

Biocatalysts: A Green Chemistry Approach to Industrially Relevant Compounds

Andrew T. Koppisch and David T. Fox

Los Alamos National Laboratory, Bioscience Division, Los Alamos, NM 87545



Technology

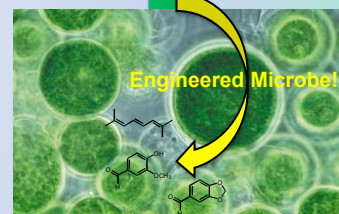
Breakthrough technology: Tunable microbes produce commercial chemicals--a **multibillion dollar industry**.



How?



Carbon source e.g. cane sugar
CO₂ source e.g. flue gas



RENEWABLE BIOCATALYST!
Requisites: sunlight, glucose or CO₂, water = RECYCLABLE...no need to "regenerate" the microbe.

Markets



- Fossil Fuels to Benzene
• Dependence on foreign oil
- Benzene to commodity chemicals
• Organic and inorganic waste
- Nylon production
• Greenhouse gas emissions (NO_x)

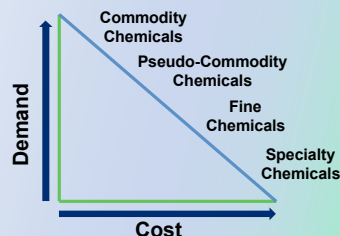
According to a 2008 Wall Street Journal article, the costs of producing a metric ton of adipic acid (\$1750/ton) accounts for roughly 97% of the sales price of the material (\$1800/ton).

With over 5 millions tons of adipic acid production in the U.S., the pollution tax credits, alone, exceeds \$10 M.

Therefore, green-based technology to this *single* compound that bypasses the use of petroleum feedstocks, organic and inorganic waste and GHG generation would be highly desirable to multiple industries (Dow Chemical, DuPont, P&G, etc.)

Commercial Readiness

Our research team has extensive experience in organic chemistry, molecular biology, and enzymology, a rare combination of historically distinct scientific disciplines. As such, we identified novel enzymes that will directly convert glucose or CO₂ into a desired chemical. Essentially, we can bioengineer and "tune" a microbe to produce a wide variety of commercially desirable compounds. Specifically, we will target commodity and pseudo-commodity chemicals for microbial production—current global demand is millions of metric tons and constantly increasing—with a high profit margin.



We are testing the viability of each enzyme in both bacteria and microalgae, optimizing microbial growth conditions, chemical toxicity, and product isolation. This is currently being accomplished at bench top scale.

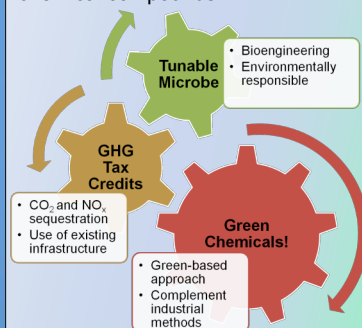
In order to advance our product to industrial scale production, we must build the foundation necessary to make our product cost competitive with current industrial methods to commodity chemicals.

Year	2011	2012	2013	2014	2015
Financing Needed	Series A \$2 M	Series B \$5 M		Series C \$10 M	
Use of Funds	Infrastructure development		Commercialization		
Funding Sources	SBIR grants, VC	VC, Industrial Partners		Industrial Partners	
Milestones	Generate IP, First genetically engineered prototype in microalgae, negotiate partnerships, license IP		Increase microbial and chemical diversity	Expand sales and marketing force, scale-up operations	Expand to pilot operations Positive Net Income

Intellectual Property

Based on our novel technology, we anticipate significant intellectual property will be generated early and often during start-up. Two invention disclosures have already been accepted by LANL's Technology Transfer Division and assigned docket numbers. Our proof-of-principle research is currently funded by a LANL sponsored LDRD ER grant (\$1.2M/3 years).

In addition, our research targets a relatively unsaturated IP market. We envision multiple entry points into 'green-based' methods to a desired chemical compounds.



Primary Goals:

- Help alleviate our dependence on fossil fuels
- Reduce greenhouse gases (GHG) worldwide
- Lower energy consumption and project costs
- Be more environmentally responsible and profitable.



Contacts

Dr. David T. Fox or Dr. Andrew T. Koppisch, Scientist 2, Los Alamos National Laboratory, P.O. Box 1663, MS M888, Bioscience Division, Los Alamos, NM 87545. Office: D.T. Fox: (505) 606-1745 A.T. Koppisch: (505) 665-3862 Fax: (505) 665-3024, E-mail: dfox@lanl.gov, koppisch@lanl.gov , LA-UR 10-02820