Speakers

John S. Russin
Vice Chancellor, LSU Agricultural Center
Feedstock

Brice Dally
R&D Manager, Virent
Conversion Technology

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Aviation Fuels Research Engineer, Shell Global Solutions
Jet Fuel

SUSTAINABLE BIOPRODUCTS INITIATIVE

A Regional Program for Production of Multiple Agricultural Feedstocks and Processing to Biofuels and Biobased Chemicals

John S. Russin
Vice Chancellor
LSU Agricultural Center

USDA-NIFA Award 2011.69005.30515

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USDA AFRI
Regional Bioenergy Projects

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11 Louisiana Sugar Mills Operate 3 – 4 Months

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> 650K Tons Bagasse Annually

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Designated Feedstocks

Energycane
September – March

Sweet Sorghum
July – October

Existing: bagasse, syrup, molasses

Designated Feedstocks

Project Goals

- Diverse feedstock streams of biomass, sugar syrup
- Year-round supply

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Many Partners

VIRENT

Power of Processes

JOHN DEERE

GENENCOR®
A Danisco Division

ENVIROSCAPES
ECOLOGICAL CONSULTING, LLC

Optinol

Sugar Cane Growers
Cooperative Of Florida

Ceres

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Many Partners

Mississippi State University

University of Kentucky

Southern University Agricultural & Mechanical College

LSU AgCenter Research · Extension · Teaching

The University of Arkansas at Monticello

The University of Wisconsin Madison

USDA Agricultural Research Service www.ars.usda.gov

> 60 different scientists and support staff

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Energycane

Sugarcane – a hybrid,
~ perennial

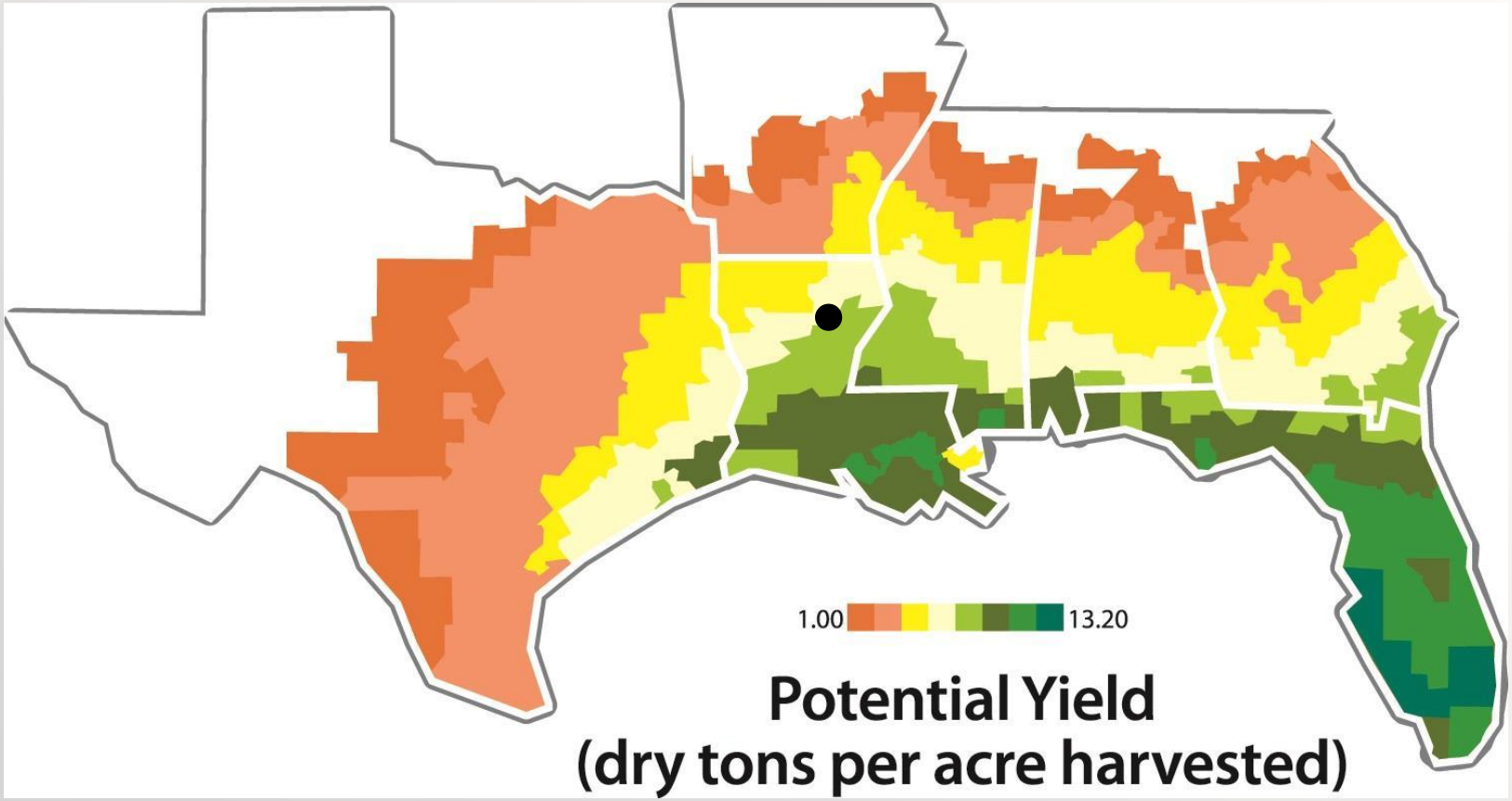
High fiber, low sugar

USDA ARS Houma,
LSU AgCenter

Low inputs, longevity

New varieties, markers,
cold tolerance

Energycane Yield Potential



Energycane Yield Potential

Sweet Sorghum

Annual

- Juice – syrup
- Seeds – starch
- Stalks – biomass

Maturity 90 – 150 days

Much of eastern U.S.

Ceres, LSU AgCenter

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Sweet Sorghum Inputs

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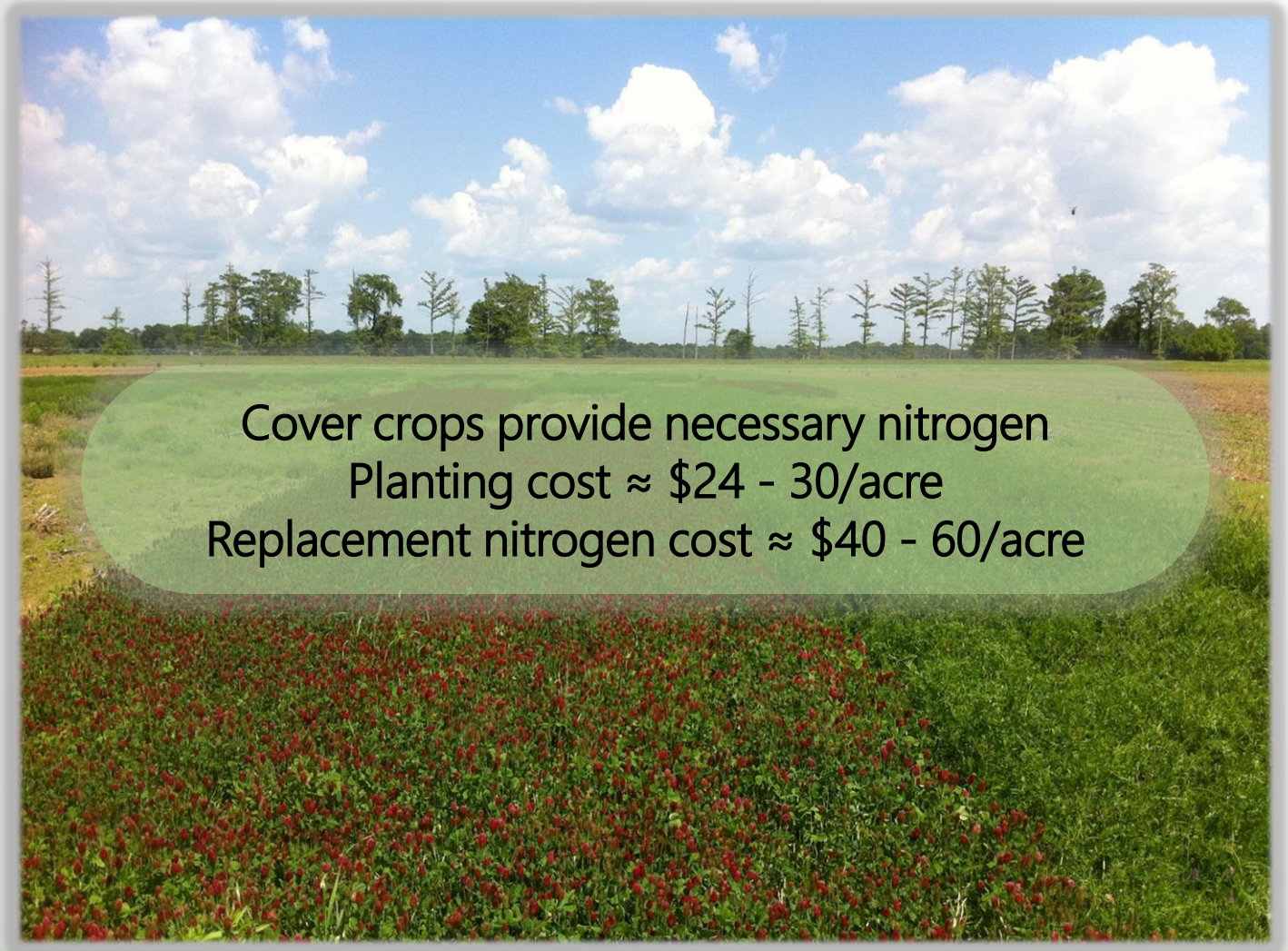
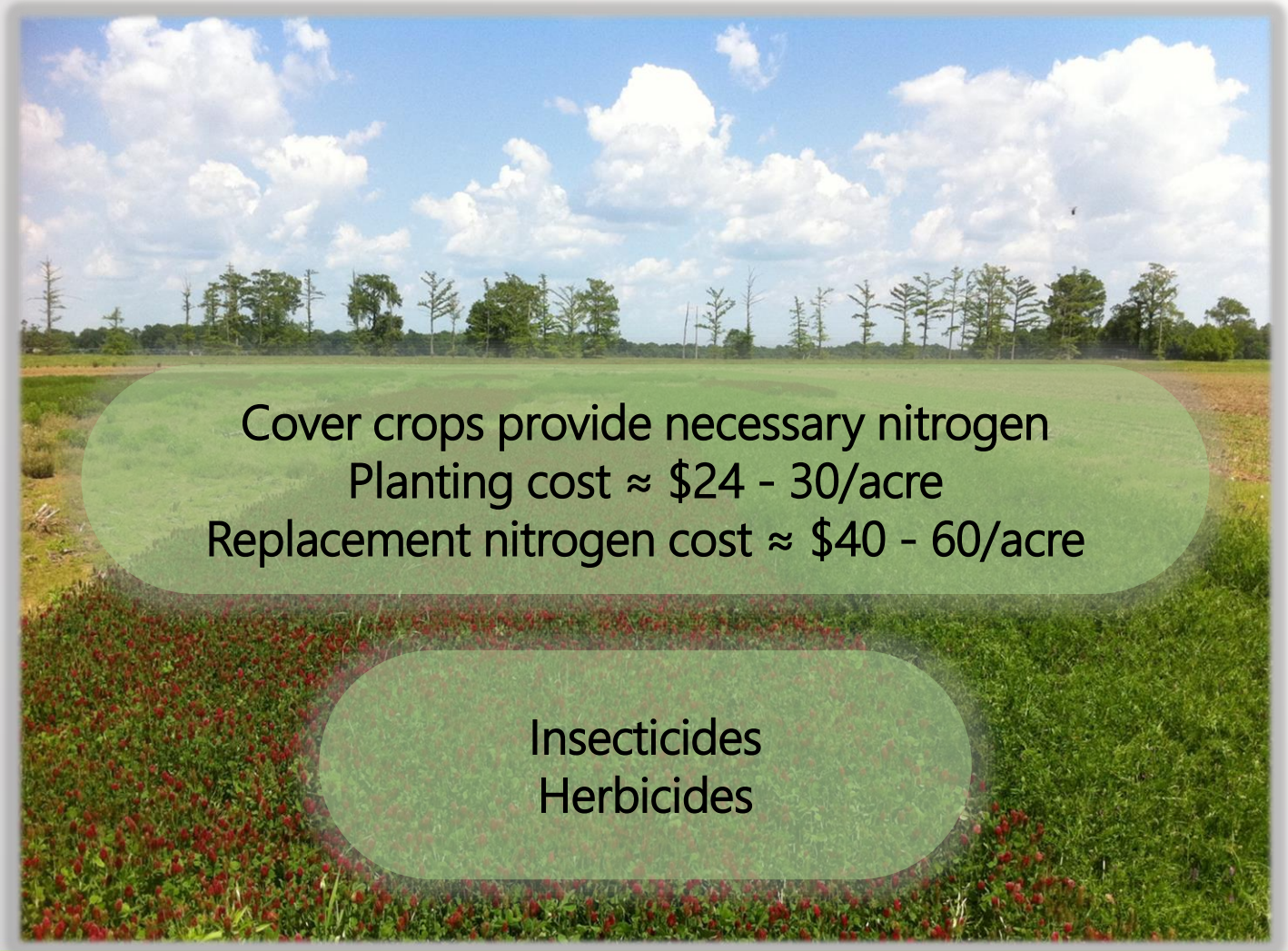
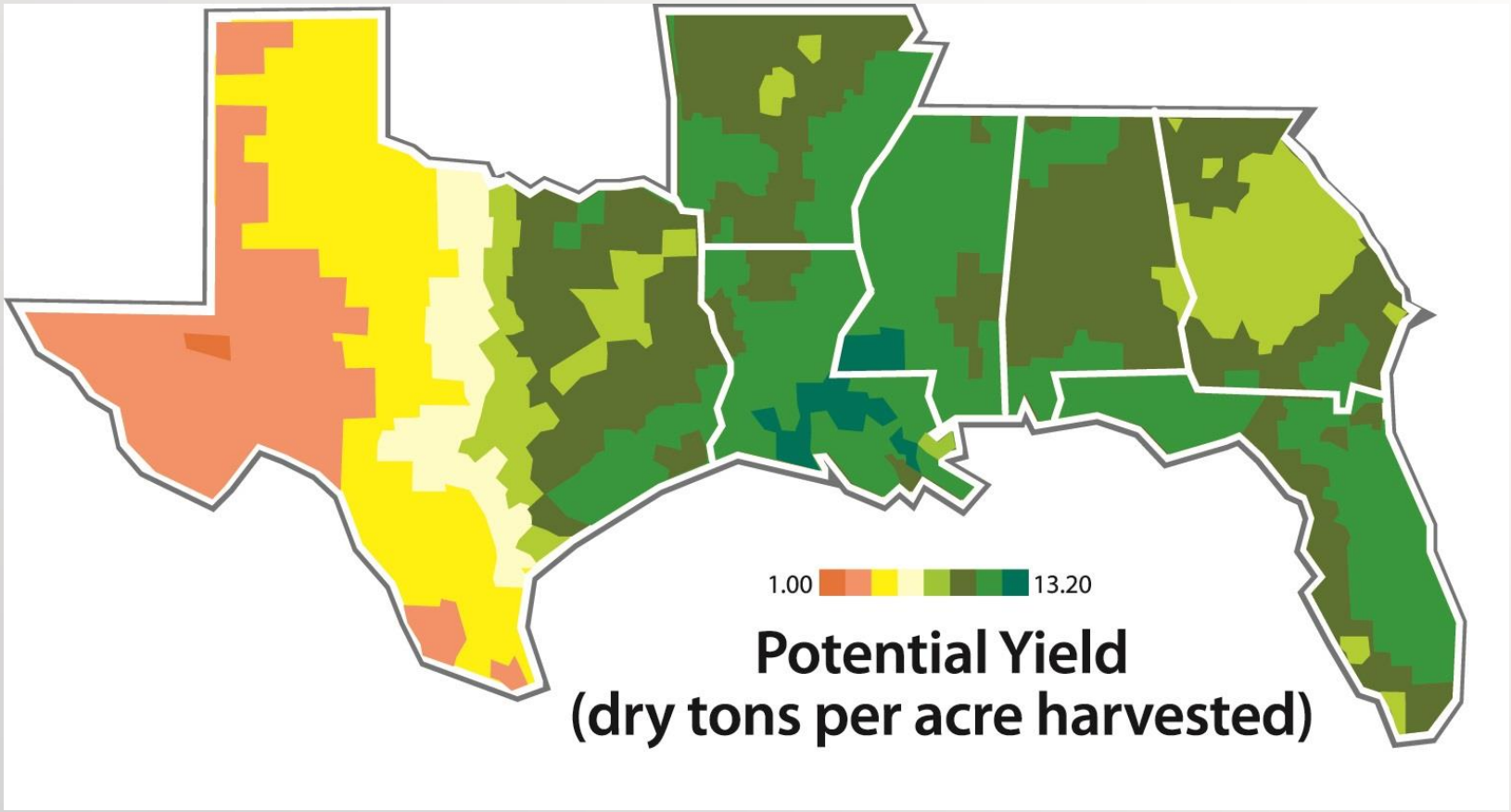
Sweet Sorghum Inputs



Sweet Sorghum Inputs



Sweet Sorghum Yield Potential



Crop Comparison

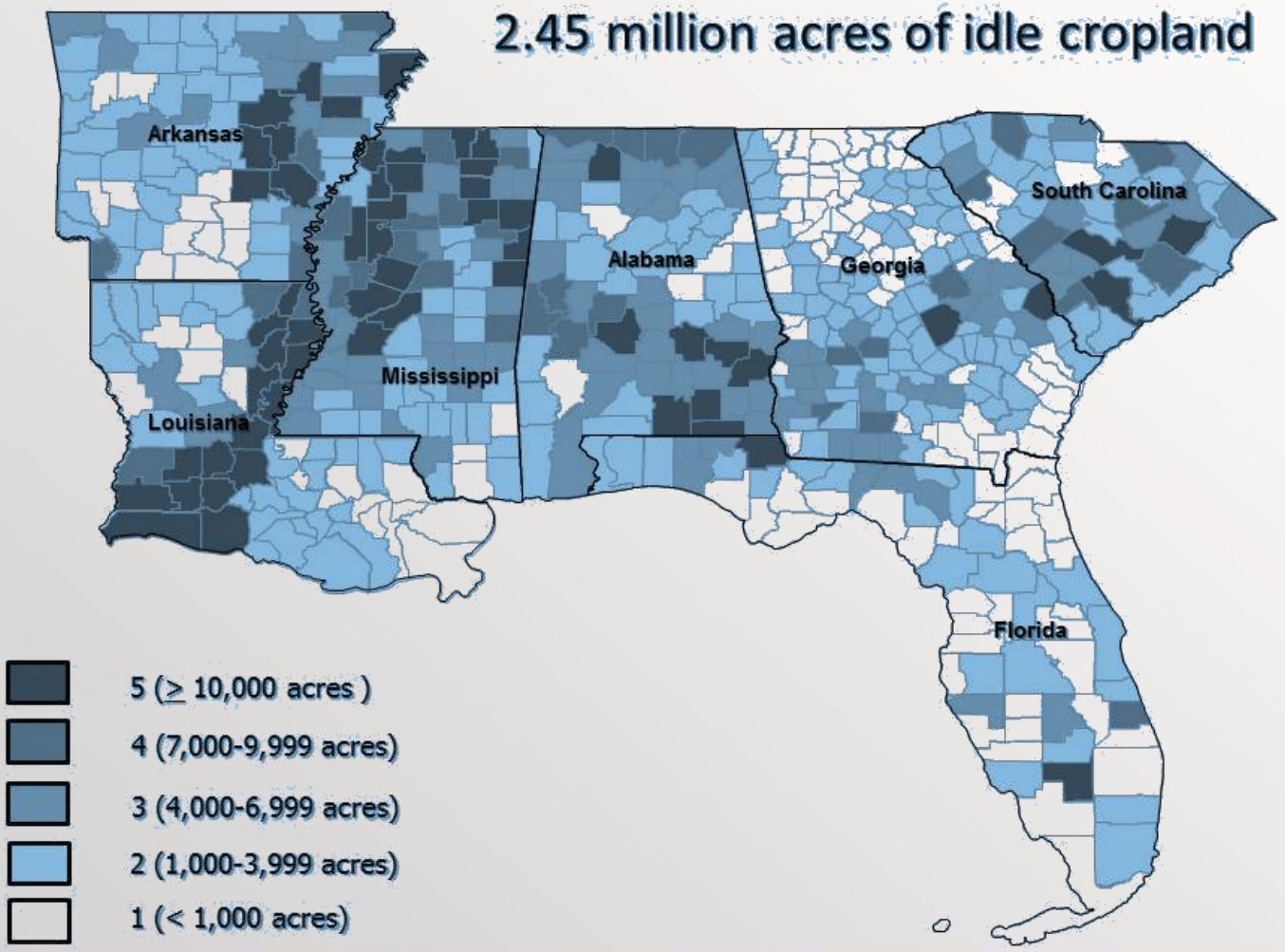
	Energycane	Sweet Sorghum
Harvest duration	7 months	3 – 4 months
Inputs	None *	$150 – 200/acre *
Planting	Perennial	Annual
Marginal lands	Yes	Yes
Dry ton/acre	5-15 (20)	5-10 (15)

* Excluding costs for crop establishment.

Year-Round Feedstock Supply

Month	Energycane	Sweet Sorghum	Bagasse	Syrups
Jan				
Feb				
Mar				
Apr				
May				
Jun				
Jul				
Aug				
Sep				
Oct				
Nov				
Dec				

Marginal Lands



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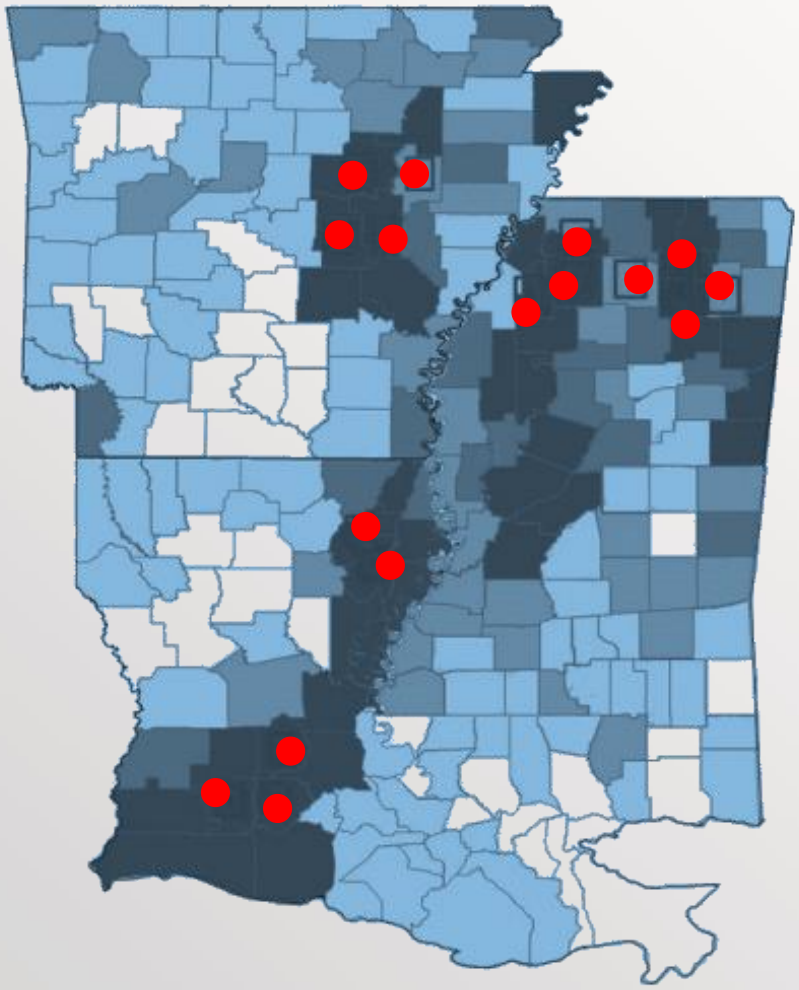
Optimal Plant Locations



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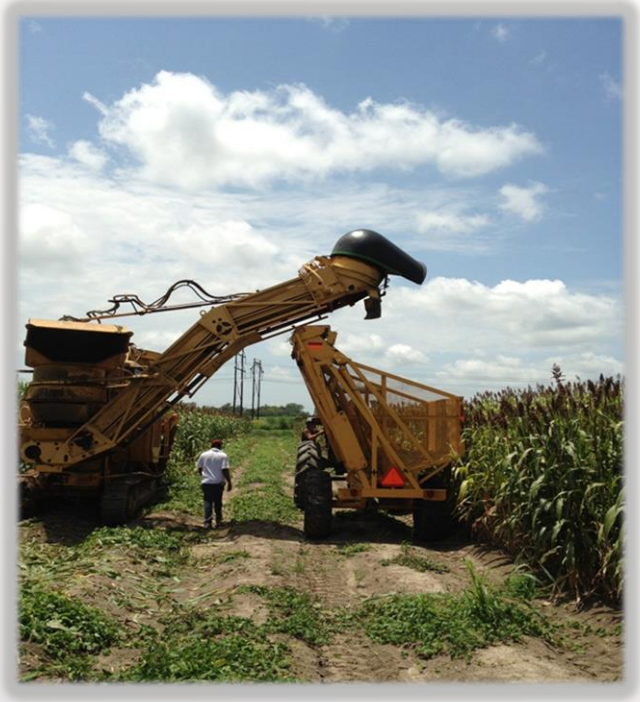
Biomass Crop Logistics

Harvest/transport equipment

- Inside cane belt
- Outside cane belt



Biomass Crop Logistics

Low-input crops

- Minimal pesticides
- Dense canopies
- Minimal fertilizer

Complete production guides available for both crops

Environmental Impacts: Soil Carbon

Converting fields to biomass crops

- Increased soil labile C
- Early indication of improved soil C sequestration

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Pilot Plant

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Targeted Bioproducts

Syrups
- From biomass
- From juices

Nanomaterials & Biopolymers
- Electrical storage
- Bioplastics
- Biomedical materials

Biobutanol
- Fermentation
- Separation

Specialty products
- Adhesives, epoxies, chemicals

Possible Future Work

Feedstock effects on processes

- Crop species – syrup quality, purity
- Syrup source – juices, cellulose deconstruction
- Support for standardized evaluation – ex. NCERC

Feedstock system effects on air quality

- Species and sources
- Process and formulation differences
- Support for local/regional air quality evaluation

VIRENT BIOFORMING

Brice Dally
Virent R&D Manager
CAAFI SOAP-Jet
January 22nd, 2016

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Virent Overview

Leading catalytic route to renewable hydrocarbon fuels and chemicals.

- Founded in 2002 and headquartered in Madison, Wisconsin, USA
- Industry leaders as partners and investor
  - Royal Dutch Shell, The Coca Cola Company, Cargill, Honda
- **BioForming® Technology**: Continuous process, catalytic technology, scalable
- Facilities include pilot and demo plants, catalyst development lab
- **Extensive Intellectual Property (IP) portfolio**
  - 120+ patents issued, 140+ patent pending applications

Partners & Investors

Cargill

HONDA
The Power of Dreams

The Coca-Cola Company

Operations and Infrastructure

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Virent BioForming® Technology

Leading catalytic route to renewable hydrocarbon fuels and chemicals.

"Eagle" Virent's Biogasoline Demonstration Plant- Madison, WI

Fast and Robust

- Inorganic Catalysts
- Moderate Conditions
- Industry Proven Scalability

Energy Efficient

- Exothermic
- Low Energy Separation
- Low Carbon Footprint

Premium Drop-in Products

- Tunable Platform
- Infrastructure Compatible
- Fuels and Chemicals

Feedstock Flexible

- Conventional Sugars
- Non-Food Sugars

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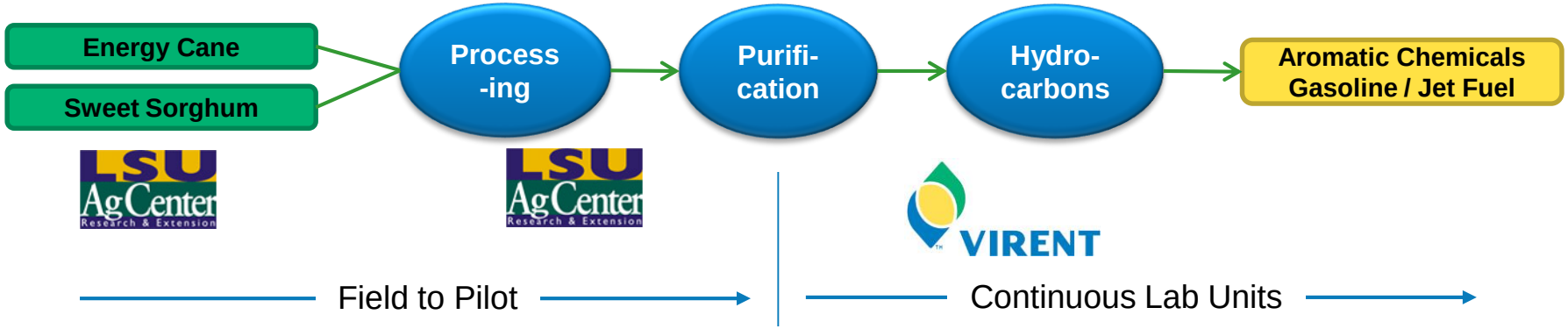
Sustainable Bioproducts Initiative

LSU LED PROJECT - A REGIONAL PROGRAM FOR PRODUCTION OF MULTIPLE AGRICULTURAL FEEDSTOCKS AND PROCESSING TO BIOFUELS AND BIOBASED CHEMICALS

USDA NIFA AFRI Bioenergy CAP: Award No. 2011-69005-30515

Timeline: 5 year project starting Q3 2011

Virent and team members will demonstrate agronomic, economic, technical, and sustainability attributes for energy cane and sweet sorghum to biofuels and bioproducts in the Southeast U.S.



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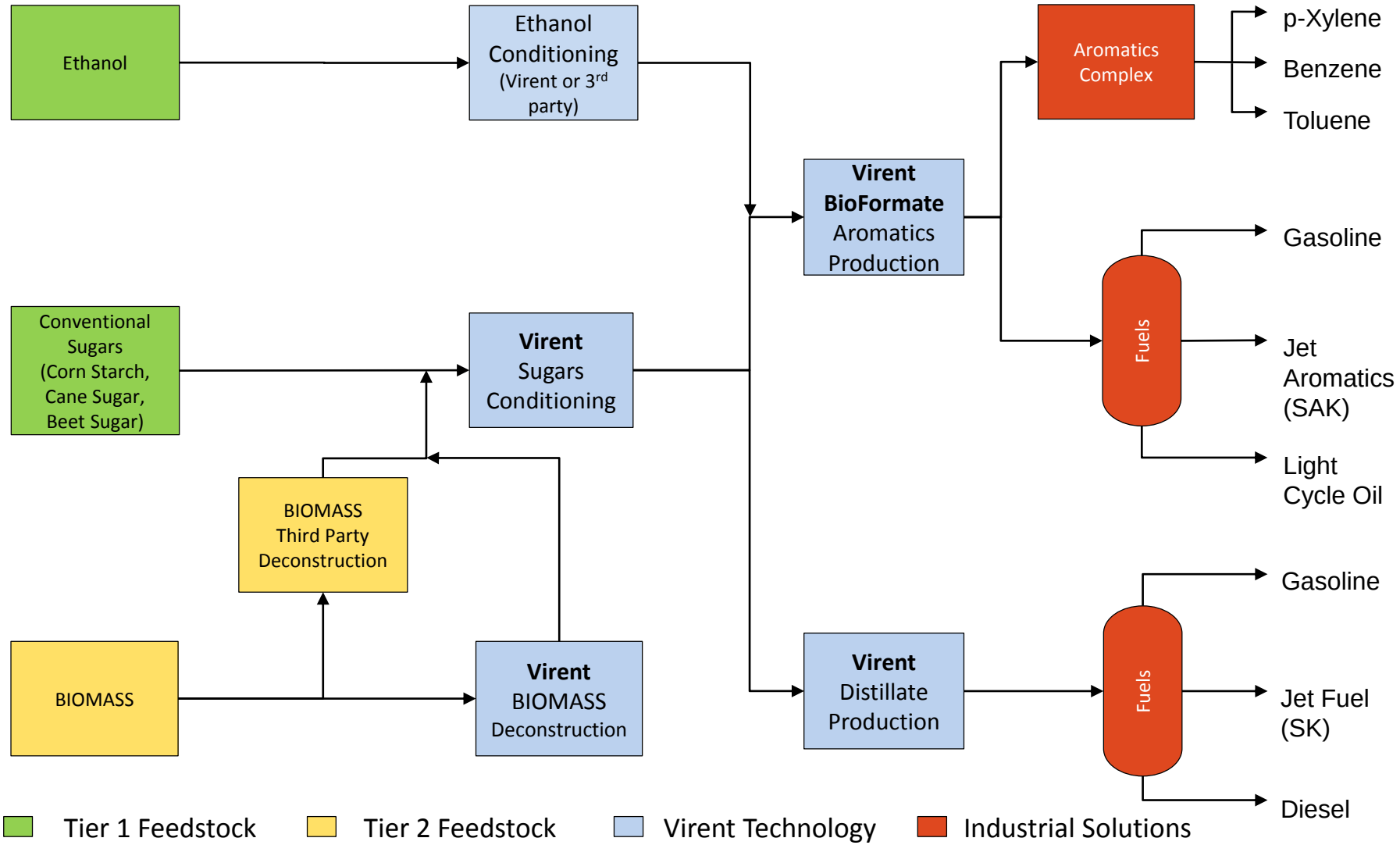
Virent Conversion Platform



SAK = Synthetic Aromatic Kerosene *SK = Synthetic Kerosene*

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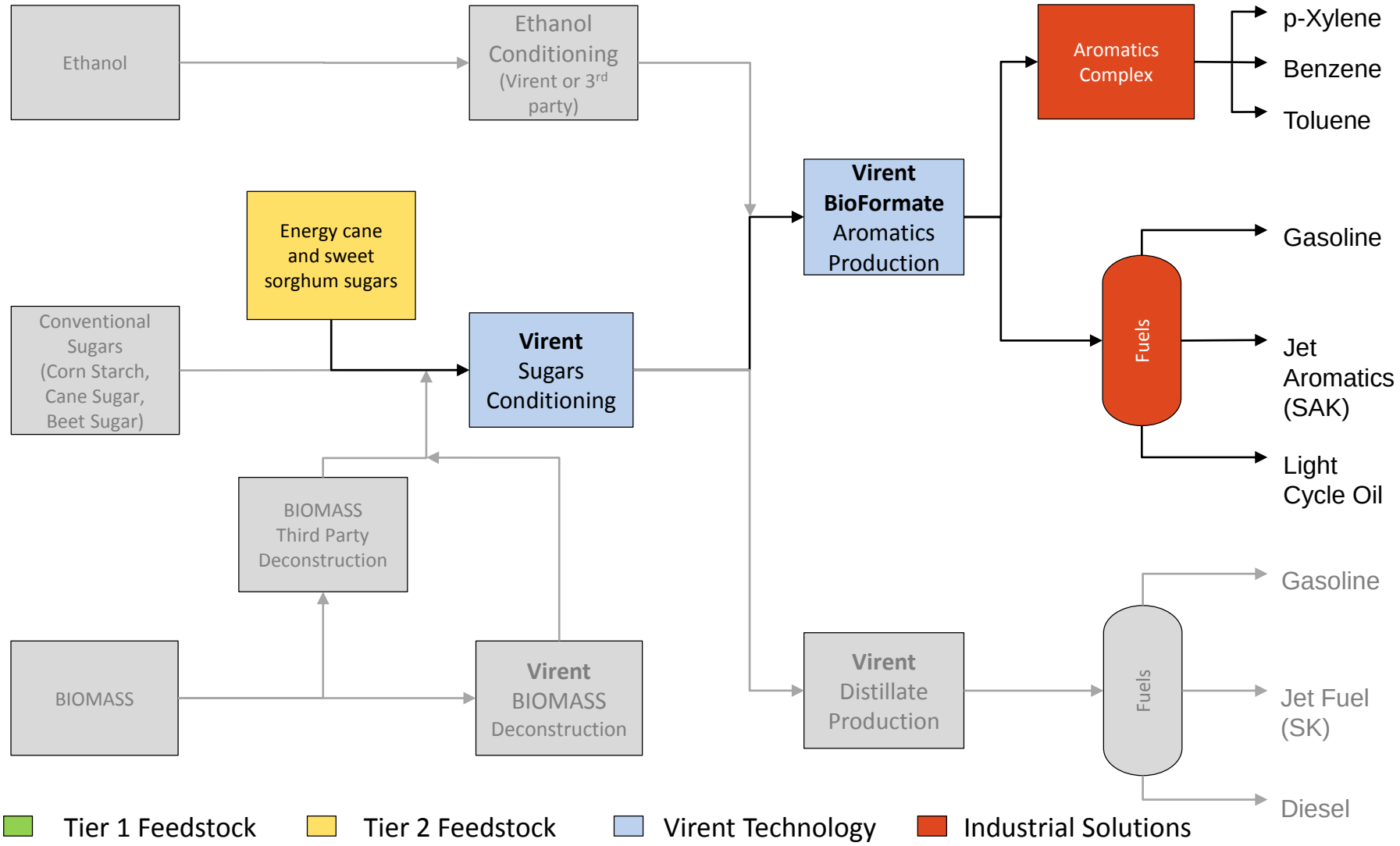
Virent Conversion Platform

- Virent LSU SUBI Project focus: new sugar feedstocks to aromatic blendstock for chemicals and fuels



SAK = Synthetic Aromatic Kerosene *SK = Synthetic Kerosene*

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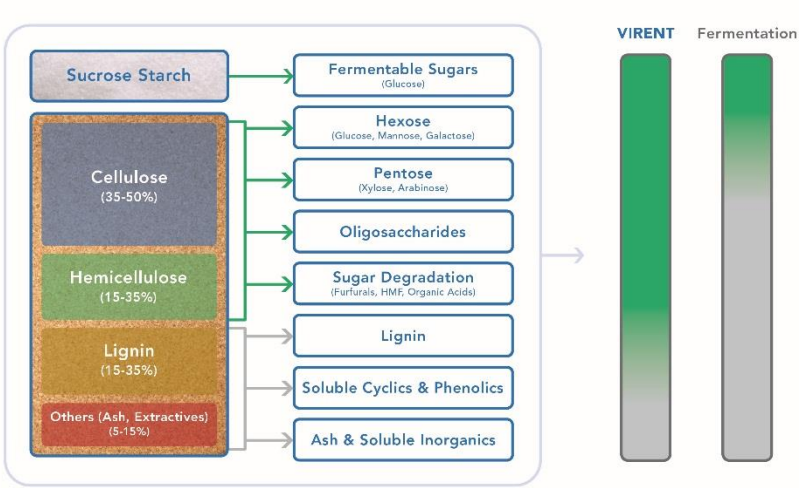
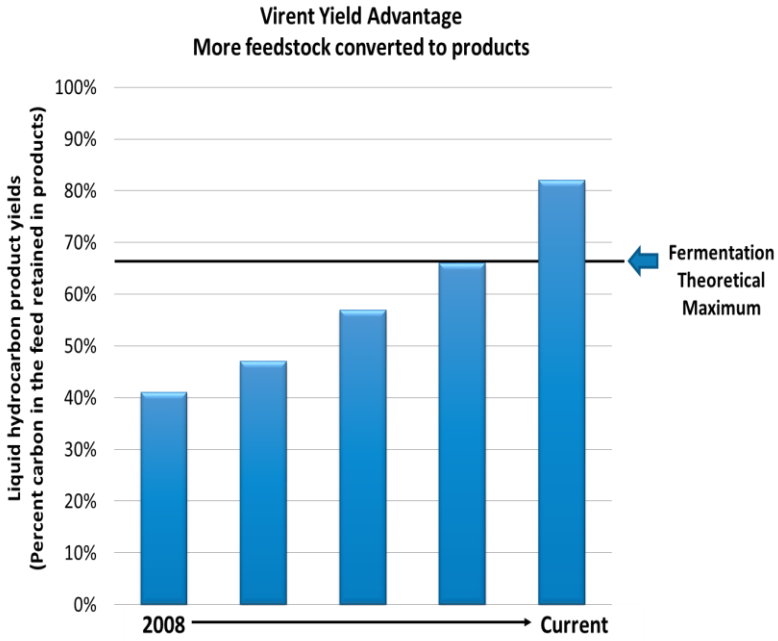
Virent Competitive Advantages

Low cost bio-based route to aromatics





Potential to access more of biomass carbon than fermentation processes

Ash content important for catalysis to avoid poisoning

Higher yields than biological pathways

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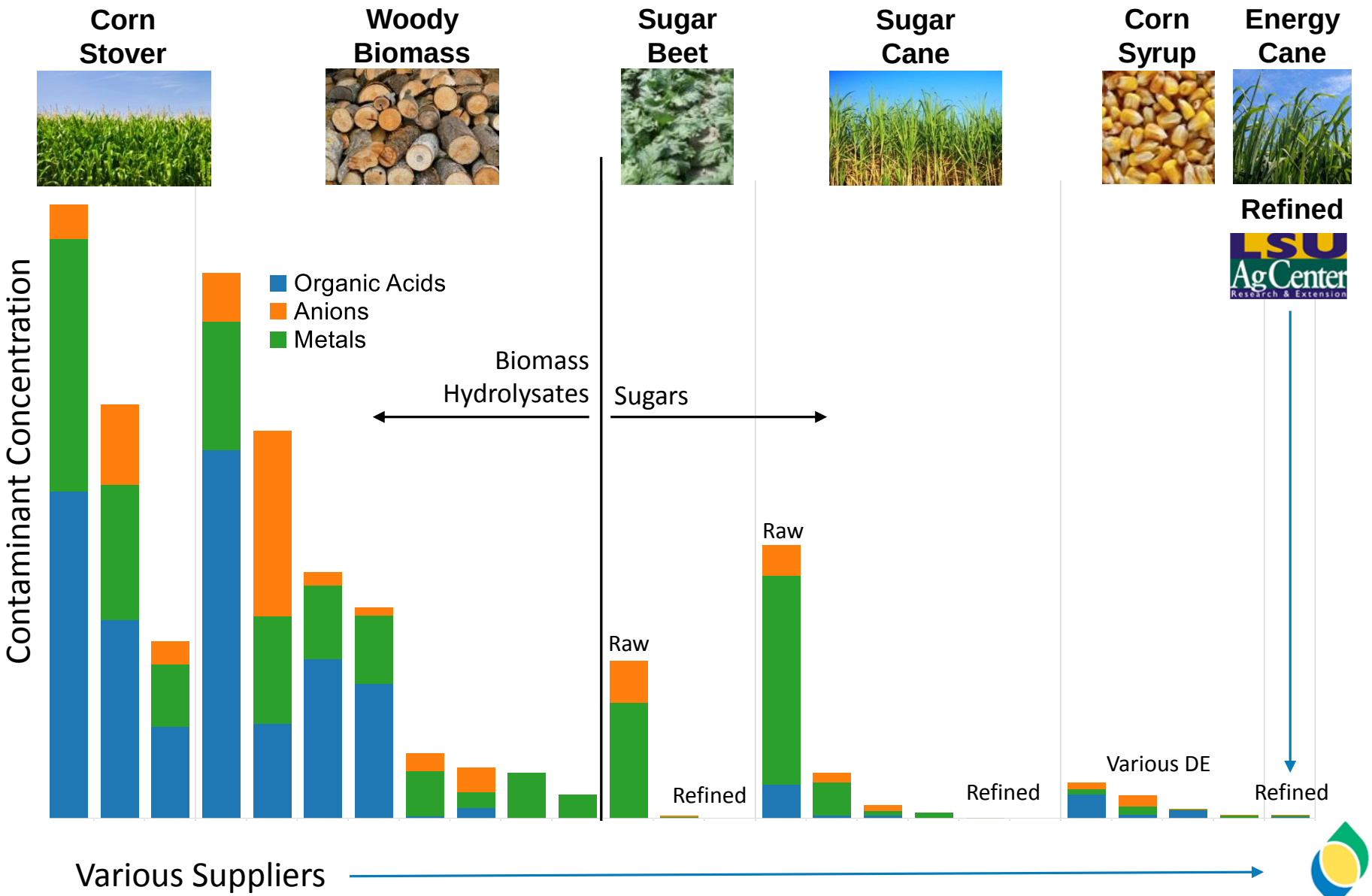
Biomass Hydrolysate/Sugar Quality

LSU Energy Cane – Attractive Contaminant Profile for Catalysis



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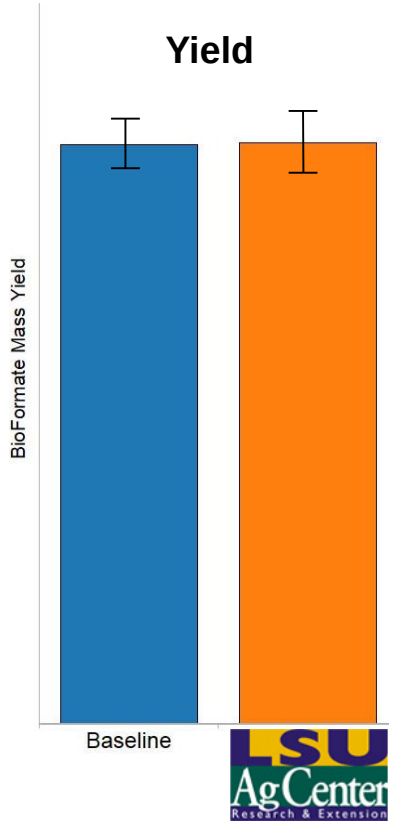
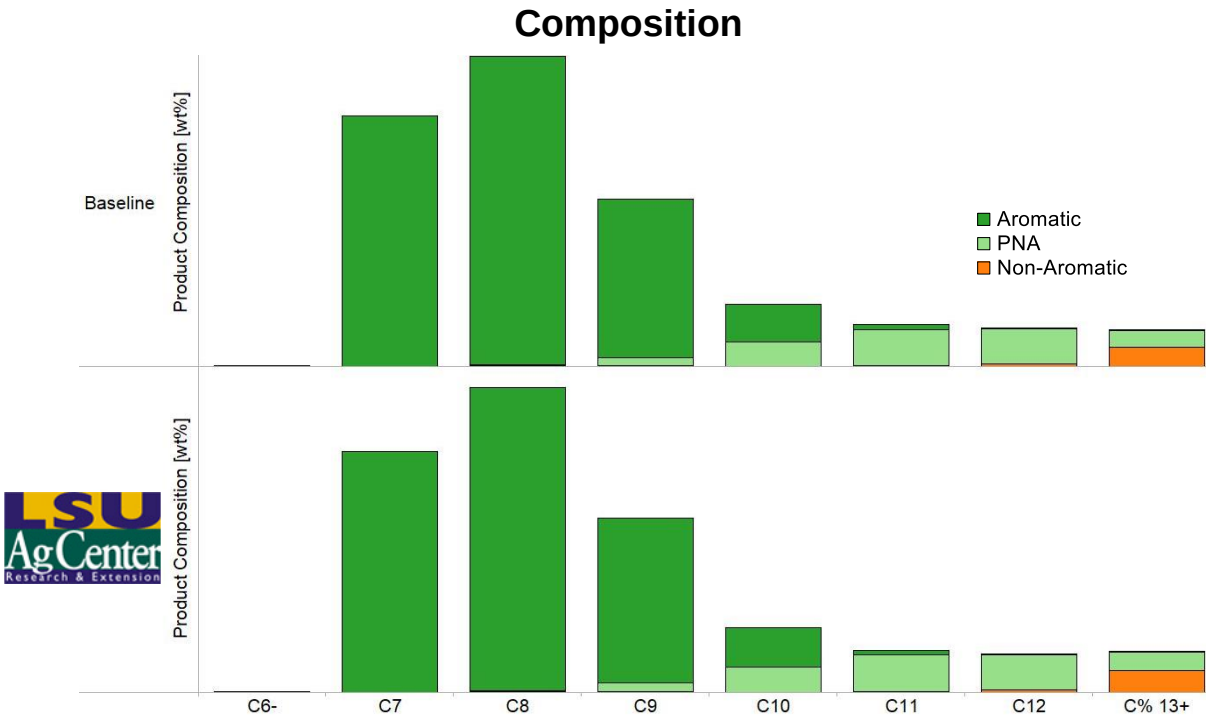
LSU Energy Cane Performance

Equivalent to Refined Sugar Baseline





- Baseline results generated within SUBI consistent with runs of hundreds of days in other projects
- 2 gallons of LSU Energy Cane processed continuously for 6 days until feedstock was depleted
- LSU Sweet Sorghum run to be completed Q1 2016
- Joint Techno-Economic Analysis with LSU and Virent based on data

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Virent BioFormPX® Paraxylene Used for World's 1st PET Plastic Bottle Made Entirely From Plant-Based Material

Virent, Coca-Cola hit key production milestone with the 100% biobased Plant Bottle

BiofuelsDigest
The world's most widely read biofuels daily

The Iconic Coca-Cola Bottle is Getting a Surprising Update

TIME

Coke, Virent debut plastic bottle made 100% from plant materials

MILWAUKEE · WISCONSIN
JOURNAL SENTINEL

PlantBottle 2.0: *Coca-Cola Unveils World's First PET Plastic Bottle Made Entirely from Plants*

Coca-Cola Journey™

New Coke bottle made entirely from plants

CNNMoney

Coca-Cola's first 100% biosourced PlantBottle debuts at Expo Milan

PLASTICS TODAY
COMMUNITY FOR PLASTICS PROFESSIONALS

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Product and Field Platforms

Aromatic Chemicals	• APR Process • BioForming Process • Aromatics Upgrading • Sugars to Sugar Alcohols	Benzene Toluene Xylenes
Aromatic Fuels	• APR Process • BioForming Process • Sugars to Sugar Alcohols • Gasoline Compositions	Gasoline AvGas **Jet – SAK** Light Oils
Distillate Fuels & Oils	• APR Process • BioForming Process • Jet Fuel Composition • DHOG Process	Jet – SK Diesel Fuel Heavy Oils
Mixed Oxygenates	• APR Process • Sugars to Sugar Alcohols	Solvents Glycols Alcohols
Specialty Products	• APR Process • BioForming Process • Sugars to Sugar Alcohols • Others	Lactic Acid Sorbitol Xylitol Mineral Oils

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Virent/Shell Partnership

- Joint Development of Technology Platform
- Joint Collaboration on Product Qualification
- SK and **SAK Jet Fuel**

Thank You

John S. Russin
Vice Chancellor, LSU Agricultural Center
Feedstock

Brice Dally
R&D Manager, Virent
Conversion Technology

Cynthia Ginestra
Aviation Fuels Research Engineer, Shell Global Solutions
Jet Fuel