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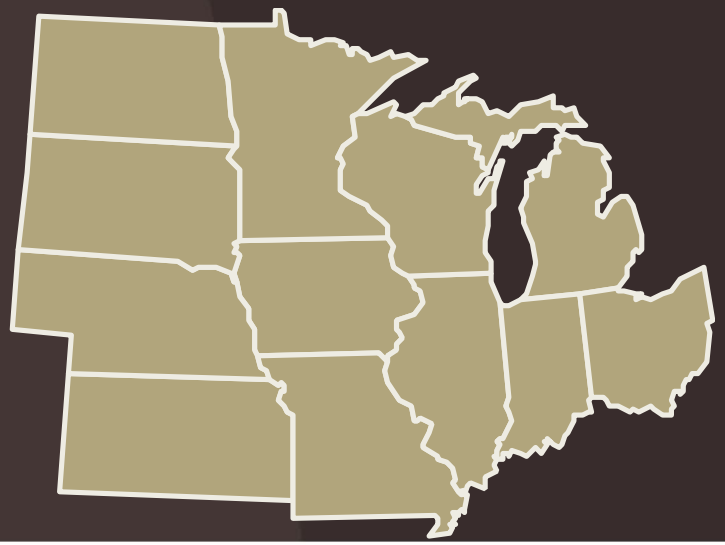
Sustainable Production and Distribution of Bioenergy for the Central USA

This project is supported by Agriculture and Food Research Initiative
Competitive Grant No. 2011-68005-30411 from the National Institute of Food and Agriculture

Midwest Sustainable Biofuels Vision

Our vision is to create a regional system for producing advanced transportation fuels and bioproducts derived from perennial grasses grown on land that is either unsuitable or marginal for row crop production. In addition to producing advanced biofuels, the proposed system will improve the sustainability of existing cropping systems by reducing agricultural runoff of nutrients and soil and increasing carbon sequestration.



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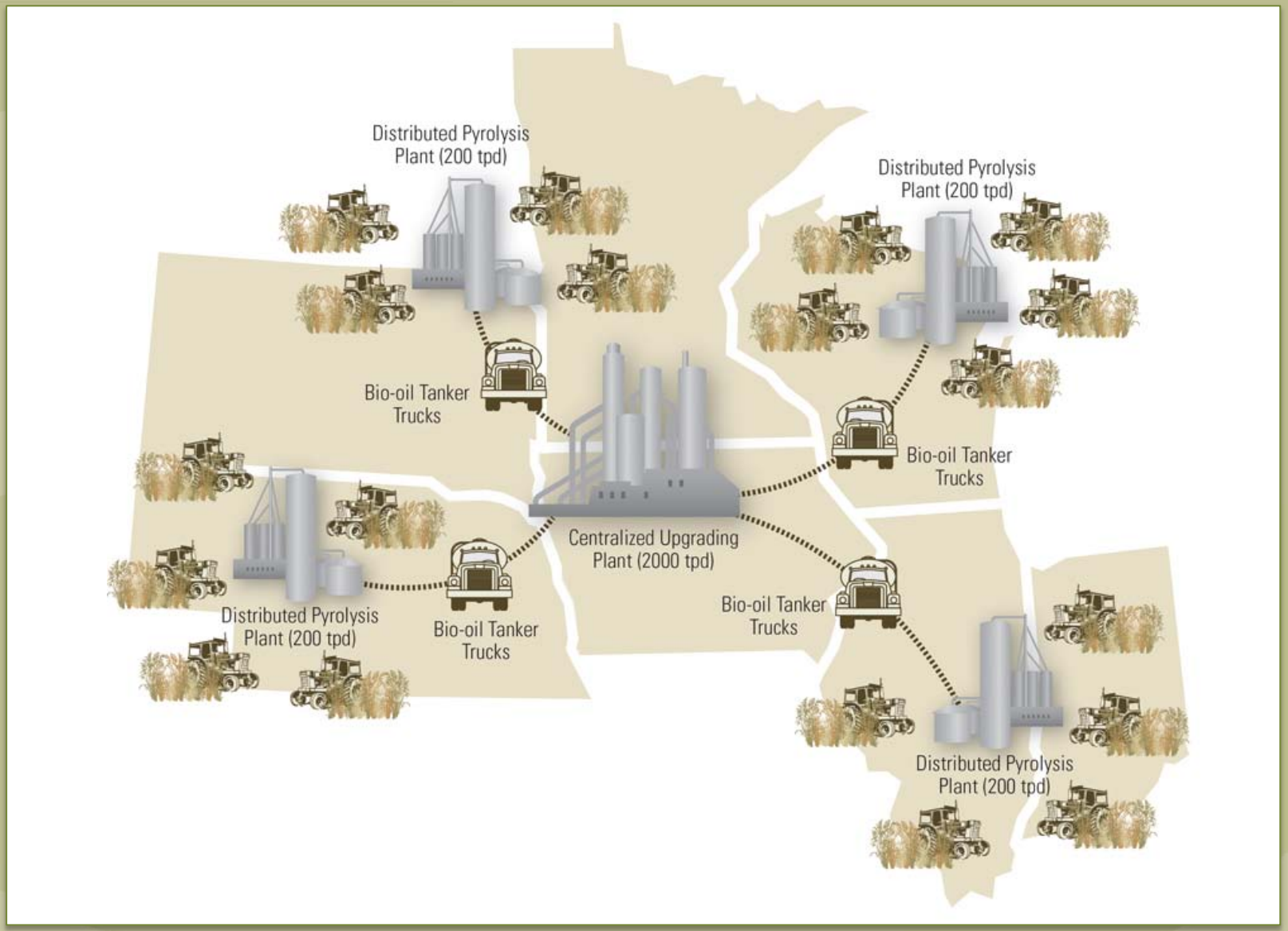
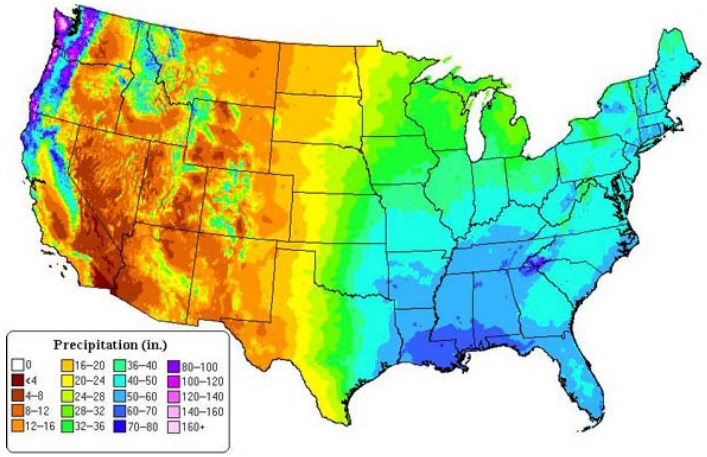
Distributed Processing



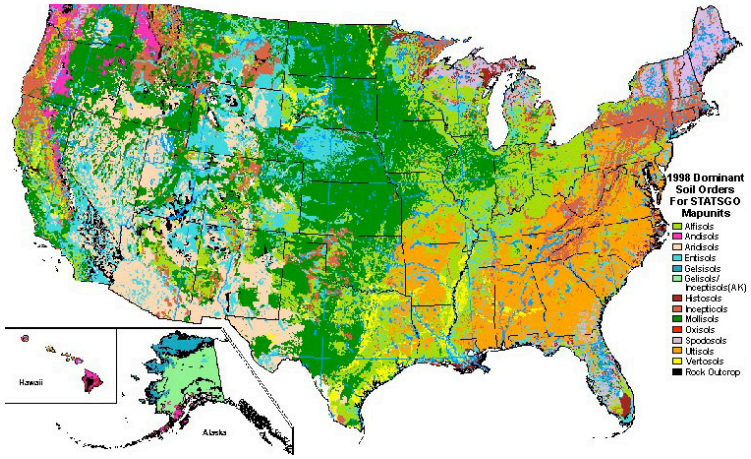
Why this region?

Precipitation



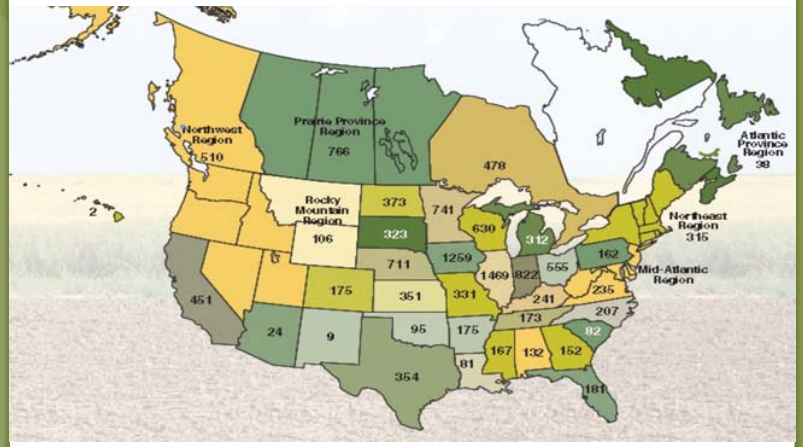
Source: USDA-NRCS National Water and Climate Center

Soils



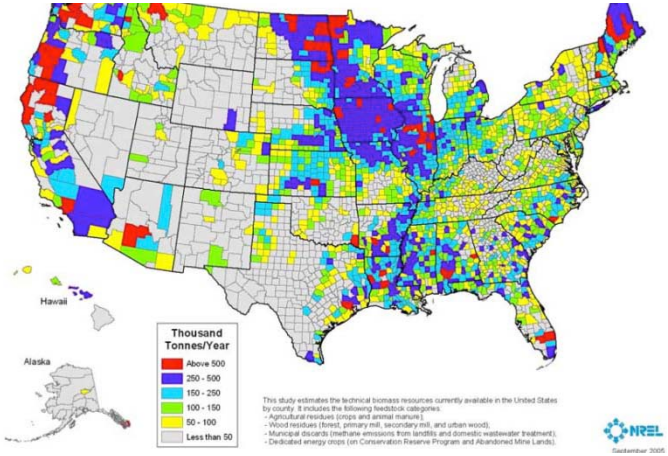
Source: USDA-NRCS

Crop Consultants



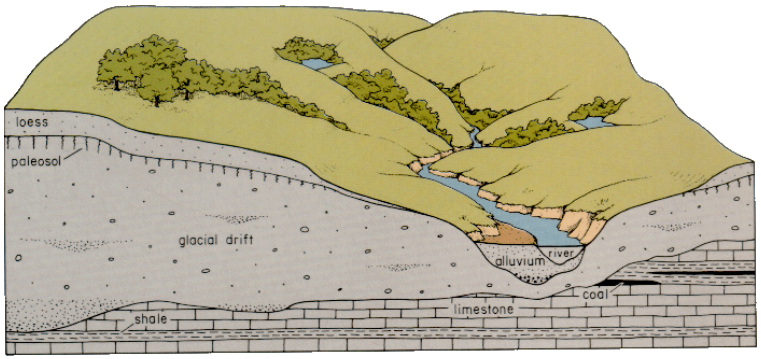
Source: American Society of Agronomy

Biomass



Source: USDOE-NREL

Why these land classes?



Source: Jean Prior, 1991. Landforms of Iowa, UI Press.

Source: NRCS

Source: Iowa State University

Source: Purdue University

Why these crops?

- High biomass yields
- Native species
- Reduce soil erosion
- Improve soil quality
- Increase carbon sequestration
- Reduce water runoff
- Increase water infiltration
- Provide wildlife habitat

Source: USGS

Why fast pyrolysis?

Rapid thermal decomposition of organic compounds in the absence of oxygen to predominately produce liquid product known as bio-oil.

Fast pyrolysis can be built at small scales suitable for distributed processing.

Co-product biochar is produced at yields of 12-20 wt% biomass.

Bio-oil is refined like petroleum into synthetic gasoline and biodiesel.

CenUSA Bioenergy Program Areas

- Feedstock Development
- Sustainable Production Systems
- Feedstock Logistics
- System Performance
- Feedstock Conversion
- Markets and Distribution
- Health and Safety
- Education
- Extension and Outreach
- Commercialization

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Feedstock Development

- Developed one new cultivar (Liberty) and have several more in the pipeline.
- Documented increased biomass yields of 35-40% compared to 20-yr-old cultivars.

Ken Vogel (USDA-ARS, Lincoln, NE) and Michael Casler (USDA-ARS, Madison, WI)

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Sustainable Production Systems

- Quantified field-scale transportable biomass yields of various perennial feedstocks under a wide range of environmental conditions.
- Demonstrated commercial pelletability of several perennial feedstocks.
- Demonstrated that switchgrass on marginal lands is more likely to be invaded than to be invasive.

Rob Mitchell (USDA-ARS, UNL) and Jeff Volenec (Purdue)

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Feedstock Logistics

- Developed an intensive conditioning and wide-swath drying process that reduced field drying time.
- Conducted technoeconomic analysis that showed that the lowest cost grass feedstock involves pre-cut mega-wide round bales

Stuart Birrell (ISU) and Kevin Shinners (UWM)

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System Performance

- Completed baseline modeling of the Upper Mississippi and Tennessee/Ohio River Valleys regarding the potential impacts of dedicated biofuel crops.
- Life-cycle analysis of air-quality and climate-change impacts for various transportation fuel options.

Jason Hill (UMN) and Cathy Kling (ISU)

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Feedstock Conversion

- Developed technoeconomic model to evaluate the potential of various perennial feedstocks for conversion to value-added fuels and chemicals.
- Developed a lignin-catalytic pyrolysis response model.

Robert Brown (ISU)

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Markets and Distribution

- Evaluated farm-level adoption decisions, including effects of policy, markets, and contract mechanisms.
- Estimated threshold returns to make perennial biofuels economically sustainable.

Keri Jacobs and Dermot Hayes (ISU)

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Health and Safety

- Detailed analysis of all tasks associated with biofeedstock production for hazard targets of personnel, equipment, environment, downtime, and product.
- Determined potentially hazardous respiratory exposure limits associated with biofeedstocks.

Charles Schwab and Mark Hanna (ISU)

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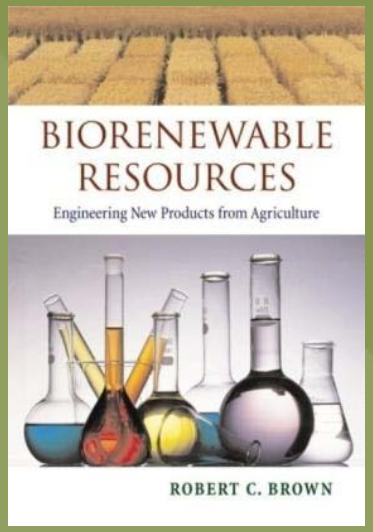
Education

Developed a shared bioenergy curriculum for the northcentral USA.

Provided interdisciplinary training for undergraduate and graduate students.



Raj Raman (ISU) and Pat Murphy (Purdue)

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Extension/Outreach

- Produced numerous outreach publications.
- Reached thousands of potential stakeholders through on-farm, classroom, and online demonstrations.

Jill Euken (ISU)

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Commercialization

- Developed a proprietary pretreatment that enables continuous pyrolysis of industrial lignin streams by preventing char agglomeration in the reactor.
- Provided quantitative data on the conversion of several perennial feedstocks to pyrolytic fuels and chemicals.

Tom Binder ADM, Ret. & Frank Lipiecki, Renmatix

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