TRANSITIONING FROM THE BUCKET TO THE BARREL
WEBINAR SERIES
NC STATE UNIVERSITY

Achieving Sustainability Goals with Biomass

The webinar starts at 2:00 PM(Eastern Time)

Presenter(s): Ingrid Gronstal-Anderson, University of Iowa
Travis Hedrick, Repreve Renewables
Host: Brent Bailey, 25x'25
Moderator: Helene Cser, NCSU-Extension Forestry

IBSS
Southeastern Partnership for Integrated Biomass Supply Systems

"The IBSS project is supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30410 from the USDA National Institute of Food and Agriculture."

USDA United States Department of Agriculture
National Institute of Food and Agriculture

"The webinar project is supported by The Renewable Resources Extension Act National Focus Fund Grant no. 2011-46401-31144 from the USDA National Institute of Food and Agriculture."

Webinar Program

- Orientation: Helene Cser
- Introduction: Brent Bailey, 25x'25
- Speaker(s):

  Ingrid Gronstal-Anderson, University of Iowa

  Travis Hedrick, Repreve Renewables
- Moderated Q&A: Helene Cser & Brent Bailey

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Orientation

1. Audio Setup Wizard – Allows you to ensure your audio is set up properly.
   * New Dial in option if audio is not working. Click phone icon and dial "participant" number and enter PIN.

2. Polling - Allows you to answer yes/no questions and respond in a multiple choice format

3. Chat - If the chat says "Supervised," be aware that the presenter/moderator can see all messages, even those marked private.

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B. Subject matter
C. Subject matter and CEUs
D. Requested by boss
E. Other

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A. Extension or Education Agency
B. Government Agency
C. Private Natural Resource Business
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E. Other

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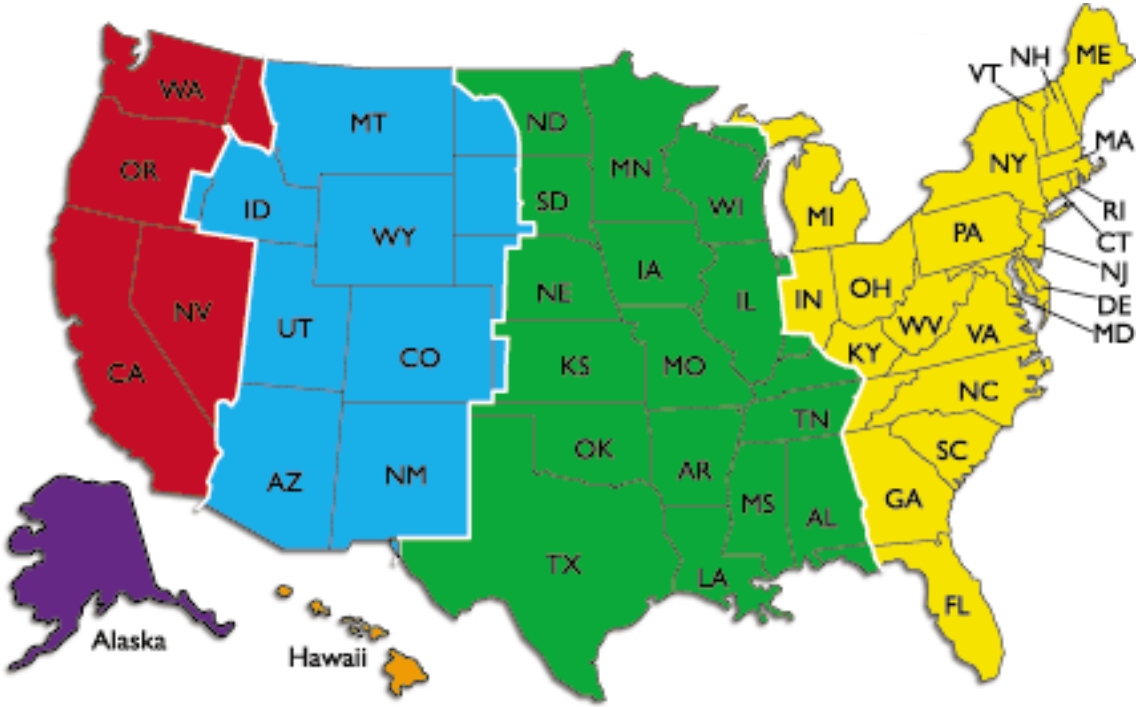
A. Pacific
B. Mountain
C. Central
D. Eastern
E. Other



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Brent Bailey

State Activities Coordinator
25x'25

Brent began his professional career as an Environmental Consultant for two central Mississippi environmental engineering firms. In 1999, Brent went to the Mississippi Farm Bureau Federation to become the organization's Environmental Programs Coordinator and served in that capacity for over seven years.

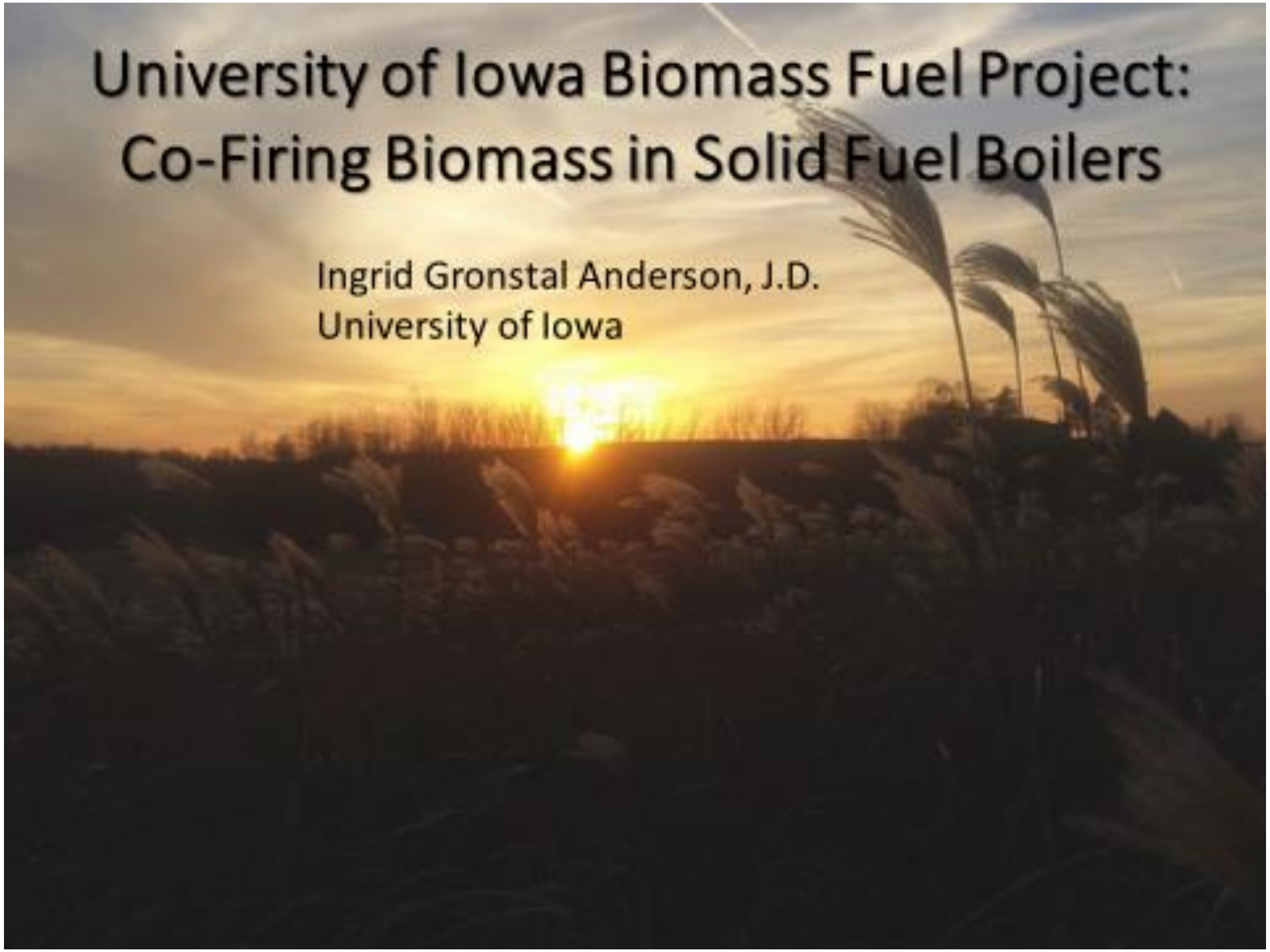
In October 2006, Brent began an association with the 25x'25 Initiative and serves as the State Activities Coordinator. The 25x'25 vision entails production agriculture and forestry producing 25% of total U.S. energy needs by the year 2025 while continuing to produce safe and abundant food and fiber. Brent is working with agriculture and forestry leaders to mobilize support for renewable energy solutions from the agriculture and forestry sectors.

Brent also serves as the Project Coordinator for the Southeast Agriculture and Forestry Energy Resources Alliance.

Ingrid Anderson

Compliance Specialist with Facilities Management
University of Iowa – Utilities & Energy Management

Ingrid Gronstal Anderson is an Environmental Compliance Specialist with Facilities Management – Utilities and Energy Management at the University of Iowa. In addition to several campus environmental compliance programs, she is heavily involved in the UI's Biomass Partnership Program. Ingrid is a 2011 graduate of the University of Iowa College of Law, and she received her B.S. from the University of Iowa in 2005. Ingrid previously worked on the Biomass Partnership Project and other sustainability initiatives with the University of Iowa Office of Sustainability. She also interned with Plains Justice, an environmental law center previously based in Cedar Rapids, Iowa. Ingrid is a licensed attorney in Iowa.



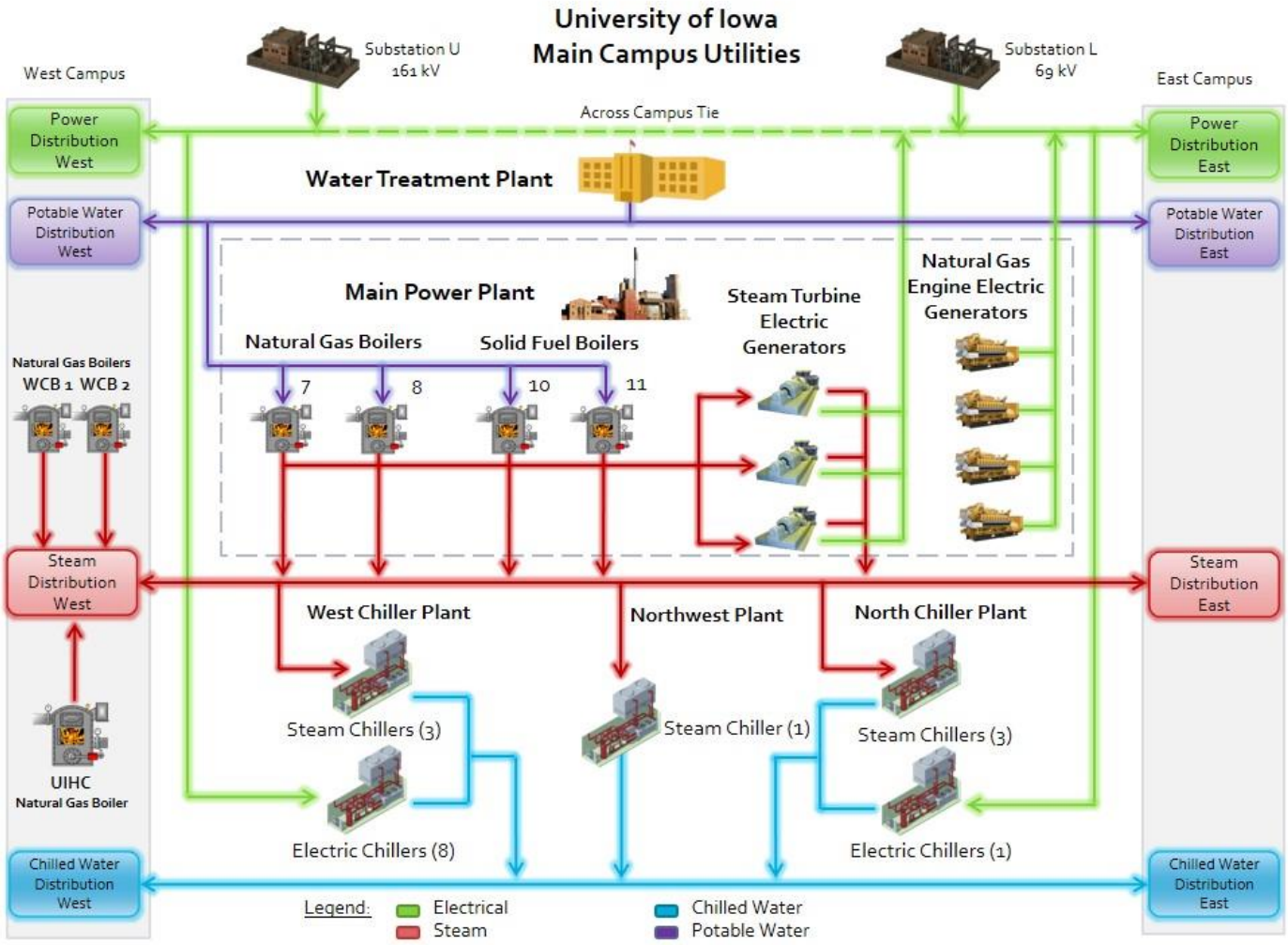
University of Iowa Biomass Fuel Project: Co-Firing Biomass in Solid Fuel Boilers

Ingrid Gronstal Anderson, J.D.
University of Iowa

Agenda

- UI 2020 Sustainability Goal
- Oat Hulls
- Wood Chips
- Energy Grasses
- Energy Sustainability Index

University of Iowa Utilities



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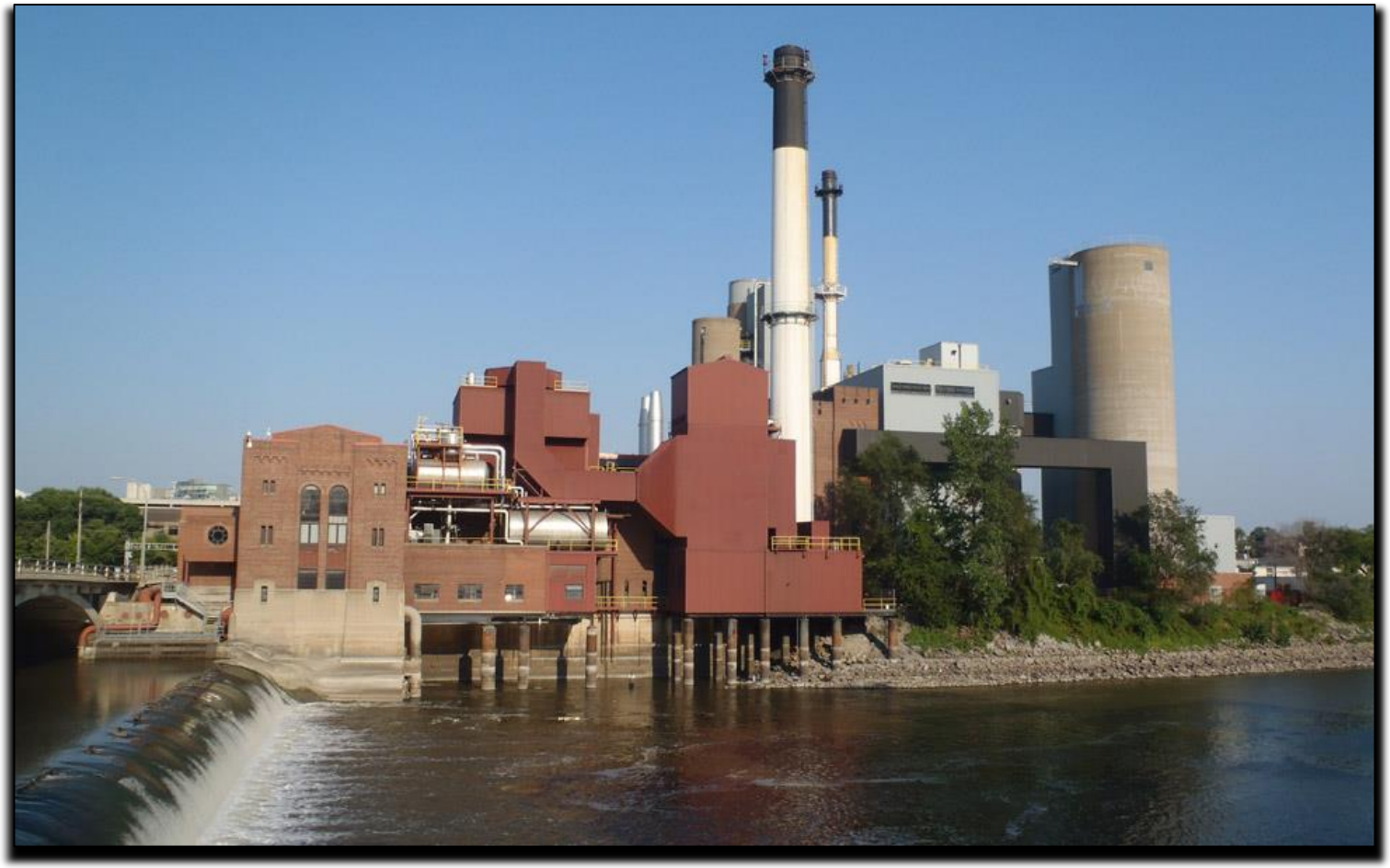
University of Iowa Main Power Plant



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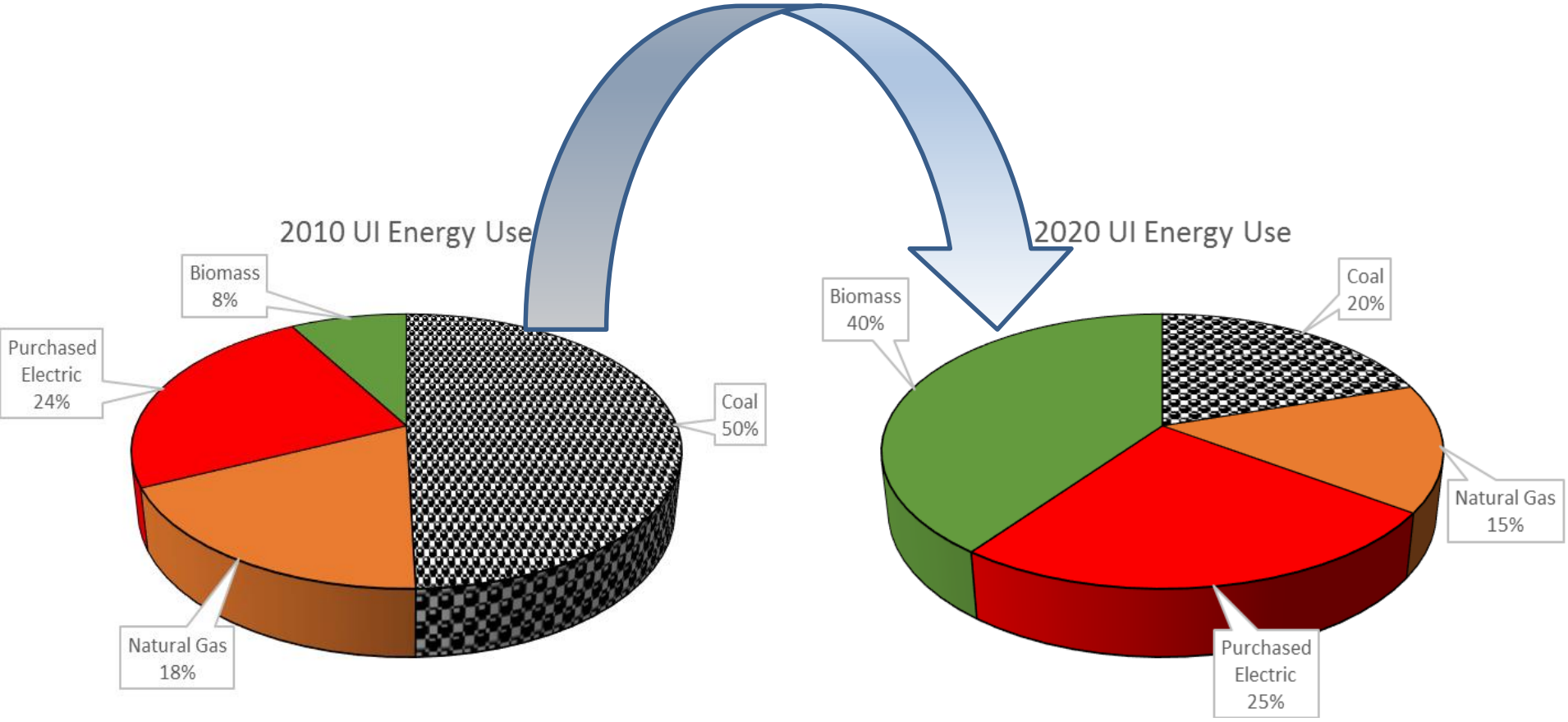
UI 2020 Goal – 40% Renewable



Fossil fuels originate outside of Iowa; biomass is sourced locally

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Biomass Fuel Portfolio

- Industrial byproducts:
  - Current: oat hulls
  - Future: cardboard recycling sludge, scrap from furniture making
- Wood chips:
  - Current/past: timber stand improvement, pallet remanufacture
  - Future: opportunity wood, short rotation woody crops
- Energy grasses:
  - Current development: Miscanthus
  - Future: prairie and switchgrass

Industrial By-Product: Oat Hulls

- UI has been burning oat hulls for energy since 2003
- Sourced from Quaker Oats in Cedar Rapids, IA
- System designed to feed oat hulls into CFB boiler
- 5-yr contract for 40,000 tpy

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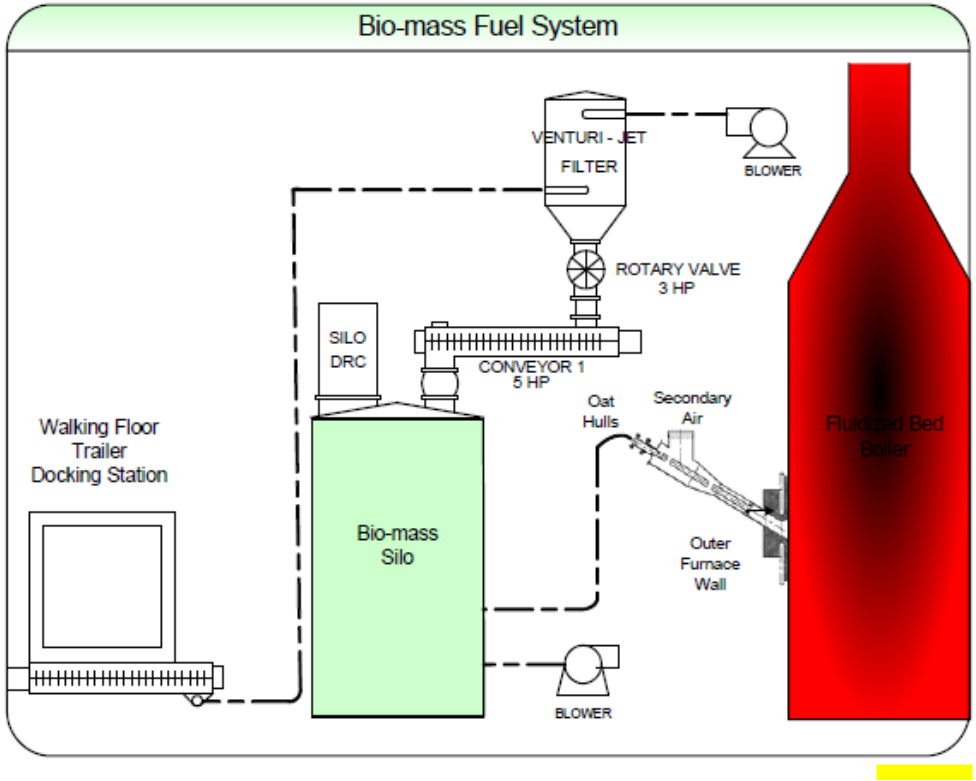
Oat Hull Combustion

- Oat hulls are pneumatically blown into the CFB boiler
- 50% oat hulls by heat input
- Stack test for PAHs with Dr. Betsy Stone, UI Chemistry Dept.
  - 50% oat hull blend emitted significantly fewer PAHs than 100% coal



Wood Chips

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Wood Chip Combustion

- Co-Fired with Coal in Solid Fuel Boilers
- Current combustion:
  - 10% wood chip by heat input to stoker boiler
  - 5% wood chip by heat input to CFB boiler
- Fuel Spec
  - Size and shape
  - Moisture content

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Energy Grasses

- Miscanthus x giganteus
  - 2 pilot plots, ~30 acres
  - Planting approx. 350 acres in 2015
  - 2500 total acres over next three years
  - Partnership with ISU, Dr. Emily Heaton, LAMPS
- Environmental benefits of perennials

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PROFITABILTY

- ~15% of land within Iowa fields not profitable in corn

ENVIRONMENT

- Planting ~15% of land within Iowa fields to diverse perennials provides disproportionate environmental benefit

ENERGY

- Planting ~15% of land within Iowa fields to perennial high-yielding energy crops provides enough biomass

Slide courtesy of Dr. Emily Heaton, Iowa State University

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Slide courtesy of Dr. Lisa Schulte Moore, Iowa State University

Lisa Schulte Moore, Matt Helmers, Pauline Drobney, Mary Harris, Matt Liebman, Randy Kolka, Jeri Neal

J. Arbuckle, Heidi Asbjornsen, Steve Bradbury, Cindy Cambardella, Mike Castellano, Rick Cruse, Bob Klaver, Laura Jackson, Mark Johnson, Matt O'Neal, Mike Rentz, Mark Tomer, John Tyndall, John Westra

Brian Gelder, Maged Noshi, Tim Youngquist, Dave Williams, Chris Witte, Xiaobo Zhou

Rachael Cox, Julia Dale, Javed Iqbal, Jose Gutierrez-Lopez, Virginia Hernandez-Santana, Rene Hessel, Sarah Hirsh, Drake Larsen, Delise Lockett, Anna MacDonald, Vilma Mateos-Remigio, David Mitchell, Amy Moorhouse, Julie Mueller, Matt Stephenson, Marlín Pérez-Suárez, Tomorra Smith

Committee on Agricultural Development

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STRIPS: Science-based Trials of Row-crops Integrated with Prairies
http://www.nrem.iastate.edu/research/STRIPs/

Adding 10-20% prairie to crop fields:

- 60% reduction in water runoff;
- 88% reduction in N runoff;
- 89% reduction in P runoff
- > 90% reduction in sediment (soil) loss
- doesn't reduce yields
- improves biodiversity and natural predators
- is cheaper than installing terraces

Zhou et al. *J Environ Qual* (2010); Hernandez-Santana et al. *J Hydrol* (2013); Cox (2012); Hirsch et al. *Ecol. Restoration* (2013); Tyndall et al. *Environ Management (2013)*

Slide courtesy of Dr. Emily Heaton and Dr. Lisa Schulte Moore, Iowa State University

Iowa Learning Farms sponsored field day Sep 2014

70 attendees at 2014 pilot plot

Ben Anderson, power plant manager, discussing biomass cofiring

Dan Black, 2014 plot landowner, talking about his experience growing Miscanthus

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Pilot Field Harvest

March 2015

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s-fuel-project/

Energy Grass Combustion

- Test burns
  - Warm season prairie grass
  - Miscanthus (pellet form)
  - Chopped Miscanthus test burn May 2015
- Handling
  - Size and shape
  - Conveying system performance
- Combustion
  - Moisture content
  - Volatility

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Miscanthus Pellet Trial Burn

Ultimate Analysis	Percent by weight
Moisture	15.58
Ash	1.51
Volatile	74.84
Fixed Carbon	8.07
Sulfur	<0.01
Btu	5,903

- 9.3% by heat input
- No binder in pellets
- Stoker boiler
- No conveyor issues
- Some early burning near boiler front water wall due to high Mxg fines
- Overall, trial demonstrated higher heat input possible by densifying grasses.

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Ground Prairie Grass Trial Burn

- Prairie grass:

Ultimate Analysis	Percent by weight
Moisture	15 to 40%
Ash	2.60
Volatile	75.21
Fixed Carbon	12.00
Sulfur	0.04
Btu	7,516

The tub grinder was not able to reduce size sufficiently to prevent plugging in oat hull pneumatic fuel injection system.

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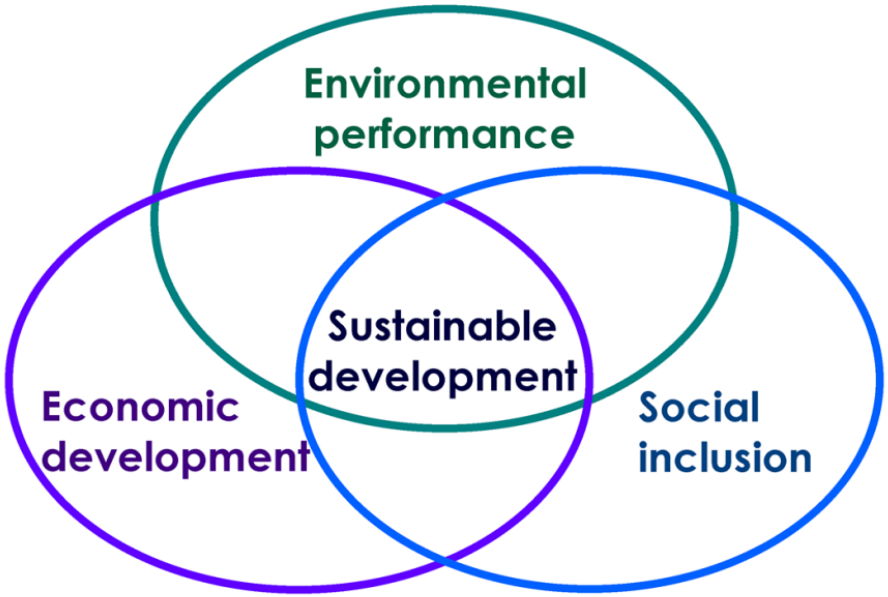
Energy Sustainability Index

- Project funded by the Leopold Center for Sustainable Agriculture
- Decision-making tool to compare biomass sources using the three lenses of sustainability.
- Future iterations will add the capability of evaluating fossil and other renewable fuels.
- Dynamic and flexible to accommodate new and better information.
- Available for other institutions.



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Thank you……….

Travis Hedrick

Director of Operations
Repreve Renewables

Travis Hedrick joined REPREVE Renewables in October 2013. Prior to Repreve he held a leadership position at Fazio Design, a leading golf course design and development firm. He also has been an advisor for Repreve since 2010 and was instrumental in the development of the ACCU Yield™ System and project management activities. Travis brings 14 years of experience in project development and management skills to the team. He is skilled in delivering advanced solutions to improve operational and supply chain efficiencies. He holds a bachelor's degree in Mechanical Engineering and Drafting Design from Fairmont State University, Fairmont WV.

REPREVE RENEWABLES

Where Things are Growing

Then, Now and Next In Ag Solutions

May 21, 2015 Webinar Presentation

Presented by:
Travis Hedrick
Repreve Renewables
Director of Operations
Thedrick@repreverenewables.com
Office: 336-316-5465

REPREVE® RENEWABLES

Discussion topics

- Who we are
- Then and now
- Giant Miscanthus crop overview
- Business model

REPREVE® RENEWABLES

Repreve Renewables at a glance

- An agricultural company producing and selling dedicated renewable biomass feedstock with application for:
  - Animal Bedding
  - Bio power
  - Bio fuel
  - Flavor & fragrances
  - Bio based materials

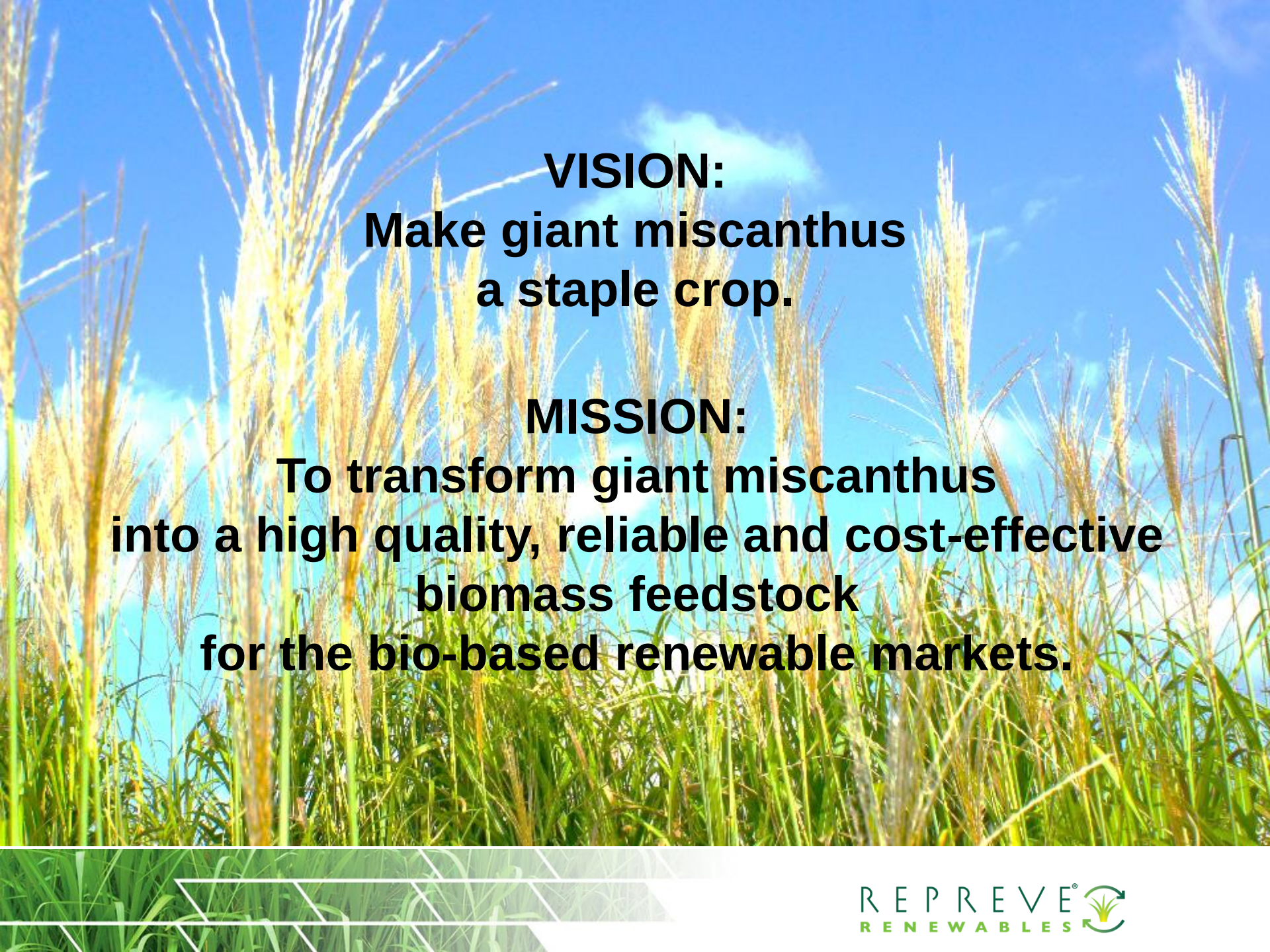
- Developed and acquired IP and proprietary assets:
  - ACCU Yield System, proprietary rhizome processing and establishment equipment platform
  - Miscanthus genetics and parental lines, including the first seeded variety

- Largest foundation and certified rhizome inventory in the U.S.

- Headquartered in Greensboro, NC with
  - Commercial production in 6 states (NC, GA, MS, OK, IA, MN)
  - Genetic station in Tifton, GA

Accomplishments

- Recipient of the USDA's Biomass Crop Assistance Program Project 11 (NC)
- Production acres established in 6 states with 100% of harvested volume sold
- Created a bedding solution for poultry companies
  - Product proof of concept achieved. 4 universities, industry expert and over 3 million birds.
  - 9 integrators representing over 60% of the U.S. market across 6 six states with commercial trials (purchased 100% of trial material)
  - Supply agreements established with the #1 and #3 largest poultry integrator in the U.S.
- Selected by University of Iowa as it's ag service provider for its Biomass Fuel Project. 10 year contract
  - Supplied miscanthus for successful boiler test burns
  - Worked with growers and landowners to contract 350 acres for the 2015 planting season. 10 year contracts in place
  - Partnered with the University of Iowa, Iowa State University and City of Cedar Rapids on a conservation trial to evaluate nutrient runoff reduction strategies utilizing perennial grasses



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Giant miscanthus research summary…

- Many potential uses because of its composition
- High yields
- Good for the environment

BUT……..

- No commercial scale technology to plant it
- Too costly to establish
- No active markets

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The solutions…

accu™ YIELD SYSTEM

A proprietary precision agricultural system developed to plant and establish giant miscanthus.

ACCU Lifter™

+

ACCU Processor™

+

ACCU Drop™ Planter

Proprietary Genetics and Research Trials

=

Performance

Cost

VALIDATION

University of Iowa's recent selection of Repreve Renewables as its ag service and business provider for its renewable Biomass Fuel Project

Recipient of the **USDA's** Biomass Crop Assistance Program Project 11

Current **landowners** and **growers** expanding acres

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$40 billion plus potential opportunity in US for plant based renewable feedstock

Animal Bedding	•Revenue	$750 million - $1 billion[1]
	•Tons	5-7 million[1]
	•Market Drivers	Improved animal health, reliable supply, stable pricing high quality and consistent spec
	•Status	Commercial launch
Biopower	•Revenue	$12-$18 billion[2]
	•Tons	280 million[2]
	•Market Drivers	Self, state and federal mandates, carbon emissions, population/income growth
	•Status	Advanced development
Biofuels	•Revenue	$20-$24 billion[3]
	•Tons	400 million[3]
	•Market Drivers	Federal mandates, carbon emissions, energy security, population/income growth
	•Status	Advanced development
Flavor & Fragrances	•Revenue	TBD
	•Tons	TBD
	•Market Drivers and all natural I	Evolving consumer taste and preferences, renewable ingredients
	•Status	Early development
Bio Based Materials	•Revenue	TBD
	•Tons	TBD
	•Market Drivers	Cost efficiency, sustainability (bio degradable, renewable farming), carbon
	•Status	Early development

1. Internal estimates
2. (18) NREL 2012 and internal estimates
3. Department of Energy Billion Ton Study and internal estimates

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Giant Miscanthus Overview

GIANT MISCANTHUS GROWTH CYCLE

Rapid Renewable Crop - Harvest first winter after planting

Planting: YR1 Only
Oct - May

Emergence: YR1
Re-Growth: YR 2-15+
Mar - May

Growth:
Apr - Sep

Dormancy:
Oct - Dec

Harvest:
Dec - Mar

8 - 10 months annually

BENEFITS

REDUCED RISKS

- **Perennial grass: Plant once and plant regrows for the next 15+ years.**
- **Minimal inputs, labor or machinery needed**
- **Heat and drought tolerant**
- **Diversification in crop mix**
- **Non-invasive crop**

ECONOMIC

- **Landowner/Grower – Long term contract with locked in pricing**
- **Minimal inputs after establishment year**
- **Direct market access**
- **Community multiplier effect**

SUSTAINABLITY

- **Climate change – reduces carbon footprint**
- **Soil quality – improves over time by building up organic matter**
- **Land use/productivity**
- **Water quality – minimal inputs and ability to retain water**
- **Biological diversity**

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Repreve's business model

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Repreve's business model

Genetics → Market Development → Land Procurement → ACCU Yield System → Agronomic Support → Harvest and Storage → Procurement Planning

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Repreve's business model

Genetics | **Market Development** | Land Procurement | ACCU Yield System | Agronomic Support | Harvest and Storage | Procurement Planning

THRIVEZ
POULTRY BEDDING

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Repreve's business model

Genetics | Market Development | **Land Procurement** | ACCU Yield System | Agronomic Support | Harvest and Storage | Procurement Planning

Community Outreach Events

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Repreve's business model

Genetics | Market Development | Land Procurement | **ACCU Yield System** | Agronomic Support | Harvest and Storage | Procurement Planning

accu™ YIELD SYSTEM

ACCU Lifter™

ACCU Processor™

ACCU Drop™ Planter

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REPREVE® RENEWABLES

Repreve's business model

Genetics | Market Development | Land Procurement | ACCU Yield System | Agronomic Support | **Harvest and Storage** | Procurement Planning

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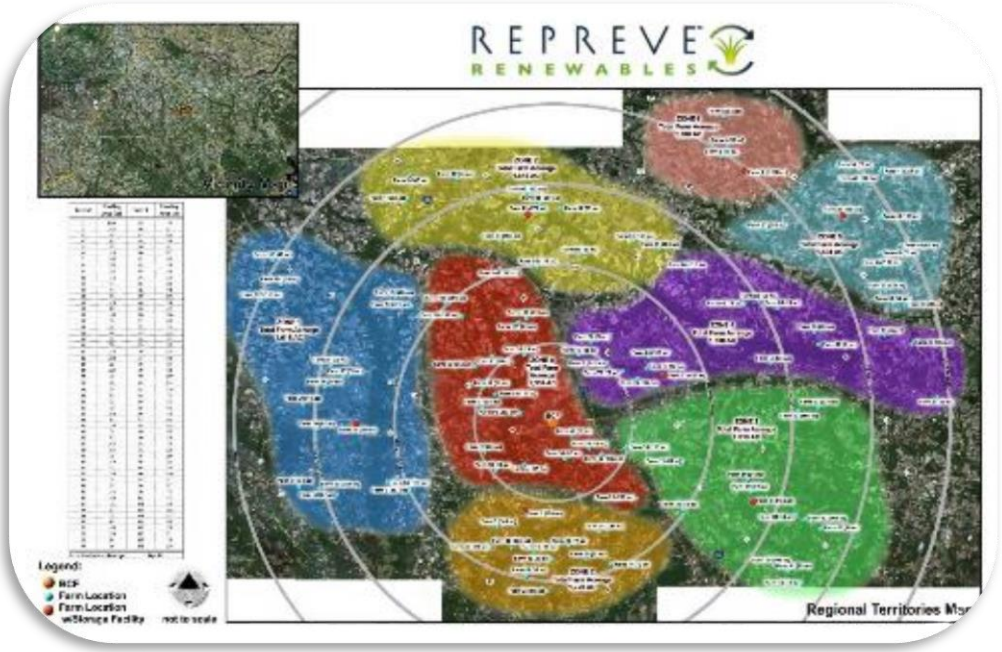
Repreve's business model

Genetics → Sales → Land Procurement → ACCU Yield System → Agronomic Support → Harvest and Storage → **Procurement Planning**



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Thank You!

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Questions and Discussion

Moderated by Brent Bailey and Helene Cser

Thank You For Your Participation!

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Keep watch for new webinars coming soon!

http://www.se-ibss.org/webinars-1/upcoming-webinars/index.html