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biomass program

Chariton Valley Biomass Project

DOE/USDA Biomass Feedstock Gate Review Meeting
March 16, 2005

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Chariton Valley Resource Conservation and Development

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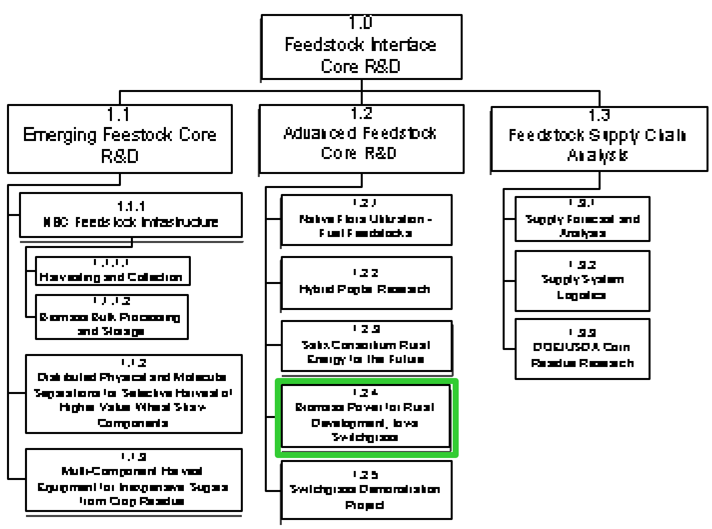
Introduction

Where is this project in the Feedstock area?



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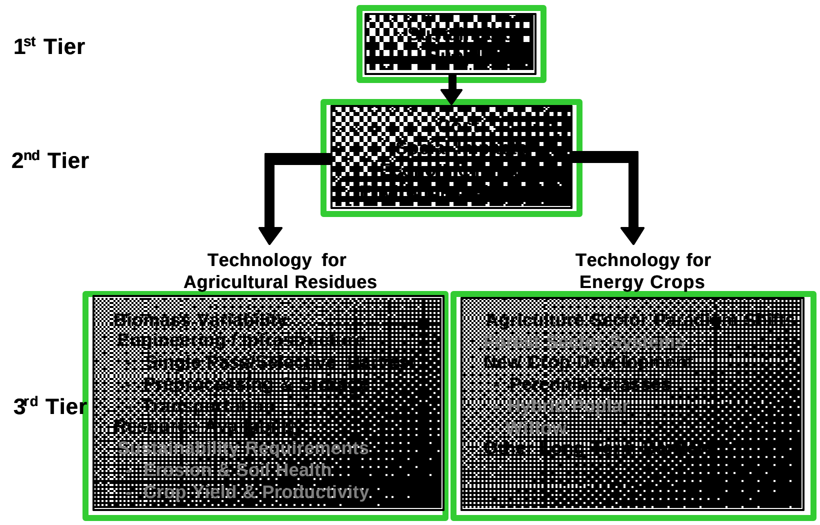
Introduction

What Barriers are being addressed?



Gray areas not covered in current review

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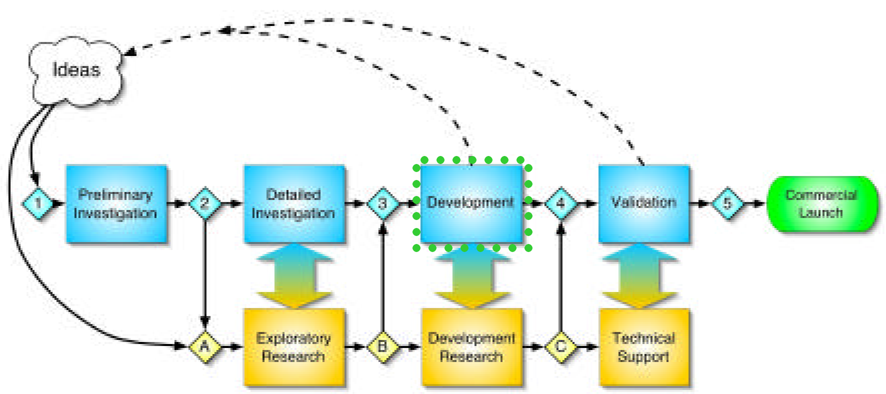
Introduction

- What Stage is the project in?



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Introduction

Stage Placement

Investigative Stages (completed August 2002)

- The first phase of the project was the critical homework stage where detailed investigation and planning were the emphasis.
- Much of that research involved investigation of agronomic practices on small scale plots and performing an economic feasibility study of of switchgrass production.

Development Stage (nearing completion, Sept 2006)

- The current phase of the project focuses on the development of convincing data that sufficient work has been completed to carry the project into the final phase of validation and commercialization.
- Demonstration of integration into real industrial conditions and commercial operation, on a smaller scale

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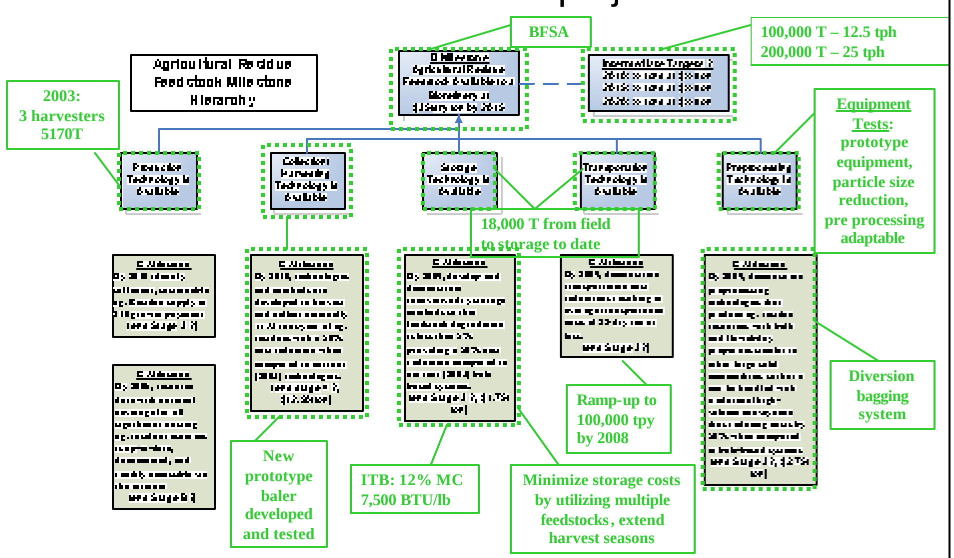
Strategic Fit

- Where does this project fit?



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Strategic Fit

Biomass Program Goal: To develop sustainable technologies capable of supplying lignocellulosic biomass to biorefineries producing fuels, chemicals, heat and power. *Biomass preprocessing system transferable to other technologies, harvesting, storage, transportation, production*.

Objective:

- Develop selective biomass harvest and collection technologies necessary to meet the 1 billion tons per year by 2030 goal and a near-term (2010) goal of 300 million dry tons per year in a sustainable manner.
- Develop feedstock infrastructure *(market incentives)* necessary to meet the $35/ton price target while assuring an economically sustainable venture for growers, equipment manufacturers and biorefinery processors.
- Develop feedstock supply forecasts, models and analyses necessary to optimize feedstock supply chains to biorefineries and reduce supply risks.
- *Subsidies would enable placement of pioneer commercial facilities that could bridge the gap between the needs of industry and economic feasibility for farmers through development of market incentives, eg. RPS, PTC, TRECs*

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Project Overview

- **Discuss project activities, participants, objectives**

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Project Overview

Project activities

Agronomic Research

Biomass Harvest, Storage, Transportation

Process Equipment Development

- Interim Test Burn
- Equipment Testing
- Process Facility Engineering Design

Market Development

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Project Overview

Project Partners

DOE
CVRCD
Alliant Energy

BCCE
TR Miles Tech Consultants
Elsam Engineering, Denmark
Kelderman Mfg
Antares

USDA
ISU
University of Iowa
ORNL
Prairie Lands

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Project Overview

Project Objectives

The primary objective of the Chariton Valley Biomass Project is to demonstrate the commercial –scale feasibility of cofiring biomass at Ottumwa Generating Station to generate electricity.

Project activities are divided into statement of work tasks which emphasize four main categories:

•Biomass Feedstock Development

•Quantify and Optimize Environmental Benefits

•Power Plant Conversion and Testing

•Biomass Market Development

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History and Accomplishments

Agronomic Research

Cropping Systems Research

Harvest Impacts on Wildlife

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History and Accomplishments

Agronomic Research

Soil Stability and Erosion

Carbon Sequestration

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History and Accomplishments

Agronomic Research

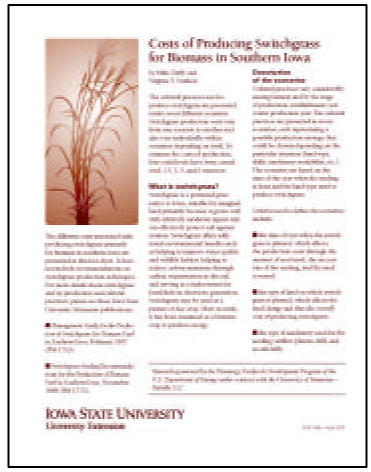
Switchgrass Production Studies

Dual Purpose Management

History and Accomplishments

Agronomic Research Outcomes

- Development of site-specific management practices
- Agronomic Research Review, July 2004
- ISU Extension Publications


Costs of Producing Switchgrass for Biomass in Southern Iowa

Iowa State University
University Extension

Switchgrass Production Costs

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History and Accomplishments

Versatility
- Harvest on rough terrain of CRP
- Greater operator safety
- Less operator training

Cost Effective
- Better fuel economy
- Direct cutting, eliminate swathing, raking
- 3-bale accumulator
  reduced costs - efficient staging

Adaptability
Small grain straw, agricultural residue - grass seed production, dried corn stalks, other biomass

Kelderman Prototype Self-propelled Baler

Demonstrated Ability Over Four Seasons
- Baler has baled over 700 hour with capacity to bale at a rate of 45 tons/hr
- 15,000 T biomass harvested to date (alfalfa, grass hay, SWG -6500T)
- 69% of harvest – three harvesters, other 2 use traditional pull-type balers

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History and Accomplishments

Process Equipment Development:
Interim Test Objectives 2003

- Emissions compliance for permitting
- Flyash utilization (by IDOT)
- 800 tons at 10-15 tph 2 wks

Uniform Process Line

Bale Infeed Conveyor

Automatic twine removal 30 sec/bale

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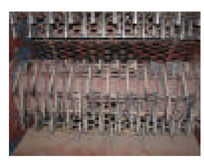
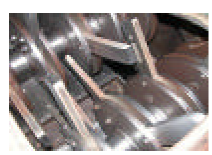
History and Accomplishments

Process Equipment Development:
Interim Test 2003

400 Hp De-baler 24 TPH 2in



Hammers 30,000 t/set
Screens 20,000 t/set



Attrition hammers 30,000 t/set

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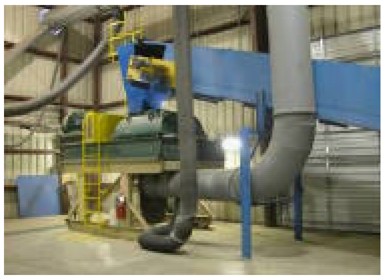
History and Accomplishments

Process Equipment Development:
Interim Test Results 2003



Enclosed infeed conveyor

- Emissions permit for Long Term Burn expected from IDNR
- Flyash meets ASTM C618 requirements for Class C flyash
- Demonstrated clean, safe, reliable operation of SWG processing for 8-10 hour periods

- Need more power on pneumatic conveyor: tests limited to 8.9 TPH
- Need automated bale moisture
- Need automated bale weight
- Need to reduce particle size
- Need verify optimum power consumption

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History and Accomplishments

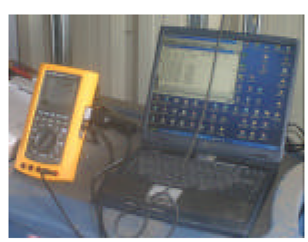
Process Equipment Development: 2004 Equipment Tests

Objectives

- Reduce Particle size
- Optimize Power consumption
- Analyze system components for reliable operation in Long Term Burn

Modifications

- Debaler: 6, 3, 2, 1, 0.5 in screens
- Eliminator
  - Widen infeed
  - Replace internal weirs
  - High wear hammers



History and Accomplishments

Process Equipment Development: 2004 Equipment Tests

Compare Interim Test

Improved particle size at optimum power achieved with 2 in screen and modified eliminator

History and Accomplishments

Process Equipment Development:
Test Facility Design for Long Term Burn

- Extend bale conveyor
- Widen bale conveyor
- Add bale shuttle
- Add bale weight and MC stage
- Increase debaler height
- Add controls to twine remover
- Add cleanup line and cyclone
- Discharge directly from eliminator to meter bin in cyclone
- Add metal separator and spark detector in cyclone leg.
- Increase capacity of pneumatic line
- Add spark detection and suppression
- Add fire protection in building

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History and Accomplishments

Supply and Market Development

•Harvest to date over 19,000T
•Storage to date over 16,000 T (after cofire tests)
•Biomass Supply Agreement
  Prairie Lands/Alliant, executed September 2004
•Production Tax Credit
  CVBP eligible, American Jobs Creation Act, 2004
•Pathways to Success Identified at 2003 Peer Review
•Cofired fly ash meets mandatory chemical and physical requirements specified for Class C fly ash in ASTM C618.
•IDOT has expressed willingness to accept cofired fly ash, contingent upon final cylinder tests final ISU report.

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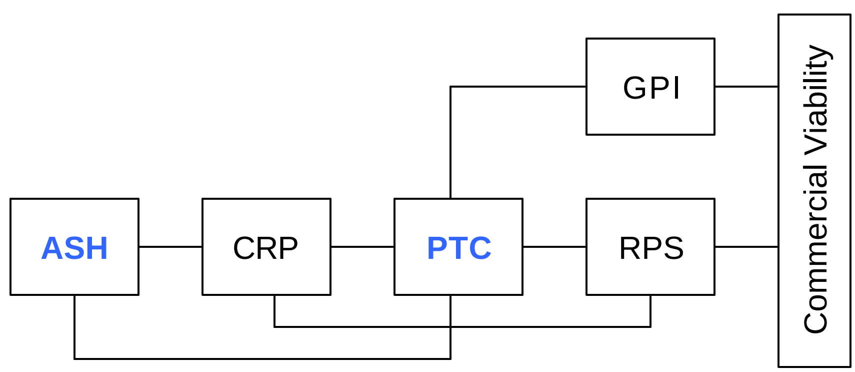
History and Accomplishments

Pathways to Commercial Success



Two major challenges: CVBP now eligible for PTC, Cofired fly ash meets phys/chem reqmts of ASTM-C618

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Plans/Schedule

- **Show plans and schedule for this project and discuss any deviations or issues**

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Plans/Schedule

Project plans and schedule

Long Term Burn

- Obtain data to prove that cofiring will not adversely affect boiler condition or performance
- Tentatively scheduled for winter 2005/2006
- 2000 hour test, 24-7
- 25,000 tons of switchgrass
- Convince industry that technology has been developed that could easily be scaled up to commercial operation (Gate 4)

Supply & market development

- Develop rapid, low-cost method for predicting biomass productivity for contracting purposes, inventory control

Deviations or issues

Funding for final test $2.5 million

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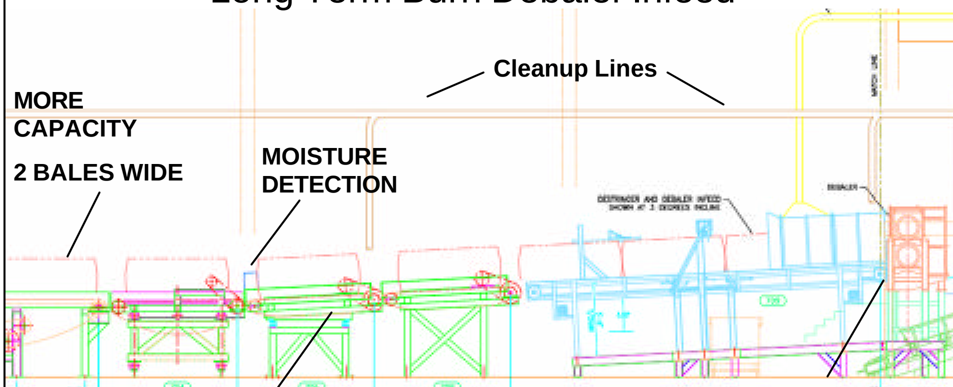
Plans/Schedule

Long Term Burn Debaler Infeed



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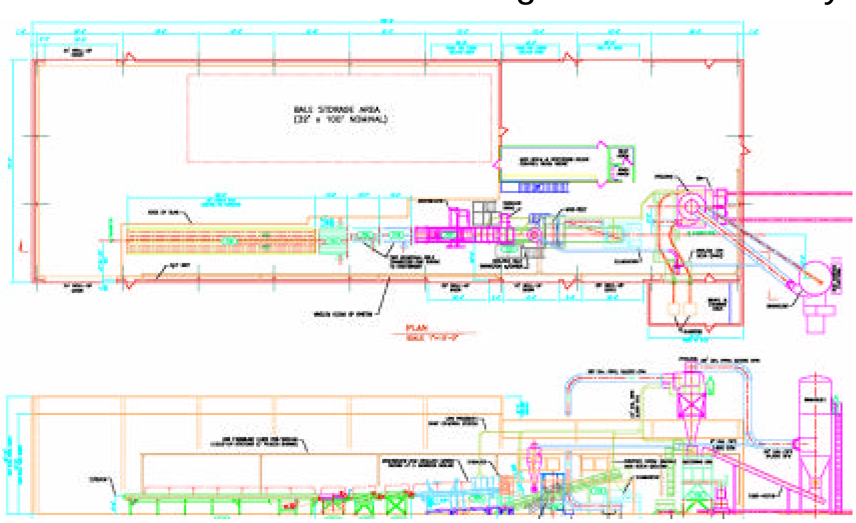
Plans/Schedule

Long Term Test Facility



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Plans/Schedule

Location of Long Term Test Burn Facility

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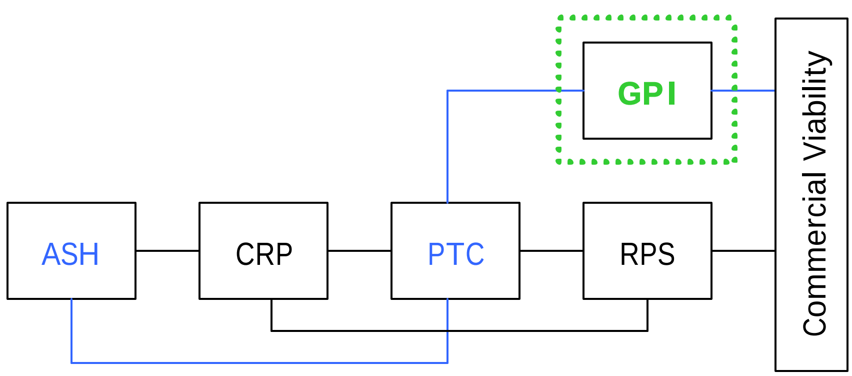
Plans/Schedule

Pathways to Commercial Success



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Plans/Schedule

Supply and Market Development

- Sell / market the premium power generated by SWG (value up to $25 per ton)
- Improve yields by implementing management plans
- Lower operating costs at process building anticipated outcome of long term test (current estimated cost at $16 per ton)
- Use CRP land and gain ability to harvest annually (lower current costs up to $13 per ton)
- Expand Iowa RPS (value = $19 to $48 per ton)

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Plans/Schedule

Supply and Market Development

Strategies for efficiency and cost reduction

Staging methods –
- Develop equipment that will haul trailer, pick up bales and place on trailer without unhooking trailer
- Eliminate load time for semi-driver

- Harvest methods –
  - Develop bale singulator that will leave stacks of 3 or 6 bales for more efficient loading
  - Harvest methods
- Kelderman Manufacturing leading this development
  - Local manufacturing and farming expertise, 25+ patents

Customers

List and discuss customers of this work

- Utilities: cofire biomass
- Biorefineries: particle size reduction, pretreatment
- Bioproducts: agriplastics, value added products
- Farmers: equipment purchase, contract balers

Feasibility and Risks

Is technology feasible?

How is it a departure from current technology, associated risks?

New technology –

- No commercial installations in US process straw in a similar way
- Commercial operations at smaller scale in Denmark (Elsam) 5 tph is standard
- Long term test will demonstrate technical feasibility of processing system at 12.5 tph
- Future plans to expand to 25tph commercial operation and automated biomass delivery system

Stage 3: Development

Emphasis Cross-cutting technical work

- Prototype demonstration of operations
- Demonstrate simulated integration at real processing conditions
- Develop engineering scale-up data

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Feasibility and Risks

Is technology feasible?

How is it a departure from current technology, associated risks?

Prototype equipment –

- Destringer-large bale twine remover
- Debaler-Hammermill in commercial use for cubing, first time used in this application
- "Eliminator"-energy-efficient pulverizing technology used in paving industry to reduce size of aggregates, modified for new application

Developing techniques

- Foreign Particle Removal
- Moisture Content
- In-line Bale Weights
- Singulator, better field loading

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Critical Issues and Show-stoppers

What are the critical performance parameters that must be met?

Gate 4: Industry must accept that sufficient laboratory and prototype work has been completed to establish that the project can be carried forth to next stage, validation.

Outcomes of long-term burn

- Prove minimal impact on boiler operation and boiler efficiency
- Prove logistics and continuous operation
- Data for scale up to 25 tph commercial operation

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Critical Issues and Showstoppers

Are there any potential show-stoppers?

- Formal approval from IDOT for fly ash acceptance
- CRP land: Ability to harvest from and retain # acres currently enrolled in project
- Sustainable supply: 70-mile radius
- PTC: Facility in place for operation by Jan 2006
- Funding

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Future Plans

If this project is successful, what's next?

- Scale up to commercial operation (validation)
- Expand to 25 tph
- Addition of automated crane system
- Market partner to lead continued development
- Continued research
- Enrollment of cooperators - 70 mile radius
  - Landowners
  - Harvesters
  - Satellite storage
  - CRP acres

Future Plans

Continuing research

- Increase yields
- Genetic breeding
- Management methods
- Harvesting techniques

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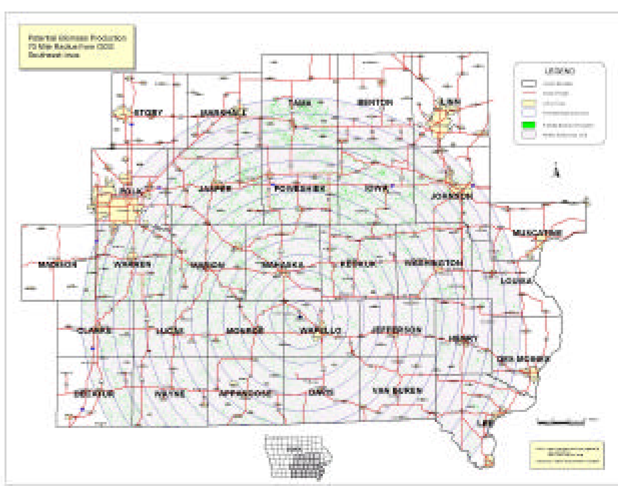
Future Plans



Outreach – 70 mile radius

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Conclusion

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Developing Home-grown Renewable Energy Sources for Biofuel Solutions