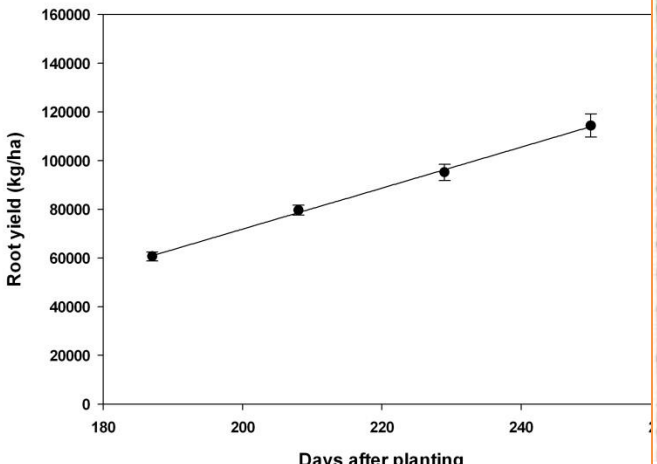
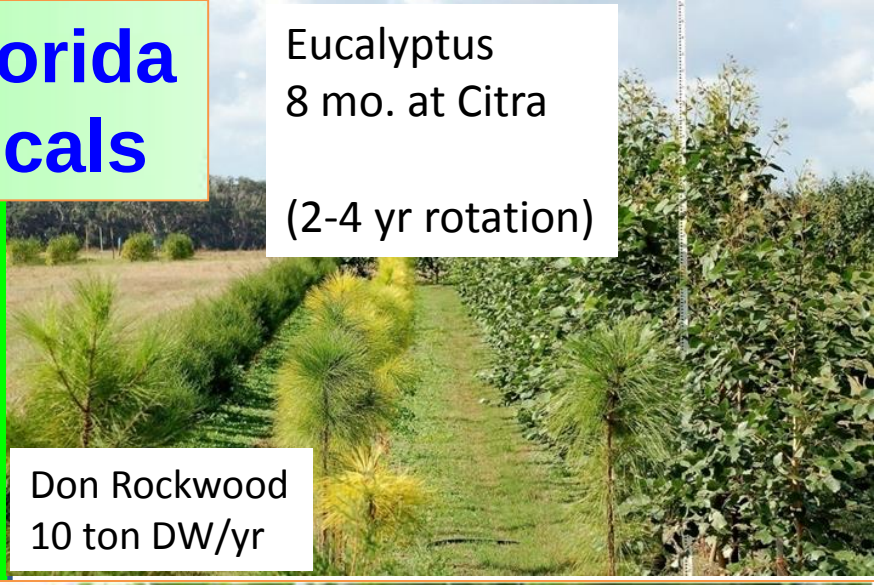
Replacing Petroleum with Florida Renewable Fuels and Chemicals

52 wet tons/acre, Tifton GA
~ 9-10 tons sugar/acre

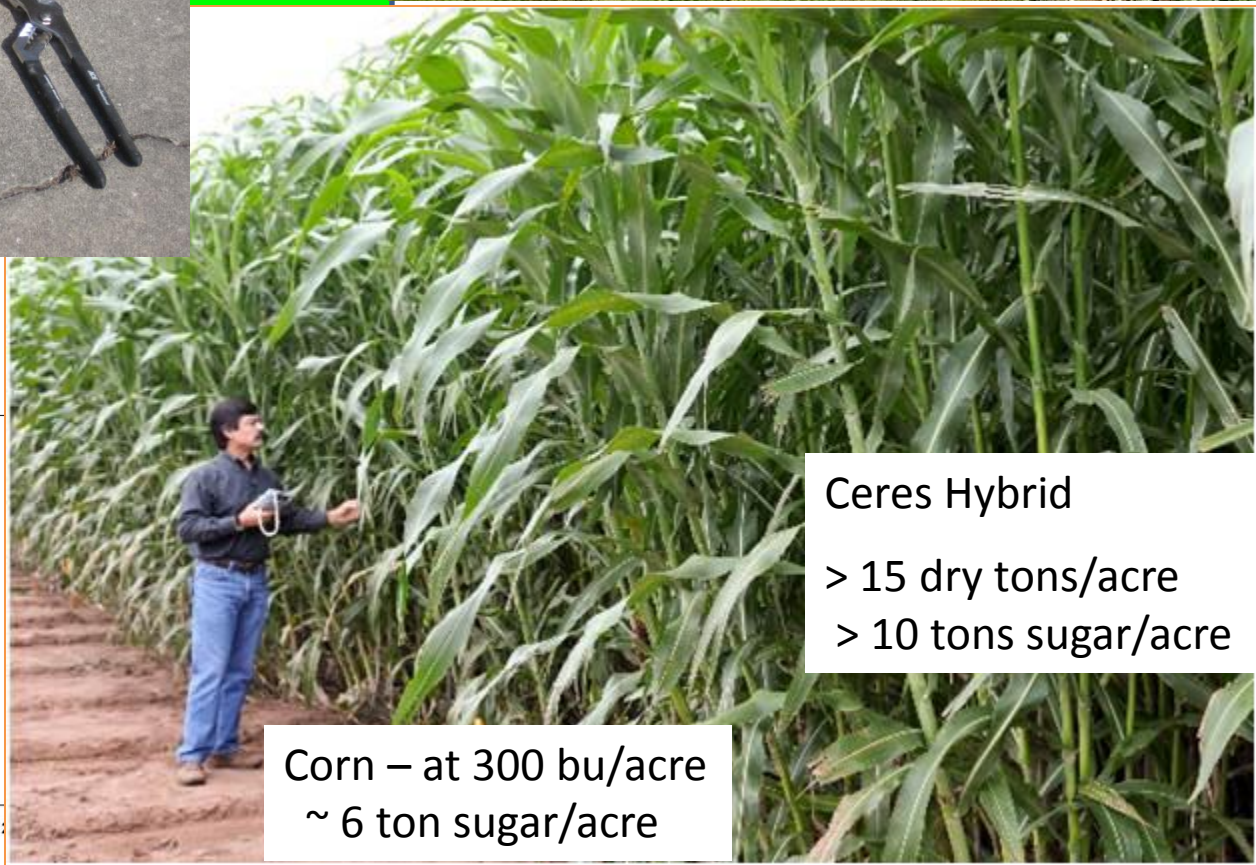


Eucalyptus
8 mo. at Citra

(2-4 yr rotation)



Don Rockwood
10 ton DW/yr

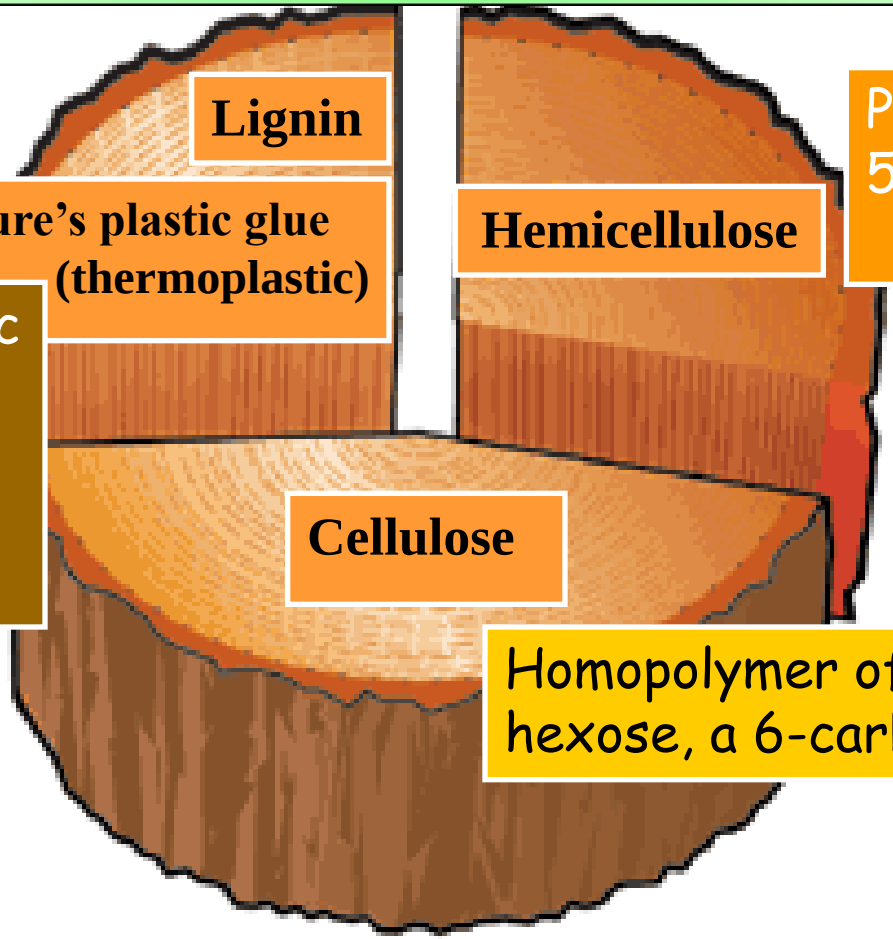


Ceres Hybrid

> 15 dry tons/acre
> 10 tons sugar/acre

Corn – at 300 bu/acre
~ 6 ton sugar/acre

Woody Biomass ~60-70% Carbohydrate → sugars
Sweet Sorghum/sugar beets – 50% DW sugar
(Corn grain ~70% starch; plant ~ 40% dry wt starch)

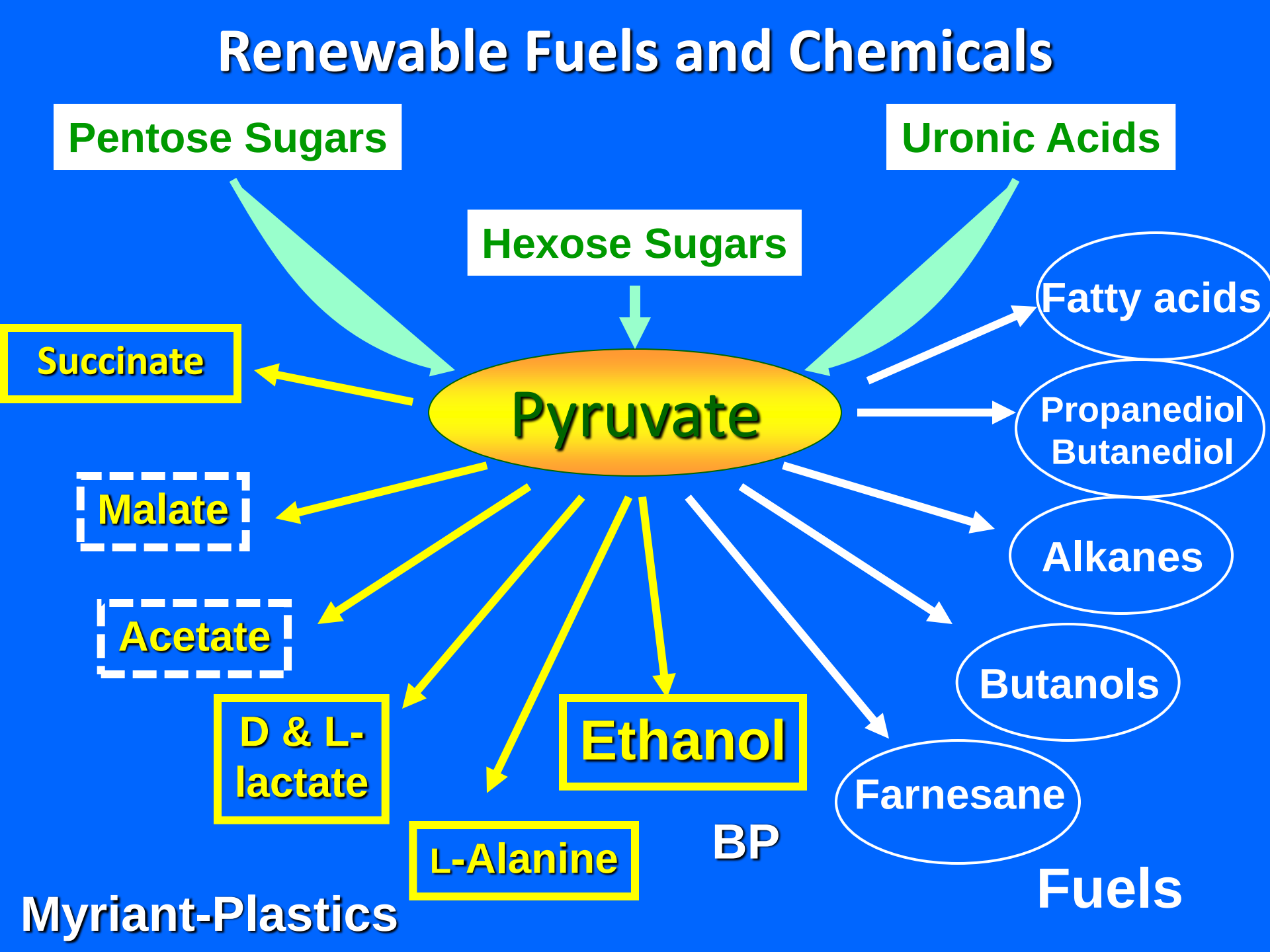


Primarily pentoses, 5-carbon sugars also 6-C sugars

Black thermoplastic that can be burned to provide energy for ethanol production.

Homopolymer of glucose, hexose, a 6-carbon sugar.

Composition of Lignocellulosic Biomass


Renewable Fuels and Chemicals
Pentose Sugars
Uronic Acids
Hexose Sugars
Fatty acids
Succinate
Pyruvate
Propanediol
Butanediol
Malate
Alkanes
Acetate
Butanols
D & L-
lactate
Ethanol
Farnesane
L-Alanine
BP
Fuels
Myriant-Plastics

Cellulosic Sugars → Commercial D-lactic acid

PURAC

BIOPLASTIC

PURAC PDLA

BENEFITS

PLA plastics with HDT B (0.45MPa) values >100°C possible

New applications with better heat stability possible

More efficient in injection molded PLA

Bulk density of PLA unchanged

IMPROVING HEAT-RESISTANCE OF PLA USING POLY(D-LACTIDE)

PLA (Poly L-Lactide) is a bioplastic derived from annually renewable carbohydrate resources. PLA has conquered a promising market volume and is growing fast. The semi-crystalline biopolymer has mechanical properties comparable to polystyrene and is being used as an eco-friendly packaging material. However, the adoption and growth of PLA is currently limited by a number of technical challenges. The most prominent material property of PLA that needs improvement is the poor heat resistance. Heat-deformation of PLA already takes place at temperatures below 50°C. This poses major issues in storage, transport and use of pallets and finished articles. A solution for the low heat-stability while maintaining transparency would accelerate the acceptance of PLA and widen the application window.

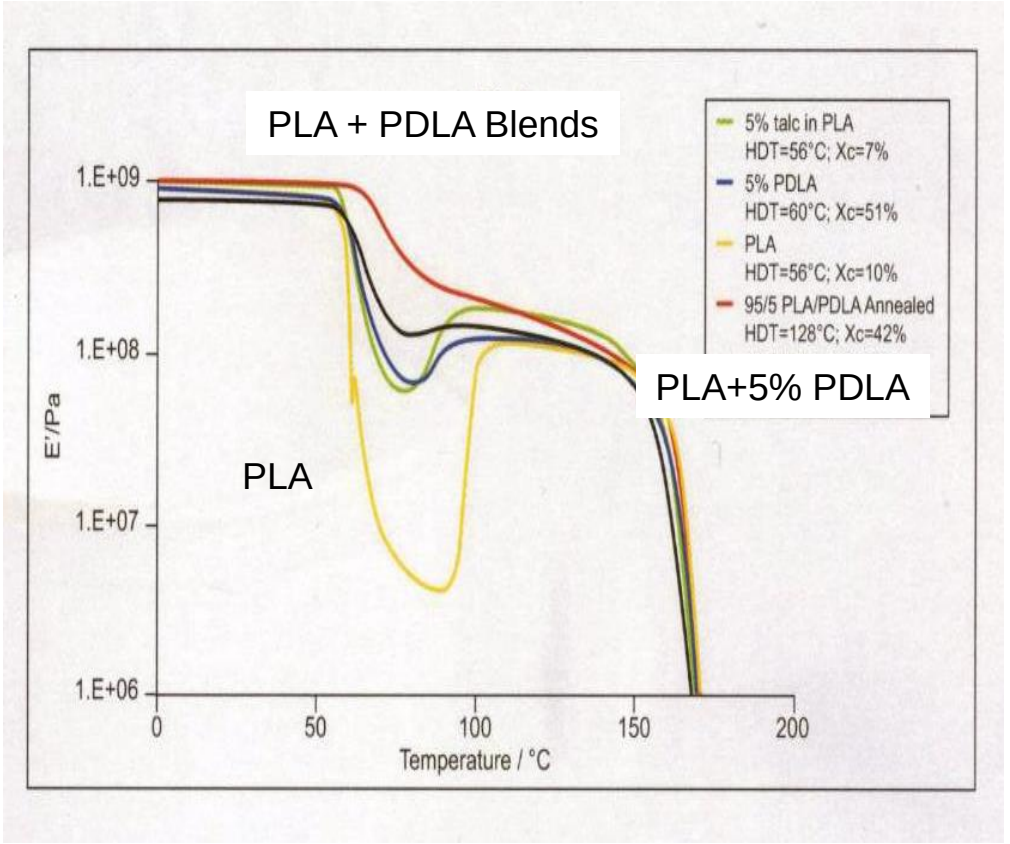
Six years of innovative research and development at PURAC have resulted in the commercial availability of D(-)-lactic acid and D-lactide, the monomer that enables large-scale utilization of PDLA (Poly D-Lactide). Melt-mixing PLA in the presence of PDLA produces in-situ sc-PLA crystallites, which act as heterogeneous nuclei for PLA, resulting in faster crystallization and higher crystallinity upon cooling from the melt. Consequently, the material exhibits better mechanical and thermal properties, like lower shrinkage and improved heat resistance (HDT). A 50/50 mixture of PLLA and PDLA, the homopolymers of L(+)- and D(-)-lactic acid, produces a semi-crystalline polymer with a melting temperature of 215-230°C, i.e., 50-80°C higher than PLA packaging grades. This sc-PLA (semi-crystalline PLA) is a suitable biopolymer for melt-spun fibers and biaxially stretched film.

About PURAC

- Global presence
- Efficient and secure supply chain
- Natural products with high quality standards
- Dedicated application expertise for customers

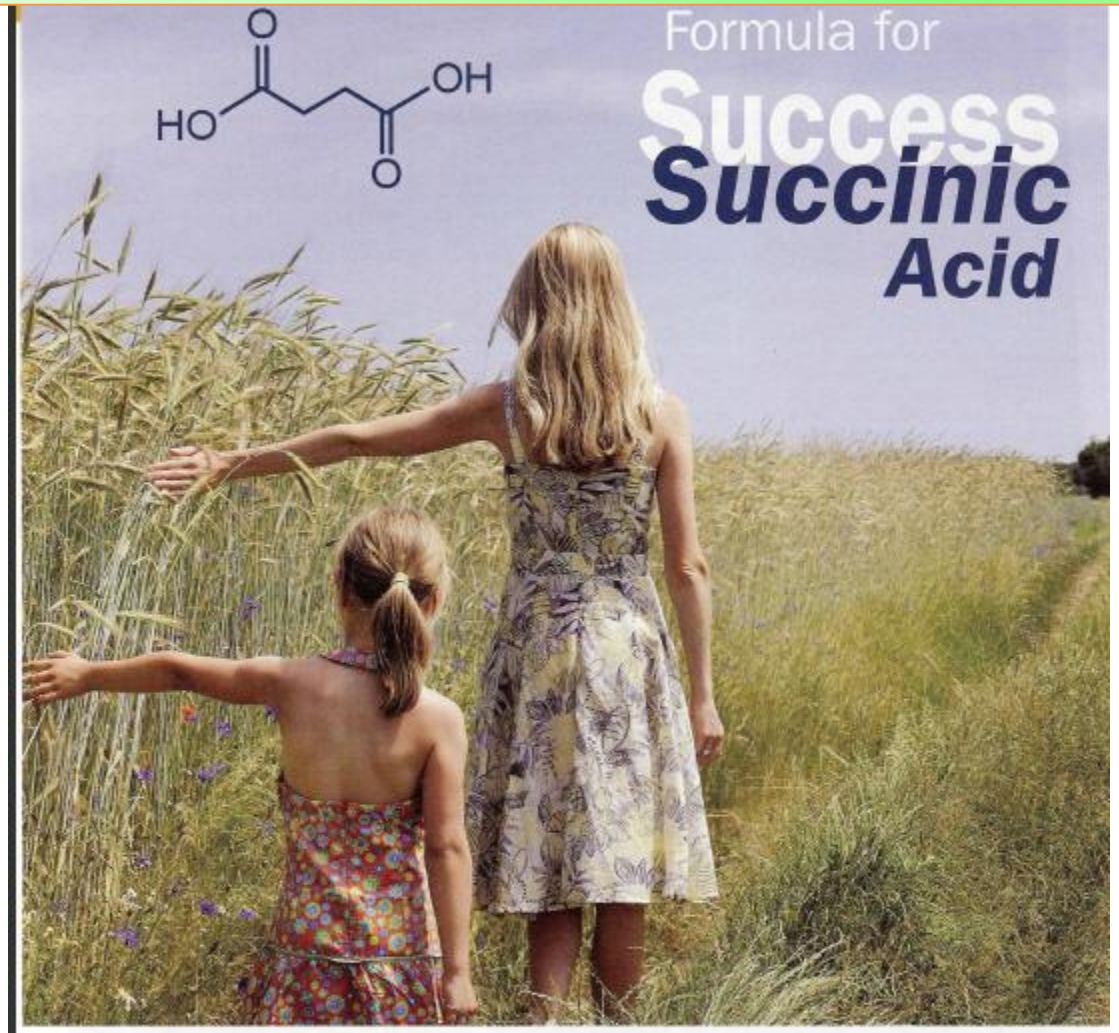
BioEnergy International, LLC
Now Myriant Technologies

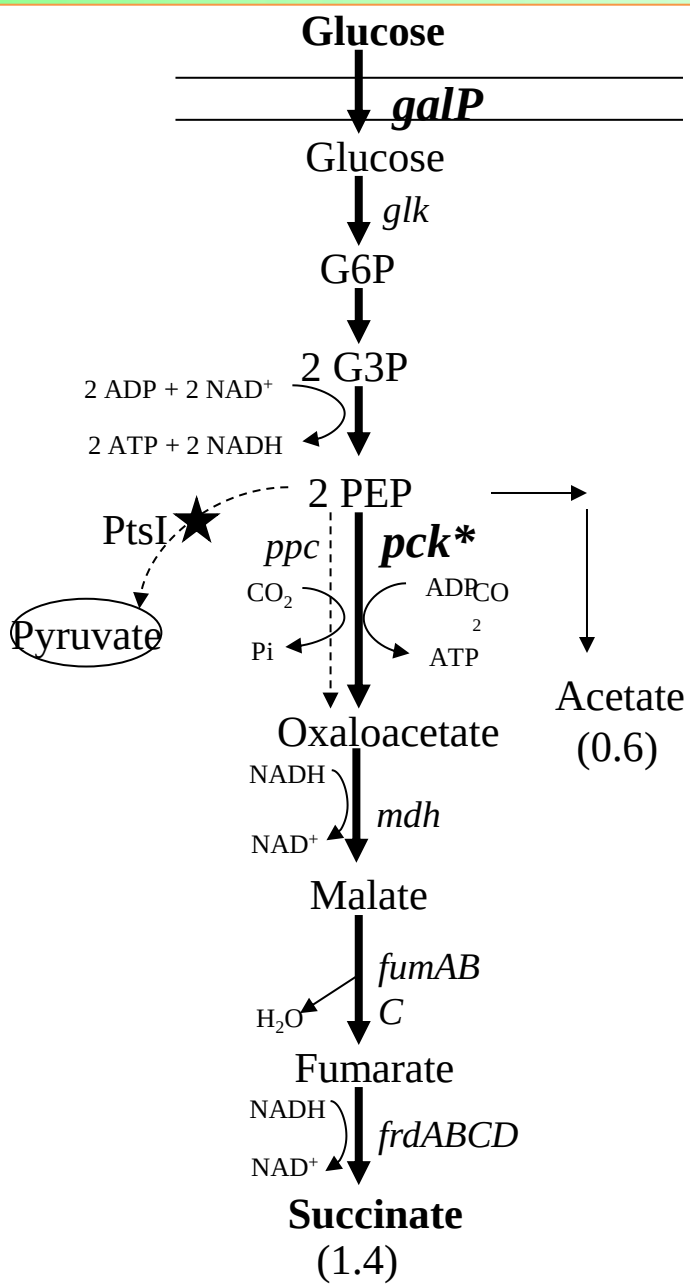
Sublicensed to Purac



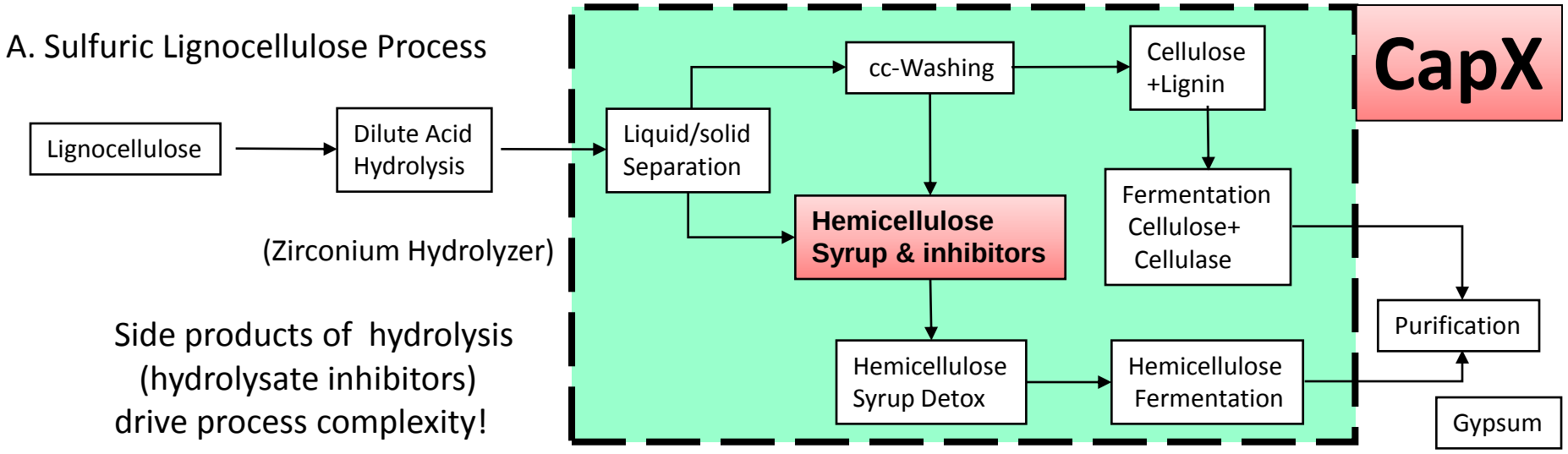
UF UNIVERSITY of FLORIDA IFAS

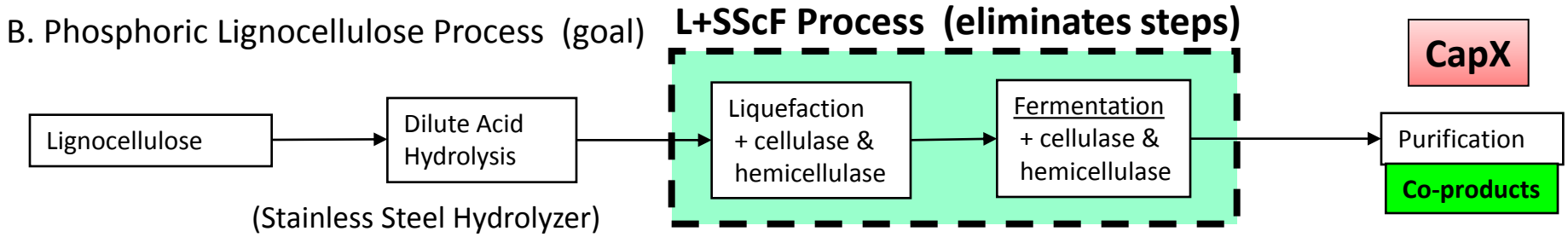
Sec. Vilsack announced Rural Development loan guarantee to Myriant (UF License) Starch to succinate plant, NE Louisiana, grain sorghum (6/18/2012).

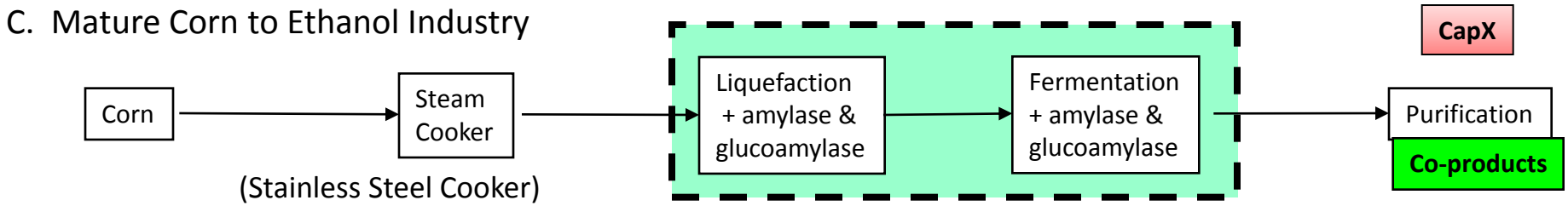




Comparison of conversion processes







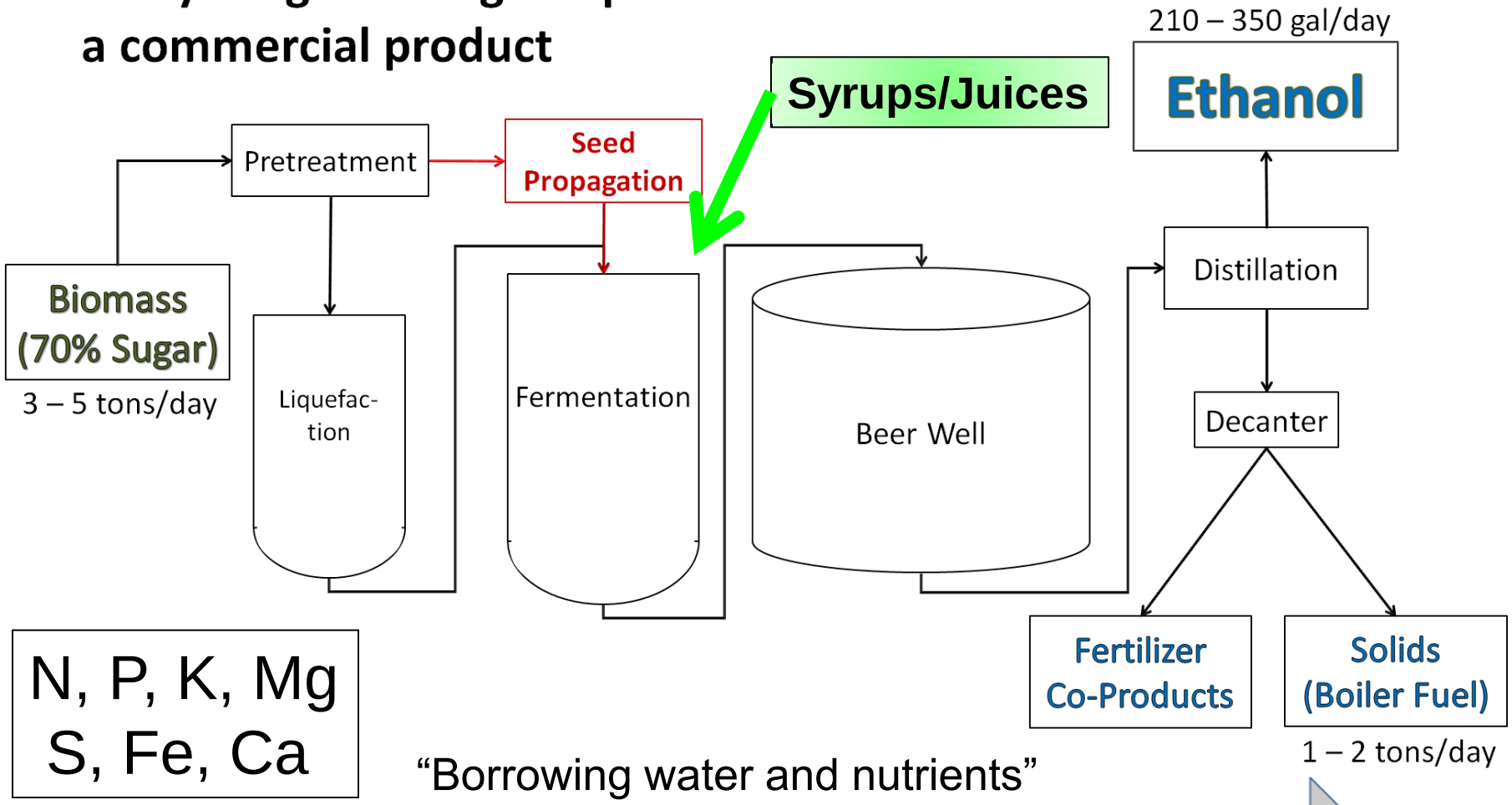
Phase I: State Board of Regents -Legislature/DOE EERE
Campus Biofuels Lab - Unit Ops (50 lb batches)





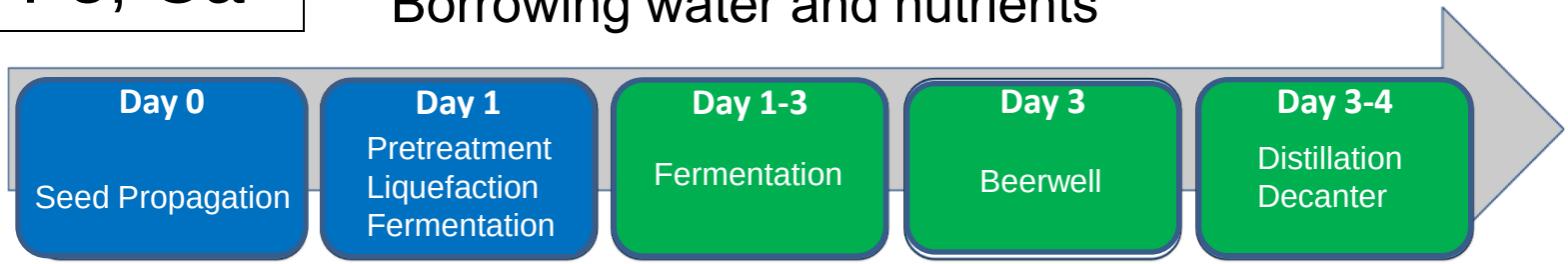


Everything entering the process leaves as a commercial product



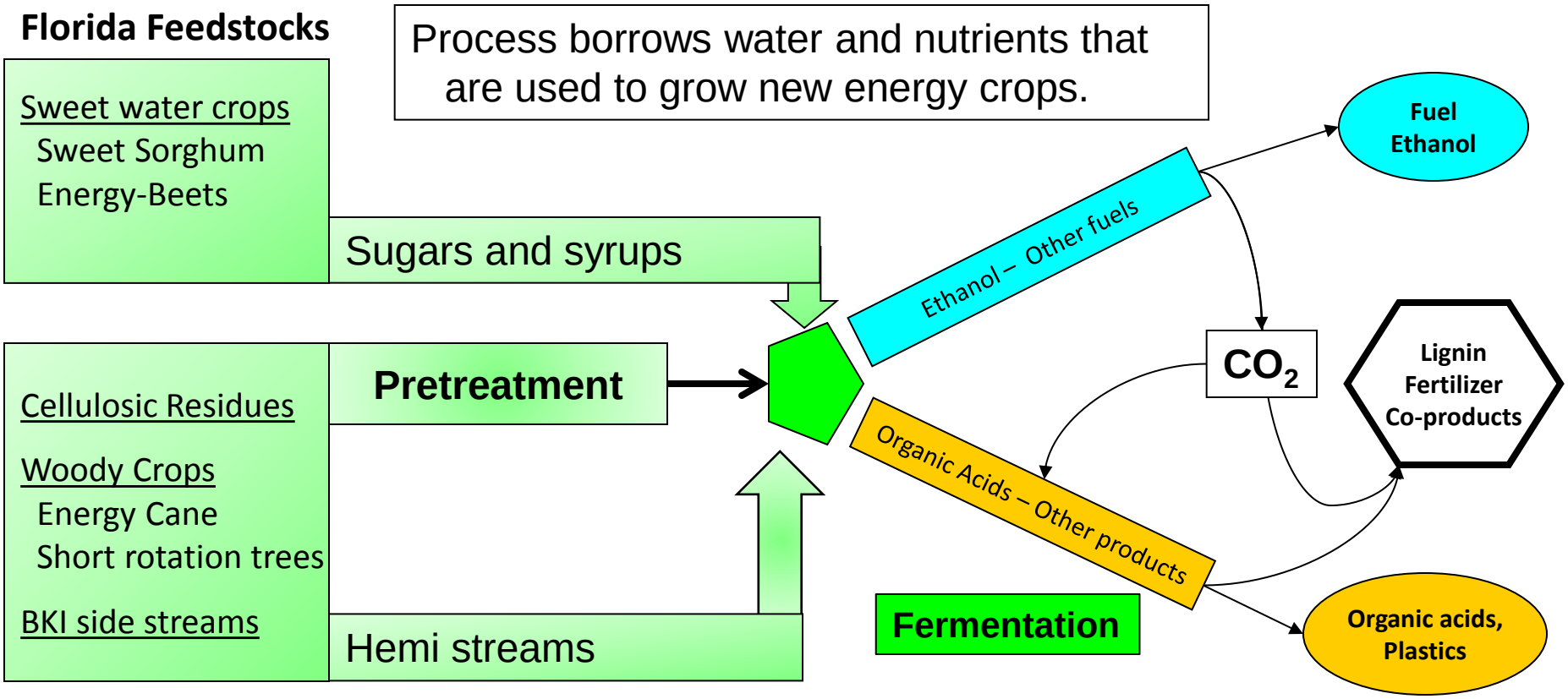
N, P, K, Mg
S, Fe, Ca

"Borrowing water and nutrients"



UF Stan Mayfield Biorefinery Pilot Plant

hosted by Buckeye Technologies, Perry FL



Maximum Capacity per Day

300-600 gal ethanol/day or 5,000 lb of organic acids

UF UNIVERSITY of FLORIDA IFAS

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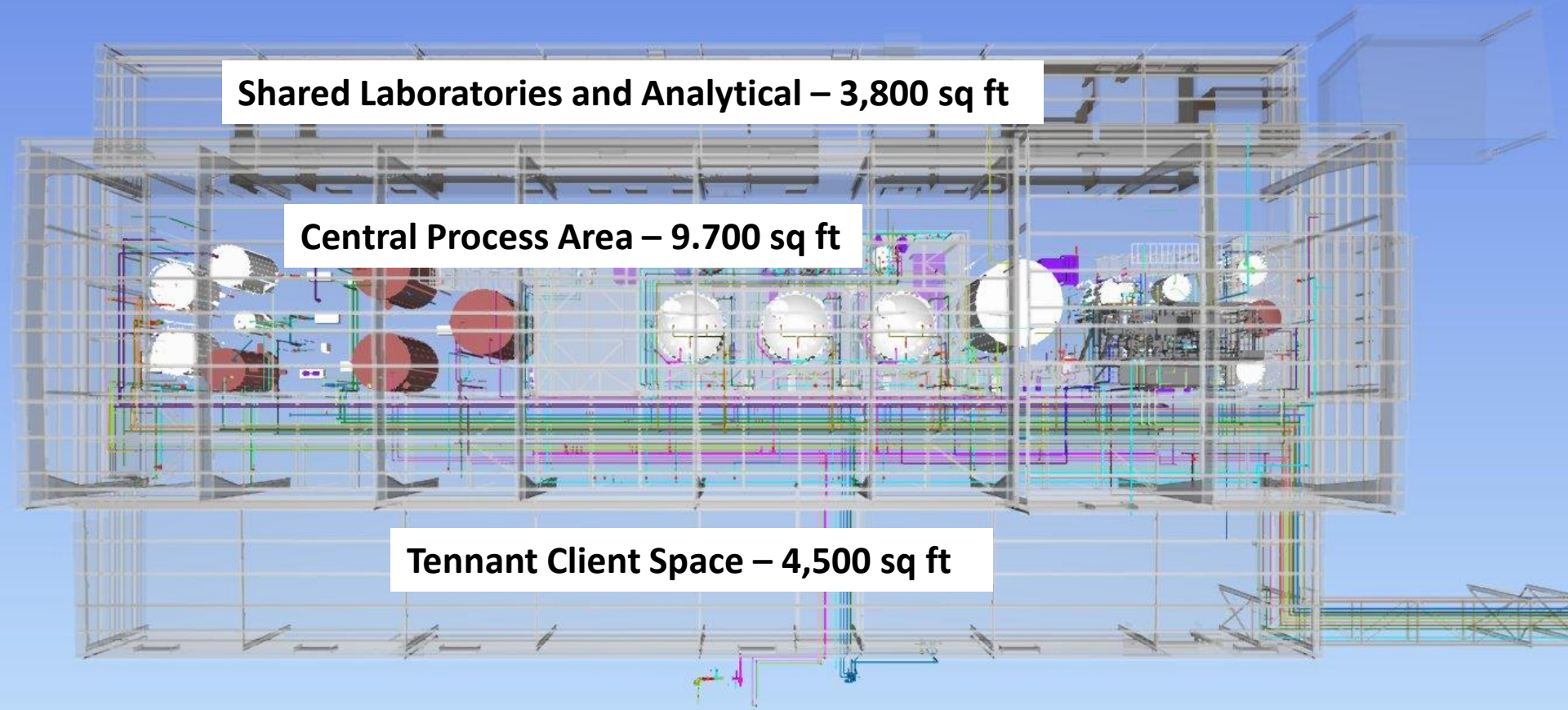

18,000 sq ft facility + office building

UF Stan Mayfield Biorefinery Pilot Plant

The Next 6 months

	Status	Est. Completion
Complete Calibrations (pumps, mixing, level controls, volumes, pH, etc.)	80%	July
SOPs	60%	August
Commissioning of Systems (Pretreatment, liquefaction, seed train, CIP, decanter, prep tank, sterility testing, thermal inactivation, fermentation, and distillation)	20%	September
Startup		Sept/Oct
Fully Operational		Dec. 2012

We Need Florida Feedstocks

To attract bio-industry, we need to identify a reliable feedstock.

We need Florida Crops that can compete with corn – providing starch or sugar.

Crops must serve as near year-round feedstocks.

We need to know what to grow, and to provide farming guidance for:
cost effective cultivation, harvesting, storage, and processing.

Cellulosic residues/crops represent a value added component for industries
based on starch or sugars, --- until cellulase enzyme cost can be reduced.

We are proposing a UF-DACS-USDA Partnership ($2 mil/ 2 yr DACS, UF match)

Agronomics, best practices, breeding, and feedstocks for testing – UF & USDA

Process development, processing, and demonstration at pilot scale – UF & DACS

No single Florida sugar crop will support year round commercial operation.
Dual crop strategy + cellulosics. Storage issues will ensure local processing and use.

Candidates: Sweet Sorghum, Energy-Beets, Energy Cane
and short rotation trees (Poplar, Eucalyptus, Pine, Cottonwood, etc.)

Higher value products targeted -- solvents, plastics, as well as fuels.

Not even fully operational, the Stan Mayfield Biorefinery is already attracting grant dollars and employment to Florida.

2011 USDA BRDI, Dr. Vermerris -Sweet Sorghum (UF / US Envirofuels) – 5 yr, $7.5 mil total
Proposal ranked in the top 3% of applicants (83). Approx. $400,000 at Biorefinery.

2012 USDA AFRI , Dr. Erickson -Sillage as fertilizer co-product for sweet sorghum – 3 yr, $500,000
Proposal ranked in top 1% of applicants (87). Approx. $100,000 at Biorefinery.

2012 - DOE US-India grant/industry grant – Dr. Pullipallilimani -- 5 yr, $5,000,000 total
Much of my work ($1 mil total during 5 yr) will use the Biorefinery.

UF-lead with Eastman, Buckeye – Dr. Shanmugam - 3 yr, $6,000,000 total Fed
Project Biosolve -Preproposal approved, writing full proposal
Approximately $1.3 mil direct will be used at the Biorefinery, UF total $3.5 mil

Over $13 mil in newly funded grants has been enabled by the Stan Mayfield Biorefinery, even before completion.

Biorefinery operation is also being used as a match to leveraged Federal Awards.

Visits from Potential Clients/Partners

Sugar to Bioproduct Companies

Itaconix (BKI host) detergents and chemicals

Eastman Chemicals (BKI host) solvents, paints, and plastics, 4 visits – **Fed Grant pending**

Myriant Technologies (UF licensee) bioplastics and chemicals, 4 visits

Qteros – biofuel production, 2 visits ; Cobalt Technologies, butanol

Chemtex/Gruppo M&G – fuel ethanol, 3 visits

New Forest Industries, Canada, Miss State -- Wood pellets and biodiesel --**Grant pending**

SCF Processing Ltd, Ireland – composite plastics, extrusion technology (lignin and fiber)

US Envirofuels, Riverview, FL -- ethanol– **Fed Grant funded, sweet sorghum**

Florida Crystals, West Palm Beach, FL – specialty sugar products

American Process (Alpena GA project) – ethanol, butanol

DOE U.S.-India Joint Clean Energy Research and Development Center – **Fed Grant funded**

Enzyme Company and Engineering Company

Novozyme – enzyme production for starch and cellulosics, 2 visits

Benchmark Design, St. Petersburg, FL; Dyadic (planned), Jupiter, FL

Education and Outreach

Bioenergy crop companies/Foresters --- Clients for co-product testing (fertilizer)

Ceres, Inc, Thousand Oaks, CA -- blade plants 10-15 t/acre

Chromatin, Inc, Champagne, IL – blade plants

Arbogen, Ridgeville, SC -- More wood from less land. 2-5 yr rotations, >10 t/acre

3 Forestry organizations (Florida Association, SE regional, UF-Industry consortium)

Additional Guests

Ribbon cutting ceremony – approximately 200 visitors

State Chamber of Commerce

SE Regional Biomass Director, Dr. Anderson, USDA-ARS Tifton Ga

State Representative Debbie Mayfield

State Representative Bill Montford

Florida Manufacturers Association (Nancy Stephens, director and Candy Munz)

BKI tours (Michele Curtis & Clay Bethea) of facilities with guests


Gravity!
Dr. Nieves
Mr. Hoffman
Dr. Geddes
Lonnie O. Ingram
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Ingram@ufl.edu
352/392-8176
Thank you