

LYGOS

*Building the Future by Replacing Petrotechnology with
Biotechnology*

California Bioresources Economy Summit

January 29, 2019

Eric Steen



Vision: \$B, global biotechnology company specializing in innovative **monomers** and **materials** from renewable starting materials

Mission: Make **better** products sustainably

Strategy: Work with **partners** to leverage Lygos' technology platform to develop and quickly bring new monomers and materials to market

100 years of petrochemistry; Innovation at the Expense of the Future.

....



“C-H” Dominated
Building Blocks



Functional Groups
Require Ext.
Derivatization

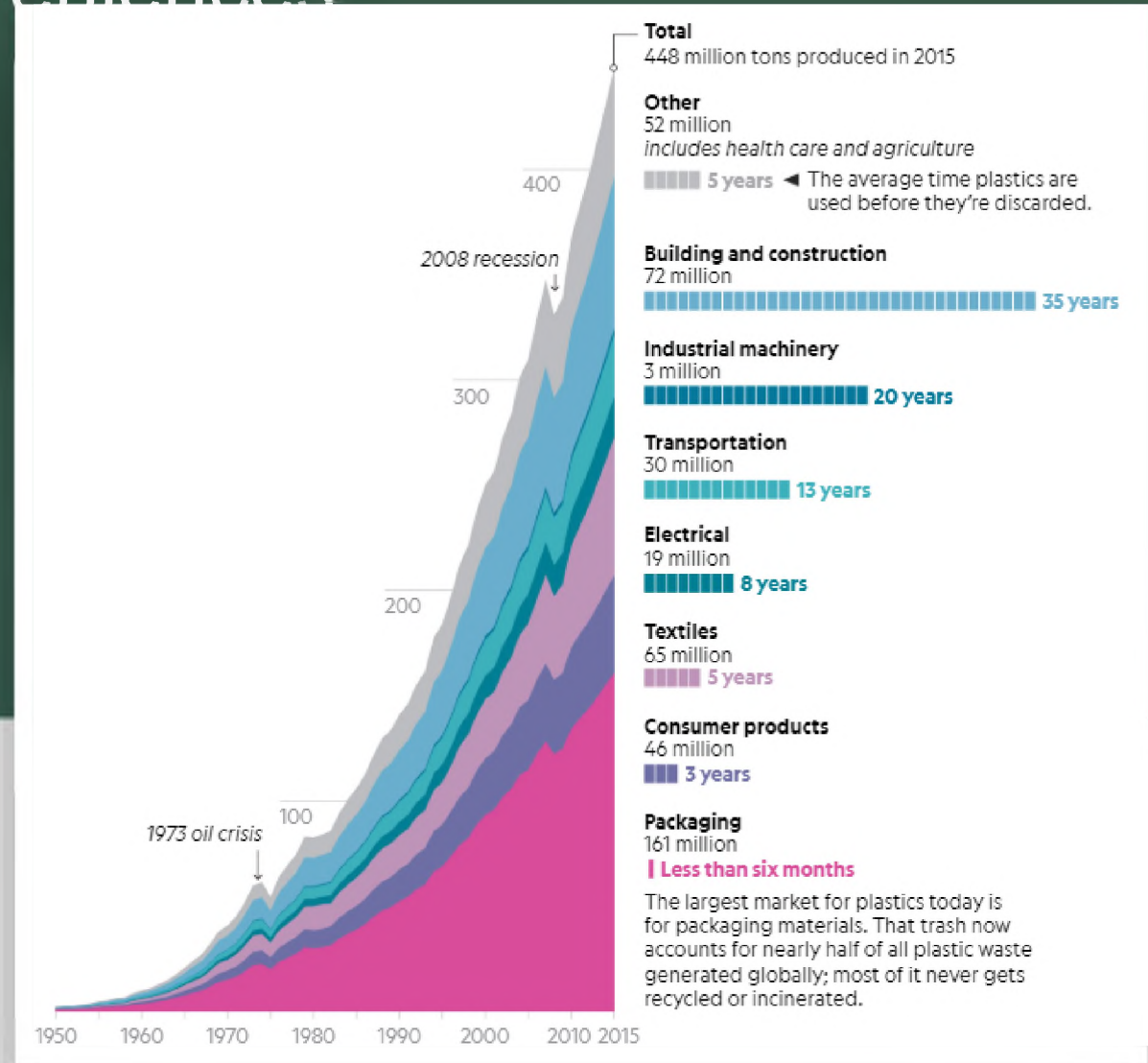


Reactive “Petro”
Chemistry Is Toxic



EHS Impacts

Petrochemistry creates enormous problems for small conveniences



Long term health & environmental impacts with equal or greater harm



US EPA Exposure Risk Assessment

- Eye pain, blindness, cataracts
- Vomiting, breathing problems
- Decreased lung function
- Ab pain leading to shock / collapse
- Skin burns
- Reproductive problems / disease



Biotechnology is enabling materials innovation

A Fundamental Shift in a **\$600B+** Market, Driven by 4 Key Bio-



Infinite new monomers, materials, products available



Kinetic/Activation Energy in Bio-Chemistry

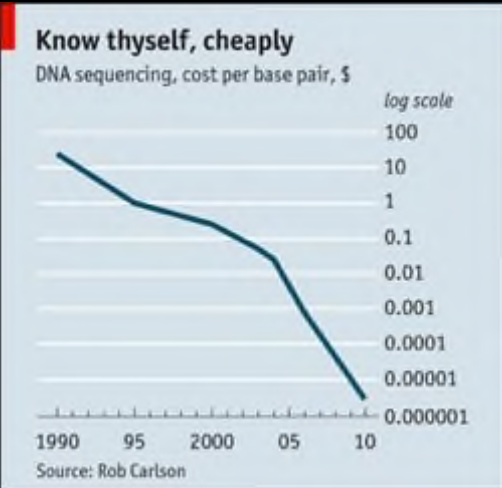


Bio-Abundance: Heteroatoms, Polarity, Chirality

LYGOS

V3.0 Industrial Biotechnology

Cheaply and quickly reading, writing, and editing DNA has set the stage for a revolution in materials manufacturing. The timing is set for exponential growth in the field.



LYGOS

DNA Sequencing (Read)

DNA Synthesis (Write)

CRISPR (Edit)

BioFabs

AI/ML

V3.0 is delivering. Now is the time.

Technology platforms accelerating; Value Propositions Better Defined; value chains built & accelerating



DNA SUPPLIERS



MICROBE ENGINEERING



CHEMICAL ENGINEERING



MANUFACTURING



B2B/C PERFORMANCE MATERIAL PROVIDERS

Diverse industries looking to biotech for products / processes

Materials, Food, Ag, Animal Nutrition, Healthcare



Smart Materials

- Functionalization at RT
- Cross-linkable polyamides
- Recyclable polycarbonate
- High gas barrier materials



Specialty Additives

- Blocked PU
- Advanced PU foam additives
- Low energy curable coatings
- Epoxy cross linkers



Animal Nutrition / AgTech

- Controlled-release / bypass systems
- Sugar substitutes
- Yield improvement boosters



Health & Human Care

- Super absorbents
- Pharma polymers - surgical, wound healing
- Controlled release - functional surfaces
- Preservatives, cosmetics, flavor, ingredients



Flagship Program: Bio-Malonate™ Products

Value to Customers

- Eliminating isocyanate chemistry (400kta in coatings) & exposure
- Full, fast cure at Room Temp

LYGOS

Value to Customers

- Solving legacy pain points
- Global Megatrends
- VOCs, EE
- light weighting
- recyclability
- EHS / Safety
- New functionality

Bio-Advantaged

- Requires Bio-platform
- Additive performance
- Recyclability
- Reactivity at Low T, P
- Non-toxic, HHS

Bio-Advantaged

- >1 g/g yield
- Proprietary enzyme
- High purity

Sustainable Supply

- Shutdown economics
- Unconstrained by cyanide supply chain

Sustainable Supply

- Economics
- Geographic Supply
- Life-cycle / eco-efficiency

Companies looking to Better Materials, Coatings, Adhesives

One example: Methylene Malonates

COATINGS WORLD
MAGAZINE NEWS RESEARCH MARKETS & TECHNOLOGIES RAW MATERIALS

BREAKING NEWS
Sirrus and BASF to Develop New Class of High Performance Automotive Coatings



Nippon Shokubai Buys Sirrus, Gaining Technology for Better Adhesives

Mar. 31, 2017



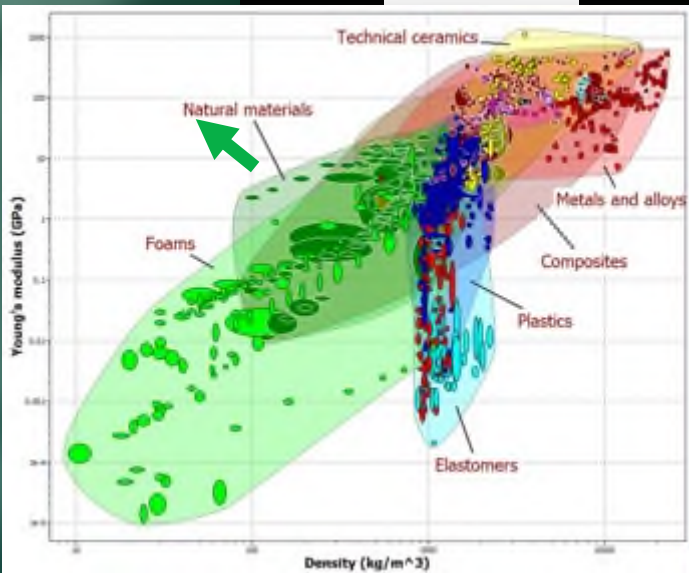
BIOBASED PRODUCTS NEWS 27 MAY 2016

Lygos and Sirrus partner to produce biobased methylene malonates from sugar

LYGOS

Bio-Malonate™ has many other material applications

Multi-market impact across \$20B+ industries



Triple Functionality imparts value in downstream materials



Other advanced polymers from malonate

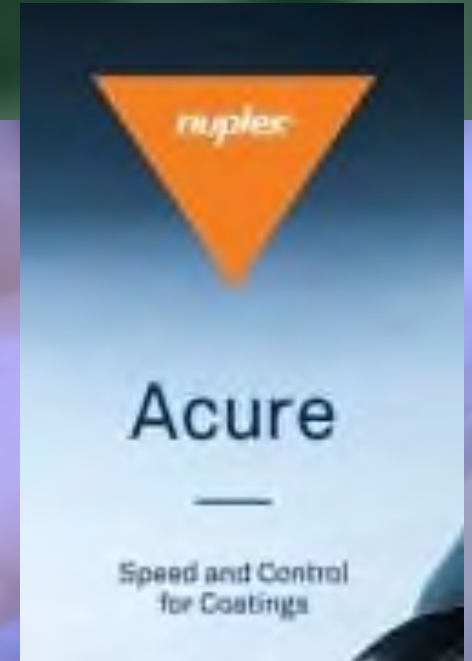
Another example: Advanced Coatings Systems

Performance

Chemical Resistance
Speed & Control – Harnessing Reactivity
High film build, molecular weights

Environmental

Isocyanate free
BPA free
Formaldehyde free
Low VOCs
Low energy “bio” cure



NBR

> Nuplex shareholders OK \$1 billion Allnex takeover

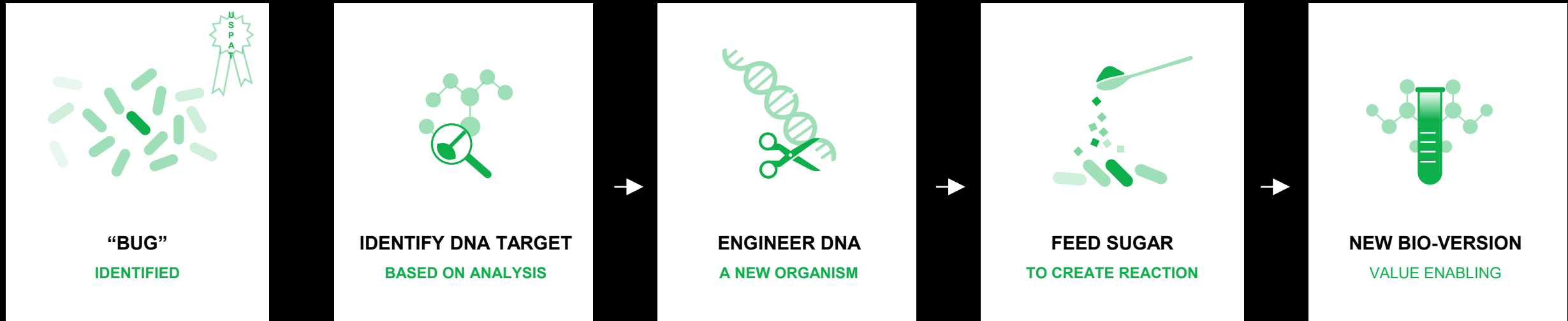
Nuplex shareholders OK \$1 billion Allnex takeover

FIONA ROTHERHAM · THURSDAY JULY 7, 2016

LYGOS

Our Bio-Innovation Engine

AGILE REPROGRAMMING; FULL STACK CAPABILITY



Proprietary Software

DNA Engineering

Chemical Engineering

Data, Learning, Improvement

Flagship Program

OUR FIRST PRODUCT FAMILY

Bio-Malonic™ Products



\$360M market today,
Supply limited, growing to \$B+



Market Expansion Customers
Need New Supply



Delivered MT+ to Customers;
Expanding

Advanced Dev

NEW PIPELINED PROGRAMS

Bio-Glyceric™

Bio-Glycolic™

Bio-Aspartic™

Application Areas

Ag Nutrient Delivery System

Biodegradable Materials

Cosmetics

Functional Films, fibers

Film formers

Addressable Markets

Early R&D Areas

FUTURE APPLICATION AREAS

Polymers

- Medical industry (Wound healing, SMART)
- Packaging industry (high gas barrier, preservative)
- Bio-responsive materials

Adhesives

Agricultural industry

LYGOS

Enabling New Materials with Biotech to Address Global Challenges in Sustainability, Energy & Climate Change

Lygos' bio-Malonate™ Program is a Case Study Demonstrating our Direction

Next Products Addressing High Gas Barrier Materials, Degradability & More

www.lygos.com