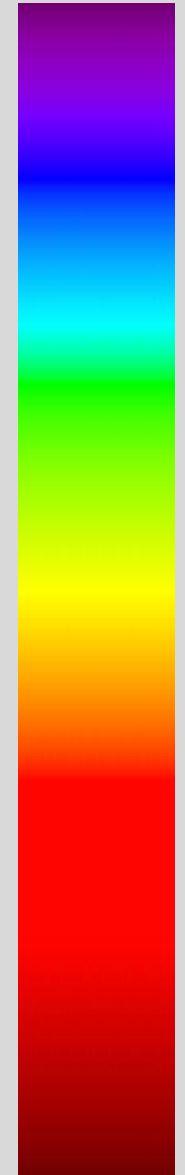
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Data Types And Data Assets

Broadly And Perhaps Loosely Defined

- Scientific Research & Data
- Published Data
- Patent Applications, Awards
- Scientific Techniques
- Scientists, Mentors, Mentees
- Heat And Material Balances (Spreadsheet)
- Process Development
- Techno Economic Models
- Business Models & Innovation
- Partnerships
- SBIR & Grant Applications
- Vendor Testing Data
- Pilot Plant Data
- SBIR Reports
- Permits
- Pilot Plant Technical Reports
- Demo / Commercial Plant Design
- DOE FOA Applications, PMC123, SF-424
- Capex / Opex / Pro Forma
- Financial And Operations Models (P&L)
- Heat And Material Balances (Process Simulation)
- Conceptual Project Evaluations (FEL1)
- Options Evaluations
- Process Design And FEL2 Economics
- DOE FOA Project Reports, CPR Reports
- Value Engineering
- Detail Design, And FEL 3 Economics
- Process Specifications & Vendor Responses
- 3D Piping And Plant Models
- IE Reports
- Construction Schedules Etc...



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Shedding Some Light on Data Types & Assets

Is There Value & Can We See It?

Purple – No Longer Relevant

Blue – Available, Less Valuable (Gone Cold)

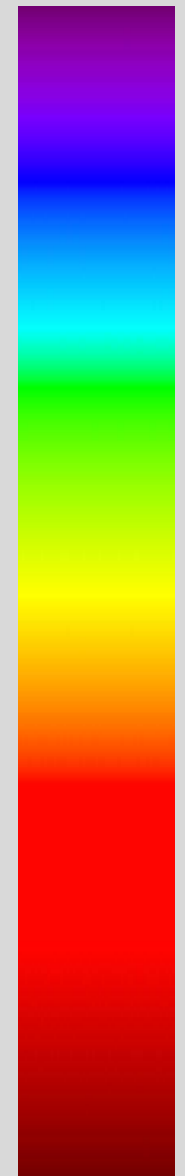
Green – Available and Valuable

Yellow – Less Available, Less Valuable (Hard to See)

Orange – Valuable, Basis of Commercial Practices

Red – Core IP & Protected

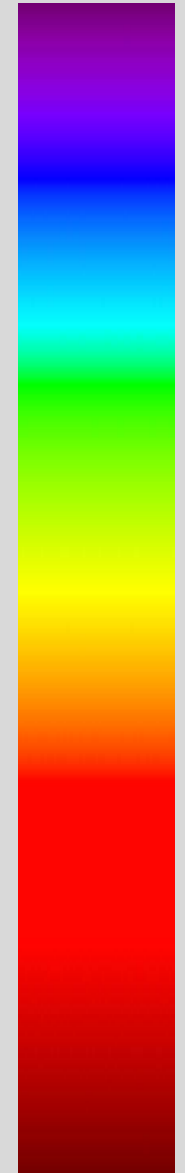
Deep Red – Highly Protected, Less Valuable



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Data Types And Data Assets Shedding Some Light

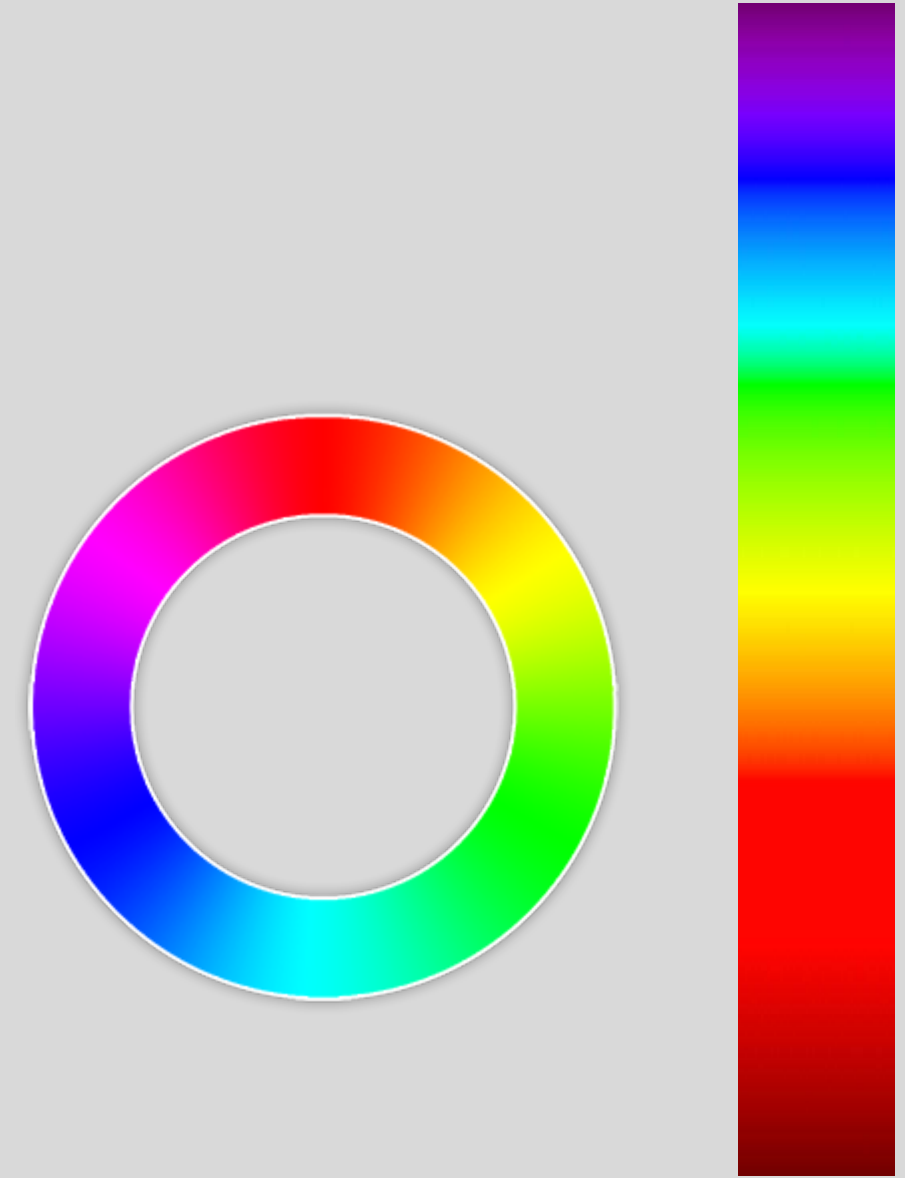
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Data Types And Data Assets Shedding Some Light

- Most Assets May Fall Into Multiple Classes And Categories
- It Is A Spectrum, Not A Binary Situation
- Much Of Information Lies With Folks Who Make Their Commercial Living Using It Or Applying It
- Sifting Through For Value & Organizing Will Be Hard
- This Is Our Work For The Next Two Days



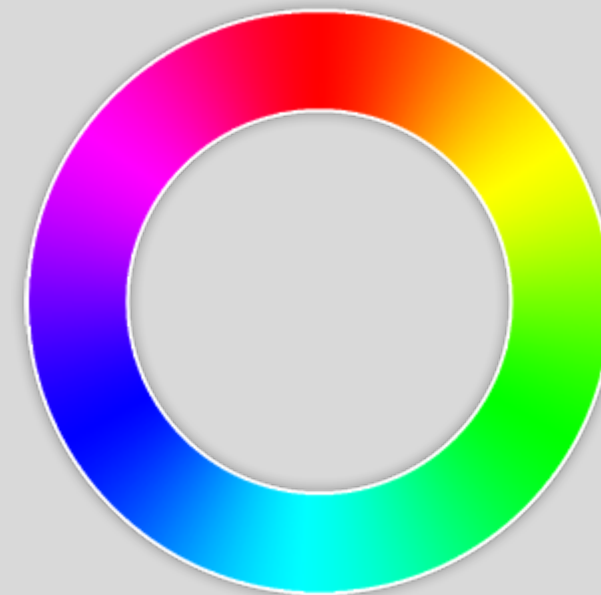
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Data Types And Data Assets

Additional Important Assets Created in These Programs

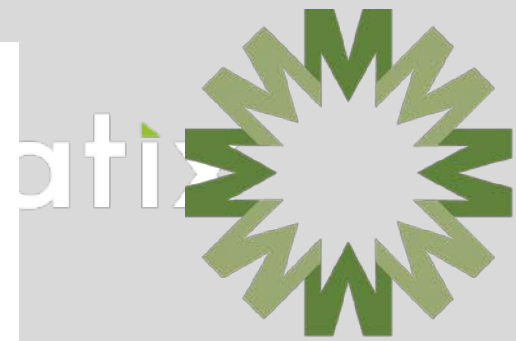
Further Ideas Of Where The Knowledge & Progress Lies In These Programs

- Experts, Scientists, Engineers, Commercial Teams As They Move On To What's Next
- & The Junior Folks Who Have Learned From Them
- Vendors Who Have Tested Their Materials, Designed And Supported Equipment, And Improved Their Systems And Equipment Design
- Engineering Companies, EPC's
- Contractors (Mechanical, I & E, Controls
- The Operations Team
- Expert Consultants – Technical, Permitting Etc
- Improvements To Equipment Designs
- Supply Chains & Product Markets
- Regulations
- Infrastructure (E.G. Hydrogen Fueling Systems)
- Political Support & Political Will
- Acquisitions, IPO's, Investor Interest Reward And Excitement
- Incorporation Of Small Startups Tech Into The Systems And Scale Of Established Ones



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Checking Back In



MASCOMA

A **LALLEMAND** Company



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Checking Back in on Those Sustainable Technologies

1990's

- MTBE processes development ... banned, inactive, replaced by conventional ethanol
- Bitumen and oil sands upgrading processes ... in operations, becoming less attractive
- Syncrude development & processing ... as per above

2000's

- Biofine - cellulose to levulinic & biodiesel ... shut down, restart, now GF Biochemicals, acquired Segetis to commercialize levulinic acid platform, teams became the founders and leaders of Mascoma
- The commercialization & buildout of 1st gen biofuels, corn based ethanol ... broadly commercialized, periods of profit & periods of losses / bankruptcies / acquisitions, nearly 10% of US transportation fuel supply
- Mascoma cellulosic ethanol ... acquired Lallemand, next generation plant on hold, several technologies, persist, development of some aspects continue Lallemand, Renmatix acquired Rome plant, Mascoma teams were critical in the development of many next generation foods, flavors, materials, replacement proteins, agtech, etc.

2010's

- Myriant & succinic acid – 4 major plants were built three shutdown in succinic, technology acquired by PTTGC ready for use at the right time, Lake Providence facility has been for sale likely to be acquired & redeveloped, teams were critical in the development of many next generation foods, flavors, replacement proteins, agtech, etc.
- Joule – algae in general has had its up and downs with companies, considered to have long term promise ongoing development in many areas, Red Rock Biofuels acquired Joule & technology
- Oasys Water – acquisition, retrenchment to increase robustness of process and technology, reemerge in 2 to 3 year

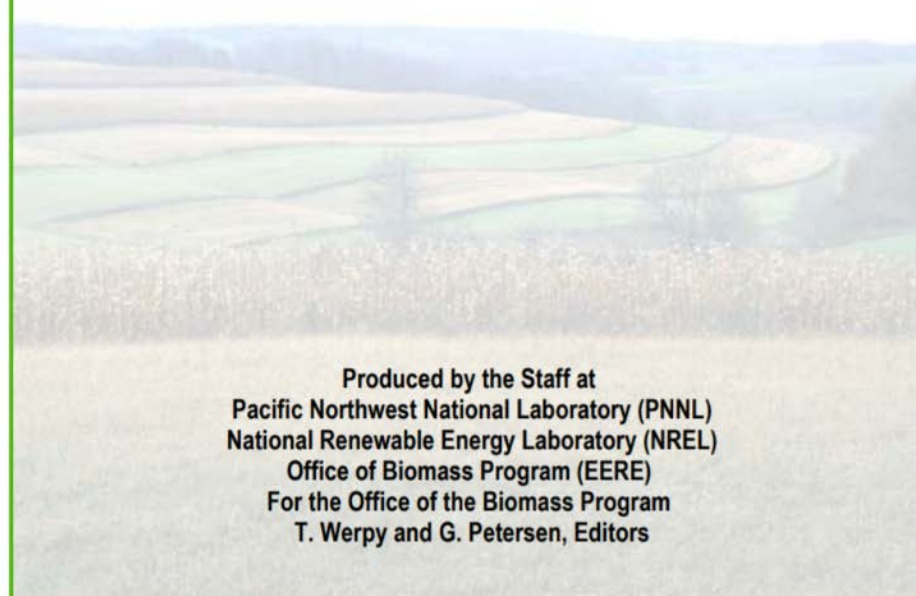


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In Closing ... What's Happened So Far Could Not Have Happened Without This Ongoing Body of Great Work...



Top Value Added Chemicals from Biomass Volume I—Results of Screening for Potential Candidates from Sugars and Synthesis Gas



Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply

April 2005

Figure 2-12: Algal Feedstock Production and Logistics Costs

Task	2011	2016 SOT	2016 Projection	2018 Projection	2022 Target
Total Algal Feedstock Cost	\$7.00E Algal Oil	\$16.22	\$11.12	\$6.30	\$5.21
Production Cost	\$7.00E Algal Oil	\$15.50	\$11.18	\$5.17	\$2.43
Harvest Cost	\$7.00E Algal Oil	\$2.58	\$2.52	\$1.09	\$0.67
Preprocessing Cost	\$7.00E Algal Oil	\$1.72	\$1.06	\$1.11	\$0.77
Recycle Credit	\$7.00E Algal Oil	-\$2.08	-\$2.14	-\$1.03	-\$0.68

USDA
U.S. Department of Agriculture



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Closing Thoughts

The Natural Cycle Of R &D And Technology Development Is To Put Forth Multiple Threads Of Inquiry

- **What Seems Brilliant Today Will Get Superseded Tomorrow**
- **But Quite Likely Will Come Back Around Again**

Many Barriers To The Obvious Sets Of Data

What Other Sets Of Data And Assets Are Out There?

Incredible Progress Has Occurred With Tremendous Support From DOE Programs

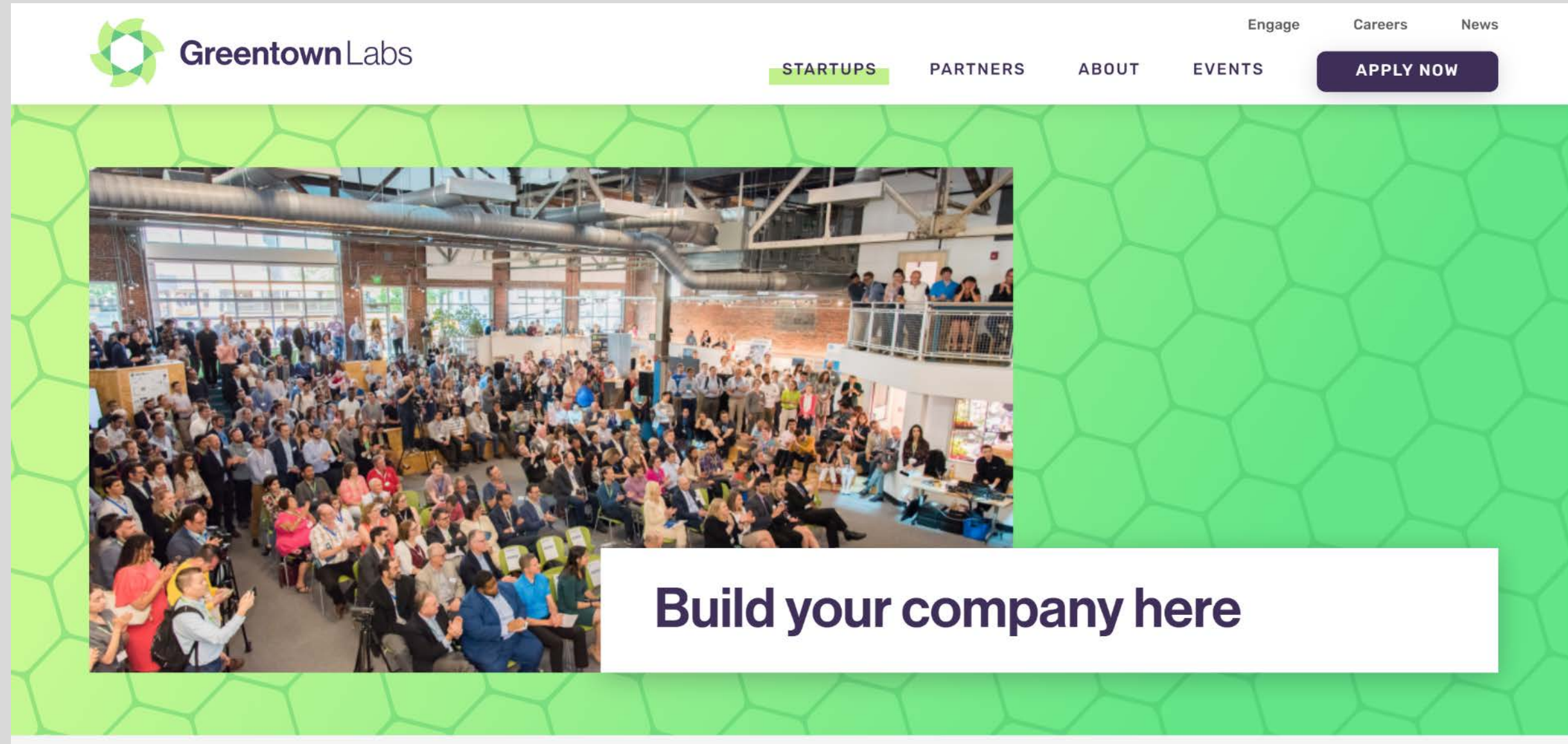
Is There Something We Would Do Differently In Launching New Funded Projects?

This Is an Exciting Workshop, Looking Forward To The Next Two Days



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Located @ Greentown Labs America's Largest Cleantech Incubator



The screenshot shows the Greentown Labs website header with the logo and navigation links: Engage, Careers, News, STARTUPS, PARTNERS, ABOUT, EVENTS, and an APPLY NOW button. Below the header is a large photograph of a crowded event space with a green honeycomb pattern overlay. A white text box at the bottom of the image reads "Build your company here".



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Questions, Discussion



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