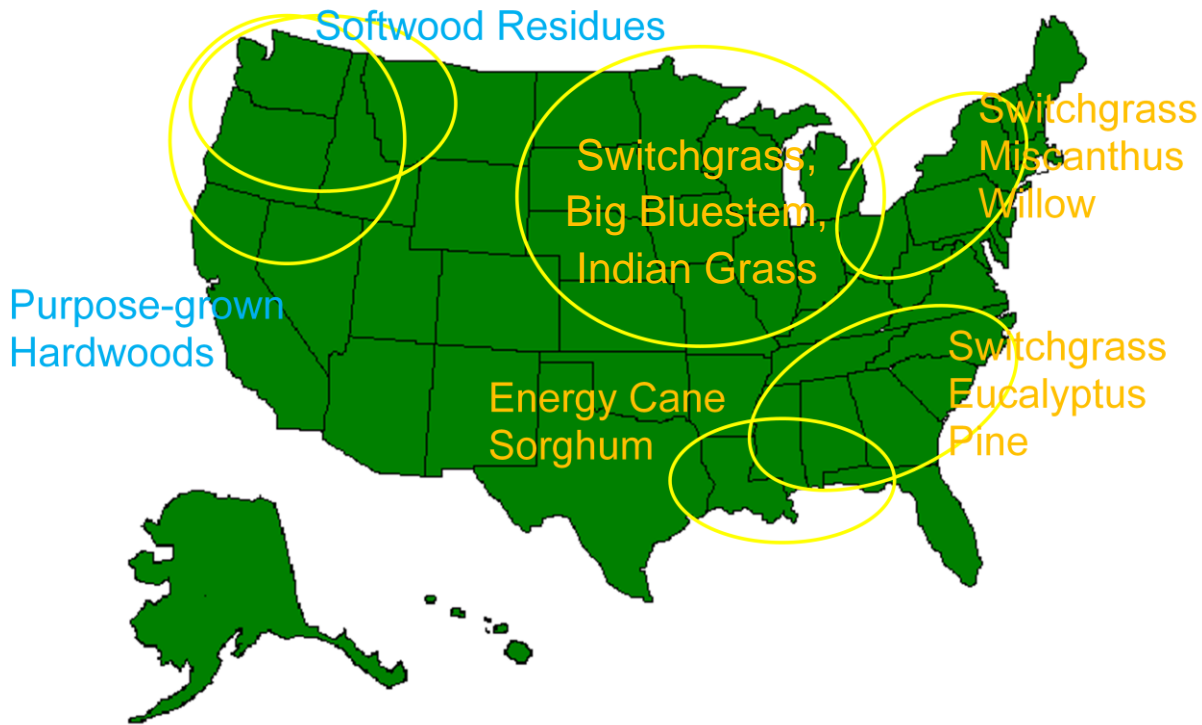
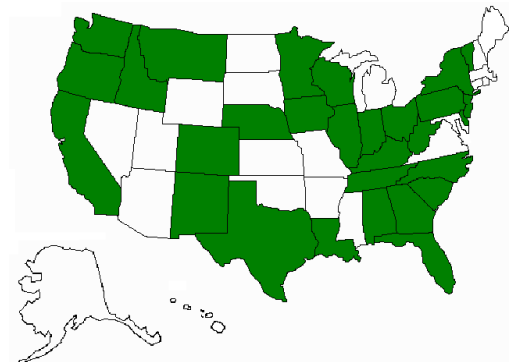


**NIFA – AFRI Regional Sustainable Bioenergy Systems
Coordinated Agricultural Projects (A6101)**



Institutions included in Funded Partnerships:

- 25 States
- 25 Land-Grant Universities
(including 6 minority-serving institutions)
- 6 Non Land-Grant Public Universities
- 1 Community College Regional Consortium
- 2 Private Non-Profit
- 9 Federal Partners
- 27 Industrial Partners



State Participation in CAP Projects (Green)

CAP Feedstocks:

Gustafson, University of Washington:	Purpose-grown poplar, red alder
Cavalieri, Washington State University:	Forest residues: Douglas Fir , Western Red Hemlock, Lodgepole Pine, other softwoods
Moore, Iowa State University:	Switchgrass, Big Bluestem, Indian grass
Kochergin, Louisiana State University:	Sweet Sorghum, Energy Cane
Rials, University of Tennessee:	Switchgrass, Pine, Eucalyptus
Richard, Pennsylvania State University:	Purpose grown willow, Miscanthus, and Switchgrass

System for Advanced Hardwood Biofuels in the Pacific Northwest (AHB-PNW)

Principal Investigator

Richard Gustafson
pulp@u.washington.edu
(206) 543-2790

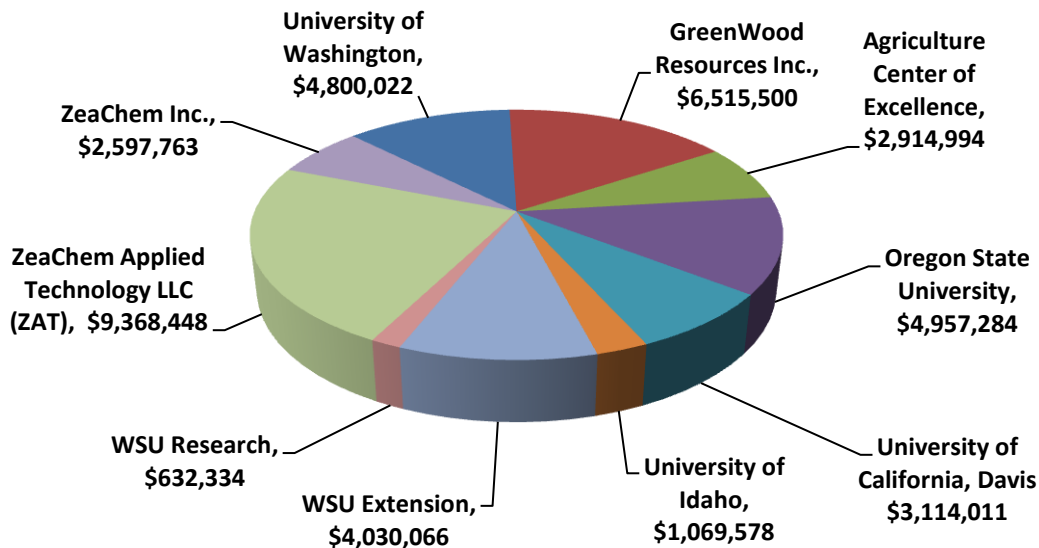
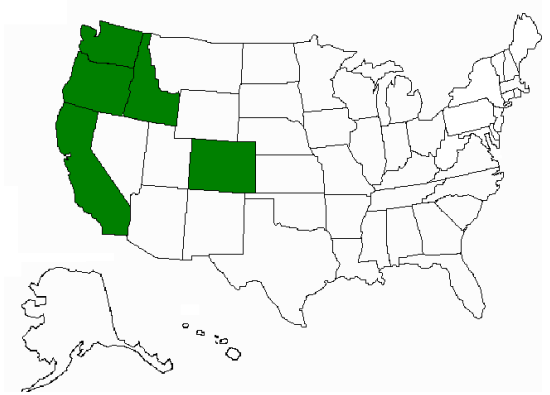
University of Washington

\$40,000,000 (5 years)
Award 2011-68005-30407

Numbers in Brief

27 Key Personnel from 6 Universities, a Community College Consortium, and 2 Industrial Partners from 5 States:

- WA:** University of Washington (\$4,800,022)
Washington State University Extension (\$4,030,066)
Agriculture Center of Excellence (\$2,914,994)
Washington State University (\$632,334)
- OR:** GreenWood Resources Inc. (\$6,515,500)
Oregon State University (\$4,957,284)
ZeaChem Applied Technology LLC (\$9,368,448)
- CO:** ZeaChem Inc. (\$2,597,763)
- CA:** University of California, Davis (\$3,114,011)
- ID:** University of Idaho (\$1,069,578)



CAP Outcomes

The university/industry partnership led by the University of Washington will ready the Pacific Northwest (PNW) for a 2015 introduction of an infrastructure compatible biofuels industry targeting biogasoline and renewable aviation fuel.

Sustainably grown regionally-appropriate woody energy crops will help to revitalize the region's agriculture/forestry sectors by supplying a sustainable advanced biofuels industry that supports both large and small growers and brings jobs to rural communities in the region. The consortium will endeavor to mitigate technology risks along the entire woody biomass energy crop-based biofuels supply chain to allow the financing, construction, and operation of multiple biorefineries in the PNW region.

Project Objectives

- Establish commercial tree farm development with four 100-acre Phase I tree farms across a range of marginal sites in the PNW. Phase I tree farms will be used to demonstrate, quantify, and/or refine biomass productivity, site sustainability, management costs, harvesting and processing technology, and environmental impacts.
- Develop a new class of poplar and alder energy varieties using classical hybridization methods to improve crop adaptability to sites of marginal forest and agricultural quality. Hybridization work will be supported by a study of genes controlling the expression of energy traits.
- Research low-impact silvicultural methods in terms of the application of naturally-occurring symbiotic organisms (endophytes) that can fix atmospheric nitrogen, increase water use efficiency, and control diseases.
- Develop methods of controlling gene flow from tree plantations in combination with a USDA Biotechnology Risk Assessment Grant based on zinc finger mutagenesis.
- Refine near-infrared spectroscopy as an indirect method to evaluate hybrid poplar varieties for defensive phytochemicals and biomass composition.
- Develop and deploy scalable technologies to convert hardwood energy crops into 100% infrastructure compatible gasoline and jet/diesel biofuels.
- Expand the capabilities of the 10 ton/day Boardman, Oregon integrated biorefinery for the production of hydrocarbon fuel blend stocks – bio-based jet, diesel, and gasoline.
- Produce the first 8,000 gal truckload jet/diesel in 2013 and gasoline in 2015.
- Validate infrastructure compatibility by delivering test quantities of advanced biofuels to consumers through existing marketing and distribution systems.
- Provide regional sustainability analyses, data collection, and management tools to address the economic, environmental, and social issues and mitigate the risk of unintended consequences while building support for the industry.
- Develop a rigorous stakeholder outreach program to educate landowners and land managers.
- Foster workforce development opportunities across the supply chain and support extension and outreach programs through the development of regional K-12 and college (university and community college) curricula.

**Northwest Advanced Renewables Alliance (NARA):
A New Vista for Green Fuels, Chemicals, and Environmentally Preferred Products**

Principal Investigator

Ralph Cavaliere
cavaliere@wsu.edu
509-335-2682

Washington State University

\$40,000,000 (5 years)
Award 2011-68005-30416

Numbers in Brief

41 Key Personnel representing 8 Universities, 1 Tribal College, 1 NGO, 3 Federal Partners, and 4 Industrial Partners from 9 States:

WA: Washington State University (WSU) (\$13,016,111)

University of Washington (\$3,642,727)

Weyerhaeuser (\$4,819,602)

Catchlight Energy (Unpaid)

Western Washington University

Facing the Future

OR: Oregon State University (\$4,821,444)

USDA-USFS-PNWRL (\$88,909)

Greenwood Resources (\$750,000)

ID: University of Idaho (\$2,812,884)

DOE Idaho National Lab (Unpaid)

NM: National Center for Genome Resources (NCGR) (\$1,175,000)

WI: USDA-USFS- Forest Products Laboratory (\$1,125,509)

MT: University of Montana (\$591,600)

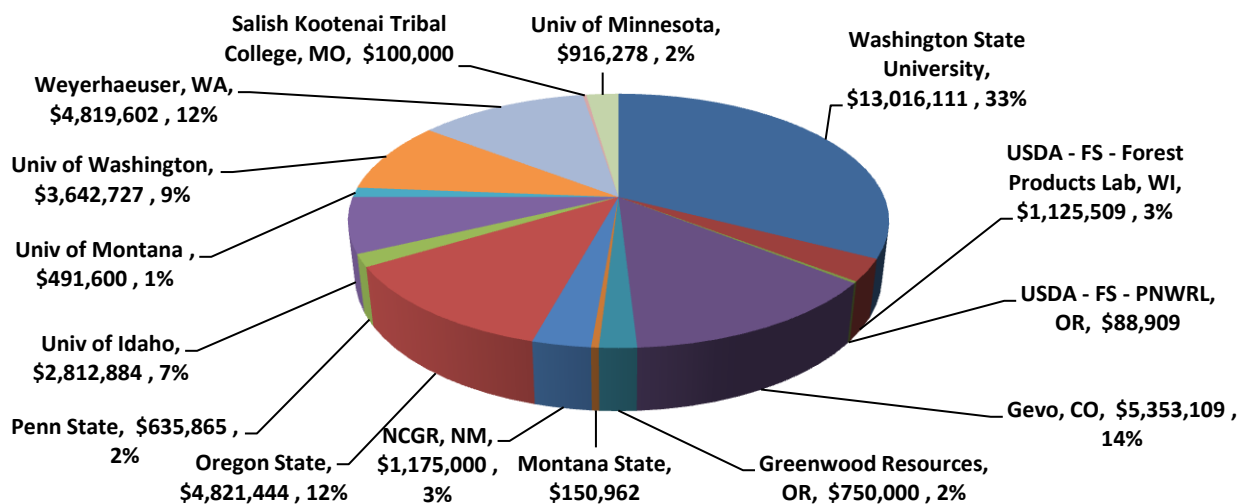
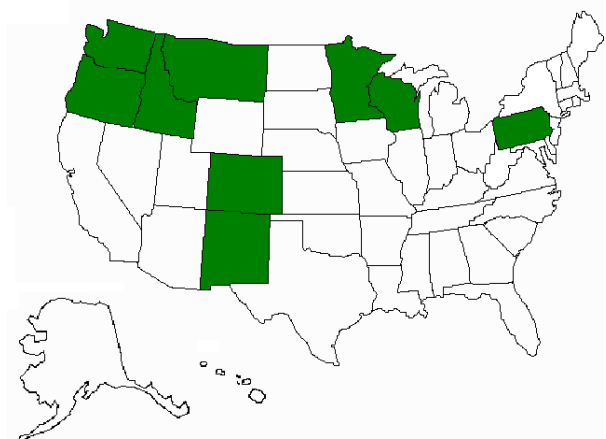
CO: GEVO (\$5,353,109)

Montana State University (\$150,962)

MN: U of Minnesota (\$916,278)

Salish Kootenai Tribal College (\$100,000)

PA: Penn State University (\$635,865)



CAP Outcomes

Northwest Advanced Renewables Alliance (NARA): A New Vista for Green Fuels, Chemicals, and Environmentally Preferred Products (EPPs) has been created to both address and develop regional sustainable solutions for aviation fuel and key petrochemical replacements from sustainable woody-based resources in the Pacific Northwest.

It is envisaged that NARA will serve as a national model in this regard with its game-changing approaches. In addressing this regional and national grand challenge, NARA seamlessly links all of the major research institutions in the Pacific Northwest and tribal colleges, with industrial partners as well as various federal laboratories. The approach taken involves feedstock development, sustainable forest/plantation production, new methodologies to identify the most promising plant lines/forest residuals and their subsequent conversions into aviation fuel/petrochemicals at scale and cost needed. If successful, the project will contribute significantly to improving rural prosperity and job creation in the region.

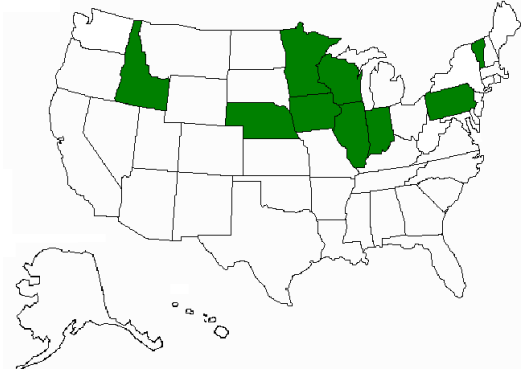
Project Objectives

- Develop and improve Douglas-fir/Western red hemlock and for aviation fuel and bioproduct production.
- This highly integrated effort will evaluate sustainable forestry techniques and logistics to produce and move wood materials (forest residuals) from the forest to a processing facility. These forest treatments and removal of biomass will be evaluated using a series of environmental metrics to assess their long-term impact on the ecosystems and watersheds.
- Co-product value streams from lignin residues will be developed to support economics of fuels production. With the industrial team led by feedstock experts at Weyerhaeuser and biofuels producer Gevo, other anticipated outputs are on a 5-year commercial track to assess commercial viability of producing bio-aviation fuels and co-products.
- The social science/outreach team will additionally engage communities and stakeholders to examine perceptions and needs of these groups in developing a sustainable supply chain. Product attributes necessary to increase market share and value for our products will be evaluated and connected with technical components of the research.
- Develop comprehensive biofuels literacy with citizens from the K-12 through university level, and move them into the workforce. Supporting this near-term effort with research and technology aimed at long-term sustainability of the industry are researchers from the major universities from our four-state region augmented by select academics providing key expertise in critical areas, regional and national USDA researchers, and the National Center for Genome Resources.

Central USA (CenUSA) Agro-ecosystem Approach to Sustainable Biofuels Production Via the Pyrolysis-Biochar Platform

Principal Investigator

Kenneth Moore Iowa State University of Science & Technology **\$25,000,000 (5 years)**
kjmoore@iastate.edu Award 2011-68005-30411
515-294-5482



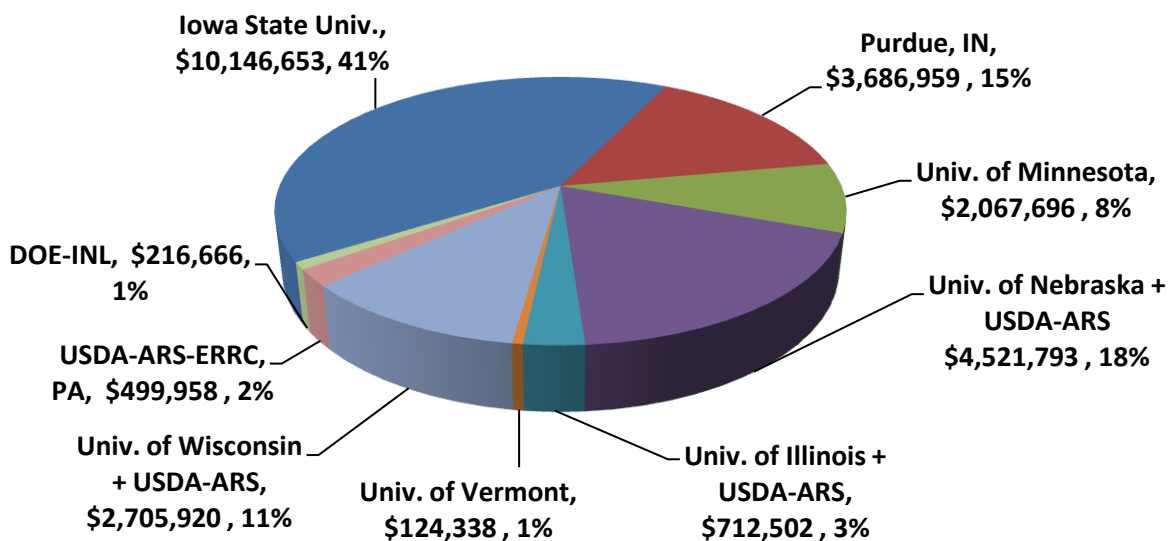
Numbers in Brief

19 Key Personnel from 7 Universities and 5 Federal Partners from 9 States:

- | | |
|---|--|
| IA: Iowa State Univ. (\$10,146,653) | MN: Univ. of Minnesota (\$2,067,696) |
| IN: Purdue Univ. (\$3,686,959) | IL: Univ. of Illinois (\$211,232) |
| NE: Univ. of Nebraska (\$1,916,143) | USDA - ARS Peoria (\$501,270) |
| USDA - ARS Lincoln (\$2,605,650) | PA: USDA- ARS-ERRC Wyndmoor (\$499,958) |
| WI: Univ. of Wisconsin (\$1,063,458) | ID: DOE Idaho National Lab (\$216,666) |
| USDA - ARS Madison (\$1,642,462) | VT: Univ. of Vermont (\$124,338) |

Advisory Board Members:

- | | |
|---|--|
| CO: The Keystone Center (Unpaid) | KS: ICM, Inc. (Unpaid) |
| IA: Iowa Farm Bureau Federation (Unpaid) | NE: Stock Seed Farms (Unpaid) |
| IA: Vermeer Corporation (Unpaid) | NE: State of Nebraska - Nebraska Game & Parks Commission (Unpaid) |
| IL: Archer Daniels Midland (Unpaid) | |
| USDA – NRCS (Unpaid) | |



CAP Outcomes

This Iowa State University-led consortium will coordinate a regional biomass production system for advanced transportation fuels derived from native perennial grasses including switchgrass, big bluestem, and indian grass, mixed with legumes to provide nutrients on land that is unsuitable or marginal for row crop production. Outcomes will improve the sustainability of existing cropping systems by adding value to marginal land while reducing agricultural runoff and increasing carbon sequestration. The project leverages existing industrial partnerships with Archer Daniels Midland and Conoco-Phillips. If successful, the project will contribute significantly to improving rural prosperity and job creation in the region and create significant environmental benefit.

Project Objectives

- Produce biomass feedstocks specifically for thermochemical processing, and a better understanding of the impact of lignin on biofuels produced using pyrolysis.
- Use the Recurrent Restricted Phenotypic Selection (RRPS) breeding system to incorporate new germplasm into the populations, and Between and Within Half-sib Family Selection (B&WFS) for subsequent generations, utilizing single nucleotide polymorphism (SNP) markers to accelerate the switchgrass breeding programs in progress at ARS locations to increase biomass yield and traits for conversion.
- Develop basic information on the genetics and breeding structure of native legumes including Illinois bundle flower, Partridge Pea, and information on genetic variation within the species for agronomic traits.
- Development of technology and sustainable harvest logistics systems that are easily adaptable, yielding a more positive energy balance for end products.
- Exploit biochar to provide carbon sequestration of photosynthetically fixed carbon, and return biologically active carbon and plant-available nutrients to soils.
- Develop near infrared spectrometric (NIRS) calibrations for pyrolysis products of grass feedstocks for screening biomass composition and quality that can be used by industry.
- Identification and characterization of sustainable bioenergy systems and the understanding of the socioeconomic and environmental consequences.
- Using LCA methods coupled with the opportunity cost of land, evaluate system-wide GHG impacts of alternative production systems.
- Deliver science-based knowledge and informal education programs to 4-H and FFA through the development of 20 educational modules, internships, literature, and non-credit short courses to build capacity in extension educators, build awareness of the benefits of biochar agriculture, and citizen science programs for stakeholders.
- Extension: 1) build capacity in extension educators; 2) build awareness of the societal and environmental benefits of perennial and biochar agriculture; 3) develop a “citizen science” program for shared learning aimed at all stakeholders of this project; and 4) stimulate the adoption of best management practices developed by this project.

Sustainable Bioproduct Initiative (SUBI): A Regional Program for Production of Multiple Agricultural Feedstocks And Processing to Biofuels and Biobased Chemicals

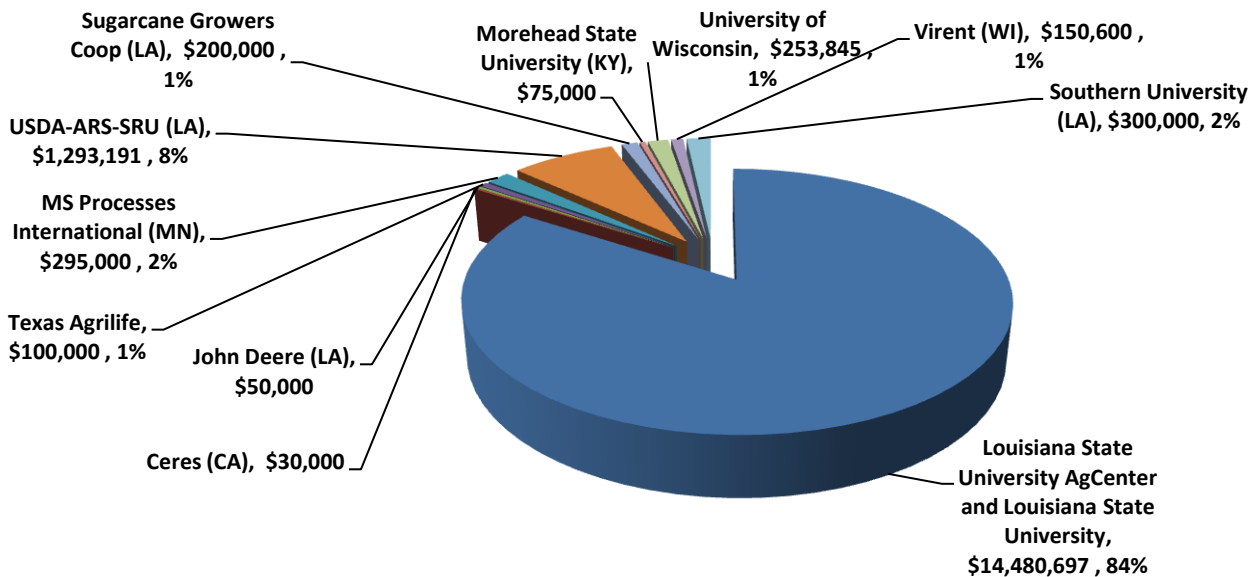
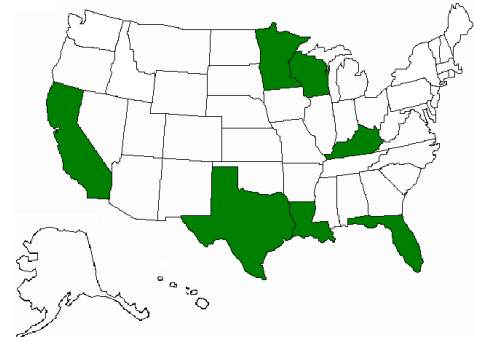
Principal Investigator

Vadim Kochergin Louisiana State University Agricultural Center **\$17,228,335 (5 years)**
vkochergin@agcenter.lsu.edu **Award 2011-69005-30515**
 225-642-0135

Numbers in Brief

37 Total Key Personnel from 5 Universities, 1 Federal Partner, and 7 Industry Partners in 7 States.

- LA:** Louisiana State University Agricultural Center and Louisiana State University (\$14,480,697)
 USDA-ARS-Sugarcane Research Unit (\$1,293,191)
 John Deere (\$50,000)
 Southern University (\$300,000)
- FL:** Sugar Cane Growers Cooperative (\$200,000)
- WI:** University of Wisconsin (\$253,845)
 Virent Energy (\$150,600)
- TX:** Texas Agrilife (\$100,000)
- CA:** Ceres, Inc. (\$30,000); Genencor (Unpaid);
 Optinol (Unpaid)
- KY:** Morehead State University (\$75,000)
- MN:** MS Processes International, Inc. (\$295,000)



CAP Outcomes

The Project will expand the Southern Regional Agricultural Sector by utilizing sweet sorghum and energy cane to produce butanol, gasoline, isoprene and by-product chemicals. This multidisciplinary regional consortium of agricultural scientists, biotechnologists, technology and engineering companies, economists and educators will address multiple aspects associated with conversion of energy cane and sweet sorghum into a portfolio of bio-based fuels and chemicals.

LSU will use energy cane and sorghum to help reinvigorate the Louisiana sugar and chemical industry through new and existing industrial partnerships. Improving biomass cold tolerance and production characteristics will produce a steady stream of biomass to be converted to economically viable sugars using existing Louisiana refinery infrastructure. If successful, the project will contribute significantly to improving rural prosperity and job creation in the region.

Project Objectives

- Evaluation of selected energy cane and sweet sorghum crops and improvement in their production through utilization of low-input, sustainable systems to ensure an uninterrupted supply of carbohydrates and fiber to biofuel production facilities.
- Utilization of existing pilot and industrial facilities, incorporating multiple crops and cutting edge processing technologies to demonstrate butanol, gasoline, isoprene and specialty chemicals.
- Development of regionally appropriate business-marketing models that integrate bio-based fuels and products into existing logistics and supply chain infrastructures based on inputs from agricultural research and techno-economic analyses.
- Expansion of educational programs at the consortium universities to support a practical training center in biofuel processing linked to an extension/outreach program targeting supply chain participants.

Southeast Partnership for Integrated Biomass Supply Systems (IBSS)

Principal Investigator

Tim Rials

trials@utk.edu

865-946-1130

University of Tennessee

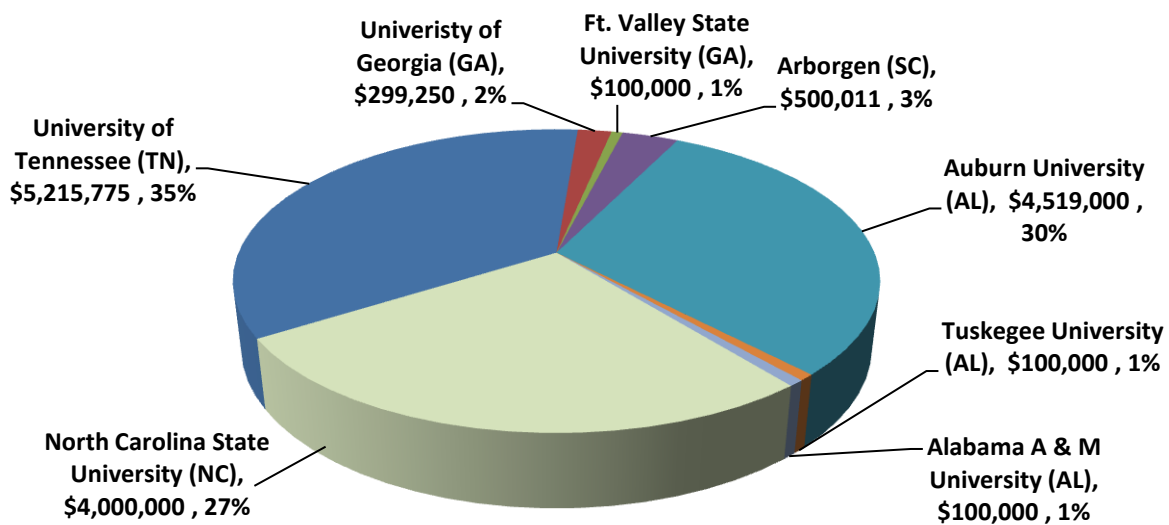
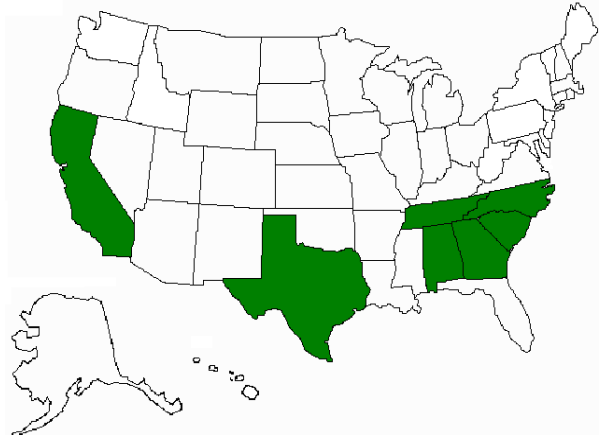
\$15,000,000 (5 years)

Award 2011-68005-30410

Numbers in Brief

48 Total Key Personnel from 4 Universities, and 6 Industrial Partners located across 7 States in the Southeastern Region, California and Texas:

- TN:** University of Tennessee (\$5,215,775)
Genera Energy (Unpaid)
- AL:** Auburn University (\$4,519,000)
Tuskegee University (\$100,000)
Alabama A & M University (\$100,000)
Louisiana Pacific (Unpaid)
- NC:** North Carolina State University (\$4,000,000)
- SC:** ArborGen (\$500,011)
- GA:** University of Georgia (\$299,250)
Fort Valley State University (\$100,000)
- CA:** Ceres, Inc. (Unpaid); Rentech-ClearFuels (Unpaid)
- TX:** KiOR (Unpaid)



CAP Outcomes

The Southeast Partnership for Integrated Biomass Supply Systems (IBSS) targets the deployment of an infrastructure-compatible (IC) biofuels industry across the region, addressing the opportunity presented by the unmatched biomass production capacity of the region. IBSS incorporates a parallel path for development that includes the near-term demonstration of IC fuel production with an industrial partner while developing the information needed to reduce the risk of broader industry deployment across the landscape. Social, economic, and environmental sustainability issues are paramount. As such, IBSS will work to establish the pipeline for high-yield, high-performance lignocellulosic biomass that is necessary for tomorrow's biorefineries to operate successfully, and will evaluate efficient methods of utilizing the biomass resource that is available today.

IBSS will develop sustainable production systems for feedstocks (switchgrass, pine, and cold-tolerant Eucalyptus) to deliver: (1) low-cost, easily converted sugars for biochemical conversion to butanol and lignin byproducts and (2) forest and mill residues, as well as dedicated energy crop feedstocks to produce Fischer-Tropsch diesel, heat, and power. IBSS will contribute significantly to improving rural prosperity and job creation in the region.

Project Objectives

- Define the impact of genetic/environmental/production factors on sugar costs and yields. Validate the effect of storage conditions, in particular for biomass that has a semiannual or annual harvest cycle, on feedstock quality. Identify feedstock characteristics impacting thermochemical conversion efficiencies to liquid fuels or to CHP products. Develop recommendations on biomass production and management methods for optimal process performance in major technology platforms.
- Build innovative Education, Extension, and Outreach (E2O) content and tools from ongoing demonstration project experience. The SEED Fellows will connect students to actual training in the community and will further an understanding of the different drivers and needs of a wide variety of landowners using different biomass feedstocks. IBSS will use the primary industrial site to pilot the use of the 'readiness index' for community development groups.
- Based on the Genera Energy and ClearFuels/Rentech sites, IBSS will further develop the sustainability metrics and communication tools needed to inform landowners, fuel producers, and community interest groups. We will develop complete field-to-wheels LCA data that track carbon, water, nitrogen and other environmental attributes defining system sustainability. The program will contribute to the development of web-based LCA tools that can be used for screening combinations of biomass feedstock production and conversion technologies for other locations in the region.

NEWBio: Northeast Woody / Warm-season Biomass Consortium

Principal Investigator

Tom Richard

tlr20@psu.edu

Pennsylvania State University

\$9,980,000 (5 years)

Award 2012-68005-19703

Numbers in Brief

18 Key Personnel from 9 Universities, 3 Federal Partners, and 8 Industry partners

PA: Pennsylvania State University,
Drexel University
USDA, ARS, ERRC
American Refining Group (unpaid)
Ernst Conservation Seeds (unpaid)
Case New Holland (unpaid)

CT: Praxair, Inc. (unpaid)

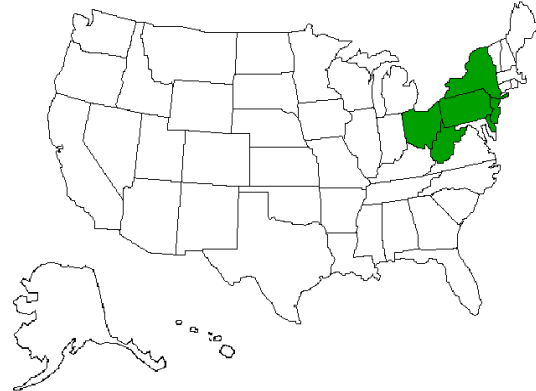
DE: Delaware State University

ID: Idaho National Lab

NH: Mascoma Biofuels (unpaid)

NJ: Rutgers University
Primus Green Energy (unpaid)

NY: SUNY-ESF
Cornell University
Double A Willow (unpaid)



Project Region: Northeast (see map)
Delaware, New Jersey, New York,
Ohio, Pennsylvania, and West Virginia

OH: Ohio State University
Aloterra Energy (unpaid)

TN: Oak Ridge National Lab

WV: West Virginia University

VT: University of Vermont

CAP Outcomes

The NEWBio consortium is targeting the development of three sustainable, cost-effective feedstock supply chains across a five state region in the Northeast. By targeting purpose-grown willow, miscanthus and switchgrass, NEWBio can address the needs of several industrial partners, grow dedicated energy crops on marginal land, and assess three different feedstock production scenarios: plantation (central management); commodity (independent producers); and contract (between producers and clients). Building on previous work and investments, NEWBio will work to integrate research, education, and extension to improve crop genetic development, sustainable production systems, harvesting, handling, storage, and preprocessing, enabling industrial partners poised to produce advanced drop-in liquid transportation and aviation biofuels to make the best decisions for plant siting and for rural communities to participate in system development and economic opportunity and growth.

Project Objectives

- Understand the values, legacies, and motivations behind decisions about land management and business development in order to design socially acceptable biomass energy systems that will overcome barriers to development.
- Generate price-supply curves, facility siting and forward-contracting tools to provide entrepreneur and investor confidence in biomass feedstock supply.
- Develop and deploy, as industry standards, sustainable production practices for perennial grasses and short-rotation woody crops to improve yield 25% and reduce costs by 20%.
- Commercialize the current pipeline of improved willow and switchgrass varieties and develop genomic tools to accelerate breeding for marginal land.
- Develop harvest, transport, storage, and preprocessing systems that increase feedstock value as biomass moves through the supply chain toward advanced biofuel refineries.
- Create a culture of safety for biomass production, transport and preprocessing to addresses machinery hazards and environmental risks to protect workers.
- Transform standards of practice for biomass value chains to greatly improve carbon paybacks, net energy yields, soil and water quality, and other ecosystem services.
- Deploy safe, efficient and integrated supply chains in four demonstration regions, each providing 500 to 1000 tons/ day of high quality low-cost sustainable biomass.
- Create learning communities of farmers, entrepreneurs, employees and investors informed about the best practices and emerging technologies.
- Provide business support services to generate at least 100 supply contracts and support more than 50 new supply chain businesses to harvest, transport and preprocess biomass from short rotation woody crops and warm-season grasses.
- Educate students, citizens, landowners and policymakers to increase public understanding of biomass alternatives, including the social, economic and environmental impacts of sustainable bioenergy in the northeastern U.S.
- Create a culture of opportunity to support corporate commitments for two commercial-scale advanced biofuels facilities and encourage many more such commitments in the northeastern U.S.

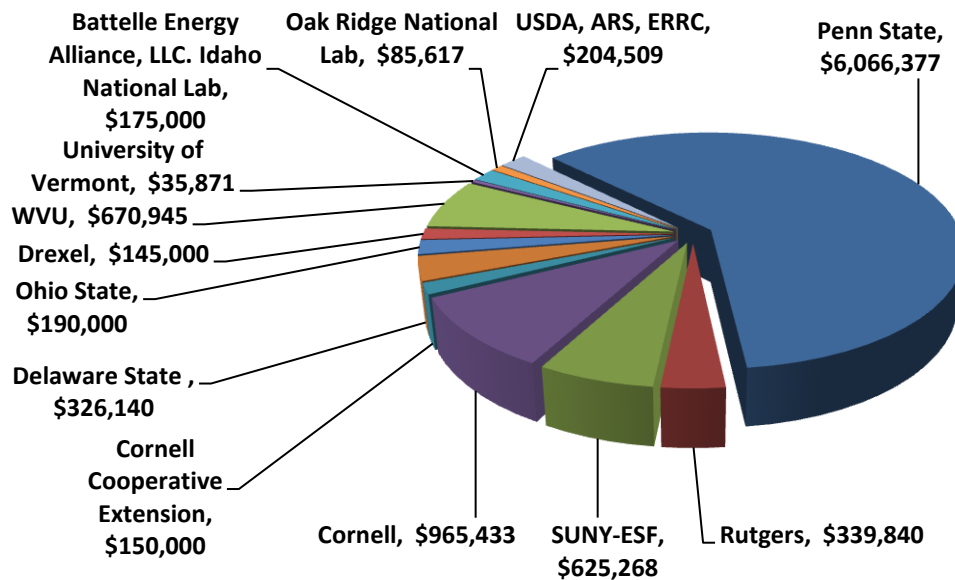


Chart: Distribution of Funding for Collaborators and Partnerships