



ARS Bioenergy Research

Don Erbach

National Program Leader

Engineering and Energy

USDA – Agricultural Research
Service

USDA Biobased Products and Bioenergy Coordination Council



The Biobased Products and Bioenergy Coordination Council (BBCC) was established by the Secretary of Agriculture to provide a forum through which USDA agencies will coordinate, facilitate and promote research, development, transfer of technology, commercialization, and marketing of biobased products and Bioenergy using renewable domestic agricultural and forestry materials. This includes promoting information sharing, strategic planning and providing policy advice to the Secretary.

Agricultural and forestry resources provide renewable raw materials for a broad range of nonfood and nonfeed products, such as chemicals, fibers, construction materials, lubricants, and fuels. Development and commercialization of such biobased and Bioenergy products provide new and expanded markets for agricultural feedstocks, accelerate market penetration, reduce U.S. dependence on petroleum and other imports of critical materials, and diversify agriculture while fostering rural and sustainable development. Such products are friendlier to the environment than their petroleum-based counterparts.

The BBCC is an outgrowth of the USDA New Uses Coordination Council, which was created by the Secretary of Agriculture in 1995, renamed the Biobased Products Coordination Council (BPCC) in 1997, and formalized as the BBCC in 2002 by Departmental Regulation. About a dozen USDA agencies with programs related to biobased products and or Bioenergy participate in BBCC activities.

[BBCC Strategic Plan](#)

[Authority for BBCC](#)

[BBCC Members](#)

[USDA Biobased Programs](#)

[USDA Funding Opportunities,
Awards](#)

Agricultural Research Service (ARS)

- In-house research arm of USDA
- Base funded. Congress appropriates money to specific locations for ARS scientists to conduct specified research (ARS is not a granting agency)
- Research is managed through national programs

www.ars.usda.gov





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the In-house research arm of the U.S. Department of Agriculture

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Research Home

National Programs

International Programs

Research Projects

Scientific Quality Review

Research Themes

National Programs

ARS Research is organized into 22 National Programs. These programs serve to bring coordination, communication and empowerment to the more than 1200 research projects carried out by ARS. The National Programs focus on the relevance, impact, and quality of ARS research.



Animal Production, Product Value and Safety

[Food Animal Production \(101\)](#)

[Animal Health \(103\)](#)

[Veterinary, Medical and Urban Entomology \(104\)](#)

[Animal Well-Being & Stress Control Systems \(105\)](#)

[Aquaculture \(106\)](#)

[Human Nutrition \(107\)](#)

[Food Safety \(animal & plant products\) \(108\)](#)

Natural Resources and Sustainable Agricultural Systems

[Water Quality and Management \(201\)](#)

[Soil Resource Management \(202\)](#)

[Air Quality \(203\)](#)

[Global Change \(204\)](#)

[Rangeland, Pasture and Forages \(205\)](#)

[Manure and Byproduct Utilization \(206\)](#)

[Integrated Agricultural Systems \(207\)](#)

Crop Production, Product Value and Safety

[Plant, Microbial, and Insect Genetic Resources, Genomics and Genetic Improvement \(301\)](#)

[Plant Biological and Molecular Processes \(302\)](#)

[Plant Diseases \(303\)](#)

[Crop Protection and Quarantine \(304\)](#)

[Crop Production \(305\)](#)

[Quality and Utilization of Agricultural Products \(306\)](#)

[Bioenergy and Energy Alternatives \(307\)](#)

[Methyl Bromide Alternatives \(308\)](#)

About the Programs

[2002 & 2003 Performance Plan](#)

[The Big Picture of ARS Research](#)

[ARS Strategic Plan](#)

Related Information

[News](#)

[Calendar](#)

[Search](#)

[ARS Research in Biobased Products & BioEnergy](#)

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[Summary of the USDA Stakeholder Workshop for Animal Agriculture, November 2001](#)

[REE Directory](#)

[British Mycological Society, International Symposium on Bioactive Fungal Metabolites](#)

[ARS Office of Scientific Quality Review](#)

[Food Safety Conference](#)

[Beef Home Page](#)



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National Programs

International Programs

Research Projects

Scientific Quality Review

Research Themes

[National Programs](#) [Quality and Utilization of Agricultural Products](#)

Program Summary: Program Direction

Vision Statement

Provide knowledge and innovative technologies that lead to new and expanded market opportunities for United States agriculture

Mission Statement

To enhance the economic viability and competitiveness of U.S. agriculture by maintaining the quality of harvested agricultural commodities or otherwise enhancing their marketability, meeting consumer needs, developing environmentally friendly and efficient processing concepts, and expanding domestic and global market opportunities through the development of value-added food and nonfood products and processes.

Research Components

- Quality Characterization, Preservation, and Enhancement
- New Processes, New Uses, and Value-Added Foods and Biobased Products

Projects in this Program - by State



Legend:

Maroon = click to see related projects in these states.
Gray = No related research in this state

Program Planning Documents

- [Action Plan](#)
- [Summary of Planning and Coordination Meeting](#)

Program Summary

- [Program Direction](#)
- [Program Rationale](#)
- [Program Component Definitions](#)
- [Projected Outcomes/Impacts](#)

Program Annual Reports

- [FY 2002](#)
- [FY 2001](#)
- [FY 2000](#)
- [FY 1999](#)
- [FY 1998](#)

Project information

- [List of Projects in this Program](#)
- [List of Project Annual Reports in this program](#)

Program Team

- [Flora, L Frank \(co-leader\)](#)
- [Radin, John W \(co-leader\)](#)
- [Erbach, Don](#)



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[The Big Picture of ARS Research](#)

[ARS Strategic Plan](#)

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[Food Safety Conference](#)

[Beef Home Page](#)

ARS Bioenergy Research

- Design and breed herbaceous plants
- Sustainable production of energy crops
- Feedstock collection
- Conversion of biomaterials to fuels
- Devise value added coproducts
- Pretreatment on farm and in rural community
- On-farm systems to supply energy needs



Ethanol

- Pretreatment processes and stress-tolerant organisms to convert biomass to ethanol
- Process Cost Reduction
- Value-Added Co-Products
- On-farm and local pretreatment and conversion



Biodiesel

- Vegetable Oil-Based Alternative Diesel Fuels, Extenders, And Additives
- Ignition And Combustion Characteristics Of Biofuels
- New Processes For Obtaining Higher Value-Added Products From Agricultural Lipids



Energy Crops

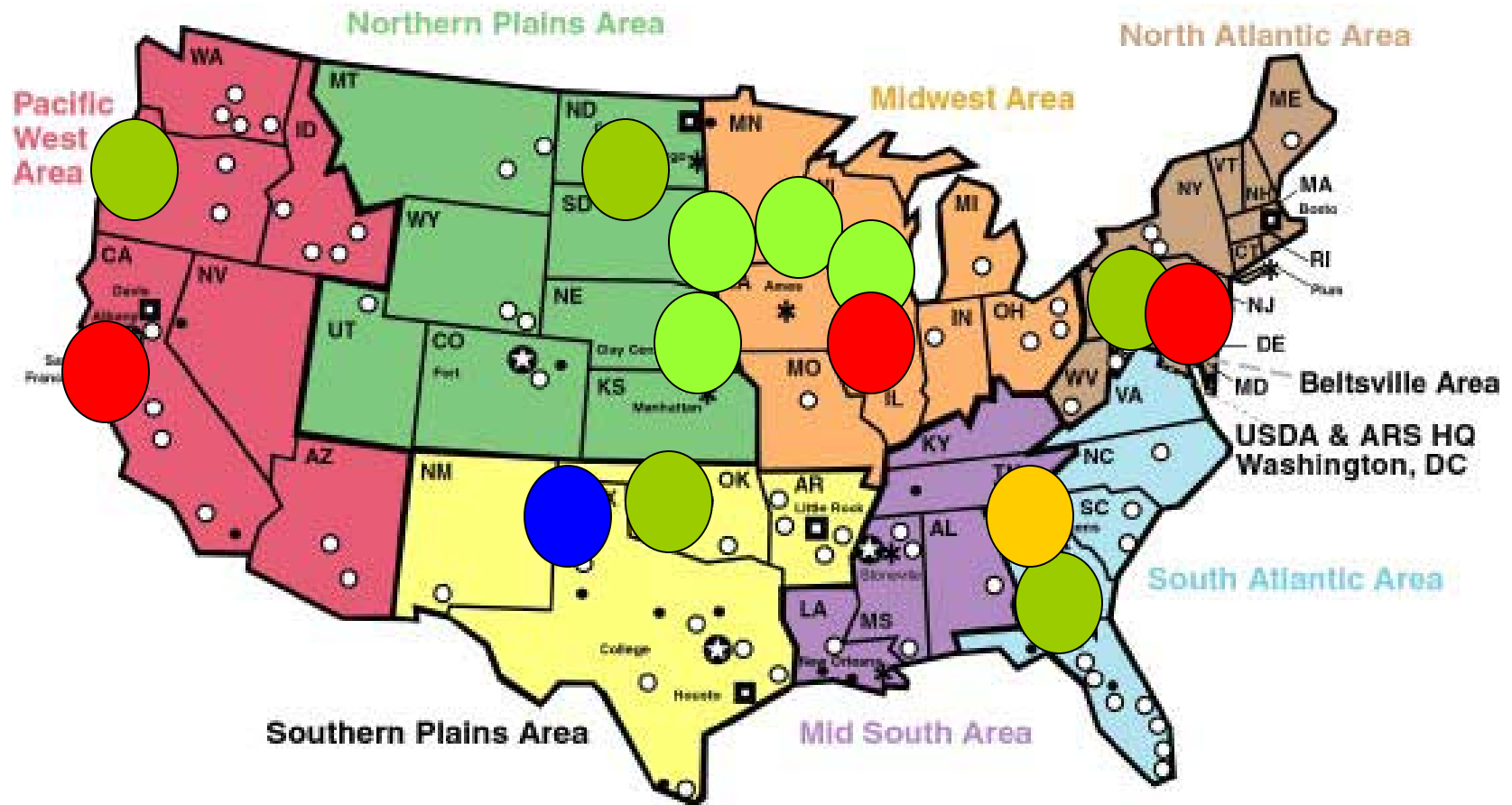
- Germplasm
 - Genetic modification of grasses, legumes, and cereal crops for conversion to biofuels
- Production management strategies
 - Management practices for sustainable energy crop production, including on buffer strips and CRP lands
- Characterize and measure feedstock quality
 - Determine effects of genetics, management, environment, and handling on feedstock quality
- Harvesting, handling, and storage



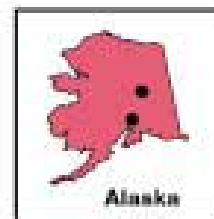
Energy Alternatives for Rural Practices

Renewable energy systems, including wind, for water pumping and remote electric power generation





- ⊙ Area
- * Research Centers
- Human Nutrition Centers
- Research Locations
- Research Worksites





**“A Vibrant
Rural America”**

Enzyme-Based Technologies for Milling Grains and Producing Biobased Products and Fuels

- **Objective:**

To create efficient, cost effective, and environmentally sustainable ("green") wet and dry-grind milling technologies to convert corn into inexpensive and high quality starch, for conversion into renewable biobased products and fuel ethanol. Develop enzyme-based processes to accomplish these goals.



Eastern Regional Research Center
David Johnston

Enzymatic Steeping Process for Corn Wet Milling

Objective:

To develop a new enzymatic corn wet-milling steeping process that will reduce the steep time, reduce SO₂ emissions, lower the capital and operating cost and enhance the quality and yield of products.



Eastern Regional Research Center

David Johnston

Improving the Economic Competitiveness of Ethanol Production

- **Objective:**
Devise and exploit commercial process efficiencies for the production of ethanol from corn, stover, and related processing residues and biomass in order to reduce the selling price of fuel ethanol. The goals include lowering process costs and the development of valuable coproducts which reduce the net cost of ethanol.



Eastern Regional Research Center

Kevin Hicks

New Biobased Products to Increase Demand for Grains

- **Objective:**

Develop new valuable products and processes for the conversion of corn and other grains into food and industrial products that will reduce endproduct cost to consumer and increase revenues to growers and rural processors.



Eastern Regional Research Center

Robert Moreau

New Processes for Obtaining Biofuels and Other Value-Added Products from Agricultural Lipids

- **Objective:**

New processing technologies will be developed for converting animal fats, vegetable oils, and their coproducts into value-added products. Targeted areas include: harvesting of industrially and/or nutritionally important fatty acids; the restructuring of and/or modification of fats and oils; production of biofuels from refined and unrefined fats, greases, vegetable oils and their processing coproducts; biobased fuel additives and lubricants; biopolymers; oxygenated and branched-chain fatty acids.

Eastern Regional Research Center

Tom Foglia



Biocatalysts to Produce Biofuels

- **Objective:**

Develop new biocatalysts that will function under harsh processing (i.e., industrial) environments including those that would allow the combined use of microbial, enzyme, and chemical conversion for the bioconversion of agricultural materials to low cost fuels and other microbial products.



National Center for Agricultural Utilization
Research

Siqing Liu

Bioprocess Engineering to Convert Biomass to Biofuel

- **Objective:**

Develop new bioprocess strategies for the fermentation of biomass substrates to biofuels and microbial products including the development of pretreatment methods that combine chemical/physical treatment with novel enzymes (e.g., hemicellulases) customized to achieve complete saccharification, methods to reduce or counteract fermentation inhibitors present in biomass hydrolysates, and improved methods for the recovery of microbial fermentation products from dilute product streams.



National Center for Agricultural
Utilization Research

Badal Saha

Evaluation of Ethanol Production Technologies

- **Objective:**

Develop and verify a standardized technique for laboratory scale dry grind ethanol (DG) processing of corn. General objectives are: (1) Develop and verify a standardized laboratory technique for conversion of corn to ethanol; (2) verify sensitivity of the standardized technique using samples of corn from hybrids having a range of characteristics; and (3) observe ethanol yields obtained from the standardized laboratory technique and commercial scale DG processing.



National Center for Agricultural
Utilization Research

Bruce Dien

Vegetable Oil-Based Alternative Diesel Fuels, Extenders, and Additives

- **Objective:**

Improve the combustion characteristics and fuel properties of vegetable oils (emphasizing soybean oil) and their derivatives as alternative diesel fuels, extenders and additives in the operation of compression-ignition (diesel) engines. Utilize fatty derivatives for performance enhancement and emissions reduction (e.g. nitrogen oxides). The objective will be met by obtaining and applying new knowledge of solubilization, low-temp flow properties, precombustion/combustion chemistry & other fuel characteristics



National Center for Agricultural
Utilization Research

Sevim Erhan

Chemical Systems for the Conversion of Vegetable Oils to Industrial Products

- **Objective:**

Convert vegetable oil (emphasizing soybean oil) for industrial materials by polymerizing, by improving the oxidative stability and by derivatizing unsaturated acids for increased reactivity. Utilize these compounds in sheetfed, heatset, flexographic and gravure printing ink formulations, in interior/exterior architectural paint formulations and as a base stock in hydraulic fluids and lubricants.



National Center for Agricultural
Utilization Research

Sevim Erhan

Conversion of Crops to Value-Added Products by Directed Molecular Evolution

- **Objective:**

Develop, by use of directed molecular evolution (DME), a set of improved specific enzymes to convert (1) starch-rich substrates directly into fermentable sugars and (2) cellulose and hemicellulose to glucose and specialty chemicals. Apply these enzymes to improve grain-to-ethanol (biofuels) fermentation conversion, as well as to create conversion processes that are effective at lower temperatures, thus minimizing the huge energy input required during typical ethanol production.



Western Regional Research Center

Dominic Wong

Development of Biopolymer Composites for Industrial and Food Applications

- **Objective:**

1) Use cereal or tuber starches to make polymer composites for non-food products. 2) Develop methods of processing starch composites into molded articles. 3) Convert agricultural fibers into biodegradable packaging, building materials and slurry-molded products. 4) Isolate cellulose, lignin and hemicellulose components from ag-fibers by applying hot-compressed water (HCW) treatment.



Western Regional Research Center

Greg Glenn

Enabling Technologies for Wheat Starch and Protein Separation, Drying, and Utilization

- **Objective:**
Devise large-scale technologies to enable the efficient and environmentally sound separation of wheat starch and protein from wheat flour, evaluate the quality of resulting products and co-products, and determine economic feasibility at different scales. Create and evaluate selective membrane barriers for the separation of ethanol-from-water and water-from-ethanol, and optimize appropriate films by applying chemical or enzymatic treatments. Develop models to improve separation strategies.



Western Regional Research Center

George Robertson

Enzymatic Processes for Increasing Industrial Utilization of Vegetable Oils

- **Objective:**

Identify enzymes involved in biosynthesis of tung oil. Develop microbial expression systems to characterize lipid-modifying genes obtained from tung. Optimize microbial expression systems for bioconversion of low-cost vegetable oils into value-added industrial oils. Study potential properties and uses of converted oils.



Southern Regional Research Center

Armand Pepperman

Agricultural by-Products As Adsorbents for Environmental Remediation

- **Objective:**

1) develop cost-effective processes to convert agricultural residues to value-added products; 2) to evaluate value-added products against comparable commercial products on a functional, economic and risk assessment basis; and 3) to develop an engineering, economic and outreach plan to utilize the value-added products in the marketplace.



Southern Regional Research Center

Wayne Marshall

Develop of Processes to Improve Oilseed Utilization

- **Objective:**

To investigate the effect of processing techniques and conditions on the chemical and physical properties of oil, protein and their by-products and on the biologically available gossypol in cottonseed products. To develop innovative separation and purification processes to enhance the utilization of oilseed products with minimum undesirable environmental impact.



Southern Regional Research Center

Peter Wan

Development of Environmentally Acceptable Technologies for Processing Corn

- **Objective:**

To develop improved processes for separating carbohydrate, protein and oil fractions from corn and rice that are environmentally acceptable, cost effective, and with improved value-added properties.



Southern Regional Research Center

Michael Dowd

Fiber Extrusion to Improve Use and Production of Ethanol Byproducts

- **Objective:**

1) Determine applicability of using fiber extrusion to improve digestibility of byproducts from ethanol production for use in cattle feed and to increase ethanol production; 2) Develop and evaluate processes and products to increase the value of corn-to-ethanol byproducts that now form distillers dried grains; 3) Determine the potential for converting byproducts formed in ethanol production into animal feed and other value-added co-products; and 4) Develop methods to add value on the farm to cellulosic biomass to be used as feedstock for ethanol production.



Northern Grain Insects Research Laboratory

Walter Riedell

Value-Added Products from Plant Materials

- **Objective:**

1. Develop methods for harvesting forages and other cellulosic materials that retain feedstock quality. 2. Develop methods to assess the energy feedstock quality of herbaceous biomass crops. 3. Develop low-cost, user-friendly assessment and processing technologies for biomass producers and processors. 4. Develop varieties of switchgrass adapted to the northern USA. 5. Develop technologies for processing and converting biomass materials to value-added products, including fuels, industrial chemicals, and enzymes.



U.S. Dairy Forage Research Center

Paul Weimer

Value-Added, Bio-Based Products Through Microbial Treatments

- **Objective:**

Enhancing value of fiber commodities, such as industrial fibers kenaf, flax, and cotton, through microbial and enzymatic activities. Design, develop, and test specific woven and non-woven materials for composites with specific properties and industrial applications. Specifically, 1) optimize retting methods for separating high and consistent quality fibers from both seed- and fiber-type flax cultivars, 2) develop standard methods and practices through established subcommittee D 13.17 of ASTM to objectively measure fiber properties, 3) through ARS-USDA, governmental, and industrial collaborations, design and produce woven and non-woven flax fiber products for construction of composites for specific industrial applications.



Richard B. Russell Research Center

Danny Akin

Spectroscopic Sensors and Multivariate Calibration Methods for Quality Assessment of Commodities

- **Objective:**

1) Identify the parts of the corn stover that contain the aromatics and map the aromatic compounds by type and ability to be extracted. 2) Develop rapid spectral methods to evaluate the quality of plant material composition following separation by mechanical processing. 3) Develop enzymatic methods to release the fermentable carbohydrates from the aromatic compounds in corn stover feedstock to use for value added products. 4) Expand the NMR reference database of raw starch from rice and other grains. Calculating the 1-4/1-6 ratio should provide a more accurate reference method data to be applied to a more rapid spectral assessment method.



Richard B. Russell Research Center

David Himmelsbach