USDA BIOMASS RESEARCH CENTERS
ARS BACKGROUND BRIEFING

BACKGROUND:

The President's Biofuels Interagency Working Group report *Growing America's Fuel* identifies USDA as having research leadership responsibility for the improvement of non-food biomass crops and woody species, and the development of sustainable production and management systems for farms and forests.[1]

The plan called for the establishment of five regional USDA Biomass Research Centers. The purpose for this USDA-led effort is to help ensure that dependable supplies of needed feedstocks are available for the production of advanced biofuels to meet legislated goals and market demand, and enable as many rural areas across the country as possible to participate and benefit economically.

Secretary Vilsack formally announced the USDA Biomass Research Centers as a part of a major policy speech at the National Press Club on October 21, 2010.[2]

WHAT ARE THE USDA BIOMASS RESEARCH CENTERS?

The Biomass Research Centers serve to compliment and coordinate USDA Agricultural Research Service (ARS) and Forest Service Research & Development (FS) intramural research from across the country to help accelerate the establishment of commercial region-based biofuel supply chains based on agricultural and forestry-based feedstocks.

- The USDA Regional Biomass Research Centers are networks of existing ARS and FS facilities and scientists located in research centers and more than 100 locations nation-wide.
- The centers help leverage USDA nation-wide intramural science capacity and provide expertise and coordination needed to lead a national research effort in the development of sustainable biomass production systems and superior performing feedstocks and value-added co-products.
- The centers utilize national natural resources networks such as the *Conservation Effects Assessment Project* (CEAP), the *Greenhouse gas Reduction through Agricultural Carbon Enhancement network* (GRACEnet), and *Renewable Energy Assessment Project* (REAP) along with a full range of science disciplines – from genetics to sustainable feedstock production to conversion and biobased product development.
- The USDA Biomass Research Centers provide a long-term leadership structure that is focused on coordinated region-based biomass research across the country. The centers maintain a national perspective that compliments and partners with other USDA and federal agency efforts focused on renewable energy, as well as those of universities, states, and private industry.

[1] http://www.whitehouse.gov/sites/default/files/rss_viewer/growing_americas_fuels.PDF
[2] http://www.usda.gov/wps/portal/usda/usdahome?contentidonly=true&contentid=2010/10/0546.xml

- The intramural-funded USDA Biomass Research Centers and USDA National Institute of Food and Agriculture, AFRI, *Bioenergy Coordinated Agricultural Projects* (CAP) and *Biomass Research and Development Initiative* grant programs were designed to be complimentary. The CAPS provide extramural funding for development of region-based biomass projects, but do not fund establishment of additional centers.

WHAT IS THE FOCUS OF THE USDA RESEARCH AT THE CENTERS?

A significant coordinated research effort is required if the U.S. is to achieve the mandated 36-billion gallons of biofuels blended into the U.S. transportation fuels by 2022. To ensure that the needed feedstocks will be sustainably produced, harvested, and available for biorefineries and other uses, the USDA Biomass Research Centers focus on four primary objectives:

- Increase biomass production efficiency to increase grower profits and reduce biorefinery transaction costs.
- Optimally incorporate biomass and other dedicated feedstocks into existing agriculture and forestry-based systems.
- Address the uncertainties of expanded production up-front to avoid negative impacts on existing markets and ecosystem services.
- Develop and find new ways to utilize value-added coproducts to help enable commercially preferred biorefining technologies.

WHERE ARE THE REGIONAL BIOMASS CENTERS LOCATED?

Regional Biomass Research Centers. The USDA Biomass Research Centers are organized into five regional research networks (Figure 1). ARS and FS share leadership responsibilities for the

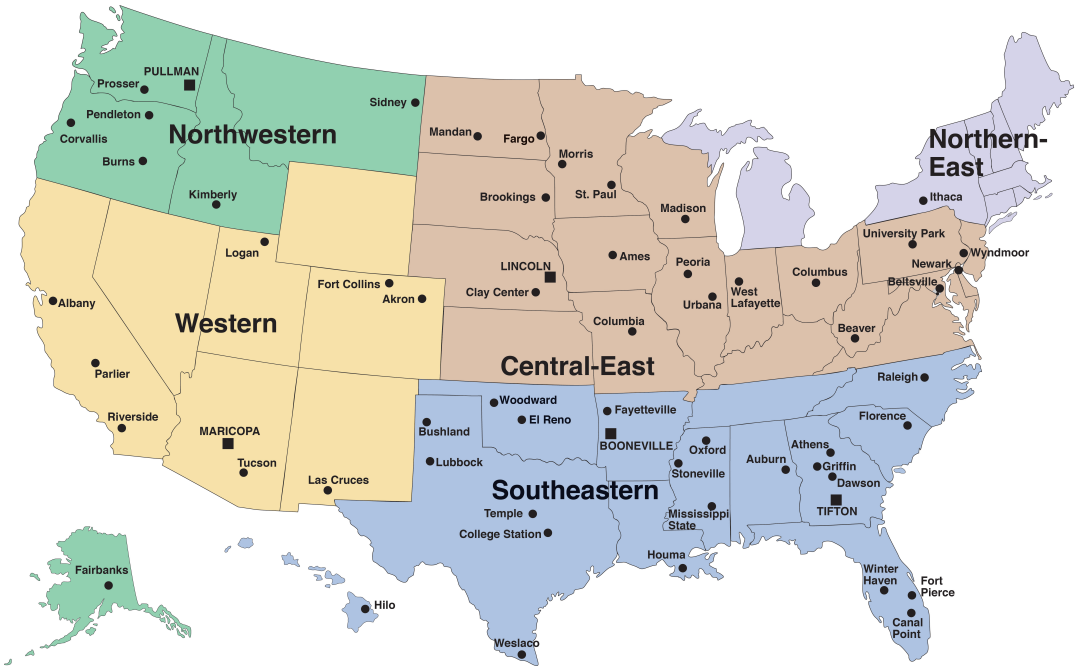

Figure 1. Map showing the five regional networks of ARS locations contributing to the USDA Biomass Research Centers. Similar networks comprise the FS contributions to the centers.

Southeastern and Northwestern Centers; ARS solely leads the Central-East and Western Regional Centers; and FS solely leads the Northern-East Regional Center.

Southeastern Regional Center

ARS Leadership. Booneville, Arkansas (Randy Raper, Southeastern Regional Coordinator) and Tifton, Georgia (Bill Anderson, Southeastern Regional Coordinator).

Forest Service Leadership. Auburn, Alabama (Bob Rummer, Southeastern Regional Coordinator).

Other contributing ARS and FS locations: Houma, Louisiana; Canal Point, Florida; Hilo, Hawaii; Auburn, Alabama; Florence, South Carolina; Dawson, Georgia; Research Triangle Park, North Carolina; Charleston, South Carolina; Pineville, Louisiana; Knoxville, Tennessee; Huntsville, Alabama; Asheville, North Carolina; Saucier, Mississippi; Gainesville, Florida; Athens, Georgia.

The Southeast region holds the country's greatest potential for producing plant feedstocks that can be used to produce biofuels. The USDA estimates that 10.4-billion gallons of advanced biofuels could be produced in the region. This region has the greatest relative need for increased research investment, compared to the Central-East region.

The highest-priority research needs for the Southeastern Region is the development of superior performing herbaceous feedstocks energycane, sweet sorghum, other sub-tropical/tropical perennial grasses, and purpose grown wood biomass, and the incorporation of these into existing row crop, pasture, agroforestry and forest-based systems to meet the needs of emerging advanced biofuel producing facilities in the region.

Energy cane-based systems have the potential to produce the greatest amounts of biofuel per unit area, and production could be further augmented by the integration of sweet sorghum to extend the length of season for feedstock supply to biorefineries. Because of small-scale farming throughout much of the region, specific emphasis will also be placed on small-farm production systems and development of partnerships with 1890's institutions. Region-appropriate needs include determining how to manage combinations of feedstocks across very heterogeneous landscapes that are subject to intermittent drought, increasing feedstock productivity using genomic methodology, feedstock supply estimation and biorefinery facility sitting modeling, short-rotation wood species management, modeling sustainable biomass removal and long-term productivity, estimating production and harvesting costs with feedstock price point estimates, technology development, and feedstock characterization.

Central-East Regional Center

ARS leadership. Lincoln, Nebraska (Ken Vogel, Central-East Regional Coordinator).

Other contributing ARS locations: Ames, Iowa; University Park, Pennsylvania; Stillwater, Oklahoma; Columbia, Missouri; College Station, Texas; El Reno, Oklahoma; Beaver, West Virginia; Morris, Minnesota; West Lafayette, IN; Columbus, OH; Urbana, IL; Madison, Wisconsin; St. Paul, Minnesota; Brookings, South Dakota.

The Central-East Region is the primary source of nearly 15 billion gallons of ethanol from corn grain starch and over half of one billion gallons of biodiesel. Excluding the corn and soybean production areas with the greatest yield potential, the Central-East Region has the

second greatest potential for contributing to the next 21-billion gallons of advanced biofuels from cellulosic biomass. The USDA estimates that 9.1 billion gallons of advanced biofuels may come from this region. The suitability of dedicated feedstock production systems that are economical in the region must be determined for areas outside of where corn and soybean production are most productive.

Primary research focus for the Central-East Regional Center is on the development of perennial grasses and biomass sorghum, and significant coordination of research with existing corn grain ethanol and corn stover cellulosic biomass. An emphasis is placed on the integration of dedicated feedstock production into central-eastern agricultural landscapes to enhance water and air natural resources quality and to minimize the adverse affects of bioenergy on existing agricultural markets. As for all regions, there are continued needs for increasing system efficiency through introduction of nitrogen-fixing plants, specifically here including alfalfa and other legumes. Integration of perennial grass feedstocks into these systems may be a way to help reduce nutrient escape from fields to surface and ground waters, and to reduce greenhouse gas emissions and increase carbon sequestration.

Northern-East Regional Center

Forest Service leadership. Madison, Wisconsin (Alan Rudie, Northern-East Regional Coordinator).
Other contributing FS locations: Rhinelander, Wisconsin, West Lafayette, Indiana, St Paul, Minnesota, Columbia, Missouri, Parsons, West Virginia.
The USDA estimates that forest and agriculture-based feedstocks produced in the North-East Region will produce 400-million gallons of biofuel that contribute toward 2% of the advanced biofuels required to meet legislated standards. Primary focus is on woody biomass with research directed at screening for superior traits; short rotation woody crops; sustainable management systems including forest health treatments and conventional forest operations; life cycle analysis; quantifying sustainable supply and demand scenarios; conversion of woody biomass to advanced fuels and coproducts; and biofuels and coproduct deployment demonstration design.

ARS contributions from units located in the Northern-East region are organized to contribute to the Central-East region.

Western Regional Center

ARS leadership. Maricopa, Arizona (Terry Coffelt, Interim Western Regional Coordinator).

Other contributing ARS and FS locations: Fort Collins, Colorado; Akron, Colorado; Albany, California; Parlier, California; Riverside, California; Tucson, AZ; Las Cruces, NM.

The western region has the least potential for producing large volumes of biofuels from biomass and other agricultural-based feedstock crops because of the relatively low natural net primary production capacity due to limited natural precipitation. The USDA estimates that only 100-million gallons of advanced biofuel will be produced from farm and forest-based feedstock production. However, large areas of public lands have been identified for full-scale production of algae for oil, and for deployment of large-scale photovoltaic and wind power generation. This will require the application of natural resources models and other ecosystem assessment and monitoring tools to estimate the impacts of such technologies on natural resources quality and guide the sustainable deployment of alternative energy technologies.

ARS feedstock research in the region primary focuses on the development of new industrial oil crops and FS on woody biomass. Oil seed crop efforts will be in conjunction with research conducted by the Northwestern Regional Center and include genomic modifications to optimize fatty acid genes and breeding new oil seed cultivars, characterizations of germplasm collections to indentify new feedstock types, and for phenotyping populations. New cropping systems are needed that fit specific local and regional niches for available resources and economic development, especially under limited available water conditions. Woody biomass efforts include management and utilization of insect, fire, or disease-killed wood and areas at high-risk of damage or loss, sustainable productivity and residual removal research, in-woods pyrolysis and biochar economics and assessment of ecological outcomes, and logistic handling and transportation costs research.

Northwestern Regional Center

ARS leadership. Pullman, Washington (Brenton Sharratt, Northwestern Regional Coordinator).

FS Leadership. Corvallis, Oregon (Bob Deal, Northwestern Regional Coordinator).

Other contributing ARS and FS locations: Sidney, Montana; Pendleton, Oregon; Corvallis, Oregon; Mandan, North Dakota; Moscow, Idaho; Missoula, Montana; Portland, Oregon; Redding, California; Fort Collins, Colorado; Seattle, Washington; Olympia, Washington.

The USDA estimates that 1-billion gallons of advanced biofuels will be produced from feedstocks derived from the northwestern region that will contribute 4.6% of the 21-billion gallons required under RFS2. Primary focus for ARS research is on the incorporation of oil seed crops into existing cereal-based production systems, and for Forest Service on woody biomass short-rotations and wood from conventional forest operations. Significant consideration is also given to the sustainable utilization of forest woody and crop straw post-harvest residues with specific attention given to maintaining soil carbon levels after harvest and the prevention of soil erosion.

Oil seed crop efforts will be in conjunction with efforts conducted by the Western Regional Center, with an emphasis on the integration of expanded production and minimization of its impact of existing wheat-based production systems. The FS woody biomass emphasis is on wood utilization; *Poplar* genomics, genetics, and short rotation management; forest resource supply and characterization; production standards for sustainable forest management systems; alternative energy policy evaluation; and economic feasibility of feedstock supply alternatives.

Contributing Cross-Location Science Teams. There are also three research teams that contribute methods and applications that are not limited to ecogeographic regions. These teams are grouped as Data Management, Feedstock Development, and Conversion & Co-product Development.

Ecosystem Services and Data Management

- Biophysical/Economic Modeling: Jeff Arnold, Temple, TX and Dave Archer, Mandan, ND│Oxford, MS; Corvallis, OR; Beltsville, MD; National Agricultural Library, Beltsville, MD; Fort Collins, CO; Dawson, GA; Wyndmoor, PA; Madison, WI; Tucson, AZ; Las Cruces, NM.

- Renewable Energy Assessment Project (REAP) - Crop residues, Soil Carbon, and Biochar: Doug Karlen, Ames, IA | National REAP team.
- Greenhouse gas Reduction through Agricultural Carbon Enhancement network (GRACEnet): Ron Follett, Fort Collins, CO | National GRACEnet team.
- Conservation Effects Assessment Project – Watershed Assessment Study (CEAP-WAS): John Sadler, Columbia, MO | National Grazingland and Cropland CEAP teams.

Dedicated Feedstock Development

- Perennial grasses – Mike Casler, Madison, WI | Lincoln, NE; Tifton, GA; St. Paul, MN; Albany, CA; and Urbana, IL.
- Energy cane – Ed Richard, Houma, LA and Jack Comstock, Canal Point, FL.
- Oil seed crops – Terry Coffeldt, Maricopa, AZ | Ft. Collins, CO; Dawson, GA; Tifton, GA; Stillwater, OK; and Raleigh, NC.
- Biomass sorghum including sweet sorghum – Jeff Pedersen, Lincoln, NE | Stillwater, OK and College Station, TX.
- Woody biomass, purpose grown wood species – Bob Deal, Corvallis OR; Alan Rudie, Madison, WI; Bob Rummer, Auburn, AL.

Biorefining and Coproduct Development

- Biorefining and Coproduct Development – Bob Fireovid, Beltsville, MD | Wyndmoor, PA, Peoria, IL, Albany, CA, New Orleans, LA, Madison, WI, Brookings, SD, and Florence, SC.

WHO WITHIN USDA LEADS THE BIOMASS RESEARCH CENTERS?

The Biomass Research Center leadership involves all levels of ARS and FS management participation through a vertically integrated organizational structure. For ARS, this includes members from the Office of National Programs (ONP) in Beltsville, Maryland, Directors of Area Offices, at least one senior-level scientist serving as a coordinator for four of the five regional research centers, and representatives from contributing locations within the regional networks (Figure 2).

- **ARS-Forest Service National Leadership Team**. The team is comprised of headquarters staff from ARS and FS. Jeff Steiner (ARS) and Marilyn Buford (FS) – Agency leads | Steve Shafer (ARS), Bob Fireovid (ARS), Carlos Rodriquez-Franco (FS), Rob Doudrick (FS), and Chris Risbrudt (FS) – This team coordinates interagency activities and communications, provides respective headquarters and department input to the *Agency Leadership Teams*, and provides directional leadership for implementing departmental initiatives.
- **ARS, Agency Leadership Team**. *Regional Coordinators* from each of the five ARS Hubs: Bill Anderson, Randy Raper, Ken Vogel, Brenton Sharratt, and Terry Coffelt; ONP bioenergy team members: Jeff Steiner (Chairperson), Deputy Administrators: Steve Shafer (NRSAS) and Kay Simmons (CPP), National Program Leaders: Bob Fireovid, Evert Byington, Jack Okamura, and Roy Scott; Office of Technology Transfer: Rob

Griesbach and June Blalock; Information Staff: Tara Weaver-Missick; Area Directors: Deborah Brennan, Will Blackburn, and Andy Hammond. The team provides overall agency-wide coordination of research, partnership activities, and communications among the five regional centers with other federal agencies, stakeholders, and customers. The *Agency Leadership Team* assesses progress and reports accomplishments across the agency and to the Office of the Secretary. The team provides recommendations for optimizing center operations and for the utilization of resources.

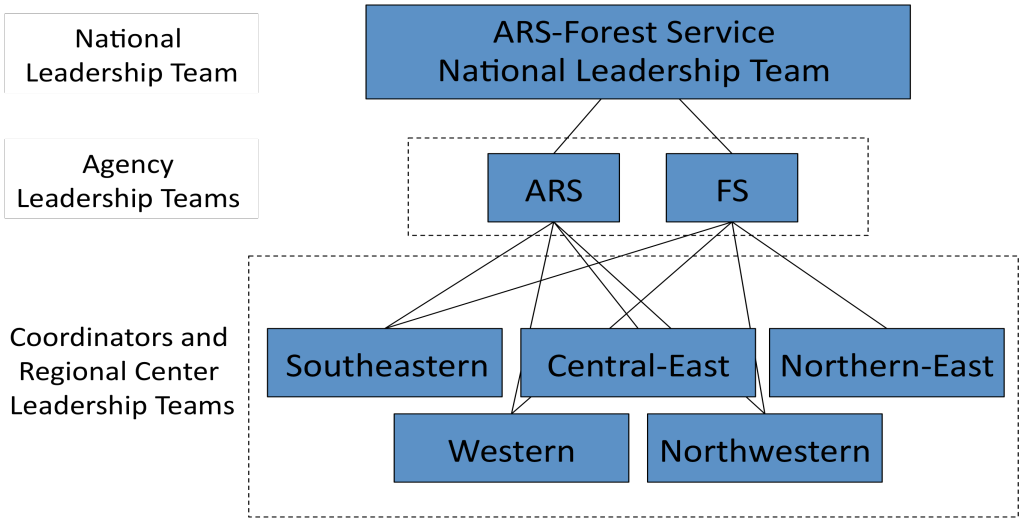

Figure 2. The leadership team structure of the USDA Biomass Research Centers. ARS and Forest Service efforts are coordinated at the Agency levels, and implemented locally by their respective research units in the field. Regional coordinators also partner between the agencies.

- **Regional Coordinators and Leadership Teams.** The *Regional Coordinators* are senior scientists primarily responsible for helping the *Agency Leadership Team* maintain communications among contributing researchers and outside partners and stakeholders. The coordinators and regional leadership teams provide up-to-date information and recommendations to the *Agency Leadership Team*. The *Regional Coordinators* provide recommendations for optimizing center operations, but do not determine how agency resources are utilized across regional networks. The teams make determinations whether existing resources are available to take on new partnership efforts, or what resources are needed to accomplish new opportunities. As point-of-contact for the centers, the coordinators refer non-research inquiries to the appropriate state-level USDA agency points of contact, and to the *Agency Leadership Team*.

WHAT IS THE RELATIONSHIP OF THE RESEARCH CENTERS TO OTHER USDA AGENCIES WITH RENEWABLE ENERGY RESPONSIBILITIES?

The USDA *Biomass Research Centers* focus their efforts on research challenges. However, USDA provides a wide range of programs and services that can also contribute to the development sustainable biofuel supply chains. ARS and FS are responsible for conducting high-priority, high-impact research that helps accelerate the establishment of commercial biomass and other dedicated feedstock industries for the production of biofuels and other renewable energy and biobased products. Since it is critical that all USDA programs and services be coordinated so

that sustainable supply chains can be established, it is also important that the research conducted by the *Biomass Research Centers* supports the programs and services of other USDA agencies. Therefore as appropriate using existing resources and by acquiring additional needed resources, research project partnerships will be planned with USDA and other federal science and service agencies, and input be given to help provide science-based guidance as requested.

It is not the responsibility of the biomass research centers to serve as overall coordinators of all USDA programs concerning biomass and renewable energy production. When research center coordinators are approached by outside customers about other USDA service agency programs, the coordinators refer questions to the appropriate contacts in other agencies. A USDA directory of the points of contact for other agencies with bioenergy programs has been provided to the coordinators. The ARS coordinators are keeping a log of outside inquiries and the referrals they have made.

The relationship of ARS and Forest Service Research to the biomass research centers, their relationships to USDA and other federal research and service agencies, and to other stakeholders and customers has been developed and is shown in Figure 3. The USDA *Bioenergy Science Team* has also been established to help communicate all USDA research activities and to provide science input to other USDA and other federal agencies that interface with agriculture and forestry.

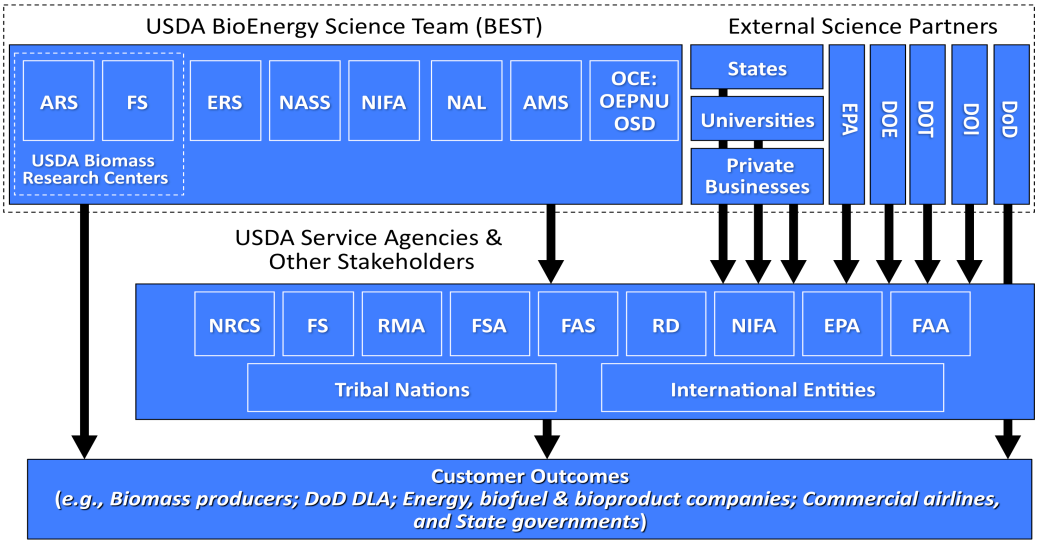

Figure 3. The relationships of contributing USDA science and service agencies involved in helping meet biofuels production mandates, and their linkages with external partners, stakeholders, and customers. The arrows indicate the direction of coordinated efforts to help accelerate the development of a commercial biomass industry.

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