



Biomass Project Development

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Switchgrass Co-firing Ottumwa, Iowa

- Ottumwa Generating Station
 - Alliant Energy / Mid-American
 - 726 MW, PRB Coal, 1982 startup
 - Twin furnace T-fired PC boiler
 - 2.5 to 5% heat input from switchgrass, 12.5 to 25 ton/hr
 - Separate biomass injection, 2 - 4 ports
- Multi year project 1996-2006
 - 3-month continuous test burn completed
 - Newly constructed facility completed
 - Long term test to investigate fouling, slagging, and corrosion impacts
 - Industry gaps identified and quantified
- Fuel
 - 3' x 4' x 8' switchgrass bales



2000+ Hour Continuous Demo

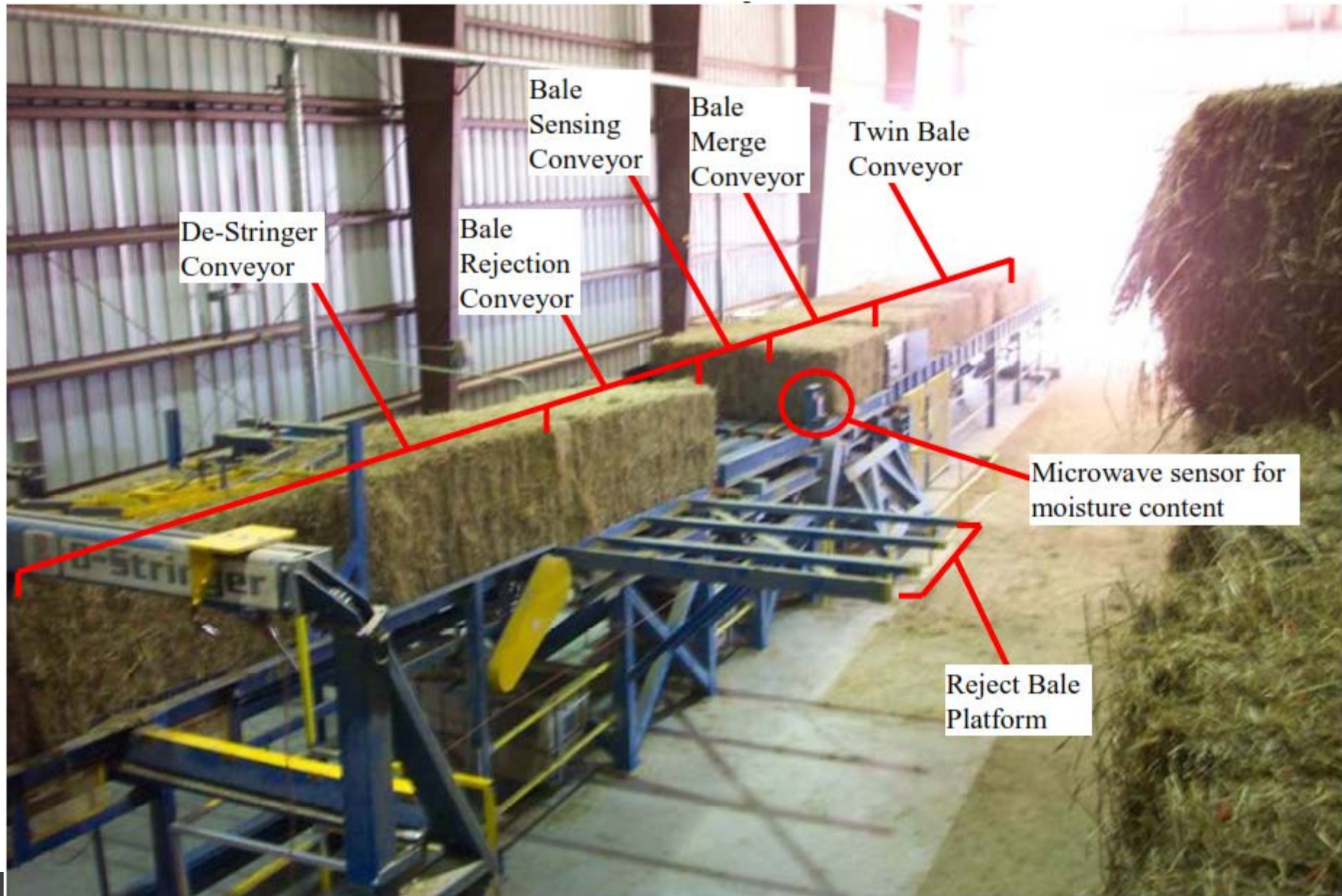


Tennessee Switchgrass Project

- Cooperative project with Dupont Biosciences
 - 2007 State Legislature appropriated \$70.5 million
- 2009 constructed a 74,000 square foot demonstration scale facility to produce 250,000 gallons of ethanol
- Switchgrass from 6000 acres
- Corn Stover research
- Closed when facility constructed in Nevada, IA
- Genera Energy – Bioenergy Supply Chain



Bale Conveyor Line Photo



Industry / Government Cooperative R&D



- Commercial-scale Switchgrass Co-firing
- Fully-automated processing system
- Project completion: 2006



- Herbaceous Biomass Logistics, Phase 1
- Square bale innovations, field-to-plant gate
- Project Period: 2010-2015



- Herbaceous Biomass Logistics, Phase 2
- Round & square bale systems, field-to-process
- Project Period: 2013-2017



- Landscape Design for Sustainable Bioenergy Systems
- Project Period: 2016-2021

Biorefinery Project Development

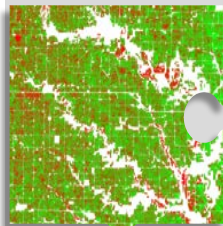
- Building strong collaborative project team
- Feedstock supply and cost characterization
- Risk and competitive analyses for biomass supplies
- Technology assessment
- Project site selection and evaluation
- Biomass harvest and logistics planning
- Financial due diligence support
 - Have bankable project on both sides of the ledger



Keys to the Commercial Puzzle

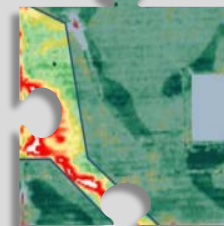
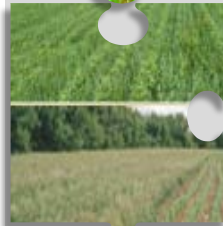
Advanced Harvest & Logistics, 2nd Pass

Regional Impact Modeling & Monitoring



Perennial Grass for Conservation & Biomass Supply

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



Subfield Precision Business Planning

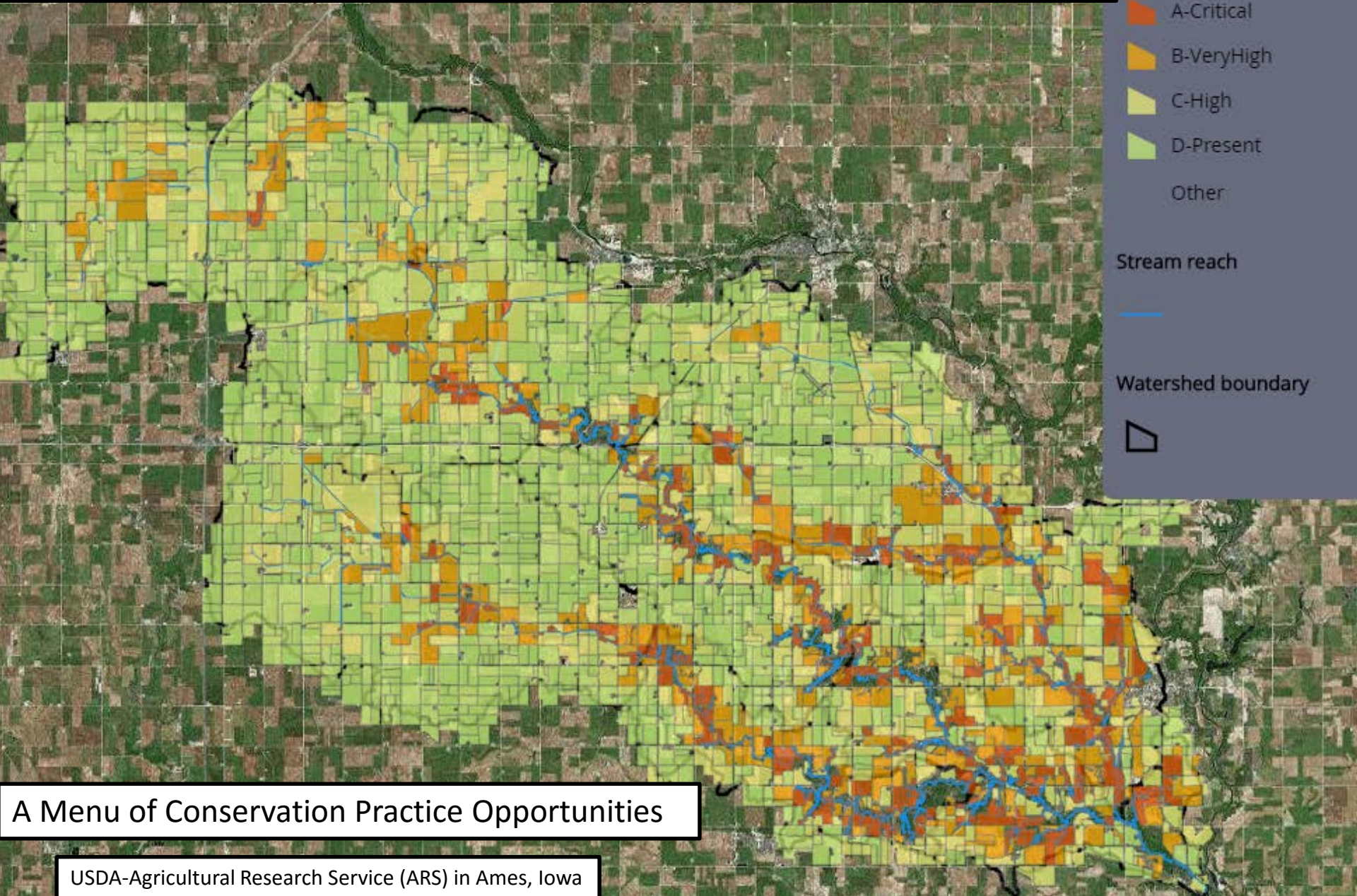
Advanced Harvest & Logistics, First Pass



Sustainable Residue Harvest

Multi-stakeholder Outreach

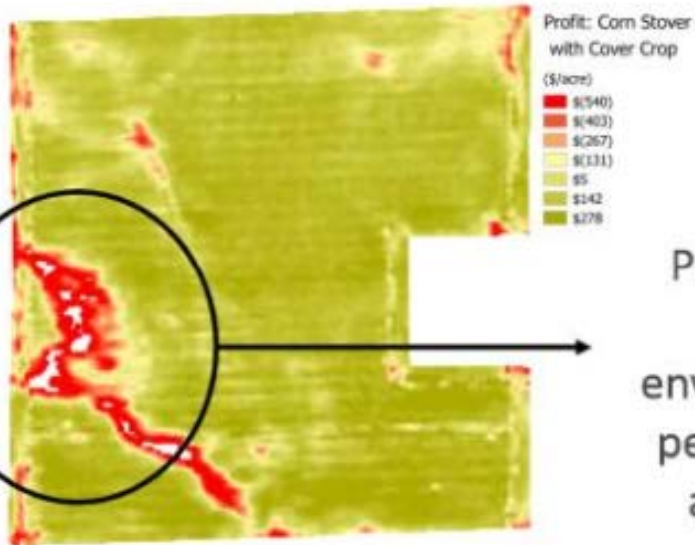
Water/Soil Health/Biodiversity Linkages



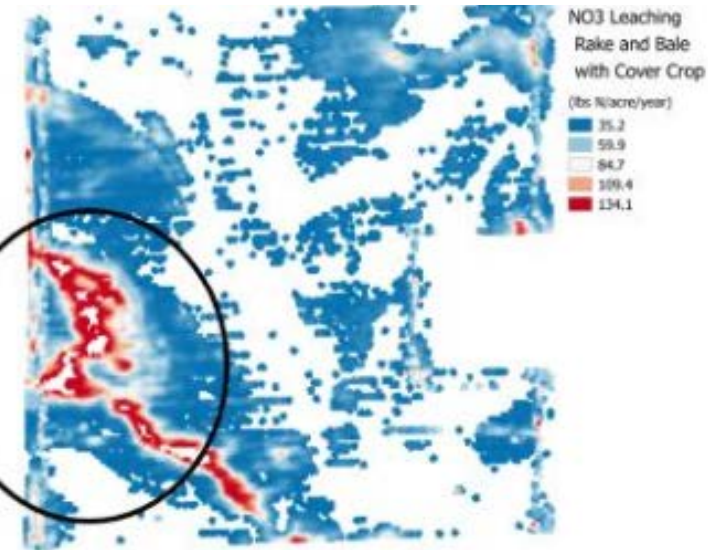
A Menu of Conservation Practice Opportunities

USDA-Agricultural Research Service (ARS) in Ames, Iowa

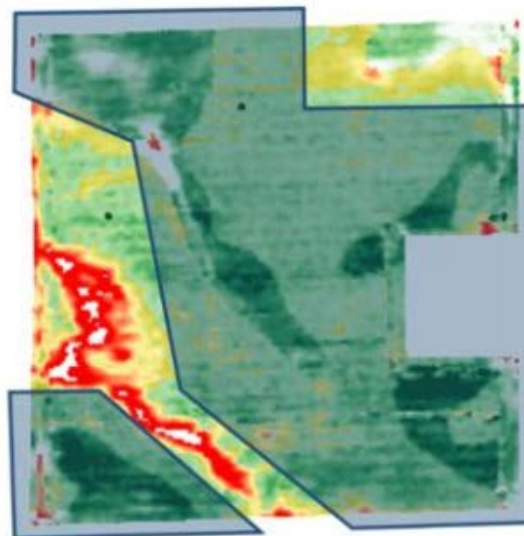
Profitability vs Environmental Performance



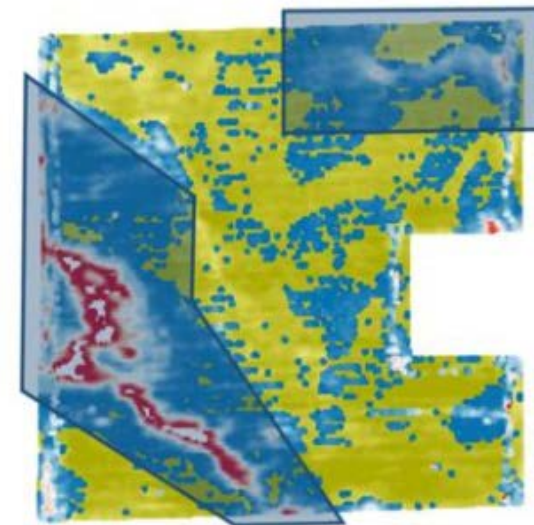
Profitability and environmental performance are linked



Stover Removal Management Zones



NO3 Leaching Mitigation Management Zones



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

Resources

- Chariton Valley Biomass Project
 - <http://www.iowaswitchgrass.com/>
- Genera Energy
 - <https://generaenergy.com/>

