SESSION 6: ADVANCED MANUFACTURING AND THE CLIMATE CRISIS: BIOMANUFACTURING

Mary E. Maxon, PhD
Associate Laboratory Director, Biosciences
Lawrence Berkeley National Laboratory

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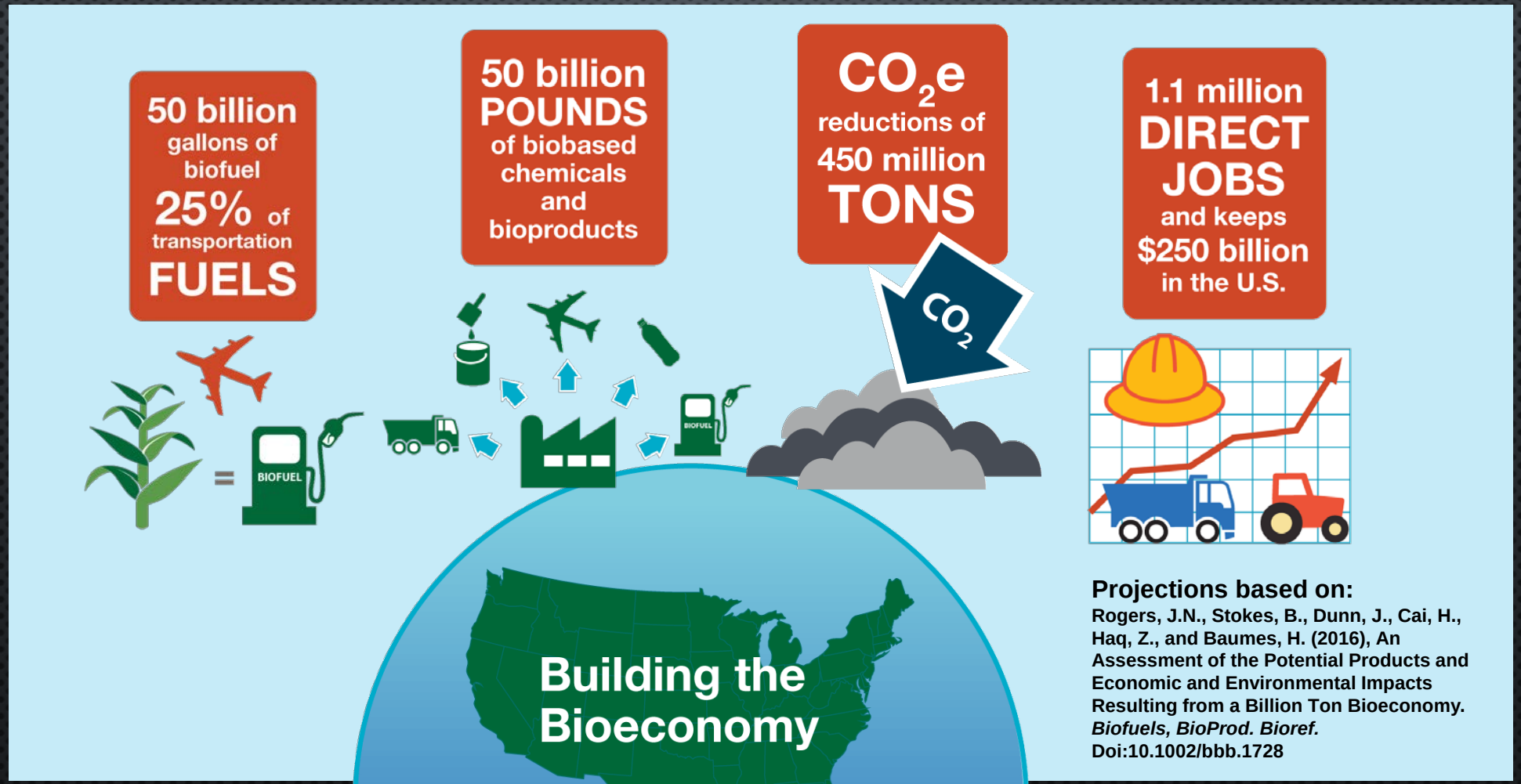
U.S. BIOECONOMY: A BILLION DRY TONS OF SUSTAINABLE BIOMASS HAS THE POTENTIAL TO PRODUCE …



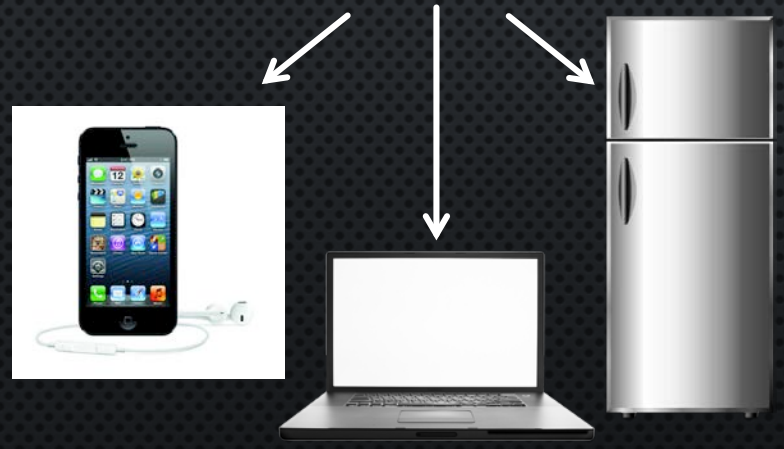
Projections based on:

Rogers, J.N., Stokes, B., Dunn, J., Cai, H., Haq, Z., and Baumes, H. (2016), An Assessment of the Potential Products and Economic and Environmental Impacts Resulting from a Billion Ton Bioeconomy. *Biofuels, BioProd. Bioref.* Doi:10.1002/bbb.1728

DNA IS A PROGRAMMING LANGUAGE

Computer Programming		Biological Programming
011100010101	**CODE**	CATTGACCTAGCA

UNIT OF UTILITY



PRODUCTS

CELLULAR FACTORIES

DEPARTMENT OF ENERGY BIOENERGY RESEARCH CENTER
JOINT BIOENERGY INSTITUTE
PARTNERS: 6 DOE NATIONAL LABS, 6 UNIVERSITIES

BERKELEY LAB

Sandia National Laboratories

Pacific Northwest NATIONAL LABORATORY

BROOKHAVEN NATIONAL LABORATORY

Argonne NATIONAL LABORATORY

UC SANTA BARBARA

Lawrence Livermore National Laboratory

UC San Diego

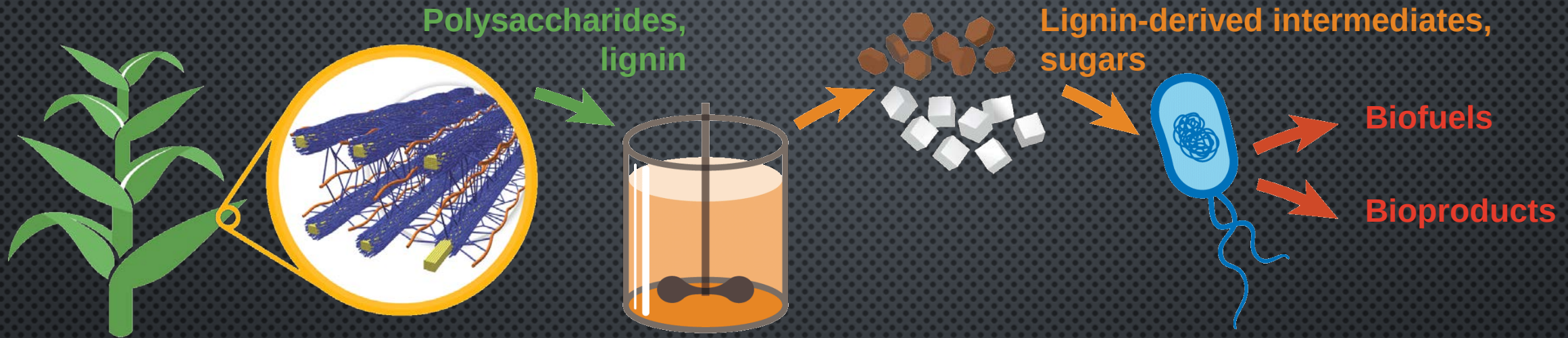
UCDAVIS UNIVERSITY OF CALIFORNIA

Berkeley UNIVERSITY OF CALIFORNIA

IOWA STATE UNIVERSITY

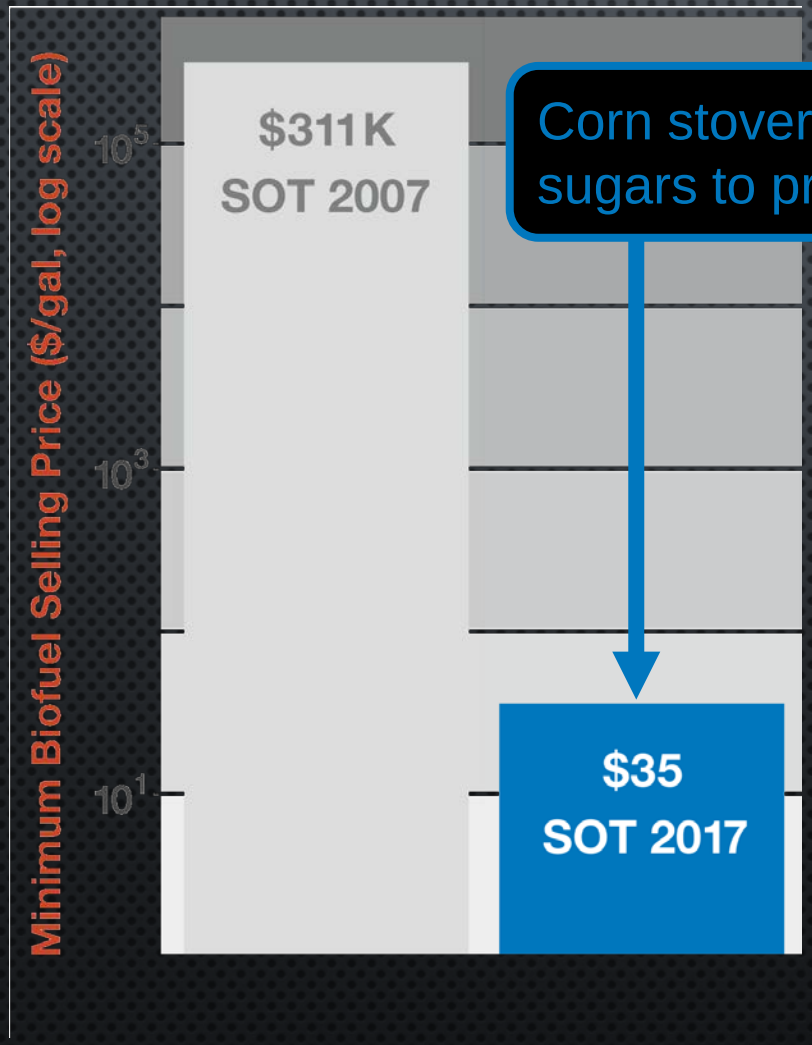
UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources

JBEI'S MISSION



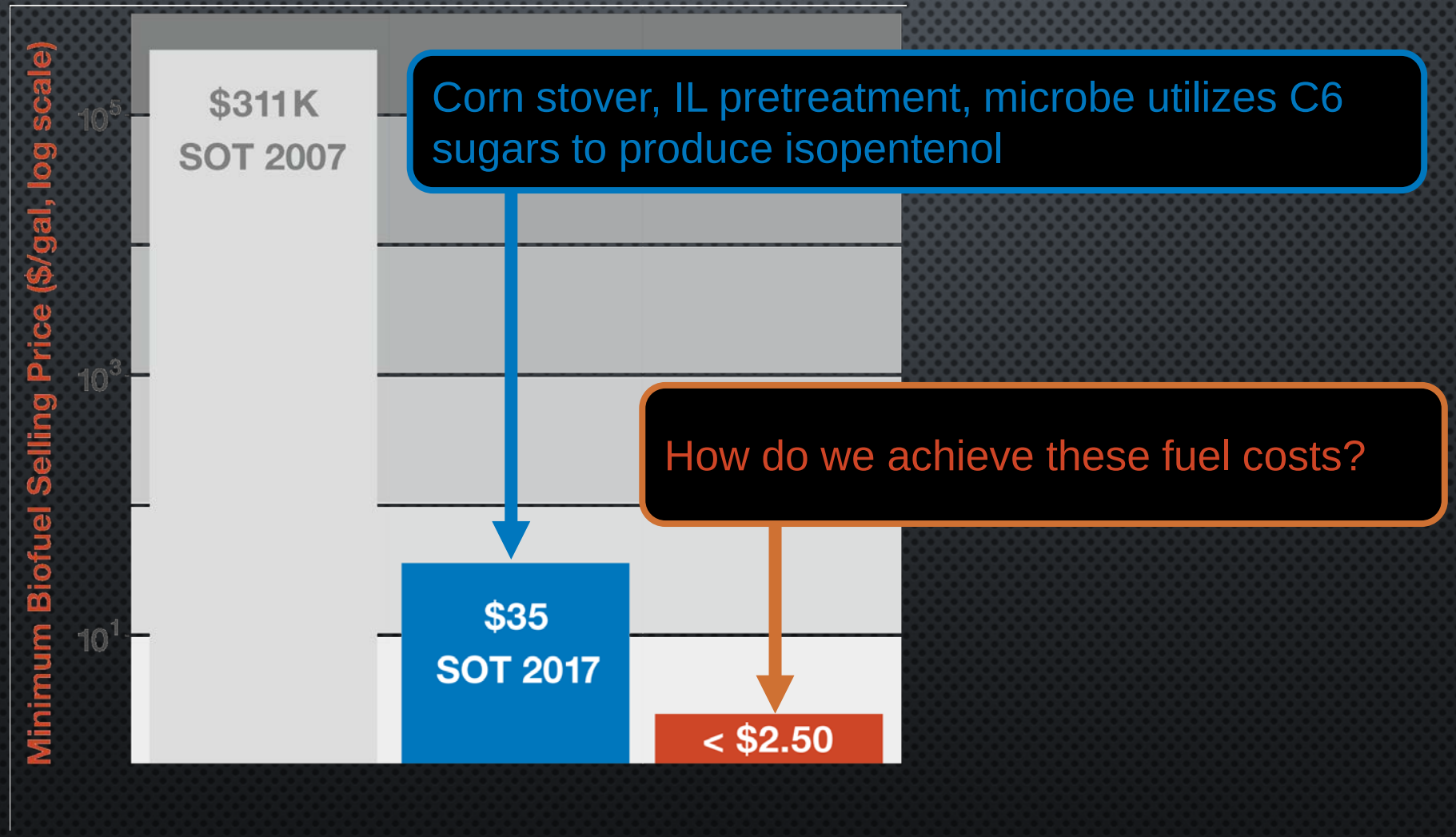
ESTABLISH THE SCIENTIFIC KNOWLEDGE AND NEW TECHNOLOGIES TO TRANSFORM THE MAXIMUM AMOUNT OF CARBON AVAILABLE IN BIOENERGY CROPS INTO BIOFUELS AND BIOPRODUCTS.

DURING THE FIRST TEN YEARS, JBEI'S RESEARCH PROGRAM REDUCED THE FUEL COST 10,000-FOLD

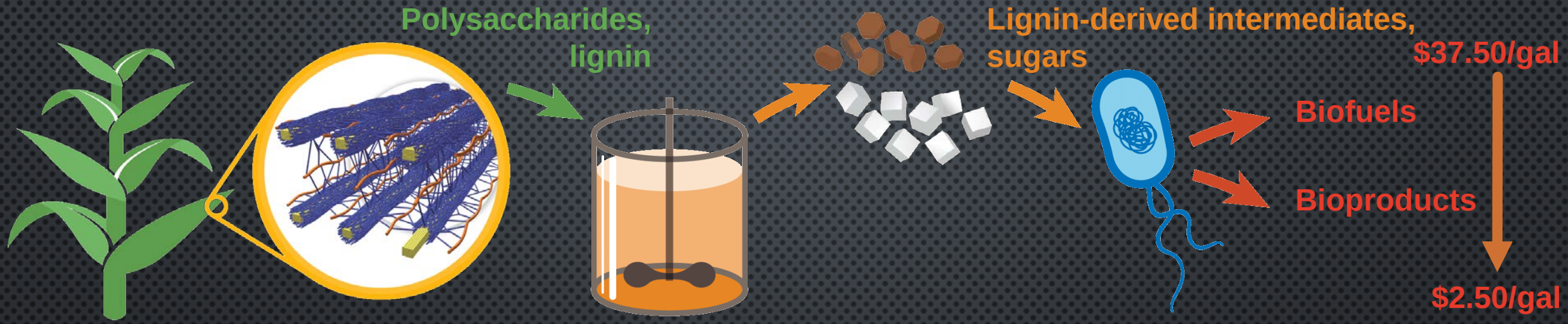


Corn stover, IL pretreatment, microbe utilizes C6 sugars to produce isopentenol

HOW DO WE MAKE BIOFUELS AFFORDABLE?

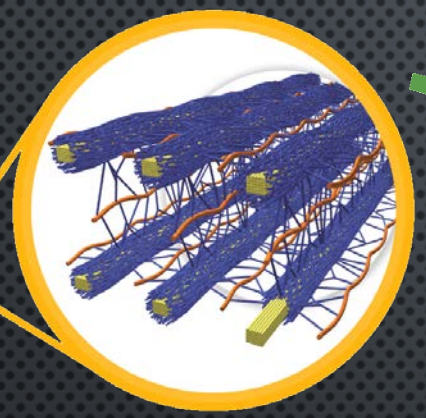


STRATEGIES FOR REDUCING COST

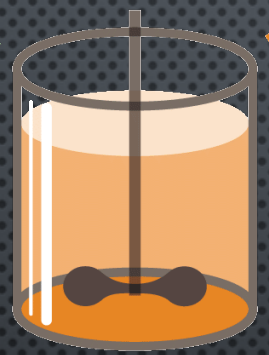


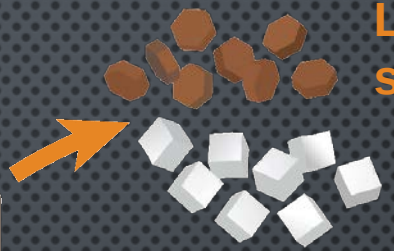
C6/C5 Ratio	Coumaric Lignin	Ensiled Biomass	Solids Loading	IL Loading & Recovery	IL Price	Sugar Yield	Hydrolysate to Bioproduct	C5 Utilization	Biofuel Yield	Lignin Utilization

STRATEGIES FOR REDUCING COST

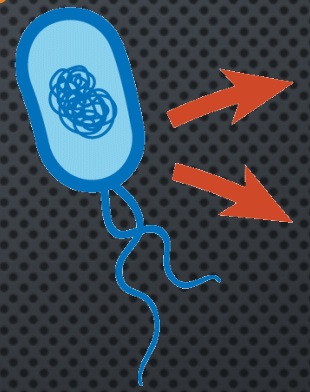


Polysaccharides, lignin





Lignin-derived intermediates, sugars



Biofuels

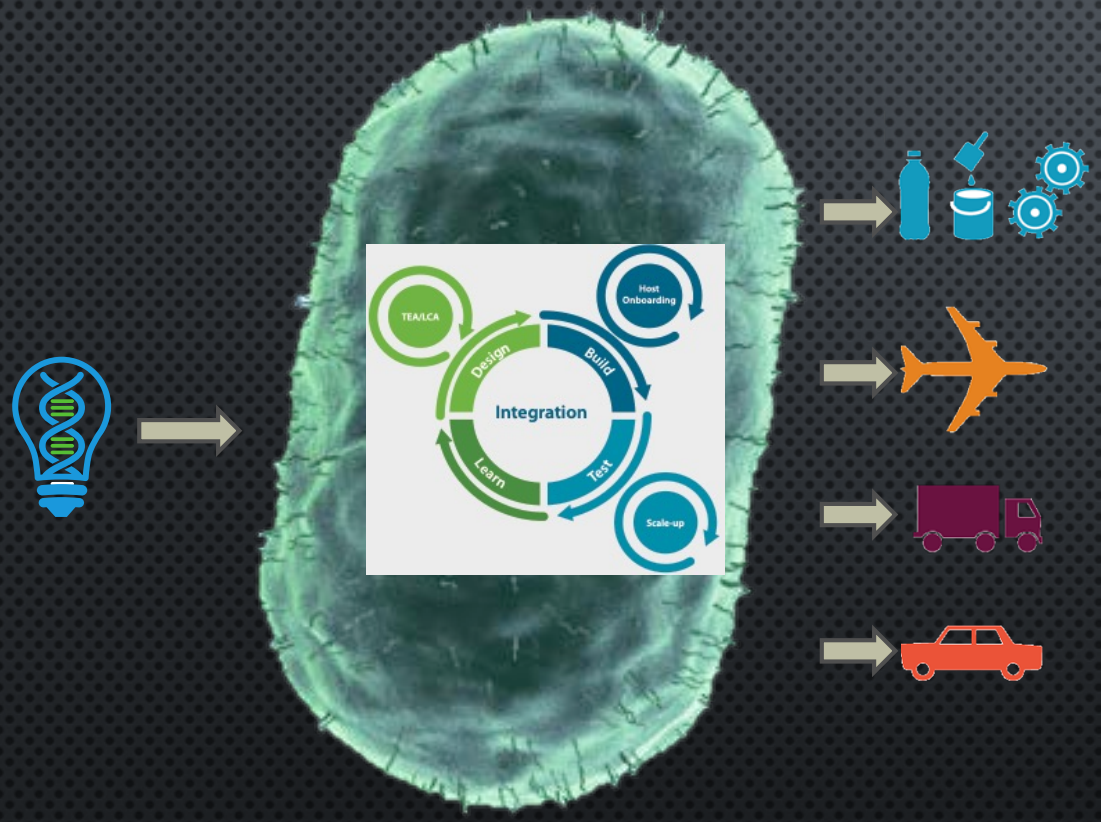
Bioproducts

$37.50/gal

$2.50/gal

C6/C5 Ratio	Coumaric Lignin	Ensiled Biomass	Solids Loading	IL Loading & Recovery	IL Price	Sugar Yield	Hydrolysate to Bioproduct	C5 Util.	Biofuel Yield	Lignin Util.
2	0%	0%	10%	10% & 85%	$2/kg	78%	0%	0%	14 g/g	Onsite energy
$2.10	$8.30	$9.50	$4.20	$5.70	$1.50	$9.50	$10.58	$12.50	$20.20	$29.80
5	50%	100%	30%	2.5% & 99%	$1/kg	95%	10%	100%	30 g/g	$10/kg bioproduct

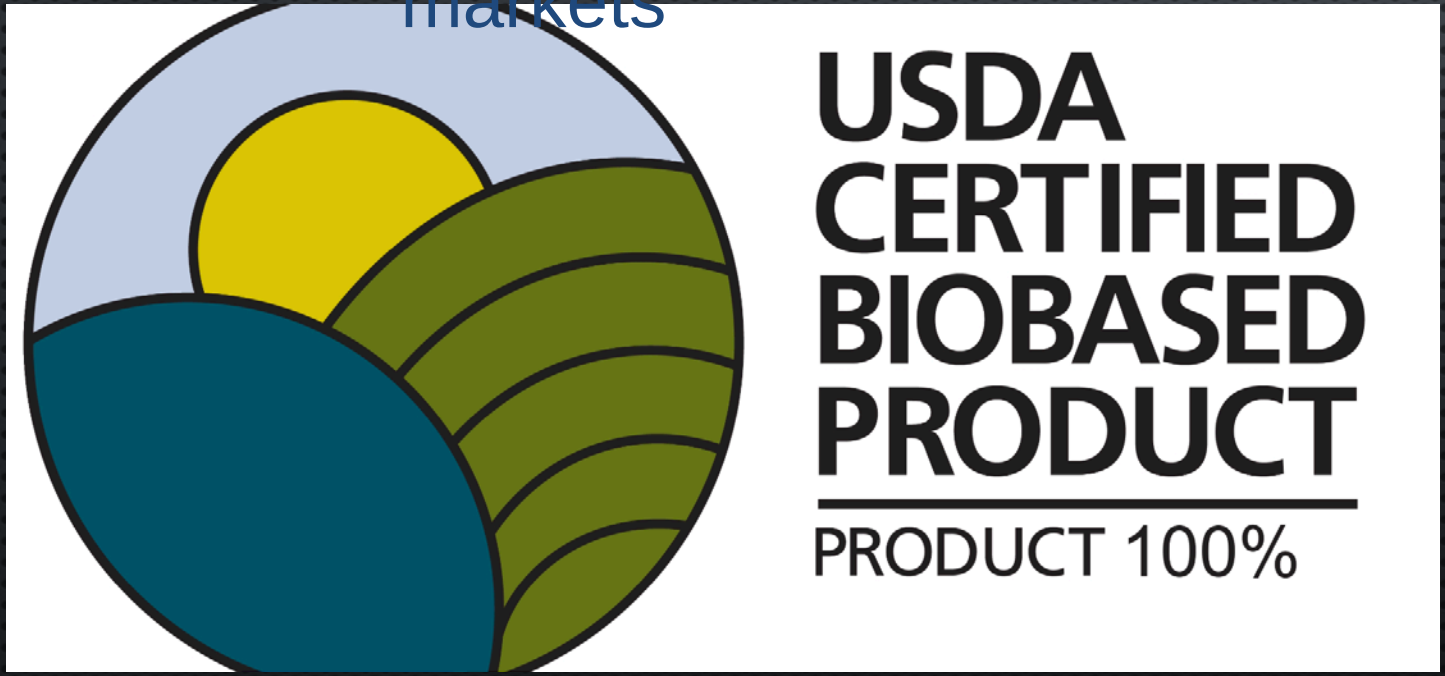
REALIZING THE PROMISE OF BIOMANUFACTURING



- Enhance partnerships with USDA
- Establish biofoundry platform infrastructure
- Develop smart bioreactors
- Develop flexible feedstock systems

USDA LEADERSHIP
BIOBASED PRODUCT PROCUREMENT: A POLICY PULL

USDA BioPreferred: Federal procurement of certified biobased products provides certainty for new markets



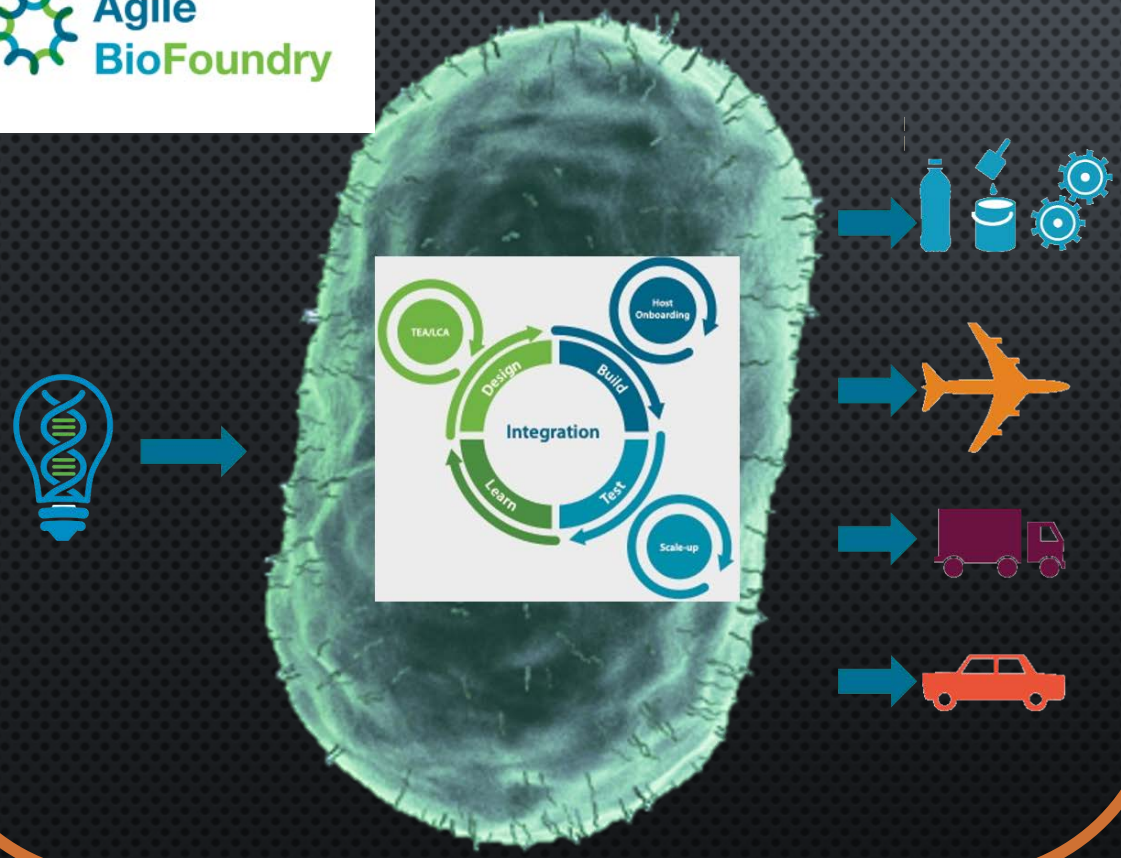
Two components:

- Certified products
- Federal procurement mandate

INFRASTRUCTURE FOR BIOMANUFACTURING

BIOFOUNDRIES – platform technologies for biological engineering

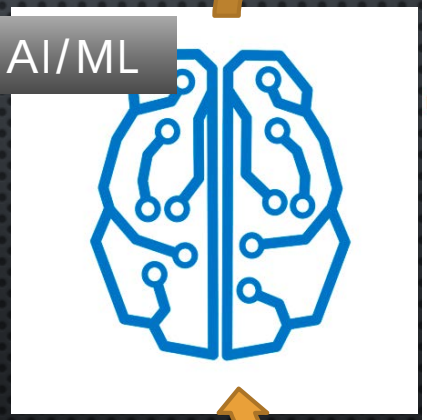
Agile BioFoundry



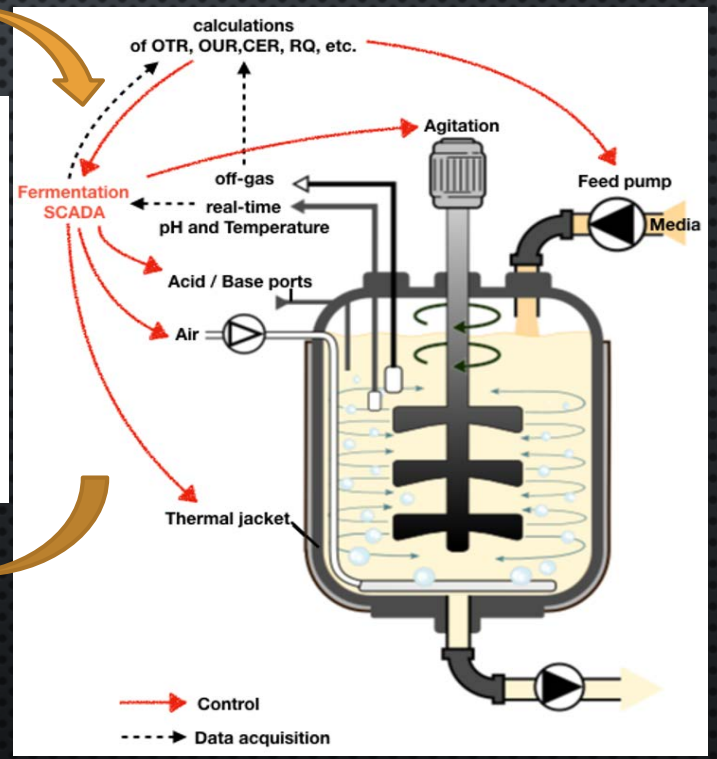
INTELLIGENT BIOREACTORS – next generation sensors and real-time machine learning to adjust reactors to drive productivity of biomanufacturing

Automated controls

AI/ML



Data



FLEXIBLE FEEDSTOCK SYSTEMS ARE NEEDED: EUROPEAN UNION RESOURCE EFFICIENCY EXAMPLES

- INDUSTRIAL-SCALE COMPOSTING OF WINE DREGS IN ITALY
- CHEESE/WHEY WASTE IN IRELAND FOR POLYLACTIC ACID FOR BIOPLASTIC
- BREAD WASTE IN NETHERLANDS FOR SUCCINIC ACID, A PRECURSOR FOR MANY CHEMICALS
- WHISKEY WASTE IN SCOTLAND FOR BUTANOL, AN ADVANCED BIOFUEL
- WASTE GAS FERMENTATION IN BELGIUM FOR ETHANOL, A FUEL ADDITIVE

Thank You

Katy Christiansen
Michael Espinosa
Jay Keasling
Blake Simmons