

# Advancing the Industrial Biotechnology Revolution

Presented by Damien Perriman  
Ausbiotech 2009, Wednesday 28 October



# Creating the Renewable Value Chain



Petroleum



Cracking



Processing



Products



**David Theriault**

Partnering with the Petrochemical Industry

**Damien Perriman**

Advancing Industrial Biotechnology

Agriculture



Milling



Fermentation



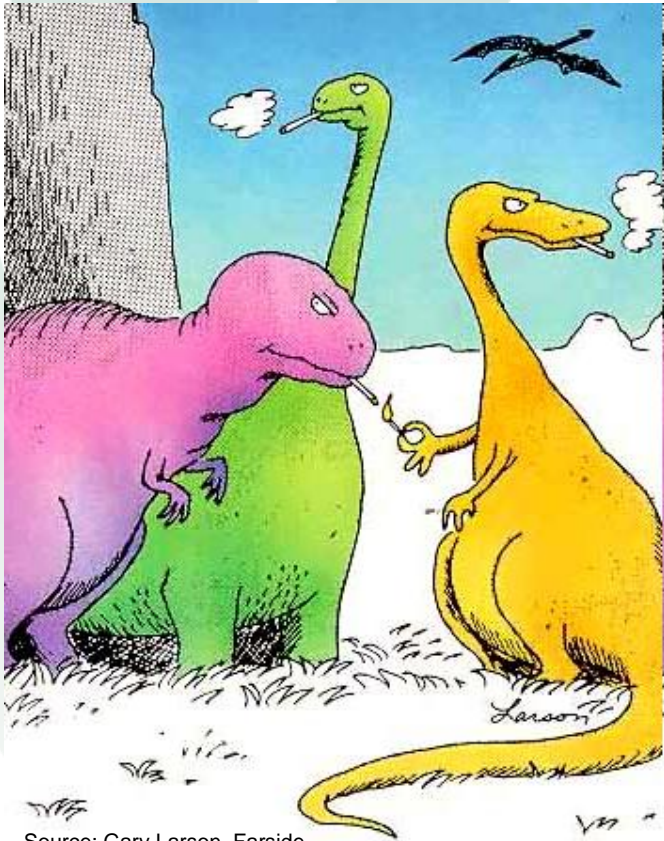
**Karl Kelly**

Biomass: Opportunities and Risks for BioEnergy

**Prof Lars Nielson**

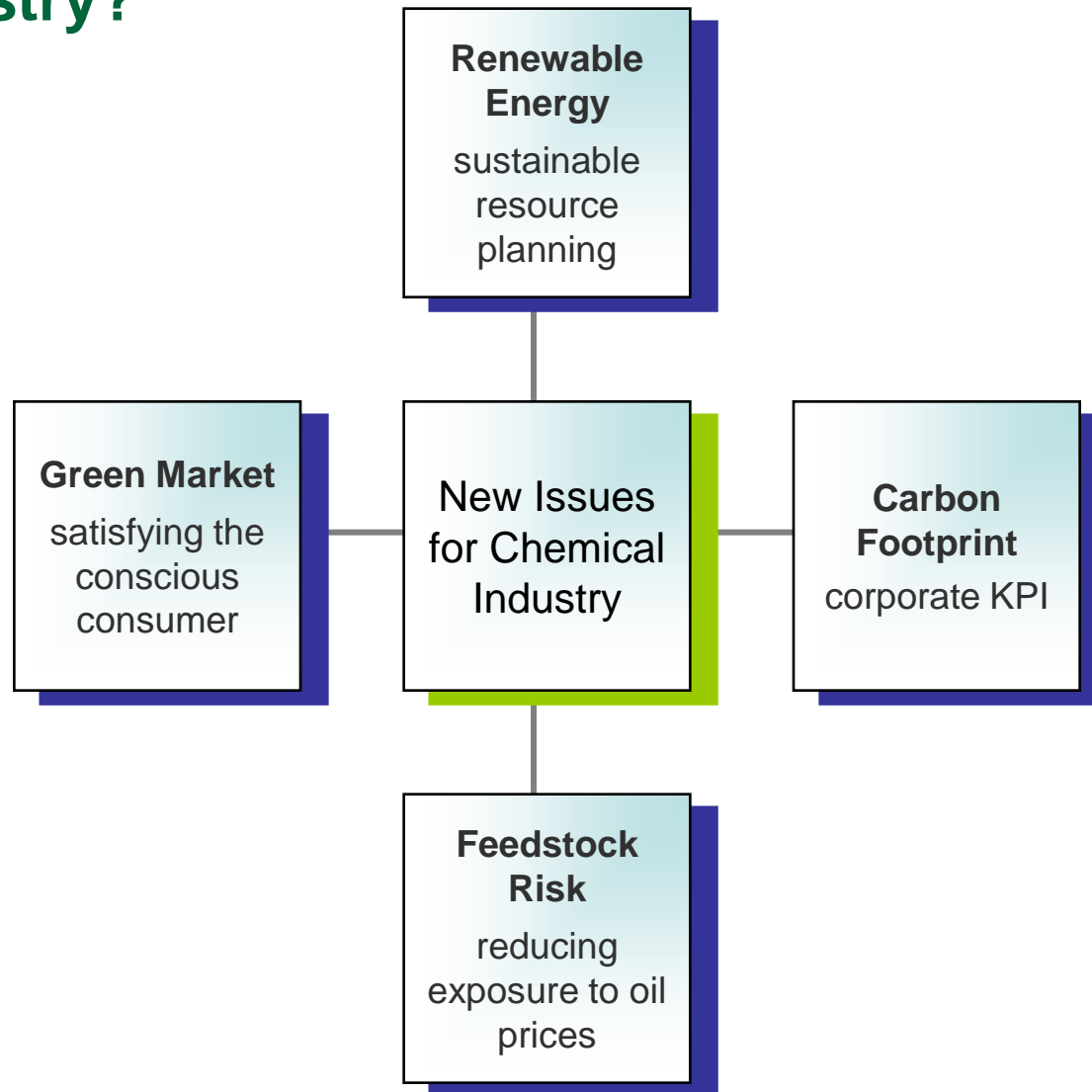
Synthetic Biology Tools

# Future Scientists may ask: what happened to the Petrochemical Industry?



Source: Gary Larson, Farside

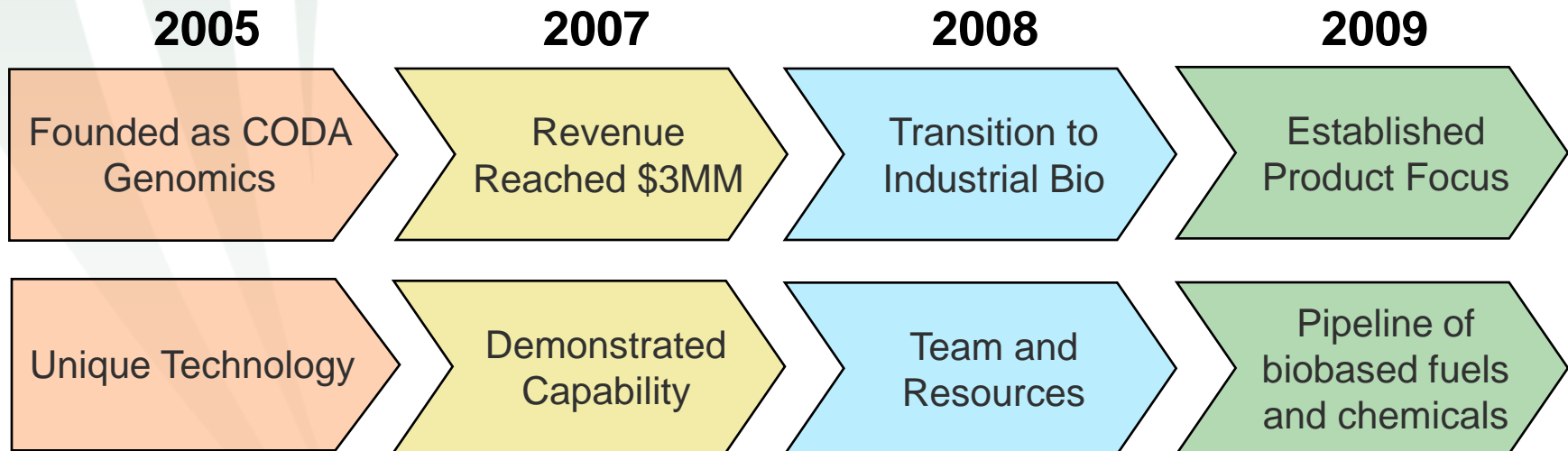
Extinction by an addiction to fossilized carbon...



# Revolutionizing Industrial Biotechnology

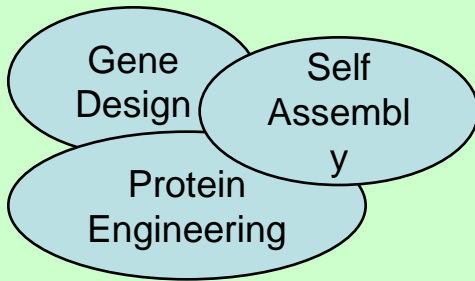


- Addressing **consumer demand** for green alternatives
- Developing **profitable biobased** processes for fuels & chemicals
- Providing **sustainable solutions** for our future

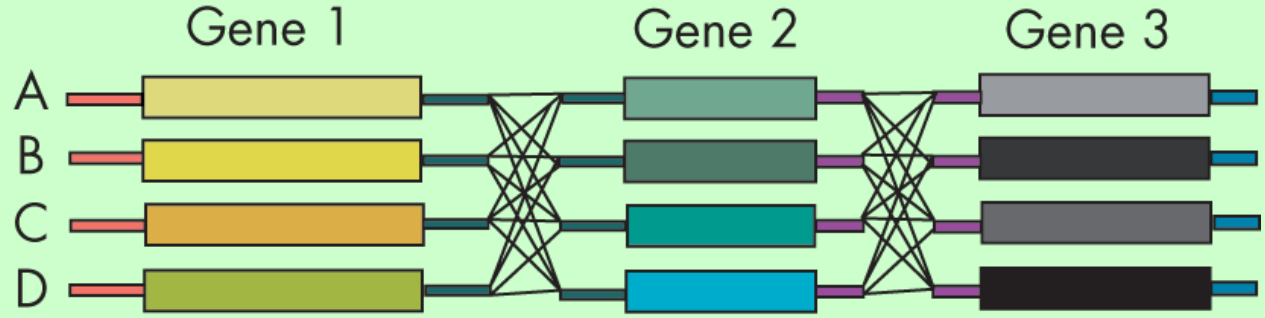


# Accelerating Strain Development

## Proprietary Tools



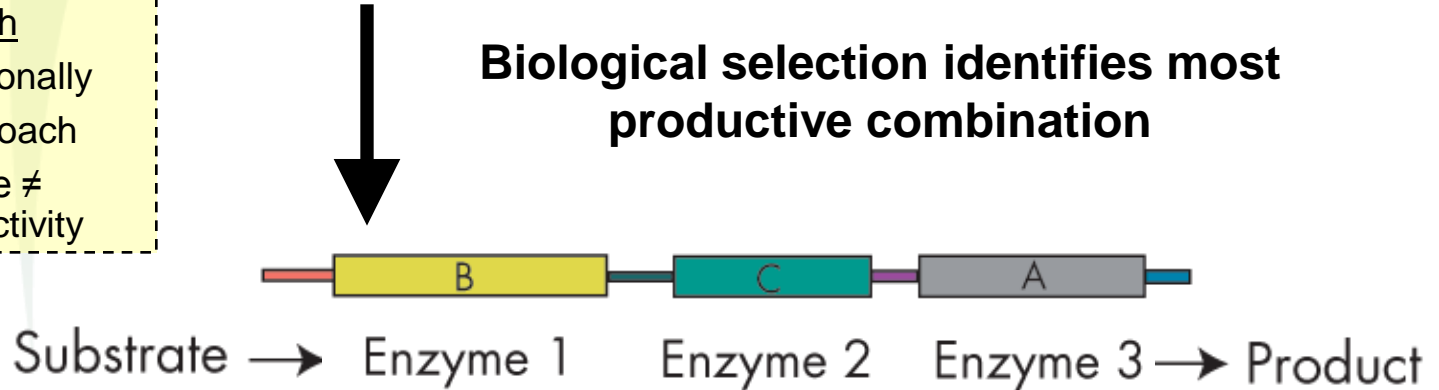
## Maximize enzymatic diversity into pathway



## Traditional Approach

Genes selected rationally  
Trial-and-error approach  
Amplifying one gene  $\neq$  pathway productivity

## Biological selection identifies most productive combination

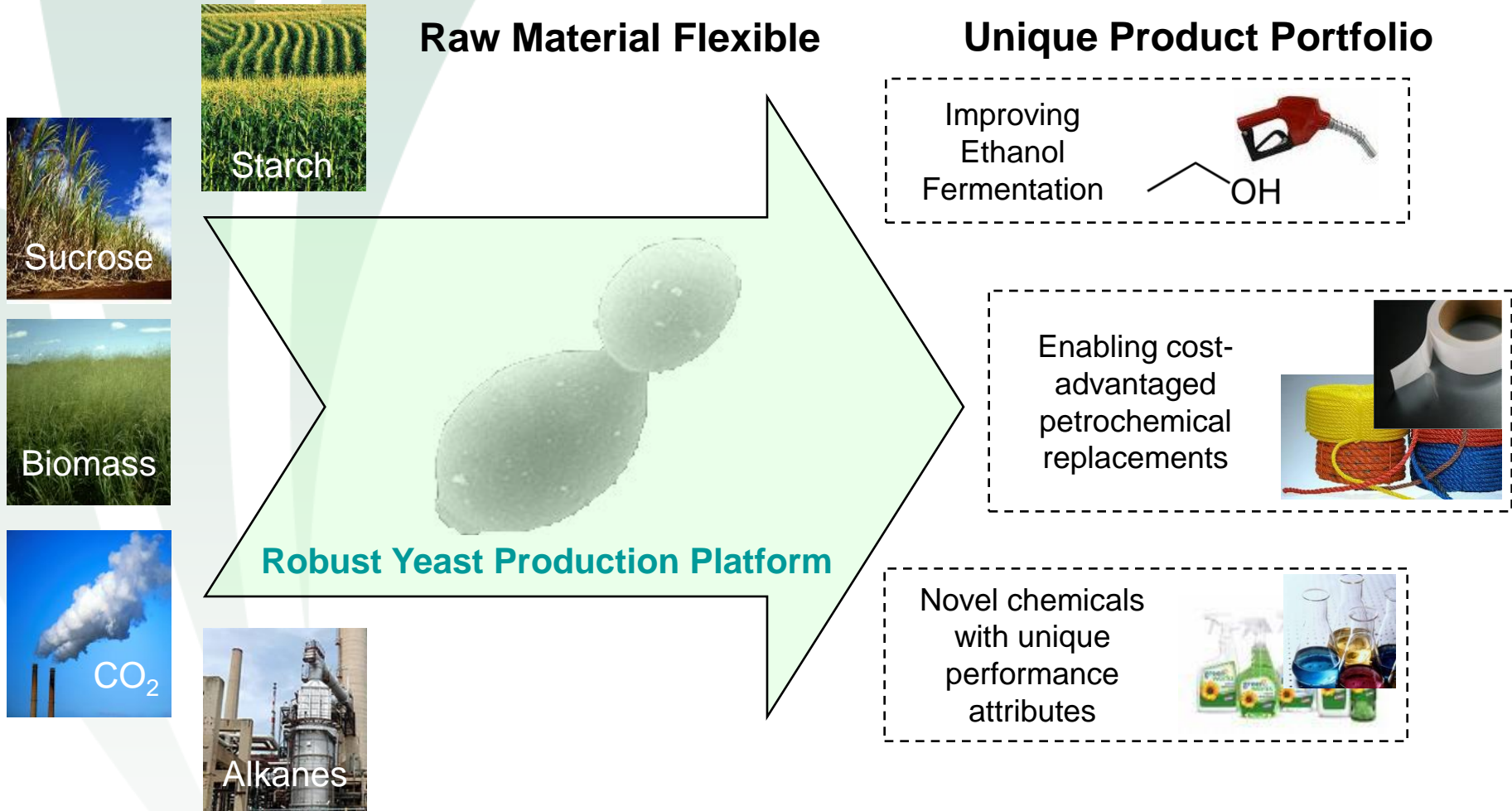


## COMBINATORIAL PATHWAY ENGINEERING

**Rapid**  $\rightarrow$  simultaneous testing of pathway diversity

**Efficacious**  $\rightarrow$  most productive gene combination selected by the organism

# Converting Carbon to Chemicals



Optimizing Carbon Flow from Raw Materials to Products

# Significant Growth for Renewables



**Renewable Chemicals** expected to exceed 15% market share by 2014

- From \$45 bn in 2009 to \$59.1 bn

*"Platform chemicals play an important role in the renewable chemicals market since they contain multiple functional groups and hence present practical potential for their conversion to families of useful products."*

Markets and Markets, Delaware

~\$375 bn

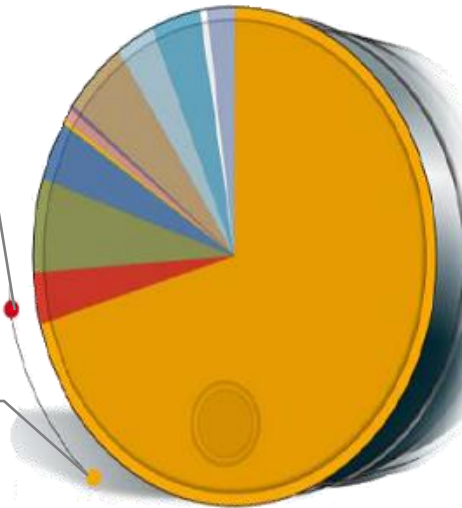
**Petrochemicals 3.4%**  
Including: naptha, ethane, ethylene, other oils

Pre tax value of petrochemical products, such as plastics, cosmetics, pesticides, detergents, paints and adhesives (excluding pharmaceuticals)

~\$385 bn

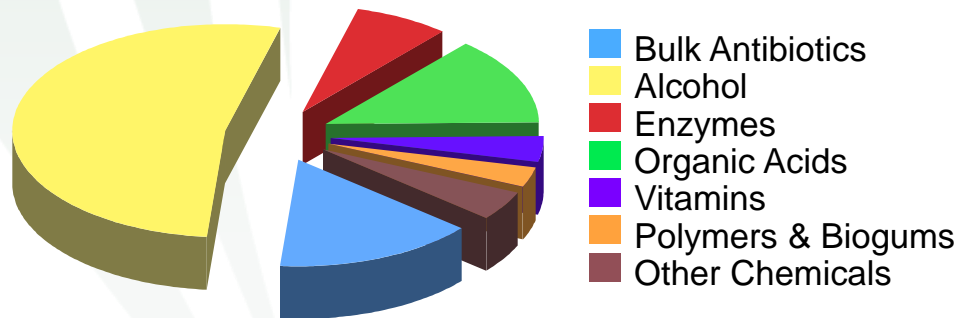
**Fuels 70.6%**  
Including: motor gasoline, aviation gasoline, kerosene type jet fuel, diesel

Pre tax value of transport fuels



**Renewable Fuels** have high growth expectations, with combined biodiesel and ethanol estimates reaching \$247 bn by 2020

(Biofuels Markets and Technologies, Pike Research)



Biobased Market Segmentation



BP plc

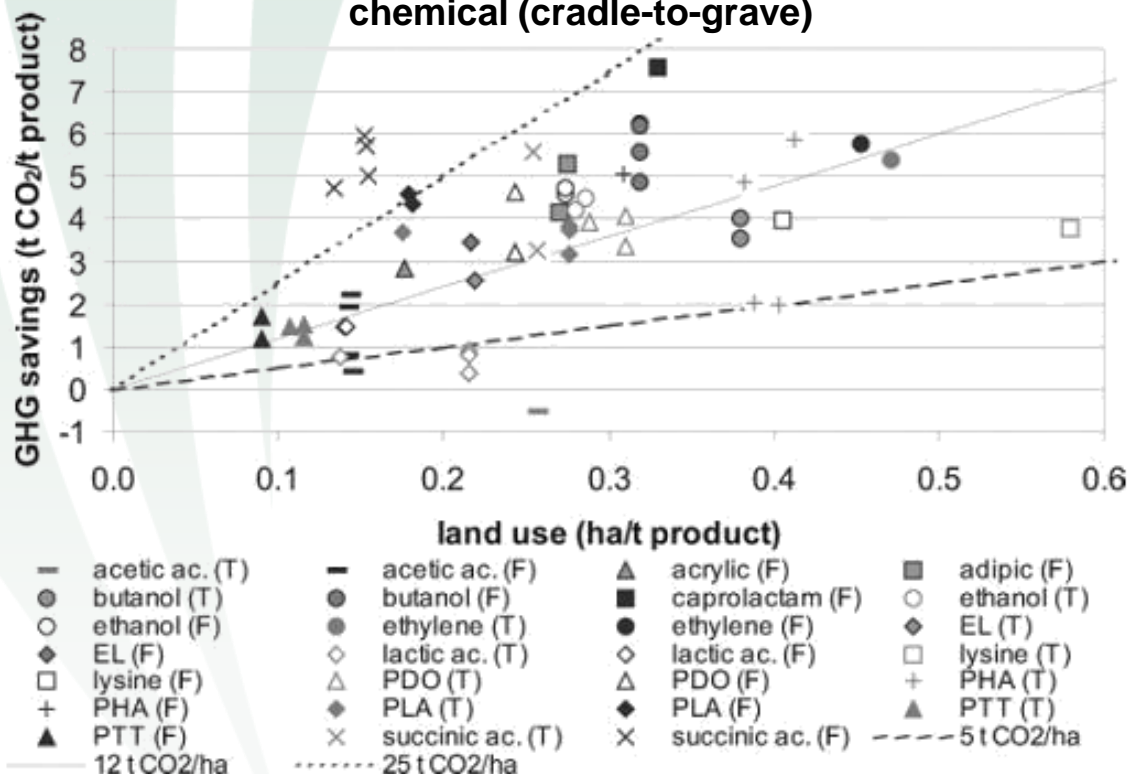
**BP Says Biofuel To Replace 25% Of Gasoline In U.S., Less Diesel**

(Bloomberg) -- BP Plc, the largest oil and gas producer in the U.S., said biofuels will supplant more gasoline than diesel in the country over the next 20 years. Biofuels will replace about 25 percent of gasoline and 8 percent of diesel in 2030, Katrina ... [Peak Oil - 09/15/2009]



Industrial Biotech Can Save the world 2.5 Billion Tons of CO<sub>2</sub> Annually (World Wildlife Fund)

GHG savings versus land use (sugar cane) per ton of chemical (cradle-to-grave)



Equivalent to:

- 415 million passenger vehicles
- 58 billion trees
- 12 million railcar loads of coal
- \$75 bn of carbon credits

# Emerging Market Pull for Biobased Chemicals

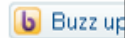


## Automobile

Bio-based materials are now in the blueprint for most auto makers - Woodbridge (Automotive Interior Manufacturer)

### Ford Researchers Look to Mother Nature for Clues on How to Create Greener, Lighter Plastics

Press Release  
 Source: Ford Motor Company  
 On 4:04 pm EDT, Tuesday September 15, 2009



## Electronics



### Sprint Expands Environmental Leadership with New Initiatives and Debut of Eco-Friendly Samsung Reclaim[tm]

Overland Park, Kan. and Dallas on Aug 06, 2009  
 Available for less than \$50, Samsung Reclaim is the most full-featured eco-friendly phone in the U.S.; Purchases of Samsung Reclaim benefit The Nature Conservancy's Adopt an Acre program

## Footwear

When consumers have the choice, they tend to want to make the greener choice - Timberland

### Sustainable footwear project

Company: *Dow Polyurethane Systems*  
 Author: *PU2PU Editor*  
 Published: *May 13, 2009*

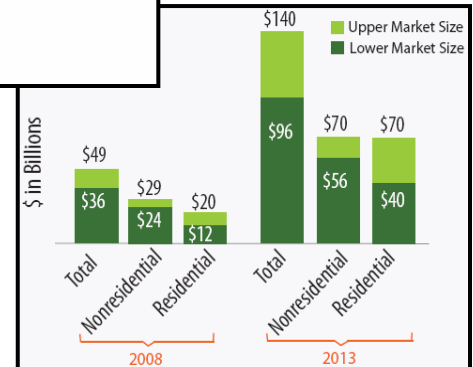


Dow Polyurethane Systems, working with the Italian producer of polyurethane shoe soles Mondial Suole, will test newly developed elastomeric polyurethane material with renewable content for use in the footwear industry. The

## Construction

### Construction Market to Increase 11% in 2010, Says McGraw-Hill Construction Outlook Report

October 16, 2009 11:20 AM ET



# Economics Favor Renewables



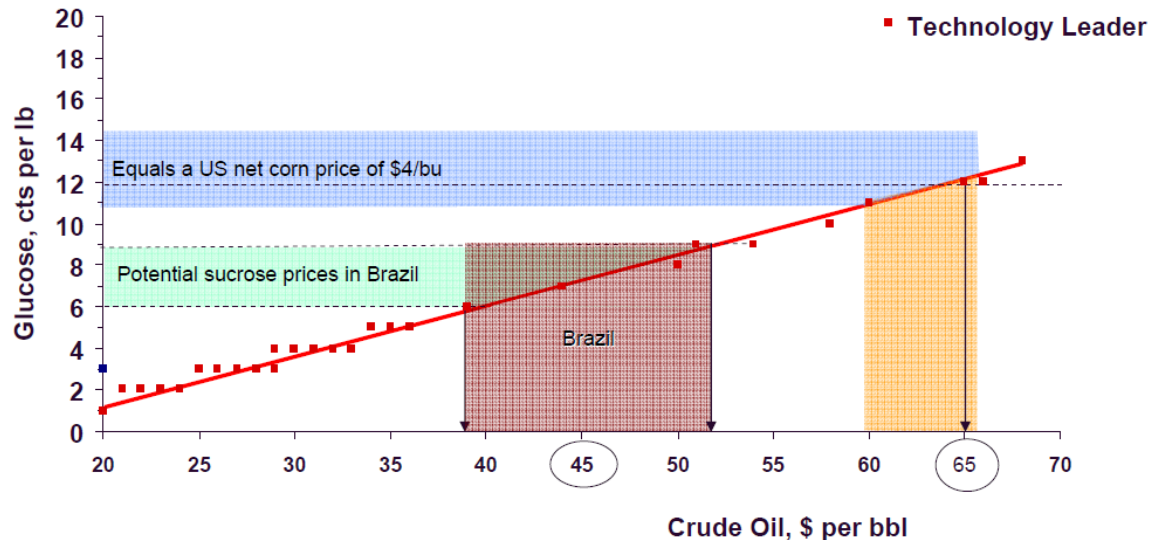
NYMEX Crude Oil Futures  
Close ( Front Month )



Crude oil increases from \$75/bbl in 2010 to \$110-180/bbl by 2020  
(U.S Energy Information Administration, Annual Energy Outlook 2009)

- For bio-based acrylic acid, sugarcane competes with \$45/bbl oil and corn competes with \$65/bbl oil
- Both raw materials are competitive today

Bio-Acrylic Acid Indifference Curve (Novozymes/Nexant), 160 K T/yr



# Redrawing the Energy Picture

- \$3 billion committed to the research, development and deployment of advanced biofuel
- U.S. DOE has funded \$578 Million for the development of renewable energy over the last 2 years
- USDA-DOE Biomass Research & Development has funded \$96 M for the development of biobased products



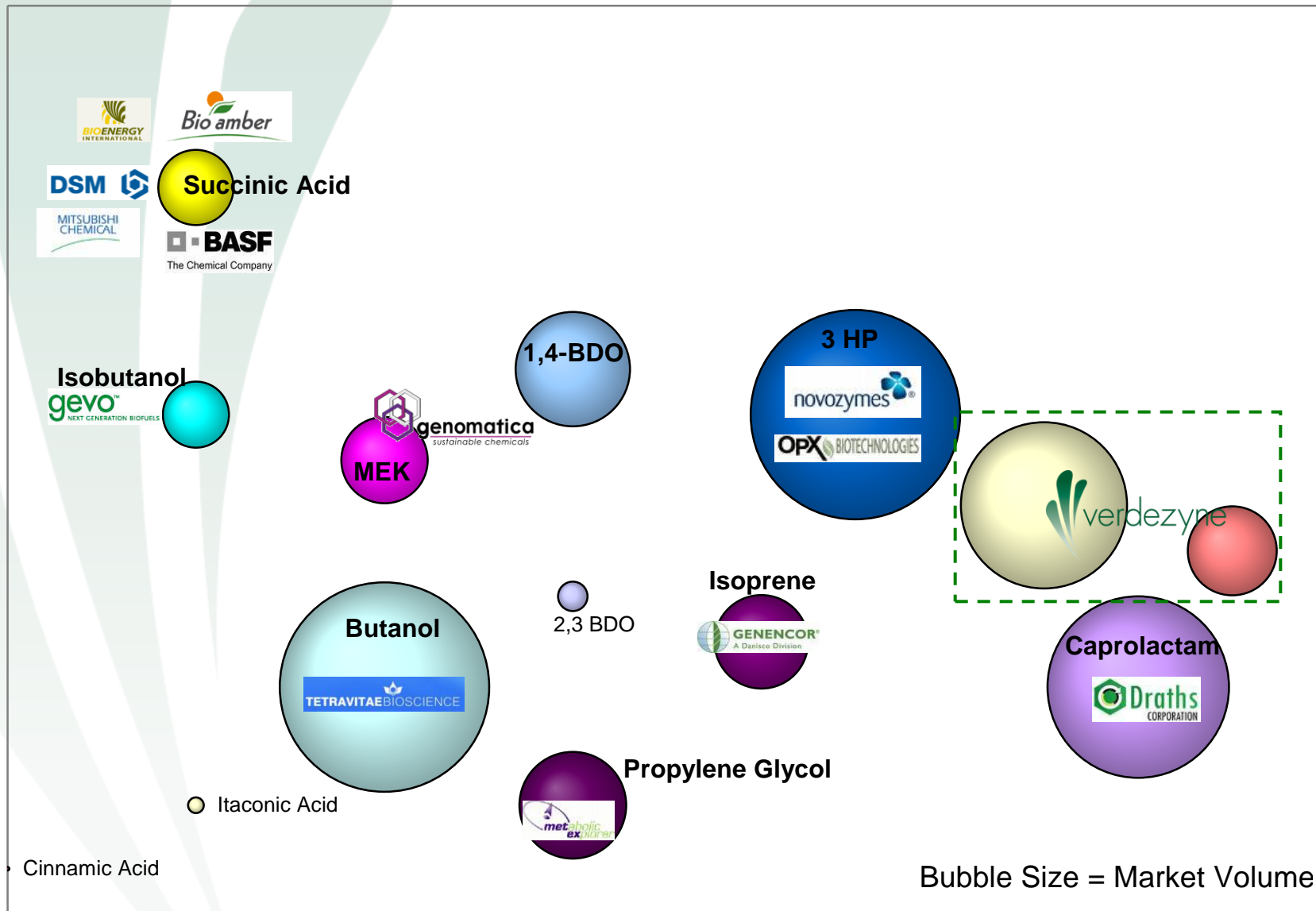
Green Jobs + Renewable Energy = A Stronger Nation  
February 28, 2009 by : Miriam Kashia <http://www.blueplanetgreenliving.com>



- U.S. Recovery Act pledges \$43 Billion to renewable energy and clean-tech programs.
- \$800 Million directly to biomass

# Landscape for Renewable Chemicals

Probability Success ~ F(IP, Tech, Competitors)



**Market Pull (Low, Medium, High)**

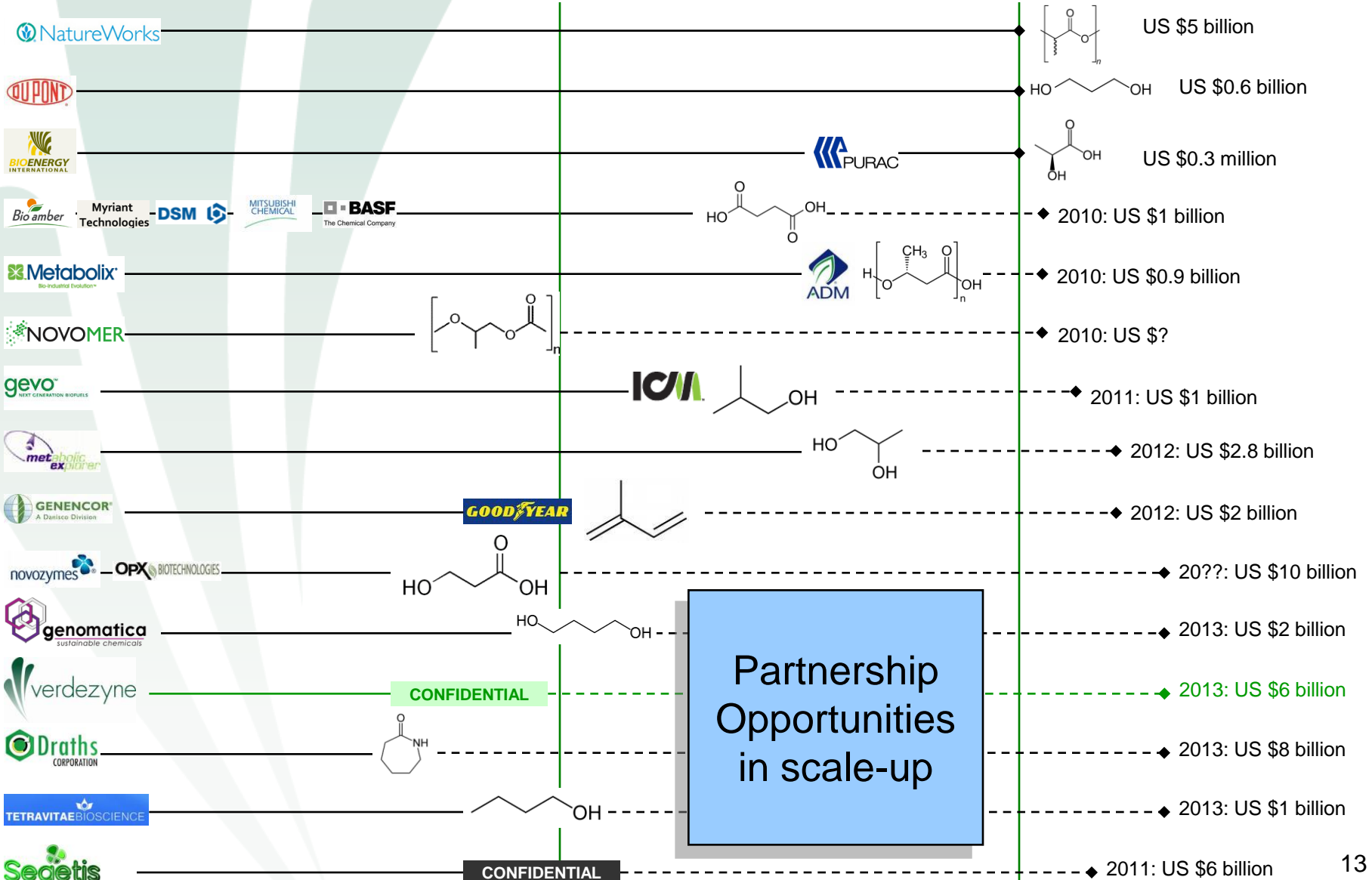
# Pipeline for Biobased Chemicals



## Development

## Demonstration

## Commercialization



Partnership Opportunities in scale-up

# “it ain’t easy being green...”

- Disrupting well entrenched supply chains
- Replacing fully depreciated capital assets
- Unfamiliar investment community
- Large, slow moving partners/customers

## On the bright side:

Disruptive technology =  
Opportunity for profit

- Demonstrated technology
- Strong government support
- Active consumer pull
- Economic advantage
- Willing and engaged industry partners



## Contact Details

Damien Perriman  
Vice President, Business Development  
Verdezyne, Inc

2715 Loker Avenue West  
Carlsbad, CA 92010  
(760) 707-5248  
dperriman@verdezyne.com