

U.S. DOE BETO Deploying Purpose-Grown
Energy Crops for Sustainable Aviation Fuel
Workshop ***A.K.A. How to get
Airplanes High on Grass !***

Bill Belden

beldenw@starktech.com

641-895-9907

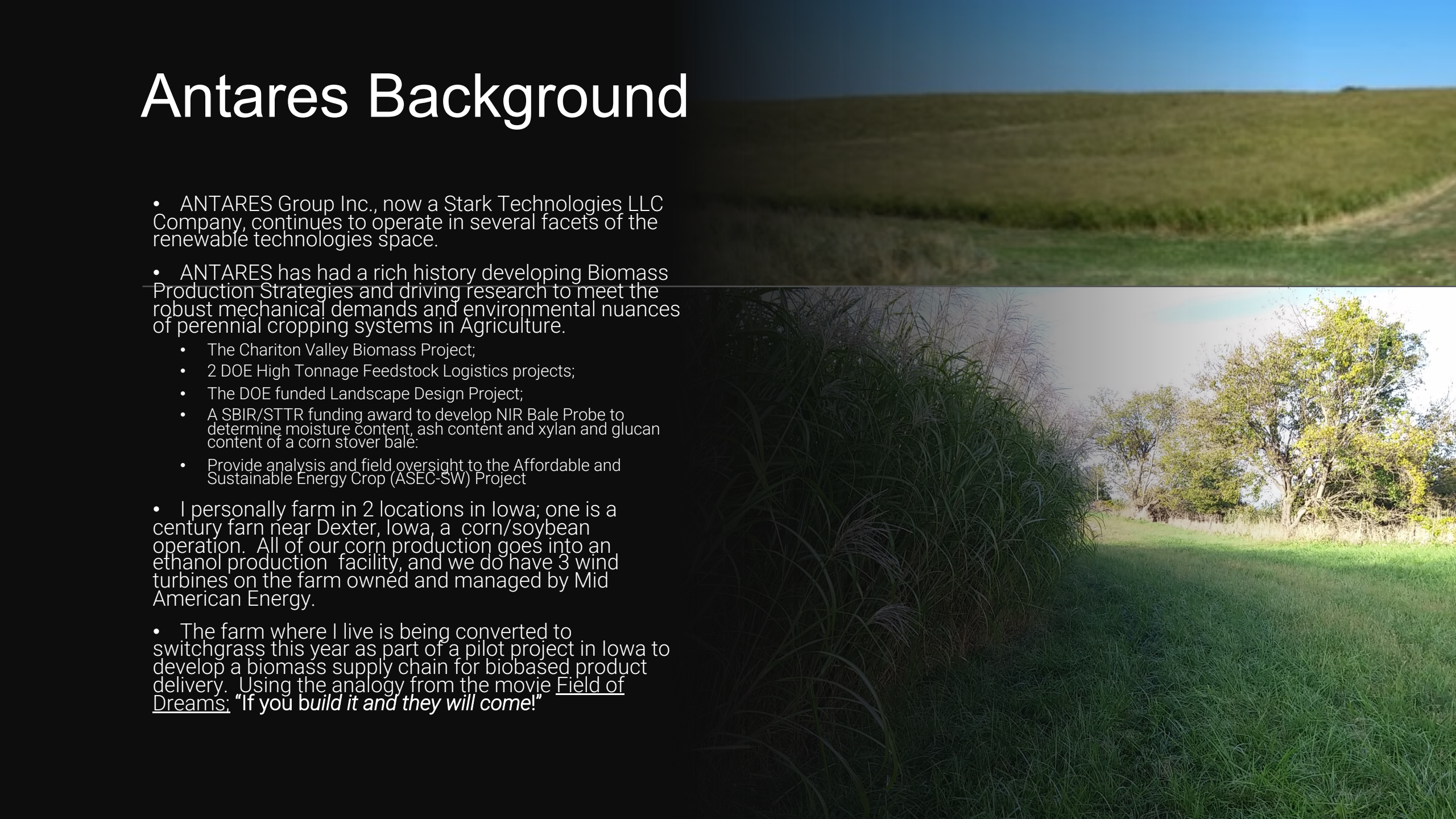
June 6-7, 2023



ANTARES
GROUP INC.

Antares Background

- ANTARES Group Inc., now a Stark Technologies LLC Company, continues to operate in several facets of the renewable technologies space.
- ANTARES has had a rich history developing Biomass Production Strategies and driving research to meet the robust mechanical demands and environmental nuances of perennial cropping systems in Agriculture.
 - The Chariton Valley Biomass Project;
 - 2 DOE High Tonnage Feedstock Logistics projects;
 - The DOE funded Landscape Design Project;
 - A SBIR/STTR funding award to develop NIR Bale Probe to determine moisture content, ash content and xylan and glucan content of a corn stover bale;
 - Provide analysis and field oversight to the Affordable and Sustainable Energy Crop (ASEC-SW) Project
- I personally farm in 2 locations in Iowa; one is a century farm near Dexter, Iowa, a corn/soybean operation. All of our corn production goes into an ethanol production facility, and we do have 3 wind turbines on the farm owned and managed by Mid American Energy.
- The farm where I live is being converted to switchgrass this year as part of a pilot project in Iowa to develop a biomass supply chain for biobased product delivery. Using the analogy from the movie Field of Dreams; ***"If you build it and they will come!"***



Deploying+Purpose Grown Crops+Sustainable+Aviation Fuel

This workshop's topic is a huge elephant to eat! The growing risks, opportunity costs, quality control perimeters, and risk management arrangements are yet clearly undefined and unanswered.

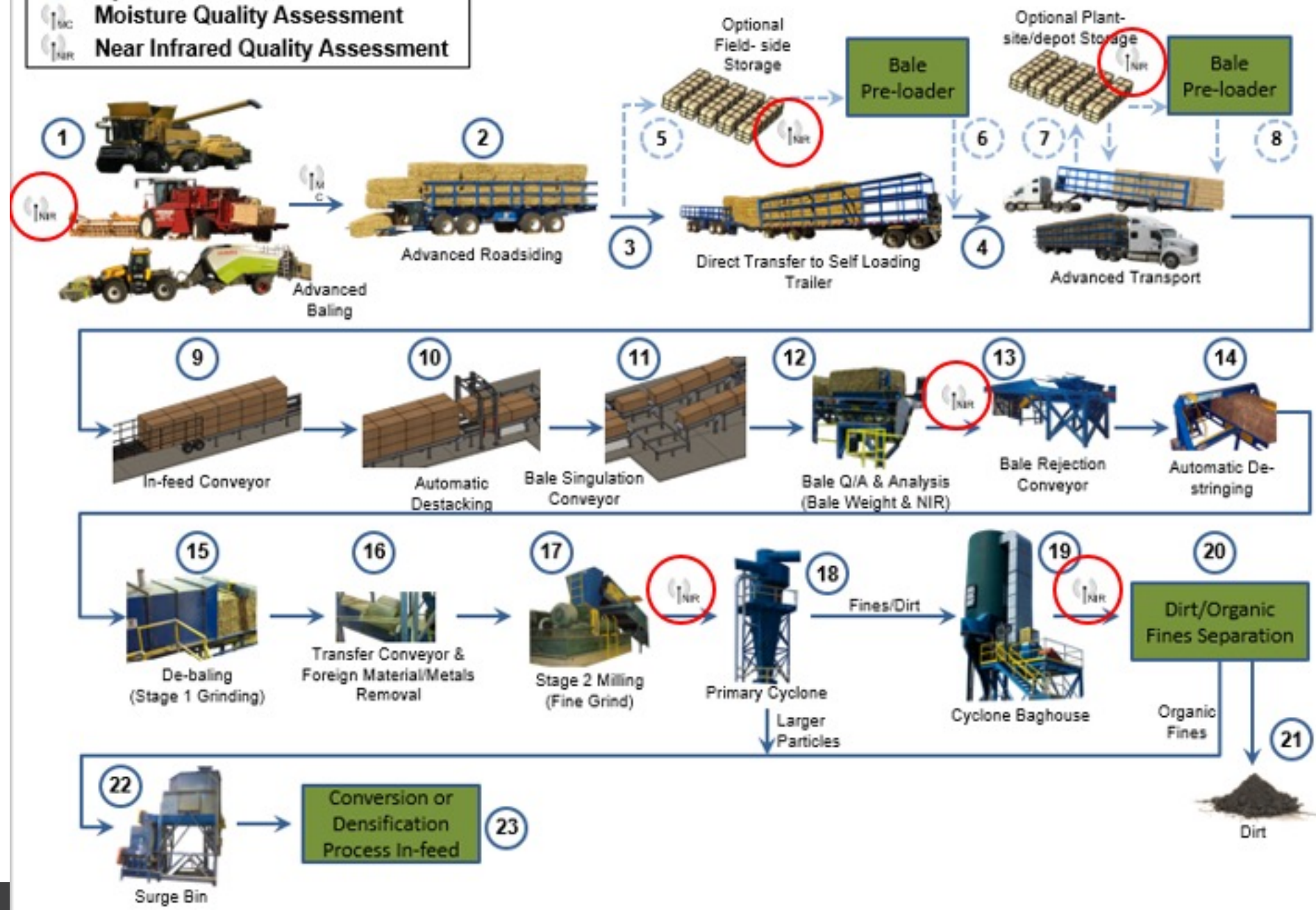
Or

Is this all about de-risking the conversion process?

- › This will take all hands-on deck approach to accomplish!
- › DOE; USDA; DOT; DOD; EPA; State Government; Local Government Jurisdictions will have influence over the outcomes.
- › President; Congress; and Justice Department must use wisdom and leadership to set salutatory policy direction in the best long-term interest of most Americans.
- › Must be driven by sound science, data, risk mitigation and long-term financial commitments not opinion or emotion.
- › A commitment to research is imperative to optimize purpose grown cropping systems.

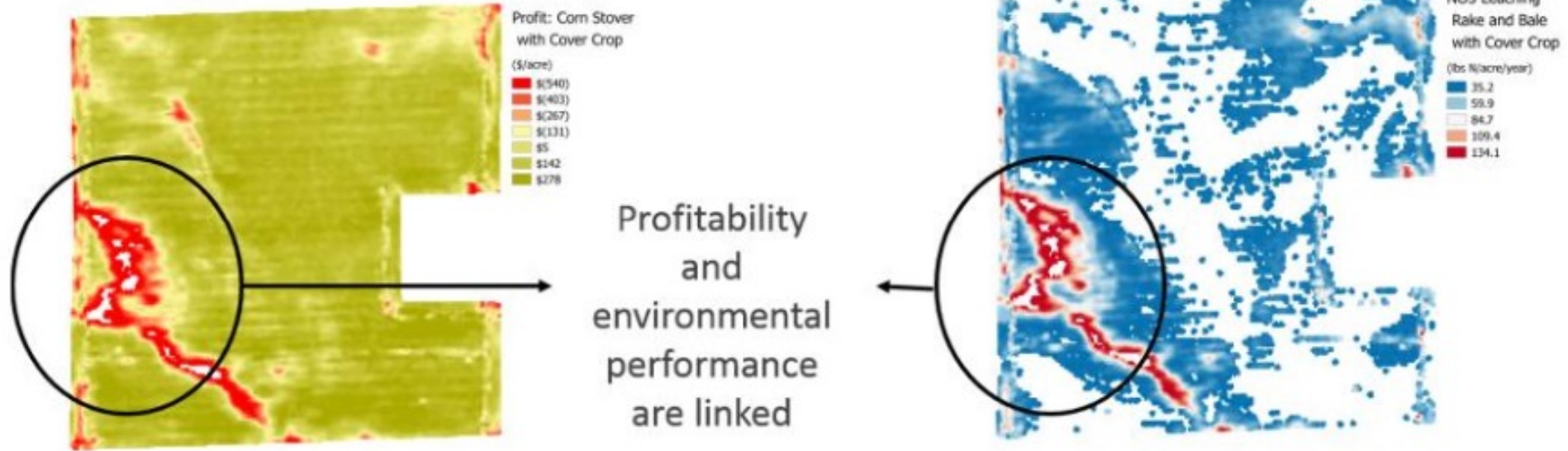
- ➔ Standard Process
- ➔ Optional Process
- ⊕_{NIR} Moisture Quality Assessment
- ⊕_{NIR} Near Infrared Quality Assessment

Advanced Feedstock Supply Chain - Large Square Bale Format

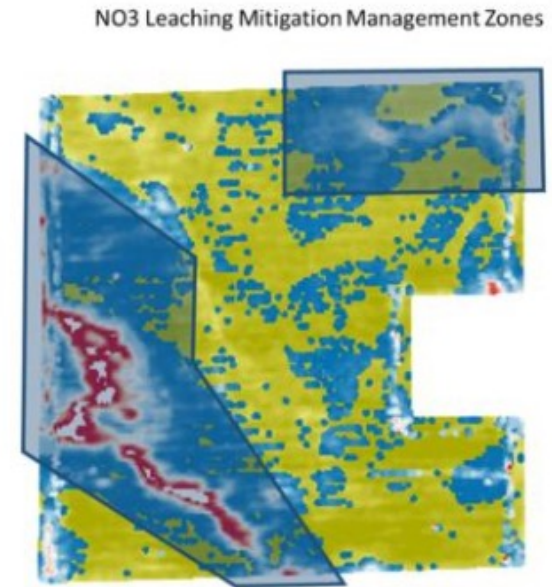
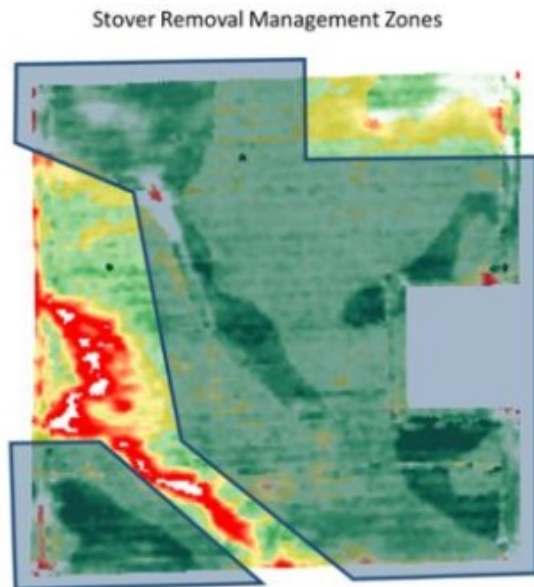


How much of this Supply Chain does the biorefinery want to control?

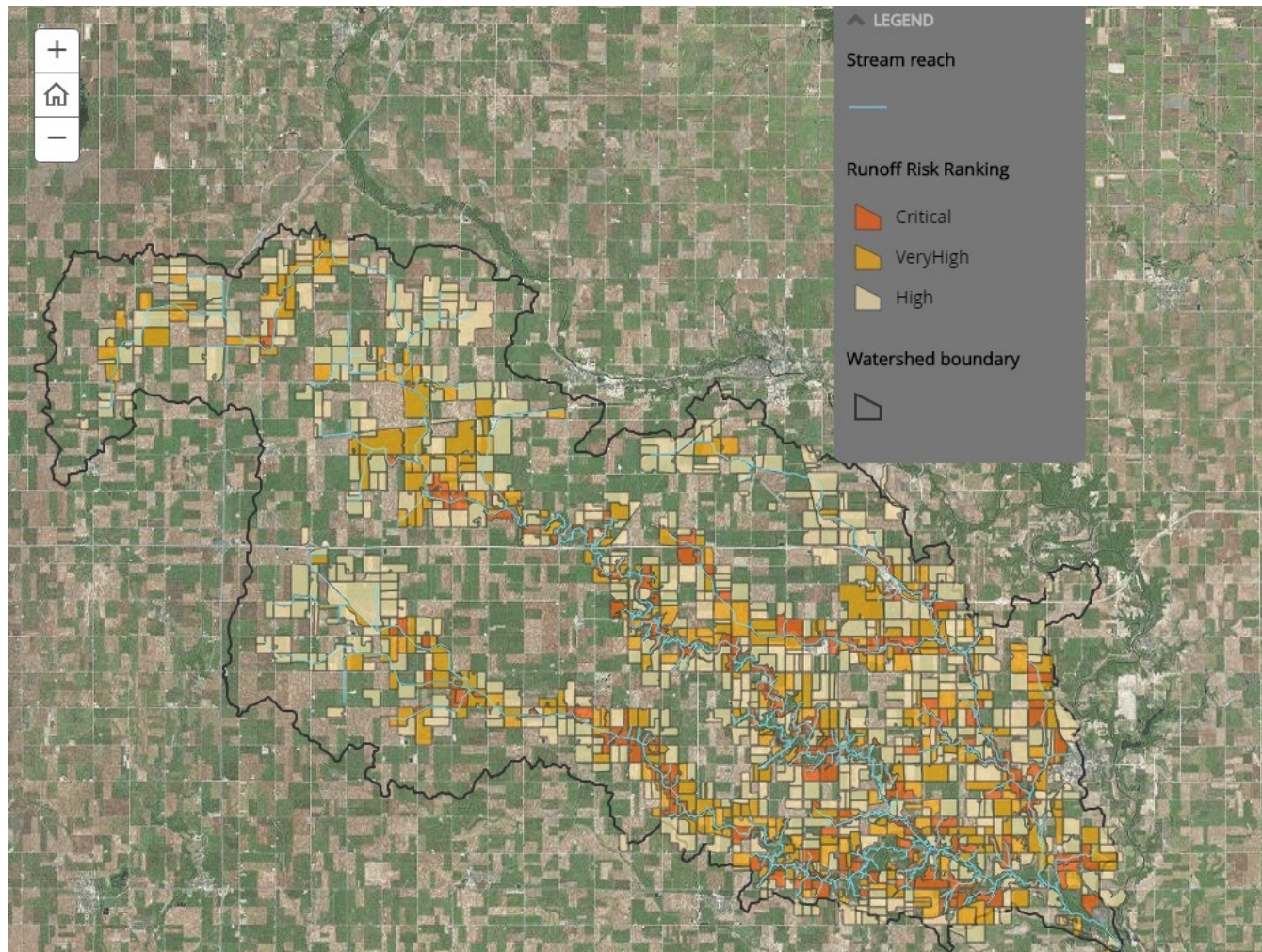
Data Driven Approach



- Changing management practices to improve profitability, environmental performance, biomass supplies



Landscape Analysis Tools



South Fork Watershed & The USDA  

A Menu of Conservation Practice Opportunities in the South Fork of the Iowa River

greater may still be impacted by runoff, this is merely a suggestion.

Runoff Risk Assessment:
Prioritize fields where multiple erosion control practices are most needed

Close to stream?

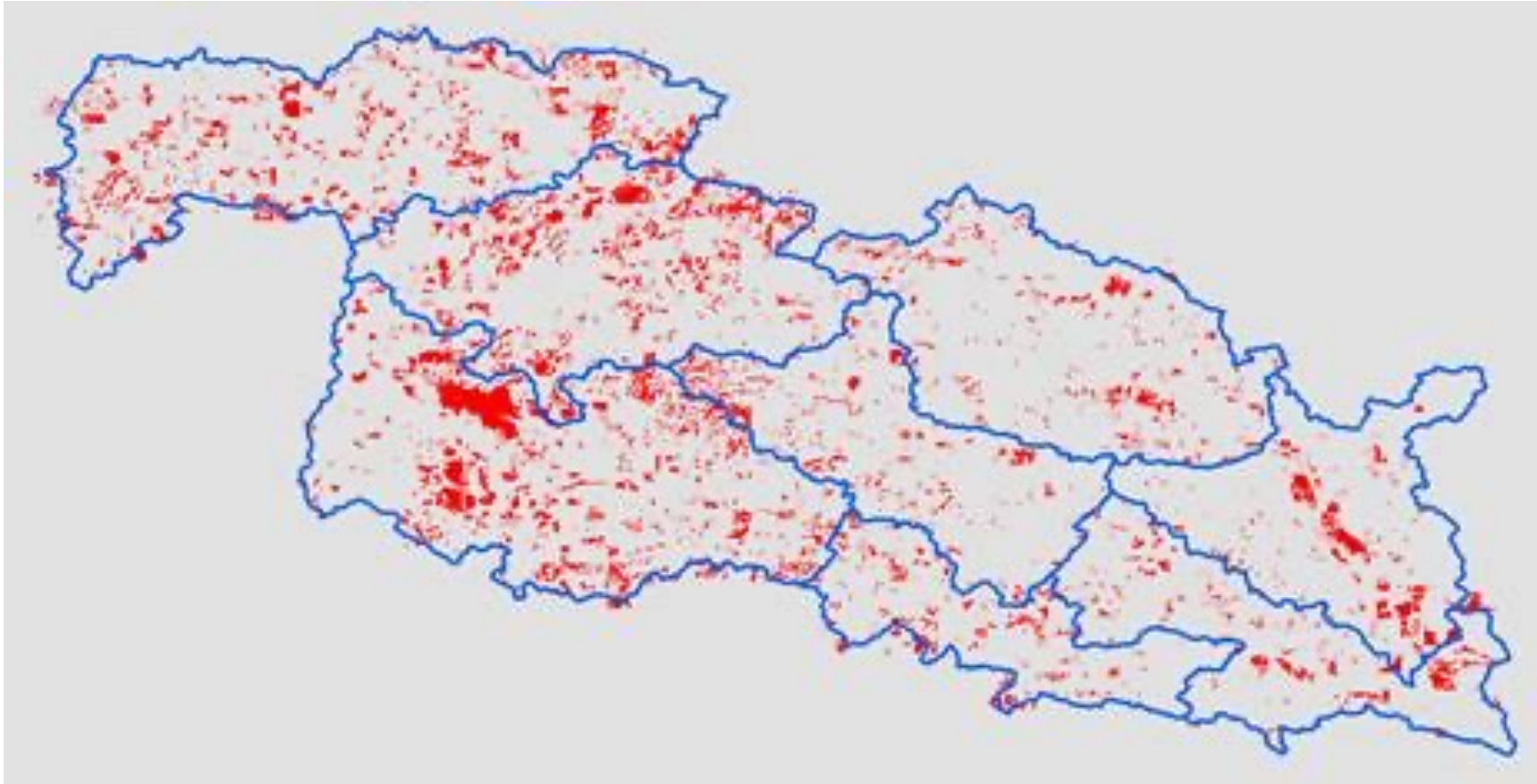
		Yes	No	
Slope steepness	H	A	B	C
	M	B	C	
	L	C		

Drainage Water Management

The inset map below shows a suitable area for drainage water management between the South Fork and Tipton Creek channels. This is a relatively flat area within the watershed, making it ideal for drainage management

Tools such as the Agricultural Conservation Planning Framework (ACPF) are being used to Identify potential sites Landscape Design changes. In this case, the nutrient runoff risk is being assessed for the Southfork watershed.

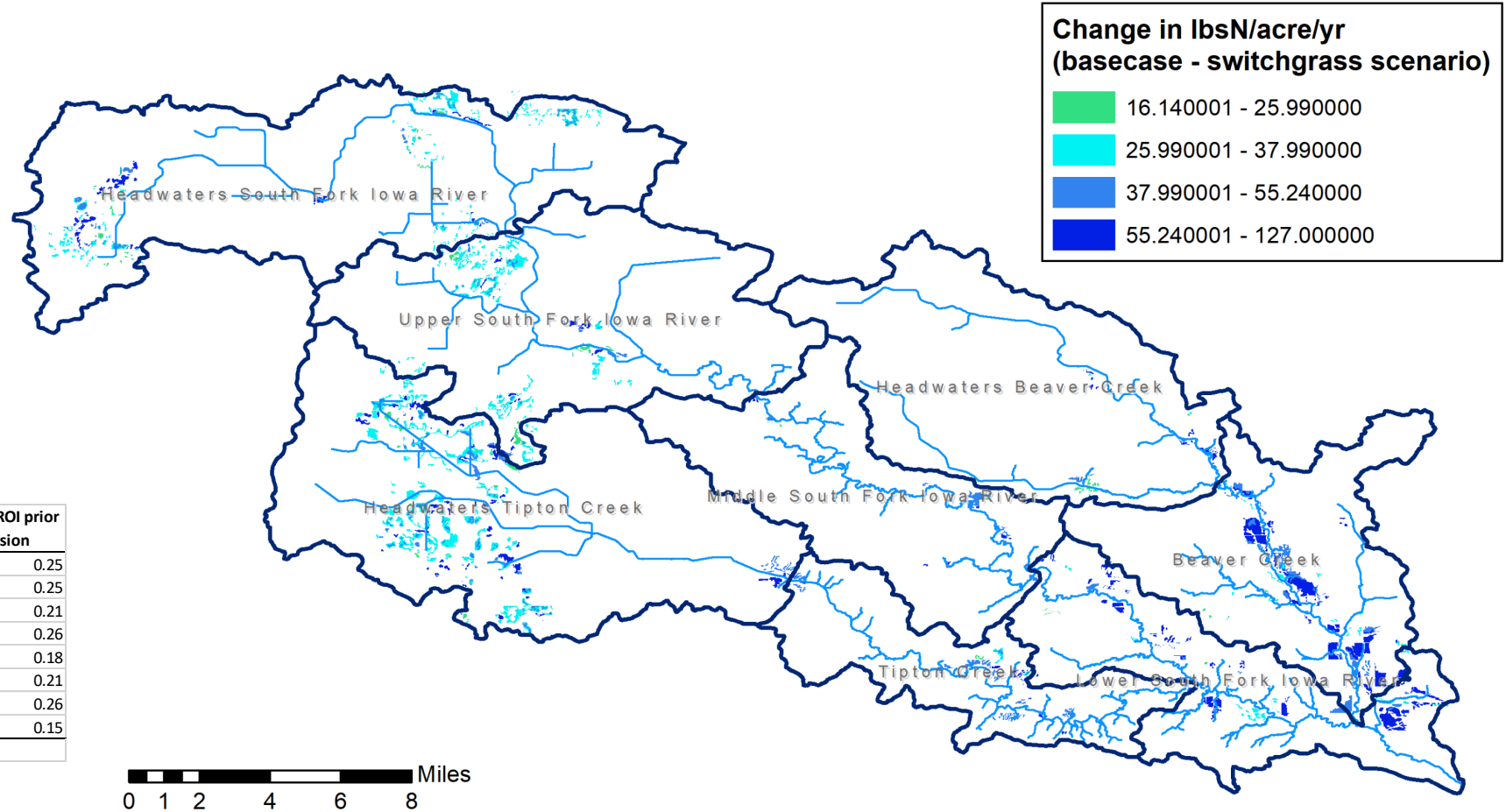
Analytics profitability at a subfield level



Lowest 10% ROI acres in the HUC12 subbasins, equal to ~19,000 acres in total.

Analysis of Iowa's South Fork Watershed: Potential reductions in nitrate leaching following switchgrass plantings on clustered areas of low ROI

Compared to a base case of conventional till corn/soy with no cover crop, no residue removal, and fall fertilizer application

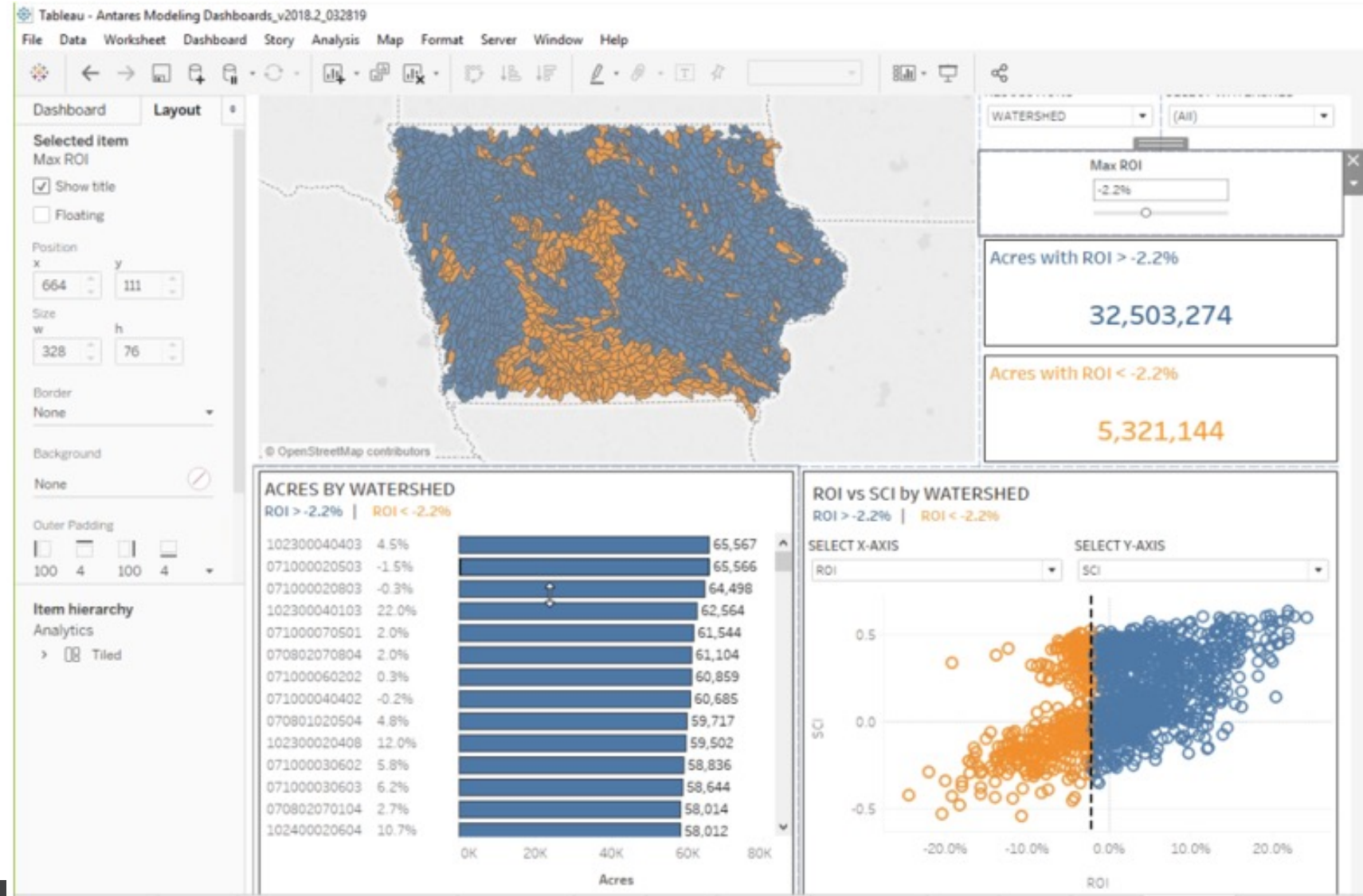


Subbasin Name	Converted Acres	Annual N reduction (lbs)	Average ROI prior to conversion
Headwaters Tipton Creek	1,875	75,818	0.25
Headwaters South Fork Iowa River	1,163	44,075	0.25
Beaver Creek	1,107	72,057	0.21
Upper South Fork Iowa River	1,006	38,871	0.26
Lower South Fork Iowa River	789	50,546	0.18
Tipton Creek	298	15,804	0.21
Middle South Fork Iowa River	140	6,557	0.26
Headwaters Beaver Creek	100	5,232	0.15
South Fork Total	6,477	308,961	

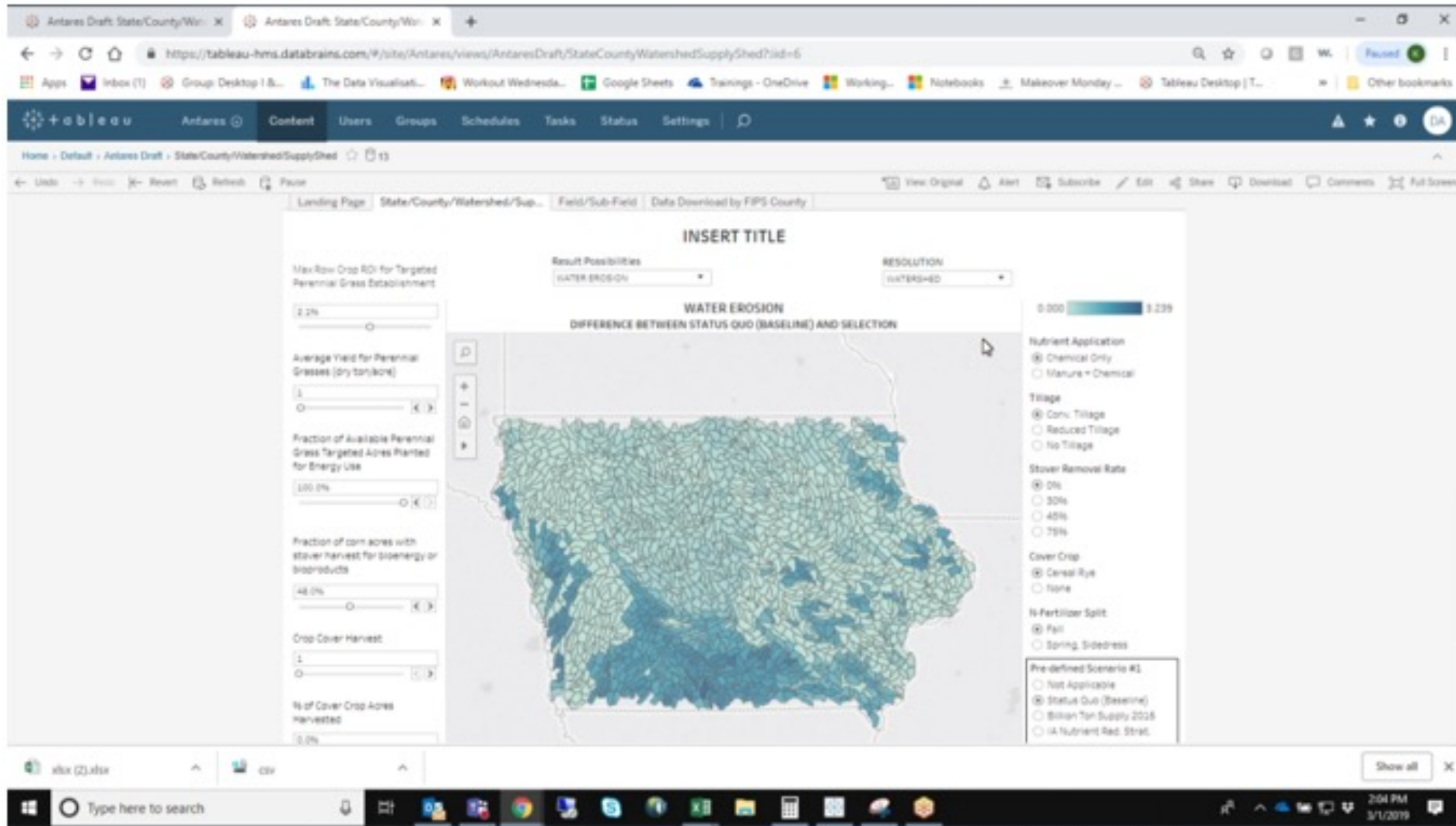
0 1 2 4 6 8 Miles

Analysis of AgSolver datasets by Esther Parish of ORNL, 2 July 2019

Analytics identifying ROI



Analytics identifying Water Erosion



Diversified Cropping System Approach

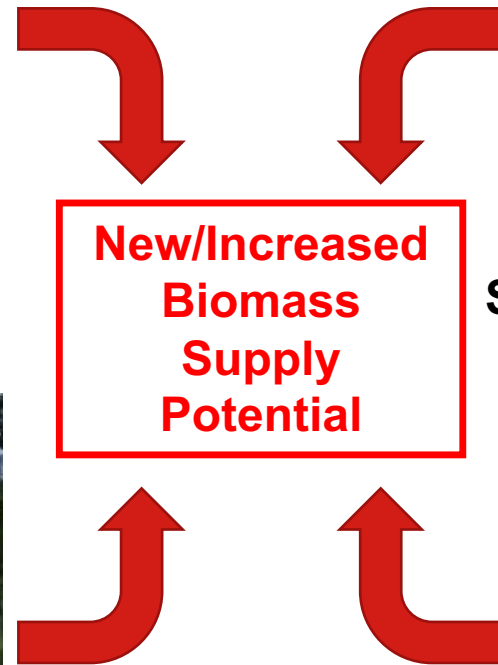
- Four primary biomass supply-related strategies:



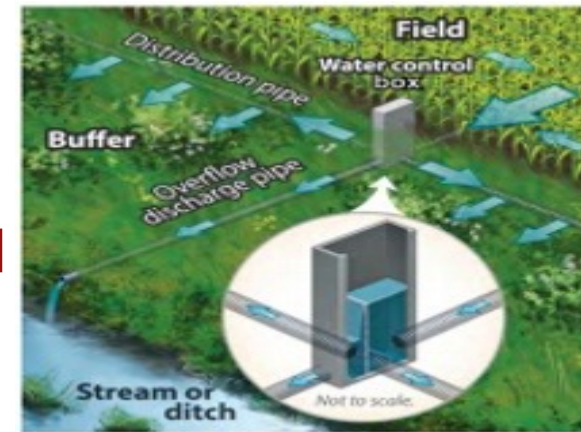
**Sustainable Stover Removal,
without Cover Crops**



**Sustainable Stover Removal,
with Cover Crops**



**Perennial Grasses on
Marginal Lands**



**Saturated Buffers with
Perennial Grasses**

Source: Frankenburger et al., unpublished

Near-Infrared (NIR) Probe for Biomass Composition Analysis

Product: Novel method to use NIR probe to sample biomass for measurement of moisture, ash and sugar content. Proprietary methods for real-time analysis.

Market need: Currently no field-deployable, mobile, accurate and reliable analysis method that can rapidly measure moisture, ash, and other biorefinery process-related parameters.

Value proposition: State-of-the-art for biomass quality sample analysis involves manual sample gathering followed by laboratory analysis. As a result, today's sampling procedures are time consuming, expensive, difficult, unreliable, and too slow to support decision-making potential. Integration of probe with supply chain management system enhances value of data.

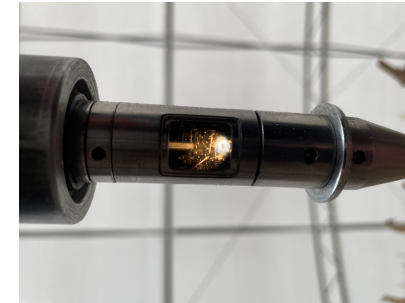
Market opportunity: Target market for biofuels likely to spill over into agriculture, pulp and paper and manufacturing, biochemicals and bioproducts (e.g., plastics), and food processing sectors.

Team: ANTARES, Idaho National Laboratory, Iowa State University's BioCentury Research Farm, Pinja (Finnish automation and controls company)

From the beginning



<2020: Prototype hand probe



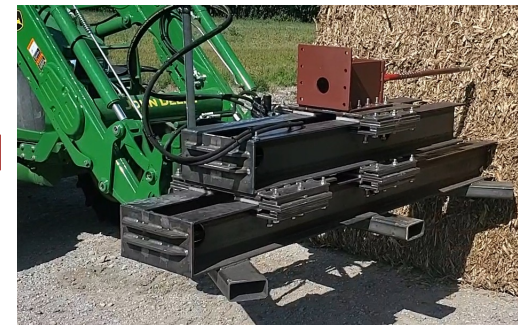
2020: SBIR Phase I demonstration



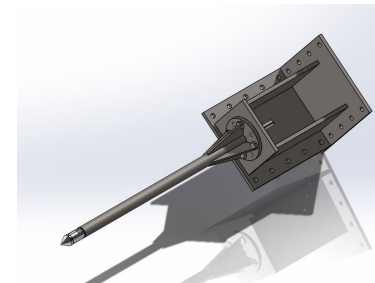
2021: Brainstorming redesign



Additional development and first commercial deployment

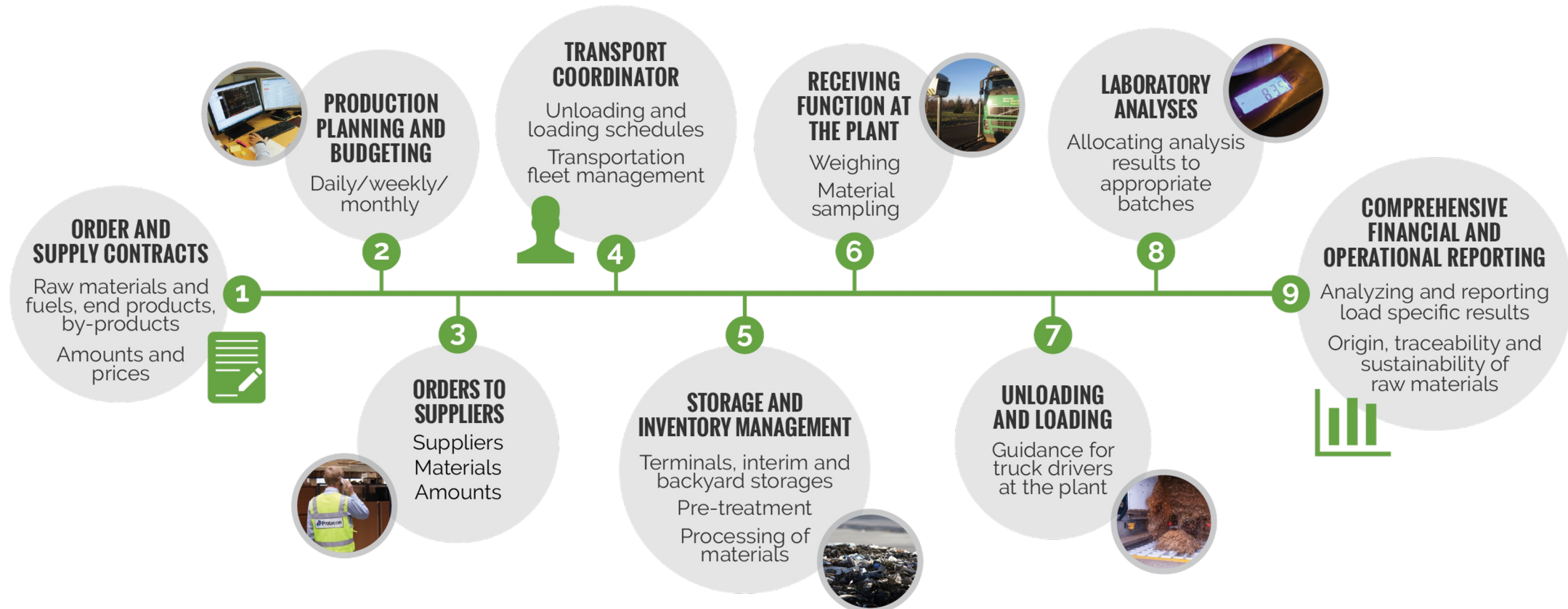


Next generation probe tractor-mounted for direct bale punch in stack or on truckload



ISU revised model for probe design

Supply chain management to streamline operations and reporting



REPORTS

- Inbound and outbound loads in all necessary units
- Inbound and outbound loads vs. budgeted
- Production plan
- Storage balance sheets
- Quality of raw materials and end products
- Traceability and origin of raw materials/feedstocks/fuels
- Taxes, subsidies, tariffs
- CO₂, NO_x, other emission reports
- Sustainability reports

INFORMATION FOR ALL STAKEHOLDERS

- Biogas plant operating company
- Suppliers of raw materials
- Customer for end products and side streams
- Transport company
- Contractor
- Laboratory
- Regulatory authorities

Information
flow for
ONCE
by PINJA

Engage Farmers/Landowners by Minimizing their risk

Data is available to target the right acre on the landscape; but what is the refinery wanting to buy, a commodity or a product?

- › What are the terms and conditions which will reward the growing risk?
- › How will refineries evaluate and reward the environmental benefits garnered by growing the crop?
- › What's the mechanism to translate and transition the information to the Farmer/Landowner?
- › By what means and what metrics does the biorefinery use to reward the opportunity costs and risk?
- › Have the Biorefineries coalesced around the needed biomass quality attributes, and can the farmer deliver?
- › Will the Biorefinery execute take or pay agreements for the entire life of the production contract?

THANK YOU



Bill Belden, Sr. Agriculture Specialist
6123 270th Pl,
Moravia, IA 52571



641-895-9907



beldenw@starktech.com



www.antaesgroupinc.com