Enabling Sustainable Landscape Design for Continual Improvement of Operating Bioenergy Supply Systems

Project Overview

Presented By:
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Presentation Objectives

- High-level overview of project
- High-level review of project context
- Introduction to planned project activities
- Initial estimates/examples of potential impacts

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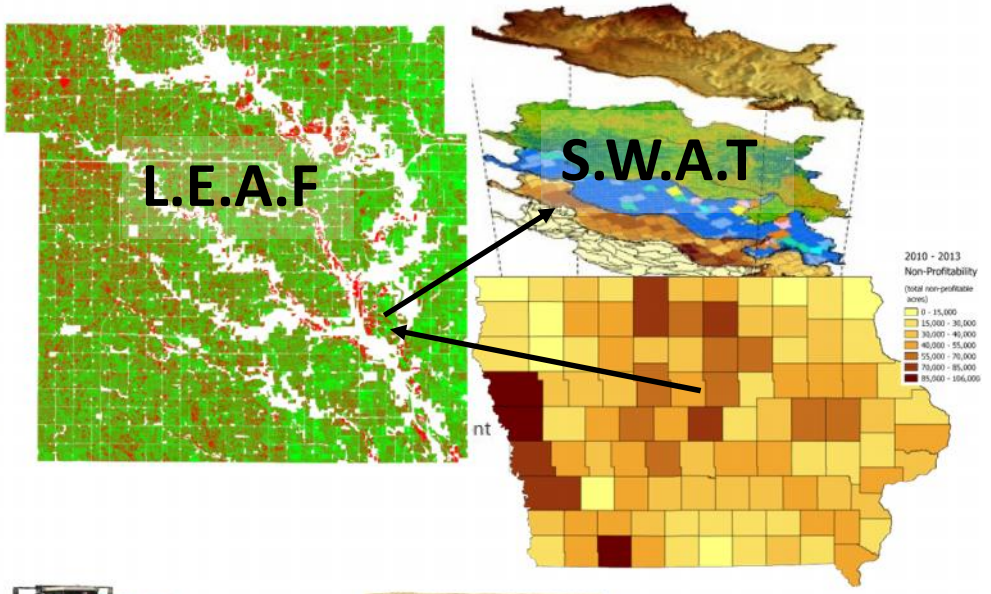
Landscape Design for Sustainable Bioenergy Systems

Project Summary:

The team will work with growers and biomass end-users to utilize subfield agronomic models to target areas within existing cellulosic ethanol feedstock supply sheds to build baseline datasets, implement conservation practices, monitor key environmental indicators, and monitor the environmental and economic impacts to the watersheds and the biomass supply chain.

Total Project Budget	$11,940,000
DOE Funds	$9,000,000
Applicant Cost Share	$2,940,000

5 year performance period,
Just getting started.



"Enabling Sustainable Landscape Design for Continual Improvement of Operating Bioenergy Supply Systems"

Required Areas of Focus:

1. Multi-Stakeholder Landscape Design Process
2. Assessment of Environmental Sustainability Indicators
3. Assessment of Feedstock Supply and Logistics

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POET Energy inspired.

DUPONT

PacificAg

AGSOLVER

Southfork WATERSHED ALLIANCE INC.

PURDUE UNIVERSITY

PENNSTATE 1855

OAK RIDGE National Laboratory

Iowa Agricultural Bio Fibers

BUENA VISTA COUNTY SOIL AND WATER CONSERVATION DISTRICT

IOWA STATE UNIVERSITY

FDC Enterprises Grasslands Services

MONSANTO

IOWA FARM BUREAU PEOPLE. PROGRESS. PRIDE.

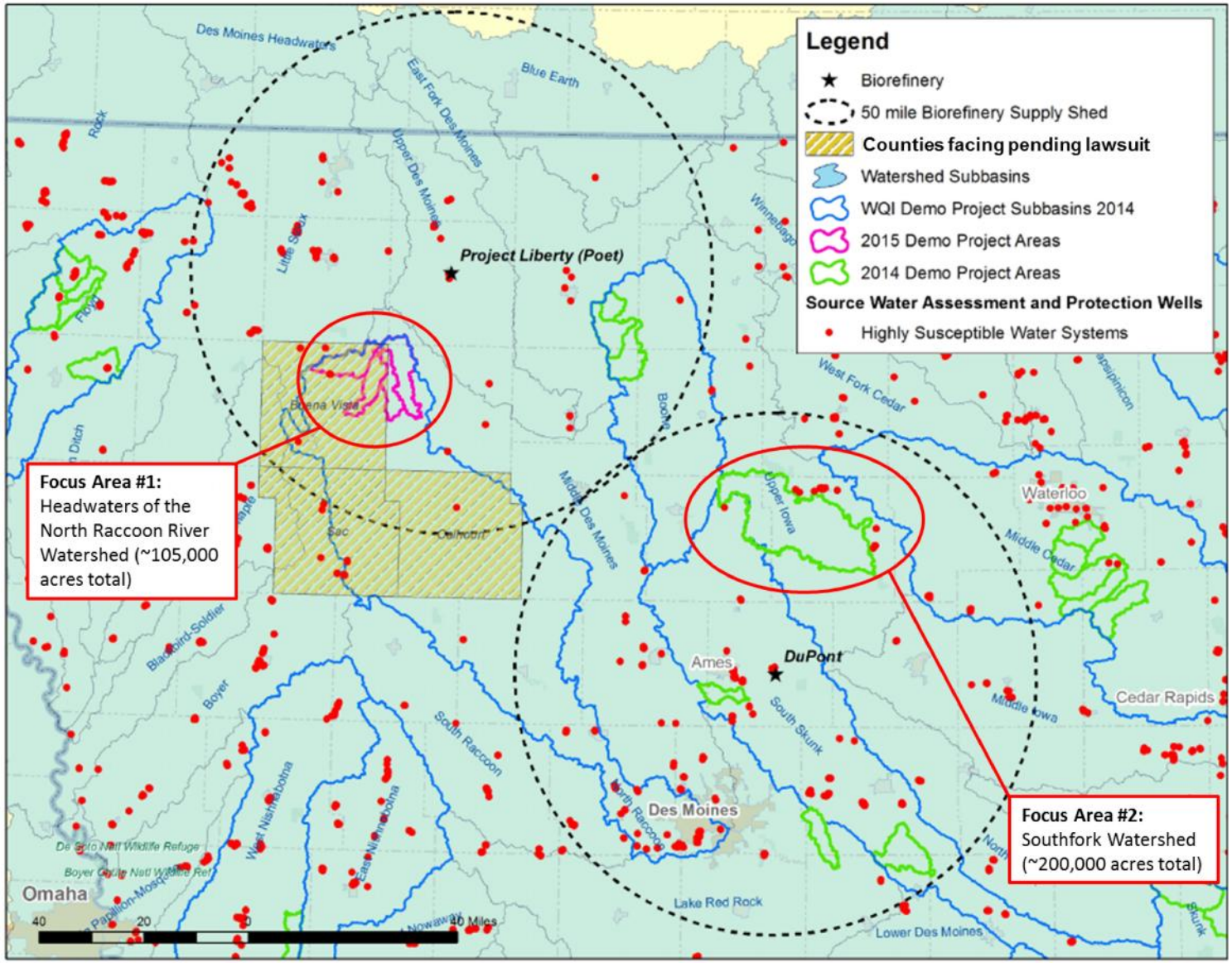
IOWA CORN

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Argonne NATIONAL LABORATORY

Targeted Watershed & Supply Areas

- Will also focus on fields and practices subject to wind erosion in the High Plains region (Southwest Kansas and surrounding areas)
- Iowa Nutrient Reduction Strategy Goals
  - Non-point
  - 41% less N
  - 29% less P



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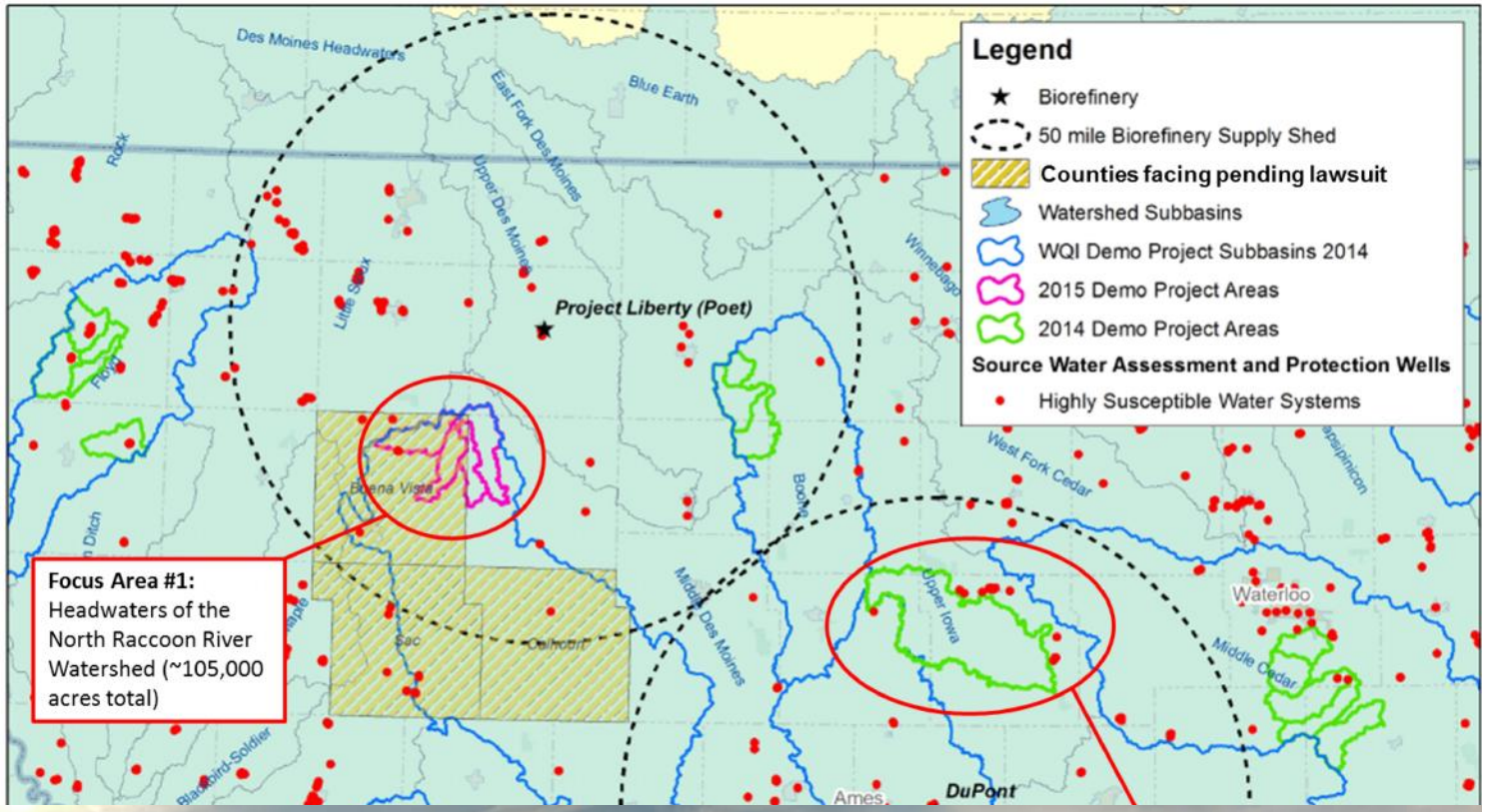
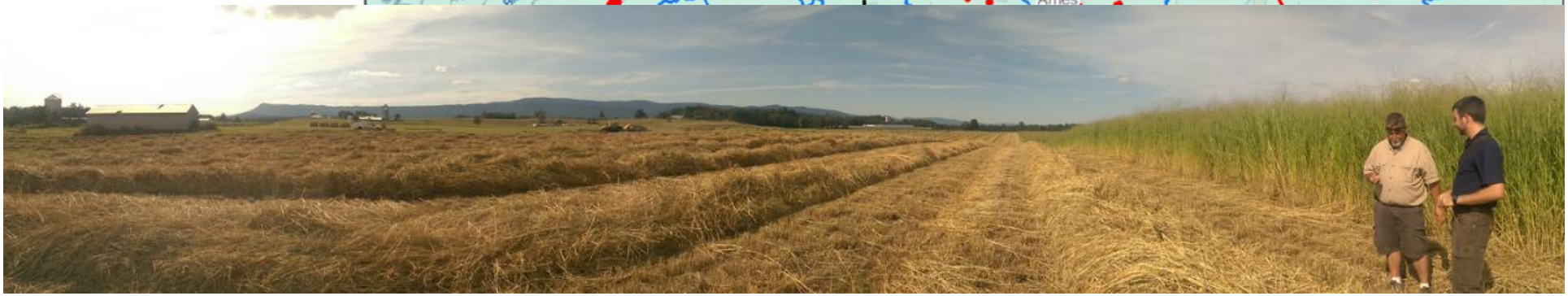




Assembling Key Pieces of the Puzzle

Advanced Harvest & Logistics, 2nd Pass

Regional Impact Modeling & Monitoring

Perennial Grass for Conservation & Biomass Supply

Implementation of Conservation Practices (Cover Crops, Buffer Strips, etc.)

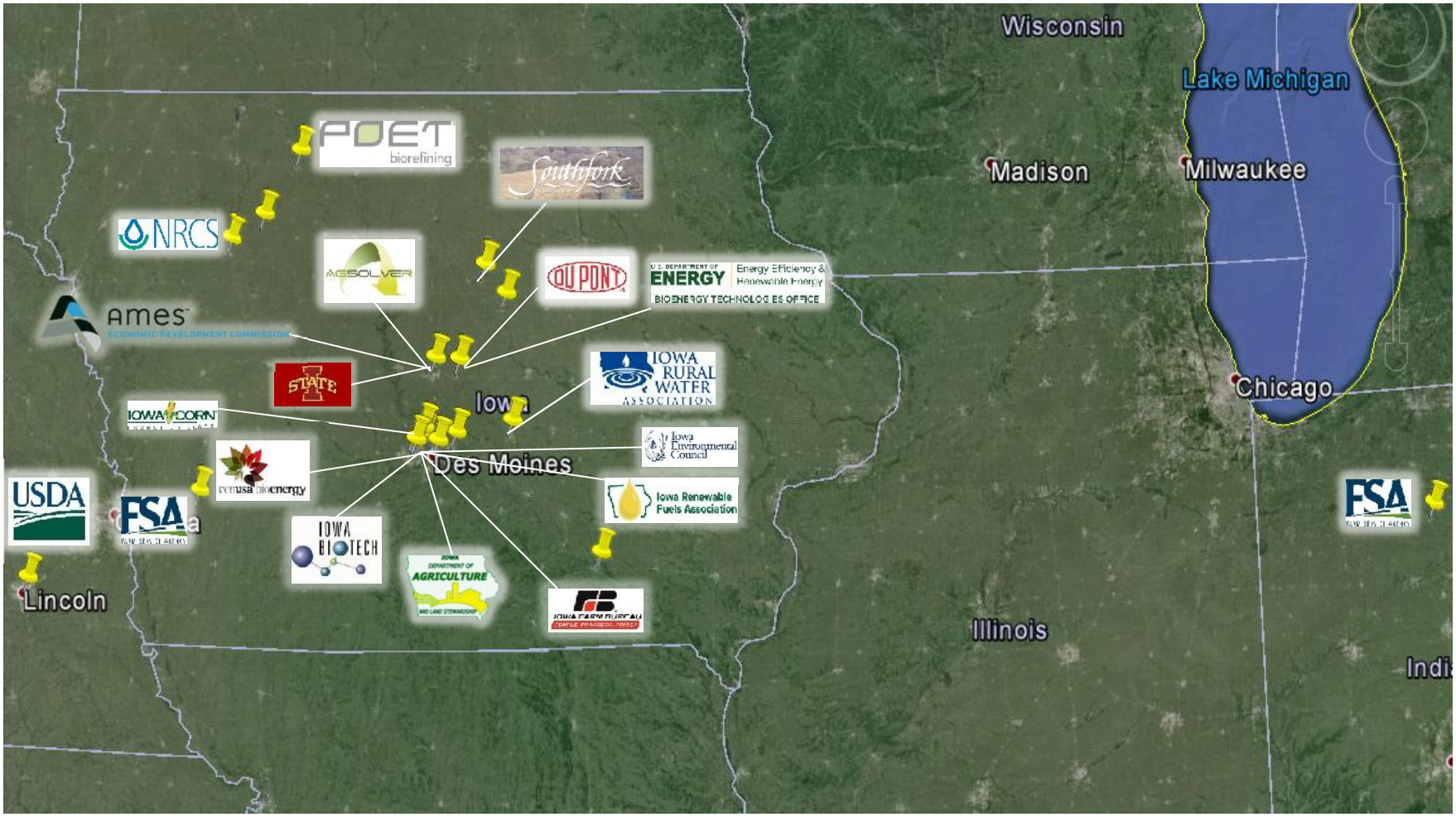
Subfield Precision Business Planning

Advanced Harvest & Logistics, First Pass

Sustainable Residue Harvest

Multi-stakeholder Outreach

Multi-Stakeholder Outreach



Environmental Indicators

Environment	Indicator	Units
Soil quality	1. Total organic carbon (TOC)	Mg/ha
	2. Total nitrogen (N)	Mg/ha
	3. Extractable phosphorus (P)	Mg/ha
	4. Bulk density	g/cm^3
Water quality and quantity	5. Nitrate concentration in streams (and export)	concentration: mg/L; export: kg/ha/yr
	6. Total phosphorus (P) concentration in streams (and export)	concentration: mg/L; export: kg/ha/yr
	7. Suspended sediment concentration in streams (and export)	concentration: mg/L; export: kg/ha/yr
	8. Herbicide concentration in streams (and export)	concentration: mg/L; export: kg/ha/yr
	9. storm flow	L/s
	10. Minimum base flow	L/s
	11. Consumptive water use (incorporates base flow)	feedstock production: m^3/ha/day; biorefinery: m^3/day

Environment	Indicator	Units
Greenhouse gases	12. CO_2 equivalent emissions (CO_2 and N_2O)	kgC_{eq}/GJ
Biodiversity	13. Presence of taxa of special concern	Presence
	14. Habitat area of taxa of special concern	ha
Air quality	15. Tropospheric ozone	ppb
	16. Carbon monoxide	ppm
	17. Total particulate matter less than 2.5µm diameter ($PM_{2.5}$)	µg/m^3
	18. Total particulate matter less than 10µm diameter (PM_{10})	µg/m^3
Productivity	19. Aboveground net primary productivity (ANPP) / Yield	gC/m^2/year

Credit: Virginia Dale & Keith Kline, Oak Ridge National Lab

Feedstock Logistics

- The Straeter Header is being upgraded for variable rate harvesting







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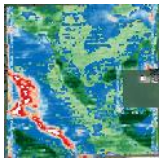
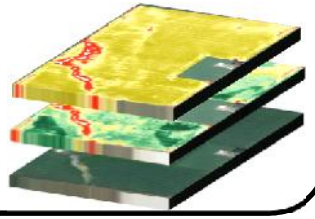
Field Work Process (Simplified)

Research Field Identified



Subfield **Profitability** Assessment Conducted



Land Management Changes Identified

Field Research Plans Developed

* Baseline Data Collection

Land Management Changes Implemented

Cover Crop

Switchgrass Establishment

Sustainable Stover Removal

(plus others by landowner preference)

* Follow-Up Data Collection

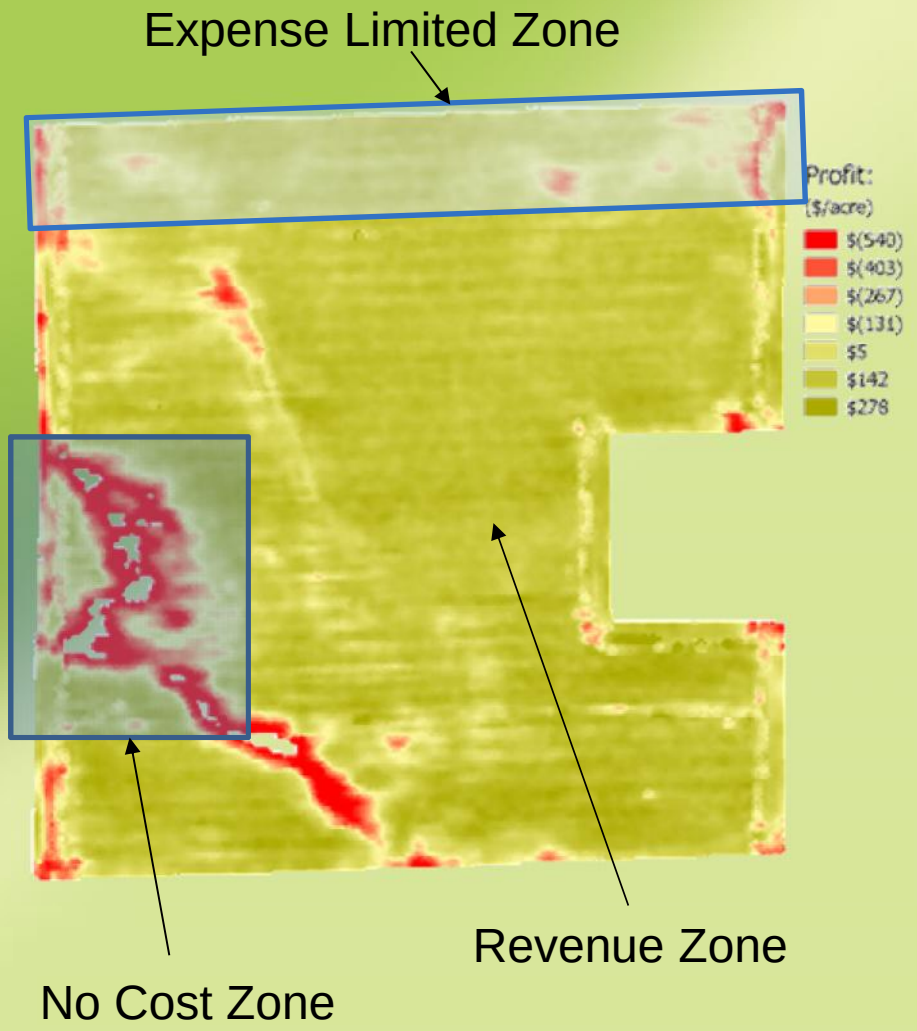
Field Harvest Conducted

* Harvest Data Collection, Analysis, Reporting

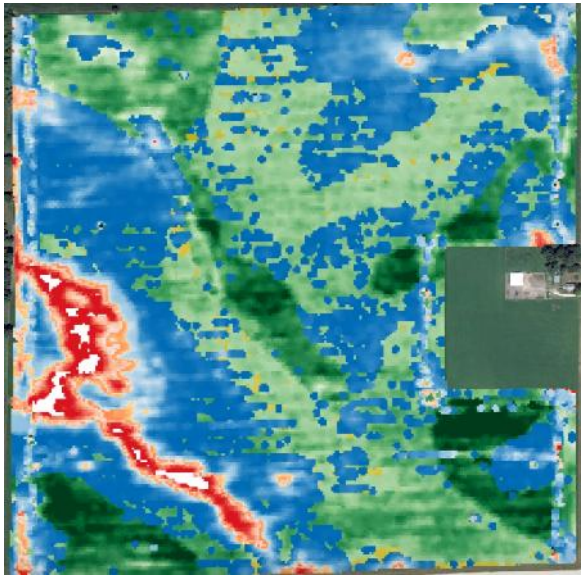
* Sustainability Model and Data Analysis Tools are developed and coordinated with a Sustainability Reporting Platform

ROI Focused Agronomic Management

- Zonal Management to Increase Profits
- 143 acre field
- Estimated $5,000 of additional profit per year (reduced expenses only)
- Environmental benefits from changed management in vulnerable zones
- New perennial biomass supply
  - Estimated 45 to 60 tons new biomass supply
- Optimized sustainable harvest of ag. residues
  - Estimated *additional* 80 to 100 tons per year (sustainably)



Advanced Data Analytics + Advances in Machine & Controls Technology and Feedstock Logistics = Improved: Sustainability, Biomass Supply Potential, Economics



Profit: Corn Stover with Cover Crop
($/acre)
- $(540)
- $(403)
- $(267)
- $(131)
- $5
- $142
- $278

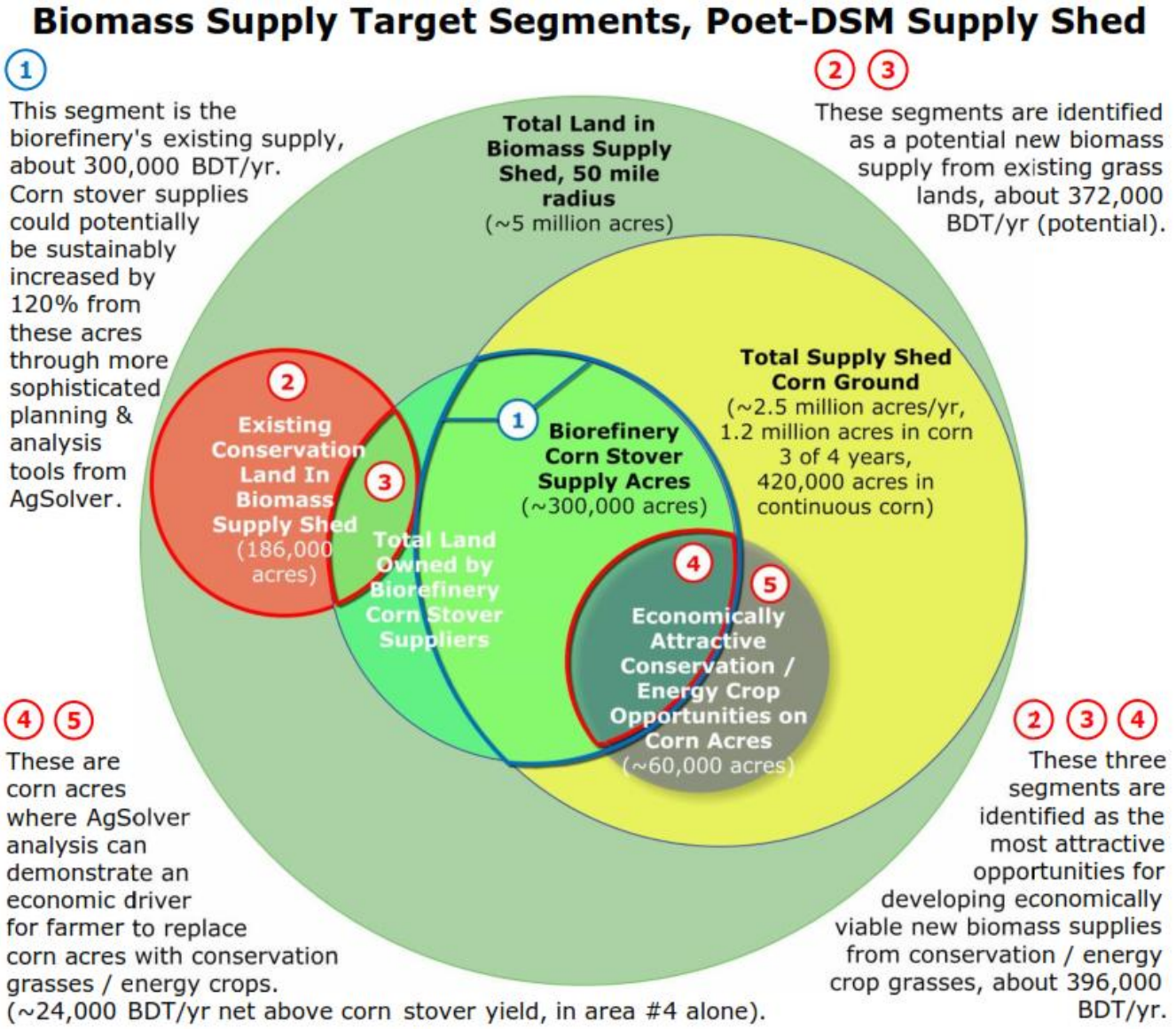
Sustainable Removal Rake and Bale with Cover Crop
(tons/acre/year)
- 0
- 1.57
- 1.70
- 1.83
- 1.96
- 2.09
- 2.22
- 2.35
- 2.45

NO3 Leaching Rake and Bale with Cover Crop
(lbs N/acre/year)
- 35.2
- 59.9
- 84.7
- 109.4
- 134.1

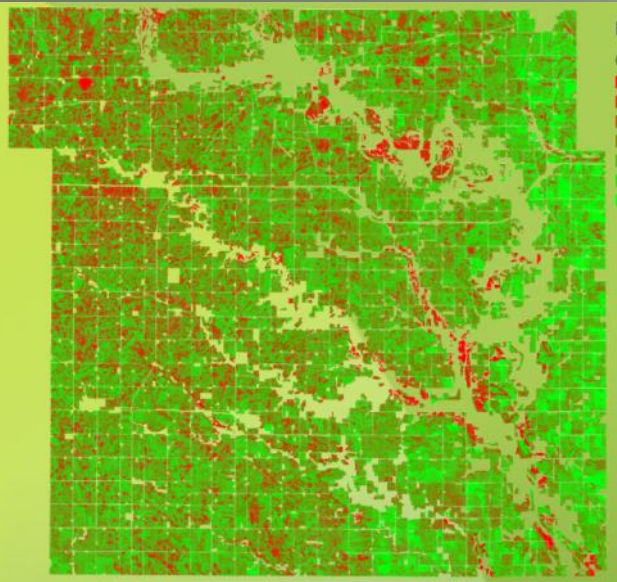
Credit: AgSolver

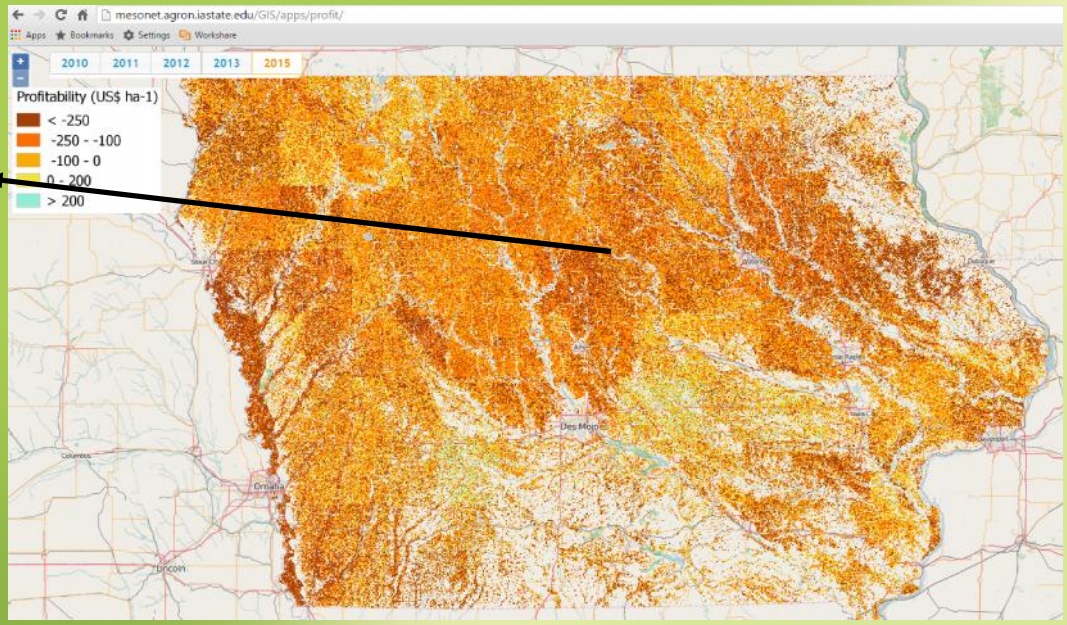
Example Impacts for a Biorefinery Supply Region in Iowa

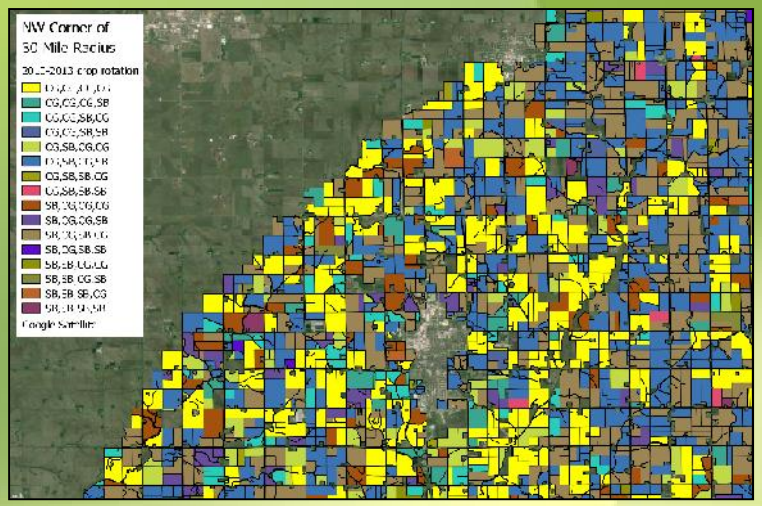
- Could our approach make a difference?
- Yes!
  - 120% increase in corn stover supply (sustainable)
  - 133% of biorefinery needs from grasses that provide conservation benefits



Identifying the Opportunities





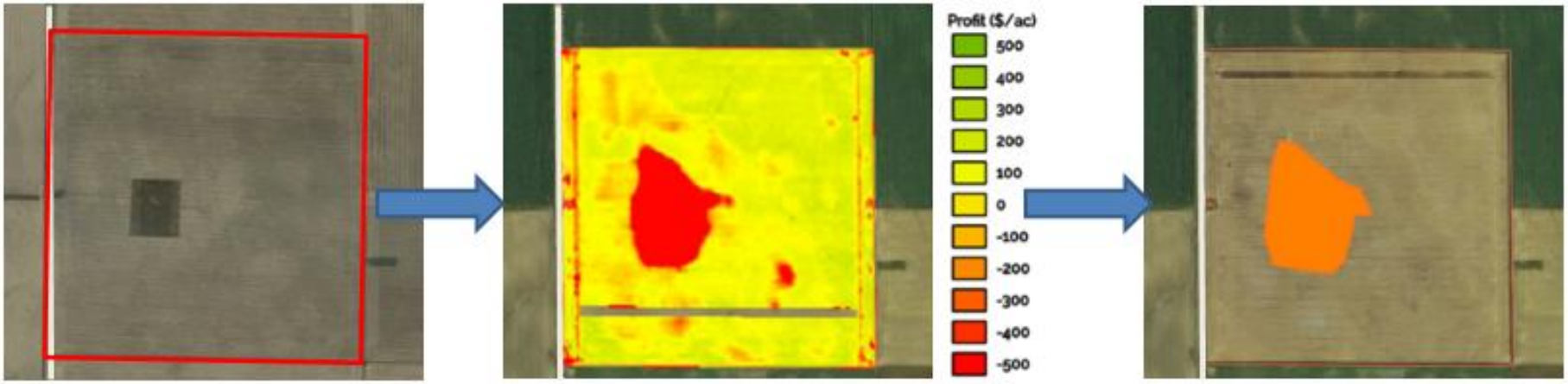


- Between 2-3 million acres annually at an expected loss
- Over $1B annually in misallocated working capital
- ~5.9 million acres of perennial grasses required to meet NRS goal for N

Initial Target Field Examples

AGS-002 Field Information

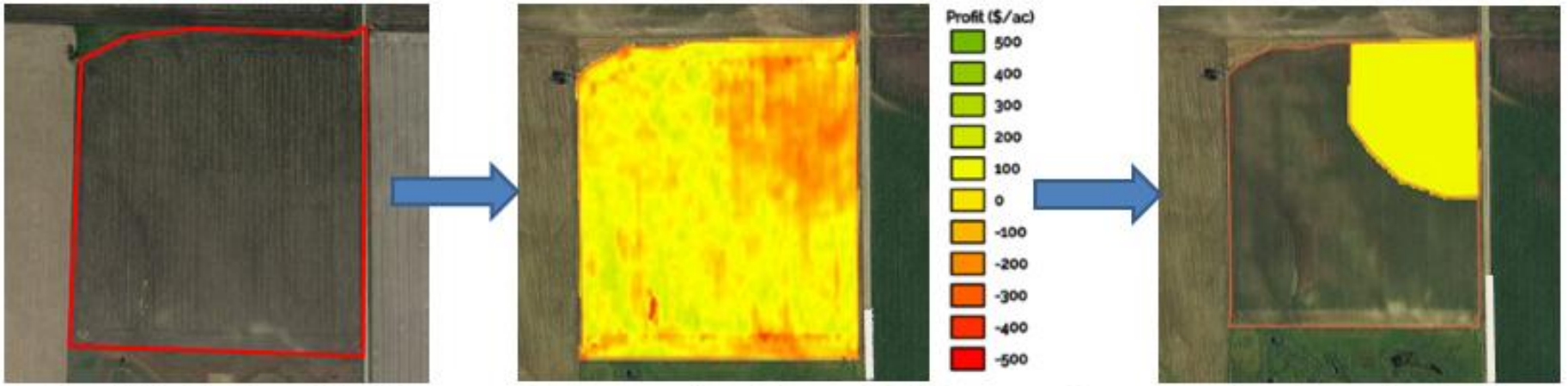
Field Boundary | Profit Zone Map | Potential Conservation Area



Total Field Size: 154.32 acres; Conservation Area: 15.3 acres; Conservation Practice: CSP

AGS-007 Field Information

Field Boundary | Profit Zone Map | Potential Conservation Area



Total Field Size: 65.26 acres; Conservation Area: 16.07 acres; Conservation Practice: CRP

QUESTIONS?

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