Overview of USDA/ARS Bioenergy Program

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Deputy Administrator

Natural Resources & Sustainable Agricultural Systems

Program Drivers- Presidential Initiatives

- Advanced Energy Initiative
  - Reduce dependence on foreign sources of oil by addressing how we power our automobiles and homes
  - Make cellulosic ethanol cost competitive by 2012
  - Includes vehicle efficiency and solar components (i.e. Solar America Initiative)

- "20–in–10"
  - Increase supply of renewable and alternative fuels
    - Set Alternative Fuels Standard (AFS) at 35 billion gallons per year by 2017
      - 5X the current Renewable Fuels Standard for 2012
      - 15% of projected annual gasoline use in 2017
  - Increase vehicle efficiency
    - Reform and modernize CAFÉ
      - 5% of projected annual gasoline use in 2017

Biofuels Legislation – Energy Title IX 2002 Farm Bill

Accompanied by Congress members, President George W. Bush signs the Farm Security and Rural Investment Act of 2002 in the Dwight D. Eisenhower Executive Office Building May 13.

Established new programs and grants

- For procurement of biobased products to support development of biorefineries;
- To educate the public about benefits of biodiesel fuel use;
- To assist eligible farmers, ranchers, and rural small businesses in purchasing renewable energy systems

Reauthorized and broadened the bioenergy program

- Extended Biomass Research and Development Act of 2002
- Reauthorized bioenergy program to expand production capacity
- Broadened business and industry loans to include more types of renewable energy

Research, Education, and Economics

USDA/REE Bioenergy Strategy

Vision

- Agriculture- and natural-resource-based energy that enhances stewardship of our environment.
- Sustainable, secure, renewable energy sources
- Vibrant and energy-efficient rural communities

Goals

- Increase production of agriculture-based energy and products
- Promote conservation and efficient use of energy across America
- Foster sustainable agricultural systems and rural communities

ARS Bioenergy R&D Goals

- Advance the development of energy crop varieties of biorefinery feedstock for every agricultural region in the Nation
- Develop production practices for biorefinery feedstock that maximize sustainable producer income for every agricultural region in the Nation
- Enable the development, in the shortest possible time-frame, of commercially-preferred biorefinery conversion processes and biorefinery co-products

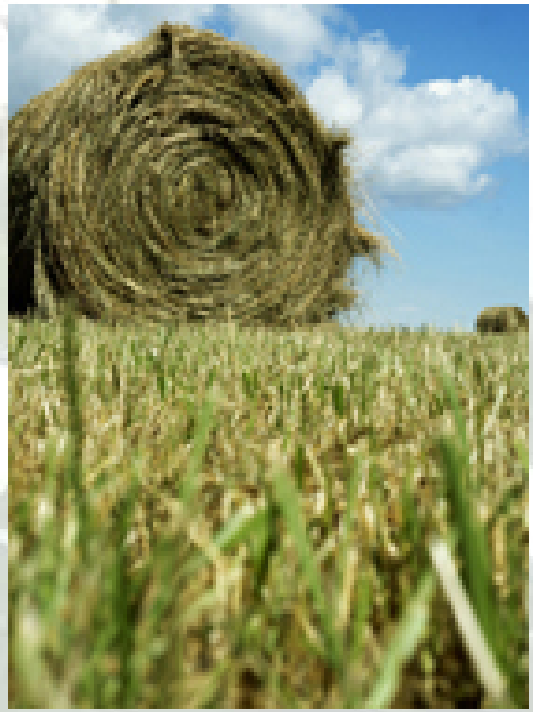
The Sustainability Challenge

Serving current demands from agriculture without eroding the potential to meet future needs/obligations.

ARS Bioenergy Program Components

Four Components – Four Teams

1. **Feedstock Development**
   Kay Simmons (L), Ev Byington, Del Delfosse
2. **Feedstock Production**
   Jeff Steiner (L), Ev Byington, Del Delfosse, Charlie Walthall
3. **Conversion & Co-Products**
   Bob Fireovid (L), Frank Flora, Jeff Steiner
4. **Integration**
   Bob Fireovid (L), Kay Simmons, Jeff Steiner



Feedstock Development

A. Breeding and evaluation of new germplasm

- Improved breeding methods
- Evaluate for specific adaptation zones
- Identify & incorporate plant traits that enhance energy production
- Rapid & reliable methods for measuring desirable traits
- Risk analyses *(gene flow, invasive sp.)*
- Improved germplasm & varieties for energy crops

Feedstock Development

B. Biological & molecular basis of plant traits

DNA markers & genetic maps for bioenergy

- Synteny among model and energy plants
- Identify and validate candidate genes that improve key bioenergy traits
- Understand inheritance mechanisms in complex polyploid perennials
- Mutant, tilling and recombinant populations to test hypotheses for control of traits
- Understand molecular basis for key traits *(cell-wall structure, growth biomass yield, conversion potential)*

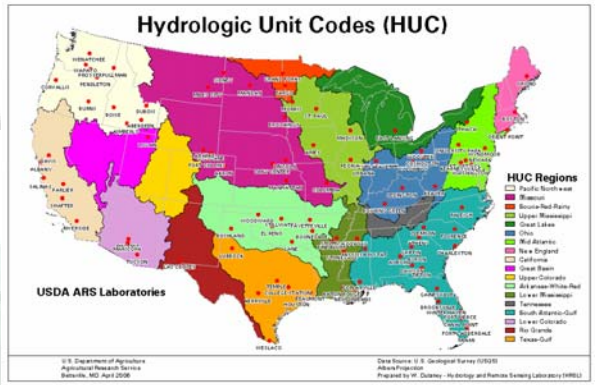
Feedstock Production

A. Region-specific, sustainable practices to maximize feedstock harvest

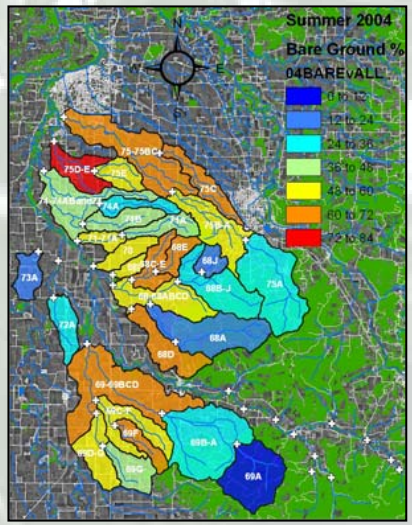
- Whole-farm optimization tools incorporating bioenergy production from crop residues, dedicated energy crops & post-harvest processing by-products
- Cover crops that increase annual biomass yield and enhance soil carbon & nitrogen
- Rotation configurations that incorporate bioenergy production into food, feed & fiber systems

Feedstock Production

B. Analytical tools to estimate potential feedstock amounts and the implications of harvest



- Operations mgmt. tools for feedstock production that consider climate, weather and soil conditions
- Models to predict effects & risks of feedstock production on economics, natural resources quality, and ecological systems services
- Decision tools for farmers and biorefinery operators



Feedstock Production

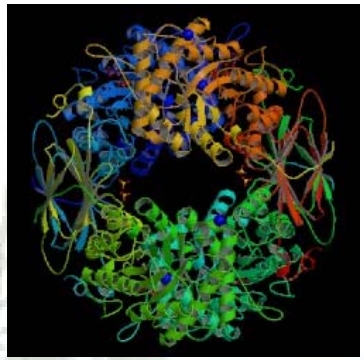
C. On-farm utilization of byproducts

Physical, chemical and biological value of byproducts as soil amendments and nutrients

- ethanol by-products
- gasification ash
- bio-char
  - NSTL – Ames, IA
  - glomalin – Mandan, ND; Beltsville, MD
  - pyrolysis – Wyndmore, PA
  - peanut hull char – Florence, SC
  - testing Eprida product – Morris, MN

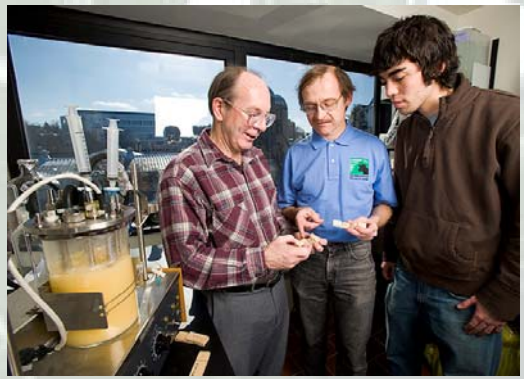
Conversion & Co-Products

- **Reduce conversion costs for cellulosic ethanol**
  - new and improved hydrolysis enzymes
  - inhibitor-resistant microbes



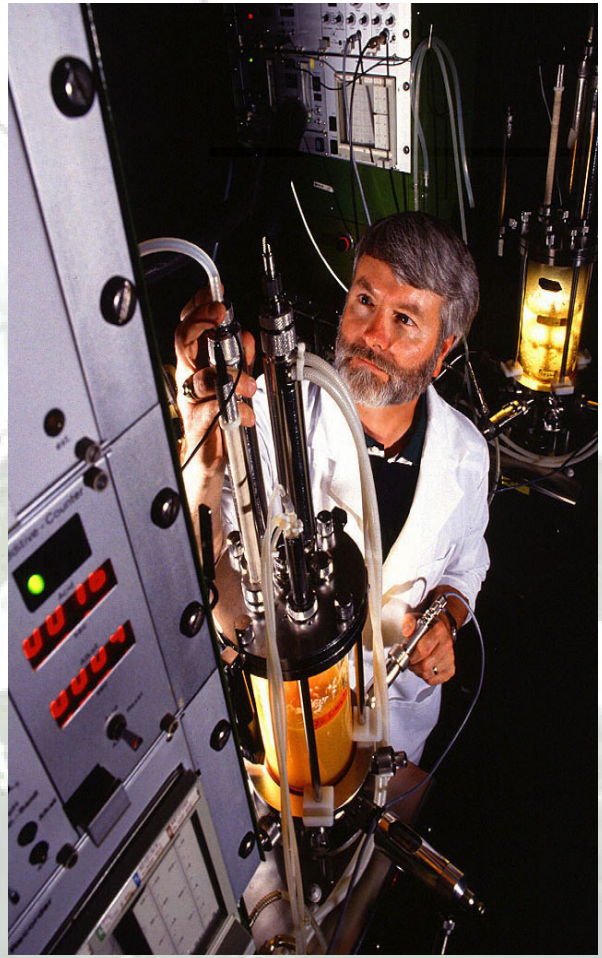
- **Develop thermochemical processes for near-to-the-farm production of energy or intermediate products**

- **Develop value-added co-products**
  - from lignin, hemicellulose, char, ash
  - microbial products (e.g., adhesives)
  - new plant-produced products



Conversion & Co-Products

- Biochemical (EtOH & BuOH)
  - starches & sugars (1st gen.)
  - cellulosic (2nd gen.)
- Thermochemical
  - farm-scale
- Biodiesel
  - fuel quality (cold flow, oxidative stability, etc.)
- Biorefinery co-products/byproducts
  - for all biorefineries *(biodiesel, biochem, thermo)*
- Process economics; market & life cycle analyses
  - identify R&D goals & priorities
- Upfront tech transfer plans & partners
  - pilot facilities at ARS regional research centers



Conversion & Co-Products

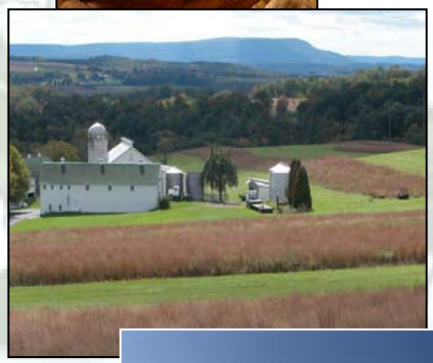
- **Biochemical (to EtOH & BuOH)**
  - **starches & sugars *(value-added co-products)***
  - **cellulosics**
    - ✓ ***preprocessing and pretreatment*** *(esp. on-farm)*
    - ✓ ***help ID key feedstock/crop traits***
    - ✓ ***lower cost***
    - ✓ ***increase energy efficiency***
    - ✓ ***minimize water requirements***
    - ✓ ***co-products***
- **Biodiesel**
  - **fuel quality *(cold flow, oxidative stability, contaminants)***
  - **glycerol and protein-meal co-products**
  - **next generation feedstock**

Conversion & Co-Products

- **Thermochemical**
  - **apply technologies to ag-based energy**
    - ✓ ***preprocessing*** (esp. on-farm)
    - ✓ ***on-or-near-farm processing***
    - ✓ ***help ID key feedstock/crop traits***
  - **co-products *(e.g., agri-char)***
- **Process Economics; Market & Life Cycle (LC) Analyses**
  - **help identify R&D goals & priorities**
  - **evaluate LC energy efficiencies, carbon, water**

Component Integration

- **Development & Production**
  - **field testing new varieties**
- **Development & Conversion**
  - **conversion testing**
  - **optimizing co-products**
- **Production & Conversion**
  - **feedstock preprocessing, pretreatment, handling, quality**
- **Cross-Component teams**
  - **Cellulosic to EtOH/BuOH**
  - **Biodiesel**
  - **Starch/sugars to EtOH/BuOH**
  - **Other fuels**

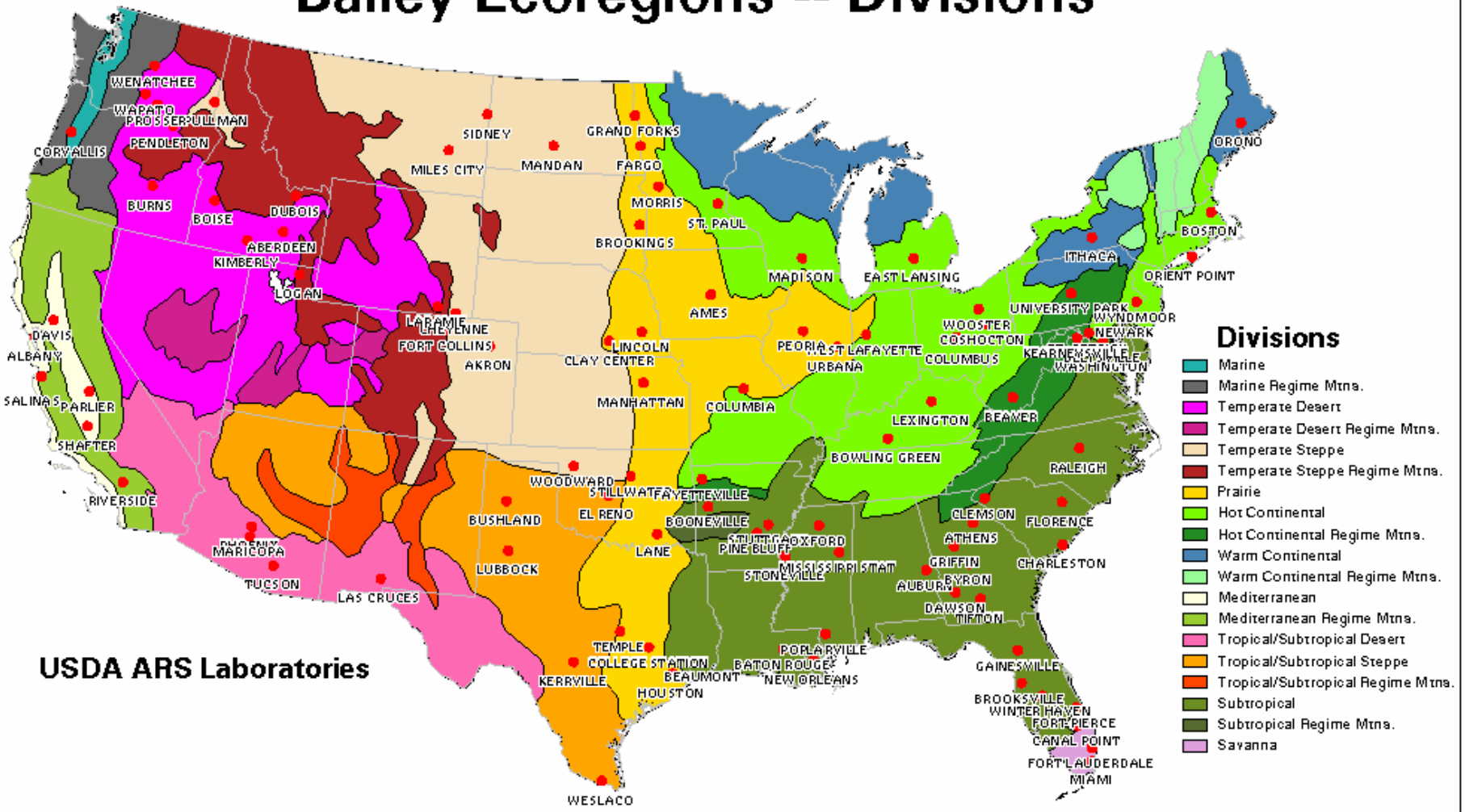


ARS Bioenergy Research

Directly involves multiple ARS research programs:

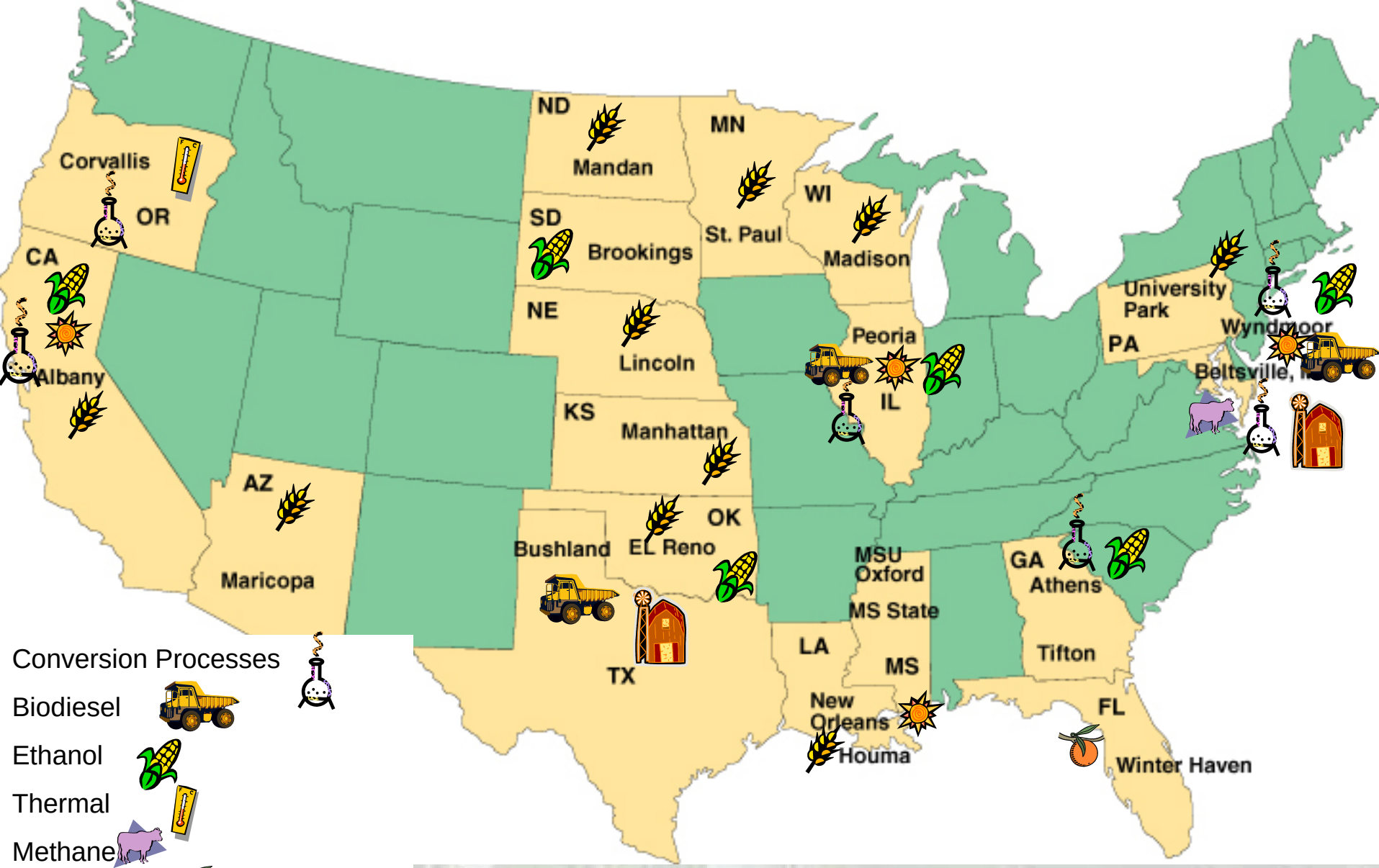
- **Bioenergy** *(307)*
- **Crop utilization** *(306)*
- **Forages** *(205)*
- **Soil sustainability** *(202)*
- **Crop improvement & protection** *(301, 302, 304)*
- **Manure utilization** *(206)*
- **Integrated ag systems** *(207)*

Bailey Ecoregions -- Divisions



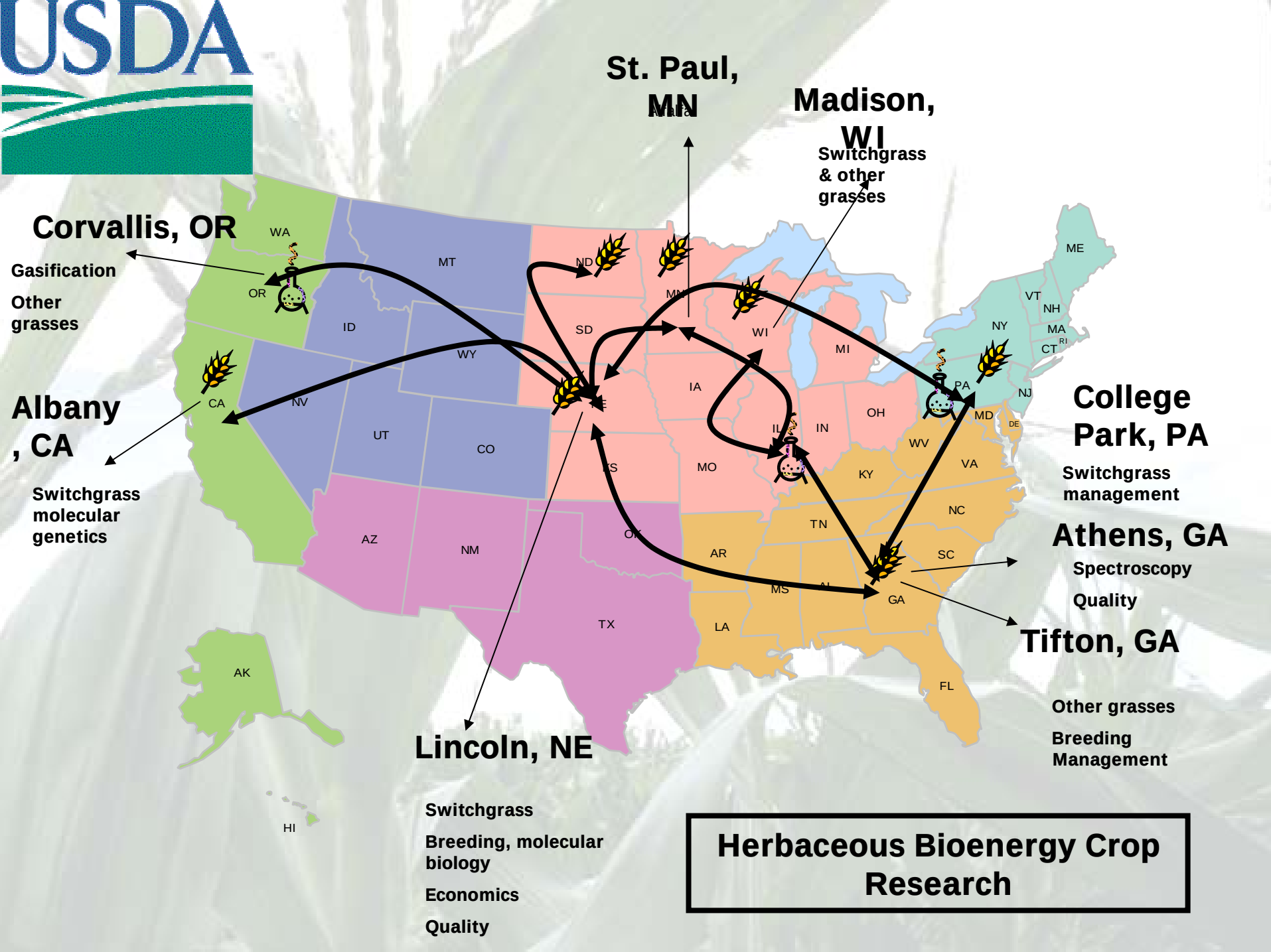
U.S. Department of Agriculture
Agricultural Research Service
Beltsville, MD April 2006

Data Source: Robert G. Bailey - USDA Forest Service
Albers Projection
Prepared by W. Dulaney - Hydrology and Remote Sensing Laboratory (HRSL)



USDA / ARS
Bioenergy / Bioproducts
Research Locations

USDA


USDA
St. Paul, MN
Madison, WI
Switchgrass & other grasses
Corvallis, OR
Gasification
Other grasses
Albany, CA
Switchgrass molecular genetics
College Park, PA
Switchgrass management
Athens, GA
Spectroscopy
Quality
Tifton, GA
Other grasses
Breeding Management
Lincoln, NE
Switchgrass
Breeding, molecular biology
Economics
Quality
Herbaceous Bioenergy Crop Research
WA
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Coordination & Cooperation

Intra-Department:

- USDA Energy Council – Research Committee
- USDA Biobased Products & Bioenergy Coordination Council (BBCC)
- REE Agricultural Bioenergy and Bioproducts Research, Education and Economics (ABBREE) Council

Inter-Departmental:

- Biomass R&D Board and Technical Advisory Committee
- Regular program staff communications between ARS and DOE-EERE, DOE-OS, EPA, NSF, DoT
- Scientist exchange program with DOE (Bioenergy Research Centers, National Labs.)


Agricultural Science: a key to food and energy security and natural resources stewardship in 21st Century.
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