Agriculture and Aviation: Partners in Prosperity

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Any recommendations included in this document do not reflect USDA or the Administration's positions.

"This is our generation's Sputnik moment... In a few weeks, I will be sending a budget to Congress that helps us meet that goal. We'll invest in biomedical research, information technology, and especially clean energy technology—an investment that will strengthen our security, protect our planet, and create countless new jobs for our people."

President Barack Obama, State of the Union Address, January 25, 2011

"Now, another substitute for oil that holds tremendous promise is renewable biofuels -– not just ethanol, but biofuels made from things like switchgrass and wood chips and biomass… Just last week, our Air Force -- our own Air Force -- used an advanced biofuel blend to fly a Raptor 22 -- an F-22 Raptor faster than the speed of sound… In fact, the Air Force is aiming to get half of its domestic jet fuel from alternative sources by 2016. And I'm directing the Navy and the Departments of Energy and Agriculture to work with the private sector to create advanced biofuels that can power not just fighter jets, but also trucks and commercial airliners."

Remarks by the President, America's Energy Security, Georgetown University, March 30, 2011

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Preface

In July 2010, the U.S. Department of Agriculture (USDA), Airlines for America, Inc. (A4A), and the Boeing Company (Boeing) signed a resolution formalizing their commitment to work together on the "FARM to FLY" initiative. The FARM to FLY program will "accelerate the availability of a commercially viable and sustainable aviation biofuel industry in the United States, increase domestic energy security, establish regional supply chains, and support rural development."[1] To advance the initiative, each organization designated personnel to serve on the FARM to FLY Working Team to discuss actions that promote the commercial-scale production of sustainable feedstocks and the development of aviation biofuel production and distribution facilities. The Team's discussions focused on existing statutory authority and areas that might require additional rulemaking, statutory, or funding changes. This report contains the FARM to FLY Working Team's findings and recommendations, and comes on the heels of the first-ever biojet-powered commercial-service airline flights in the United States, by Alaska Airlines and United Airlines, during the week of November 7, 2011.

The opportunities presented by developing sustainable aviation biofuel industry align well with President Obama's commitment to clean energy technology, the U.S. biofuels targets expressed in the *Energy Independence and Security Act*, and the goals of promoting economic opportunities in rural America by enhancing the Nation's energy independence and advancing environmental stewardship. This report documents the preparedness of the commercial and military aviation sectors to become preferred customers for biofuels, as well as the technical readiness of the aviation biofuels program, while also affirming our "flight plan" to help launch an economically self-sustaining long-term aviation biofuels supply chain. By articulating the next steps needed to ensure that aviation biofuels play a key role in meeting the Nation's energy needs and related environmental goals.

[1] http://www.airlines.org/Energy/AlternativeFuels/Documents/FarmToFlyResolution071410.pdf

Section I: The Opportunity

In his State of the Union address on January 25, 2011, President Barack Obama reaffirmed his administration's commitment to government investment in clean-energy technology research, development, and deployment as "an investment that will strengthen our security, protect our planet, and create countless new jobs for our people."[2] The President's remarks underscored the "promise of renewable energy,"[3] building on his pledge to develop a commercially viable biofuels industry in America.

Just a year earlier, on February 3, 2010, President Obama announced a series of steps that the Obama Administration was taking to boost biofuels production in the United States. The Biofuels Interagency Working Group's report that outlined strategies to support the existing biofuels industry and the establishment of an advanced biofuels industry in order to meet the *Energy Independence and Security Act's* target of producing 36 billion gallons per year of U.S. biofuels by 2022 prompted these actions. The report, "Growing America's Fuel,"[4] called for "an outcome-driven re-engineered system." The strategies included supporting the development of first- and second-generation biofuels and accelerating the development of third-generation biofuels—including aviation fuels. The USDA Biofuel Strategic Production Report and regional roadmap, released in June of 2010, further highlighted these strategies.[5]

The report also addressed the use of regional supply-chain systems to ensure that all fuels produced are compatible with the U.S. transportation fuel infrastructure. Moreover, it explicitly recognized the progress and potential in the area of aviation, with a stated goal to "[s]ecure lead customer purchase commitments to stimulate production of feedstocks and biofuels with a concerted effort directed to our military and airline industry."

Since the July 14, 2010, formal launch of FARM to FLY, the opportunity for the commercial and military aviation industries to serve as the primary catalysts for a successful U.S. biofuels industry has gained increased momentum.

On October 28, 2010, *The Economist*, in a story on the recovering prospects of biofuels, rightly noted that, "There is no realistic prospect for widespread electric air travel: …if you want low-carbon flying, drop-in biofuels are the only game in town."[6] The story concluded with the apt observation that, "Over the long run, the future for biofuels may be looking up."
On December 29, 2010, the editorial board of *Biofuels Digest* recognized the USDA and the U.S. Navy with their Public-Public Partnership of the Year Award for their "cooperative work in

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[2] http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address
[3] In July 2009, *Scientific American* magazine determined that cellulosic biofuels could "fundamentally change the world", ensure U.S. energy independence while greatly benefiting the environment, create U.S. jobs, prevent trade imbalances and provide new, secure, and green sources of fuel. The *Scientific American* article cited government studies showing that the U.S. can produce at least 1.3 billion dry tons of cellulosic biomass every year without decreasing the amount of biomass available for food, animal feed or exports, and concluded that "this much biomass could produce more than 100 billion gallons of [fuel] per year – about half the current annual consumption."
[4] http://www.whitehouse.gov/sites/default/files/rss_viewer/growing_americas_fuels.PDF
[5] http://www.usda.gov/documents/USDA_Biofuels_Report_6232010.pdf
[6] http://www.economist.com/node/17358802, "The post-alcohol world: Biofuels are back. This time they might even work" (Oct. 28, 2010)

developing advanced biofuels for naval onshore and fleet operations."[7] On January 10, 2011, Jim Lane, the publication's Editor-in-Chief, further remarked, "There is no initiative which is doing more right now to stimulate interest in and action on aviation biofuels than the FARM to FLY sustainable aviation biofuels initiative, launched by USDA and the aviation industry last year."

In December 2010, the Future of Aviation Advisory Committee (FAAC) endorsed the deployment of sustainable alternative aviation fuels to improve the environmental impact and competitiveness of the U.S. aviation industry, stating that the United States should "exercise strong national leadership to promote and showcase U.S. aviation as a first user of sustainable alternative fuels. This would involve increased coordination and enhancement of the concerted efforts of government and industry to pool resources, overcome key challenges, and will take concrete actions to promote deployment of alternative aviation fuels.

In keeping with these goals, in August 2011, the Obama Administration announced a joint effort by the USDA, the Department of Energy (DOE), and the Department of the Navy to develop and support production facilities for aviation and marine biofuels.

While it is true there are some reports that cast doubts on the potential for advanced aviation biofuels development. Many of these studies are based on outdated information. As noted, look to a special report published in *Biofuels Digest* entitled "RAND Van Winkle: An inside look at RAND's controversial survey of military alternative fuels" on February 3, 2011.[9]

[7] http://biofuelsdigest.com/bdigest/2010/12/29/solazyme-amyris-neste-oil-ceres-and-bunge-among-winners-of-biofuels-digest-awards/

[9] http://biofuelsdigest.com/bdigest/2011/02/03/rand-van-winkle-an-inside-look-at-rands-controversial-survey-of-military-alternative-fuels/

Section II: Findings

Poised for the Future

Coupling the need, interest, and initiative of the pursuit of aviation biofuels by the American aviation industry with the opportunities provided by American agriculture presents a unique opportunity for a sustained biofuels industry. However, Federal Government leadership and assistance are needed to create a bridge to an aviation biofuels industry that can be sustained exclusively by private capital. To secure the future of the industry requires proof of concept—more precisely, proof of commercialization—in the near term. The focused commitment of limited government resources in the near term to support investment in biofuels innovation can help secure a future in which domestic businesses are the primary funders of a large share of commercial-aviation renewable fuel production. The production of environmentally preferred aviation biofuels by U.S. companies will also support the President's goal of dramatically increasing U.S. exports to support our nation's main street rural economy and win the future.

Several years ago, the aviation sector organized itself to take on the role of principal supporter and developer of a sustainable aviation biofuels industry. In 2006, A4A, Aerospace Industries Association (AIA), Airports Council International-North America (ACI-NA), the Boeing Company, and the Federal Aviation Administration (FAA) formed the Commercial Aviation Alternative Fuels Initiative® (CAAFI).[10] The goal of the coalition is to organize and mobilize efforts to successfully address the challenges associated with creating a viable aviation biofuel supply chain, bring alternative aviation fuels to market, and enhance energy security and environmental sustainability for aviation through these fuels. Scores of U.S. companies are now actively planning projects, seeking financing, and building alternative-fuel processing facilities to take advantage of the opportunity to collaborate with the aviation industry and produce significant quantities of alternative jet fuels. There are several fuel technology processes already approved for use, with others in the advanced stages of approval. In addition, the FAA has set an ambitious target of one billion gallons per year of aviation biofuel capacity by 2018, which the CAAFI team believes is achievable if sufficient progress is made in supporting a sustainable supply chain.

Farm to Fly

The FARM to FLY initiative has brought together the U.S. aviation community, government stakeholders, USDA, DOE, Department of Transportation (DOT), and the Department of Defense (DOD) who expressed unified support for the President's goals of environmental stewardship and energy independence. Through a commitment of resources dedicated to research and development, deployment through public-sector leadership and financial incentives to bring production online, this coalition ensures that aviation biofuels will become an economical and environmentally preferred alternative to petroleum-based jet fuels, in the near future. This commitment also includes the creation and implementation of programs and incentives to assist American farmers in the selection and cultivation of energy crops for conversion into affordable and sustainable aviation biofuels.

[10] http://www.caafi.org/

Unlike other supply-side driven alternative-fuel efforts, the aviation-fuel user community is pulling demand for aviation biofuels. The United States can exercise strong global leadership and ensure a prosperous future by creating a strong, viable public-private partnership to accelerate the availability of a commercially viable and sustainable aviation biofuel industry. Making FARM to FLY a model for success to exemplify the nexus between clean-energy innovation and rural development has unified the U.S. aviation community's desire to work with USDA, DOE, and other Federal agencies. With the right policies in place, the American airline industry will become a ready and willing buyer of competitively priced alternative fuels.

Why Commercial Aviation?

The U.S. commercial aviation industry is a key contributor to the American economy, providing more than 5 percent of U.S. gross domestic product and nearly 11 million well-paying American jobs. However, unlike ground transportation, aircrafts cannot fly on batteries, nuclear energy, solar cells, or wind turbines. The aviation industry is completely dependent upon the petroleum-based jet fuel supplied in part by politically unstable nations, subject to significant price swings, and poses significant environmental concerns. These issues have pushed the creation of a viable biobased jet fuel industry to the forefront of strategic importance to the future of the U.S. commercial aviation industry and the U.S. military.

	JET FUEL					AVIATION GASOLINE			TOTAL
FISCAL	U.S. AIR CARRIERS 1/			GENERAL		AIR	GENERAL		FUEL
YEAR	DOMESTIC	INT'L.	TOTAL	AVIATION	TOTAL	CARRIER	AVIATION	TOTAL	CONSUMED
Historical*									
2000	14,746	5,297	20,043	972	21,015	2	333	335	21,350
2005	13,978	5,378	19,356	1,527	20,883	2	295	297	21,180
2006	13,461	5,851	19,313	1,643	20,955	2	283	285	21,241
2007	13,538	6,045	19,583	1,486	21,069	2	274	276	21,344
2008	13,179	6,289	19,468	1,706	21,174	2	248	250	21,424
2009	11,478	5,767	17,244	1,447	18,691	2	227	229	18,921
2010E	11,202	5,869	17,071	1,432	18,503	2	220	222	18,726
Forecast									
2011	11,360	6,270	17,630	1,472	19,103	2	220	222	19,325
2012	11,587	6,451	18,038	1,671	19,709	2	219	221	19,929
2013	11,882	6,665	18,547	1,834	20,381	2	218	220	20,601
2014	12,187	6,905	19,092	1,898	20,991	2	215	217	21,208
2015	12,496	7,157	19,653	1,962	21,615	2	213	215	21,830
2016	12,770	7,412	20,182	2,029	22,211	2	211	213	22,424
2017	13,022	7,666	20,688	2,093	22,781	2	211	213	22,994
2018	13,235	7,918	21,153	2,153	23,306	2	210	212	23,518
2019	13,443	8,175	21,618	2,215	23,833	2	210	212	24,045
2020	13,673	8,438	22,110	2,283	24,393	2	211	213	24,606
2021	13,873	8,709	22,583	2,349	24,931	2	212	214	25,146
2022	14,049	8,992	23,041	2,413	25,454	2	214	216	25,670
2023	14,218	9,280	23,498	2,483	25,981	2	217	219	26,199
2024	14,366	9,575	23,941	2,555	26,497	2	220	222	26,719
2025	14,513	9,883	24,395	2,630	27,026	2	224	226	27,251
2026	14,644	10,193	24,838	2,706	27,544	2	227	229	27,773
2027	14,771	10,508	25,279	2,784	28,062	2	231	233	28,296
2028	14,891	10,825	25,716	2,863	28,578	2	235	237	28,816
2029	15,000	11,146	26,146	2,946	29,092	2	239	241	29,333
2030	15,119	11,480	26,599	3,032	29,631	2	243	245	29,876
2031	15,242	11,818	27,060	3,118	30,178	2	247	249	30,427
Avg Annual Growth									
2000-10	-2.7%	1.0%	-1.6%	4.0%	-1.3%	0.0%	-4.0%	-4.0%	-1.3%
2010-11	1.4%	6.8%	3.3%	2.8%	3.2%	0.0%	0.0%	0.0%	3.2%
2010-20	2.0%	3.7%	2.6%	4.8%	2.8%	0.0%	-0.4%	-0.4%	2.8%
2010-31	1.5%	3.4%	2.2%	3.8%	2.4%	0.0%	0.5%	0.5%	2.3%

Table 1—Jet and Aviation Fuel Consumption

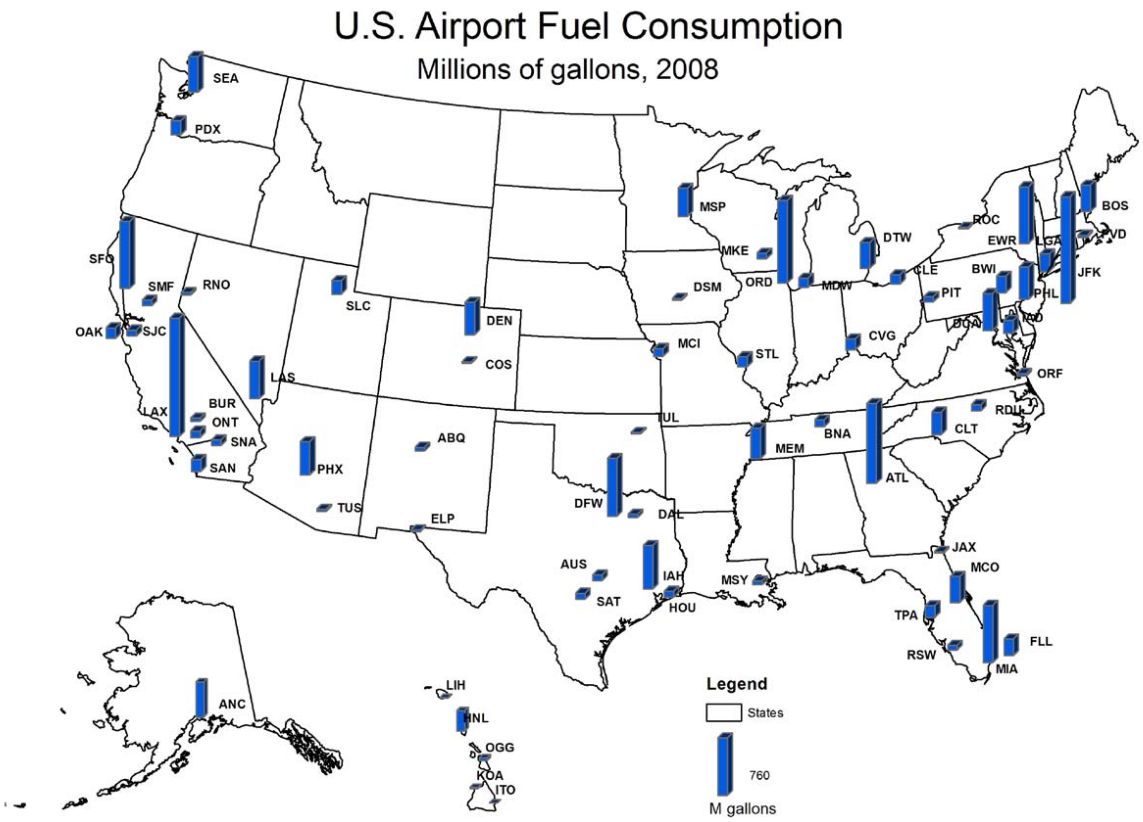
Source: Air carrier jet fuel, Form 41, U.S. Department of Transportation; all others, FAA, APO passenger and cargo carriers estimates [11]

[11] http://www.faa.gov/about/office_org/headquarters_offices/apl/aviation_forecasts/aerospace_forecasts/2011-2031/

President Obama noted that "in the Nation's ongoing efforts to achieve energy independence, biomass and biofuels promise to play a key role in providing the Nation with homegrown sustainable energy options and energizing our economy with new industries and jobs."

In 2010, the U.S. produced approximately 12 billion gallons of biofuels, mostly from corn grain ethanol. However, when compared to investments made in surface transportation fuels like ethanol and biodiesel, government efforts to date have not emphasized research, development, or commercialization of alternative fuels for aviation. This investment difference exists even though aviation biofuel meets the rigorous industry standards for quality and safety, is a complete drop-in substitute for the petroleum-based fuels currently used in aviation, and can use existing fuel transportation and storage infrastructures.

The largest 40 U.S. airports account for more than 90 percent of the jet fuel used by commercial aviation. Thus, if aviation biofuel producers can deliver to these 40 airport "gas stations," they have access to virtually the entire 17-to-19 billion gallon-per-year commercial jet-fuel market.



Map 1—U.S. Airport Fuel Consumption

Source: USDA Agriculture Research Service F2F Case Study[12]

[12] http://www.ars.usda.gov/SP2UserFiles/Program/213/Gardner%20USDA%20ARS%20F2F%20Case%20Study.pdf

These factors were among those recognized by the FAAC in December 2010, when it endorsed the pursuit of sustainable aviation alternative fuels as the first of its 23 recommendations.[13] Responding to the FAAC recommendations, Secretary of Transportation Ray LaHood wrote the following, "I also expect to see a lot of support for the committee's environmental recommendations. The White House is already focused on environmental considerations, and I think they'll find recommendations like increasing the use of sustainable fuels right on target." [13a]

FARM to FLY has emerged as the nation's most promising effort, to date, to promote aviation biofuel development across the Federal Government and in partnership with the private sector. The USDA and DOE are working together with the FAA, DOD, other government agencies, and airlines and aerospace manufacturers, to promote this new industry.

Jets Ready for Advanced Biofuel

Before alternative jet fuel can be approved for commercial use, it must meet rigorous safety and performance standards set out in the applicable specification, which is controlled by ASTM International, an organization devoted to the development and management of standards for a wide range of industrial products and processes. This specification, in turn, is included in FAA product approvals and required air carrier manuals. In 2009, ASTM International approved a jet fuel specification for aviation biofuel (and other synthetic alternatives) made through the Fischer-Tropsch process.[14] In July 2011, the organization approved a second method of aviation biofuel production based on hydroprocessed esters and fatty acids (HEFA).[15]

Both Fischer-Tropsch and HEFA-derived biojet can be produced in the United States using homegrown feedstocks and result in drop-in fuel that is fully interchangeable with traditional jet fuel. The successful conclusion of the specification approval process for these two fuels has paved the way for additional fuels to be examined and approved in the future. In fact, additional fuel pathways, including biofuel made from cellulose, are currently being reviewed by the relevant ASTM subcommittee. In the next few years, a variety of feedstocks and processing methods should be fully approved for "drop-in" jet-fuel use.

The FAA, along with airline engine and airframe manufacturers, recognize ASTM International's authority to designate standards for the definition of "jet fuel" that can be accepted in aircraft that meet FAA certification standards. By meeting ASTM standards for jet fuel, appropriately derived and documented biofuels can enter the jet-fuel market as a substitutable product—fully intermixable and usable without changes to pipelines or storage facilities, and without modifications to engines and aircraft. This means that today's airplanes are "biojet-ready."

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[13] http://www.dot.gov/faac/ and http://www.dot.gov/faac/FAAC_Recommendations.pdf

[13a] http://fastlane.dot.gov/2010/12/future-of-aviation-advisory-committee-delivers-recommendations-for-industrys-future.html

[14] ASTM D7566 - 10a Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons approved in 2009, http://www.astm.org/Standards/D7566.htm

[15] ASTM D7566 - 11 Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons was approved on 1 July, 2011, http://www.astm.org/Standards/D7566.htm

Synergy with the U.S. Military

The U.S. Air Force plans to convert one-half of the petroleum-based jet fuel that it uses to nonpetroleum-based fuel by the year 2016. The U.S. Navy has announced a goal of supplying 50 percent of its total energy consumption from alternative sources by 2020. Other branches of the U.S. military have also implemented robust programs to reach similar goals. Ongoing collaboration and coordination on research, development, fuel approval, and fuel deployment by the commercial aviation industry and the military have resulted in significant mutual benefits and accelerated progress.

The activities of DOD to develop and promote the use of domestically produced fuels are critical to reducing greenhouse gases, creating jobs in rural communities, reversing our trade imbalances, and ensuring America's national security and energy independence. Recognizing the opportunities that aviation biofuel can bring, the U.S. passenger and cargo airline industries are working to stimulate this emerging market. Several U.S. airlines recently committed to negotiate the purchase of renewable jet fuels under multiyear contracts. These airlines are also working within CAAFI® on research, fuel approval, and deployment opportunities. In addition, A4A has entered into a strategic alliance with the Defense Energy Support Center, now known as Defense Logistics Agency-Energy, which is the energy and fuel procurement arm of the U.S military, to pool resources and buying power to send needed market signals. The U.S. military has indicated interest in negotiating multi-year contracts for domestically produced fuels, although current Federal procurement practices limit the military's ability to make commitments beyond an initial 5-year term.

Projects "Waiting in the Wings"

Currently, there are more than 20 second- and third-generation biofuel development projects occurring throughout the United States. These projects utilize a variety of feedstock and process technologies to produce renewable fuels, and several have the potential to produce aviation biofuel. However, these projects need additional funding to support biofuel development in the near term.

The ethanol industry, the Internet, and global positioning system (GPS) may have failed were it not for initial public investments and support. Thanks in part to this support, the success of these industries has exceeded expectations. To grow and maintain the commercialization of the next generation of biofuels, including those that can serve as aviation biofuel, this type of support is needed.

Section III: USDA Programs

America's 21st century energy landscape presents needs that are greater than ever before. We face new challenges to reduce dependence on imported oil, improve the environment, and make clean, sustainable, and affordable energy alternatives available to businesses and agricultural producers.

There are a range of programs that can contribute to the FARM to FLY effort. In this section, we will describe how specific programs and projects are helping accelerate sustainable aviation biofuel production.

USDA Rural Development is helping the agriculture sector to find energy solutions by providing rural residents and communities with access to renewable energy systems and promoting energy efficiency. Rural Development also provides funding opportunities in the form of payments, grants, and loan guarantees for the development and commercialization of renewable energy systems including anaerobic digesters, wind, solar, biomass, and biofuel. By making renewable energy resources commercially available, USDA Rural Development is creating sustainable opportunities for wealth, new jobs, and increased economic activity in rural America. Rural Development is also helping to change the way Americans power their homes, businesses, and industries.

- **Biorefinery Assistance Program (Section 9003) –** Section 9003 provides loan guarantees to viable commercial-scale facilities to develop new and emerging technologies for the development of advanced biofuels from renewable biomass.
- **Rural Energy for America Program (REAP) –** REAP provides grants and loan guarantees to agricultural producers and rural small businesses to complete a variety of projects. The REAP program helps eligible applicants install renewable energy systems, which use a variety of renewable technologies that are proven commercial commercially.
- **Business and Industry Guaranteed Loans (B&I) –** The purpose of the B&I Guaranteed Loan Program is to improve, develop, or finance business, industry, and employment and improve the economic and environmental climate in rural communities. This purpose is achieved by bolstering the existing private credit structure through the guarantee of quality loans which will provide lasting community benefits.

USDA Research and Development Programs focus on improving biomass varieties and production systems to improve the performance of biobased products, including aviation fuels. These programs are supported with intramural research in ARS, the U.S. Forest Service's Research and Development, and competitive peer-reviewed research efforts funded by the National Institute of Food and Agriculture (NIFA).

- **USDA Biomass Research Centers** In response to Growing America's Fuel, USDA established five regional Biomass Research Centers (led by ARS and USFS) to help accelerate the establishment of commercial region-based biofuel supply chains based on agricultural and forestry feedstocks to meet legislated goals and market demand, and enable as many rural areas across the country as possible to participate and benefit economically. The Centers work with industry partners to produce feedstocks with

specific characteristics compatible with conversion technologies that produce energy and other biobased products, using the best natural and workforce capital within different regions.

- **Agricultural Research Service (ARS)** invests in fundamental and applied biological science and technology. Using its nationwide network of 2,000 scientists, it finds ways to produce more with less. ARS' coordinated bioenergy research program aims to enhance the market growth in biofuels through:

  (1) Feedstock Development, to research plant cell wall structure and composition, energy crop germplasm, genomics and genetic resources, crop yield and quality, and environmental and pest tolerance of crops;

  (2) Sustainable Feedstock Production Systems, to estimate sustainable yields of different crop species and varieties in different regions and under different environmental conditions; develop sustainable production methods; develop and expand existing biophysical harvesting, handling, and storage techniques; and identify new on-farm uses for co-products arising from biofuels production systems; and

  (3) Biorefining and Co-products, to develop economically sustainable processes and technologies for conversion of a wide variety of crops and plant materials to biofuels, thermochemical-based technologies to produce bioenergy on or near farms, superior microbial systems for conversion processes, and high-quality biofuels and co-products.

- USDA Provides Assistance to Defense Logistic Agency- (DLA) Energy. ARS, in cooperation with the DOE Office of Energy Efficiency and Renewable Energy, provided technical input about the potential availability of different regional feedstocks and conversion technologies in meetings facilitated by Airlines for America (A4A). The information was used by DLA-Energy to develop a Biofuels Business Case Analysis. This effort supports the Department's Farm to Fly initiative and MOUs with the Department of Navy and the FAA.

- USDA's ARS Supports Regional Oil Seed to Jet Fuel Projects. The USDA's Agricultural Research Service (ARS) has been providing support to business development projects in central California and Oklahoma that are determining the feasibility of region-based jet fuel from biomass production. The commercial partners are being facilitated by ARS researchers and the Office of Technology Transfer (OTT) with participation by the California Association for Local Economic Development (CALED) and Center for Innovation at Arlington Agriculture Technology Innovation Partnership (ATIP) network members. These efforts support the White House Start Up America initiative, the President's Interagency Working Group's Growing America's Fuels report, the USDA-FAA MOU, the Department's Farm to Fly initiative. Research through the USDA

Biomass Research Centers is supported by the Navy Office of Naval Research under the USDA-Navy MOU.

- Future Navy Fuels from Hawaii, a public and private partnership in Hawaii led by USDA-ARS has been designed to establish commercial production of advanced biofuels for use by the Navy. The USDA's ARS, Department of the Navy's Office of Naval Research, and the University of Hawaii have formed a research and development partnership with Hawaiian Commercial & Sugar (HC&S) Company on Maui, along with involvement from the DOE, to develop the most sustainable opportunities for producing advanced biofuels and renewable electricity from sugarcane and other biomass crops.

- **US Forest Service (FS) Biobased Products and Bioenergy Research Program** helps provide the science and technology to sustainably produce, manage, harvest, and convert woody biomass to liquid transportation fuels, chemicals, and other high-value products. Woody biomass is a critical renewable resource that has the potential to supply a significant portion of liquid transportation fuels, chemicals, and substitutes for fossil fuel-intensive products. Woody biomass utilization helps offset treatment costs, can offset fossil fuel use, and promotes sustainable economies. Converting this material into energy and biobased products provides numerous benefits including improved forest health and productivity and economic opportunities for rural America. Sustainable development of a healthy bioenergy/biobased products economic sector is dependent on rapid research and development progress.

  The FS R&D Bioenergy and Biobased Products Strategic Direction can be accessed online at: http://www.fs.fed.us/research/pdf/RD_Bioenergy_Strategy_March_2010.pdf.

  Critical areas of research for USFS include:
  - Sustainable and economical forest biomass management and production systems
  - Biofuels and biobased products that displace petroleum-based products
  - Information and tools for decision-making and policy analysis.

- **National Institute of Food and Agriculture (NIFA)**: The *2008 Farm Bill* created the National Institute of Food and Agriculture, to fund competitive, peer-reviewed research efforts. For example:

  - Biomass Research and Development Initiative makes funds available for uses that include advanced research on feedstock development, biofuels, and biobased product development, and biofuels development analysis.

  - Agriculture and Food Research Initiative (AFRI): NIFA offers a series of sustainable bioenergy grants targeting the development of regional systems for the sustainable production of products that: contribute significantly to reducing dependence on foreign oil; have net positive social, environmental, and rural economic impacts; and are compatible with existing agricultural systems. This

priority focuses on biological, chemical, and thermochemical processes to produce valuable co-products and industrial polymers.

- Plant Feedstock Genomics for Bioenergy: USDA and the U.S. DOE will provide resources to fund research projects focused on improving the efficiency and cost-effectiveness of various energy crops for biofuel production. The projects will utilize the most advanced genomics techniques to develop breeding strategies that will improve the potential for energy crops grown on marginal lands while still increasing their yield and quality.

USDA's Office of the Chief Economist: The Office of the Chief Economist (OCE) advises the Secretary on the economic implications of policies and programs affecting the U.S. food and fiber system and rural areas as well as coordinates, reviews, and approves the Department's commodity and farm sector forecasts. The office also has responsibility for the Office of Energy Policy and New Uses (OEPNU). Office of Energy Policy and New Uses assists in developing and coordinating Departmental energy policy, programs, and strategies. Research is currently underway on biodiesel fuels, ethanol fuels, and other sources of biomass energy.

National Agricultural Statistics Service (NASS) and Economic Research Service (ERS) are critical to the success of the FARM to FLY initiative providing information and economic analyses to understand the status and economic feasibility of the biofuel production. NASS currently coordinates with USDA's other agencies (both research and implementation) to ensure that they collect the correct statistics (including data on agricultural productivity, management methods, producer demographics, etc.) to support their programs. Similarly, the Economic Research Service and the Office of the Chief Economist conduct analyses using NASS data and data from elsewhere to inform decisions made by a variety of stakeholders.

NASS conducts hundreds of surveys every year and prepares reports covering virtually every aspect of U.S. agriculture. Production and supplies of food and fiber, prices paid and received by farmers, farm labor and wages, farm finances, chemical use, and changes in the demographics of U.S. producers are only a few examples.

The Economic Research Service (ERS) is a primary source of economic information and research in the U.S. Department of Agriculture. ERS conducts research programs that inform public and private decision makers on economic and policy issues involving food, farming, natural resources, and rural development.

USDA Biomass and Risk Assessment Programs

- **The Biomass Crop Assistance Program (BCAP) –** Administered by the USDA Farm Service Agency (FSA), BCAP provides financial assistance to owners and operators of agricultural and non-industrial private forestland who wish to establish, produce, and deliver biomass feedstocks. Although funding for new projects and transactions has been severely limited by recent appropriations legislation, to the extent that funding is available, the program can provide two categories of assistance:

- Matching payments may be available for the delivery of eligible material to qualified biomass conversion facilities by eligible material owners.
- Establishment and annual payments to produce eligible biomass crops on contract acres within BCAP project areas.

- **USDA Risk Management Agency Energy Crop Feasibility Study** – Energy crops have tremendous potential to reduce our dependence on foreign oil and create jobs in rural America. USDA's Risk Management Agency (RMA) is expanding its efforts to develop new insurance products for the producers of renewable, clean energy crops grown in the United States. Research has been completed for energy cane, switchgrass, and camelina produced as a biofuel feedstock.

Specific Investments Under USDA Programs

USDA and DOE Biomass Genomics Research Projects Summaries

On August 11, 2011, Secretary of Agriculture Vilsack announced that the USDA and the U.S. DOE will provide $12.2 million to fund 10 research projects focused on improving the efficiency and cost-effectiveness of various energy crops for biofuel production. The projects will utilize the most advanced genomics techniques to develop breeding strategies that will improve the potential for energy crops grown on marginal lands while still increasing their yield and quality.

The DOE's Office of Science is providing $10.2 million for eight of the projects while the USDA's National Institute of Food and Agriculture (NIFA) will provide $2 million for two projects. The funding will support three years of research. Outlines of the 10 research projects are on the DOE's Office of Science Genomic Science Program Web site.[7]

- University of South Carolina – Columbia, South Carolina

GENOMIC AND BREEDING FOUNDATIONS FOR BIOENERGY SORGHUM HYBRIDS

Goal: Build the germplasm, breeding, genetic, and genomic foundations necessary to optimize cellulosic sorghum as a bioenergy feedstock. This project will facilitate breeding sorghum lines optimized for energy production and selected to maximize energy accumulation per unit time, land area, and/or production input.

- Kansas State University – Manhattan, Kansas

SORGHUM BIOMASS GENOMICS AND PHENOMICS

Goal: Integrate key genomics-assisted approaches into biomass sorghum research, and combine with high-throughput and traditional field-based phenotyping methods to enable advanced breeding strategies. By both exploiting genetic diversity and understanding the genotype-phenotype relationship, predictive approaches for efficient and cost-effective breeding can be developed.

- University of Oklahoma - Norman, Oklahoma

ASSOCIATION MAPPING OF CELL WALL SYNTHESIS REGULATORY GENES AND CELL WALL QUALITY IN SWITCHGRASS

Goal: Identify natural genetic variation in switchgrass that correlates with lignocellulose-to-biofuel conversion qualities. Most plant dry matter is composed of lignocellulose, and because switchgrass yields high amounts of this material and tolerates drought and other stresses it is an attractive candidate for development into a biofuel crop. This project should enhance

[7] http://genomicscience.energy.gov/research/DOEUSDA/2011awards.shtml#page=news

understanding of the qualities that critically impact the conversion efficiency of lignocellulose into biofuels.

- Virginia Polytechnic and State University - Blacksburg, Virginia

FUNCTIONAL INTERACTOMICS: DETERMINING THE ROLES PLAYED BY MEMBERS OF THE POPLAR BIOMASS PROTEIN-PROTEIN INTERACTOME

Goal: Identify key interactions between proteins associated with wood formation in poplar, a woody biomass crop. Wood characteristics result from the coordinated actions of enzymes and structural proteins in the cells, which typically interact with other proteins to perform their roles. This project will uncover the potential of the biomass protein-protein interactome to contribute to the development of poplar trees with superior biomass feedstock potential.

- University of Missouri – Columbia, Missouri

FUNCTIONAL GENOMICS OF SUGAR CONTENT IN SWEET SORGHUM STEMS

Goal: Improve sucrose accumulation in sweet sorghum through investigating the mechanisms regulating carbon allocation to stems. A rapidly growing, widely adaptable crop, sweet sorghum accumulates in the stem high concentrations of sucrose that can be efficiently converted to ethanol, making this a valuable candidate for bioenergy feedstock. This research will use a combination of approaches to identify bioenergy relevant genes and to understand their functions in carbon partitioning in sweet sorghum.

- University of California Davis - Davis California

CREATION AND HIGH-PRECISION CHARACTERIZATION OF NOVEL POPULUS BIOMASS GERMPLASM

Goal: Provide new genomic tools for poplar breeders to identify germplasm with unique genotypes and increased biomass yields, and develop techniques for creating poplar hybrids with unique combinations of chromosomal regions. Because such properties can confer faster growth, this project addresses a challenge posed by the long generation time of trees through fast and cost-effective nontransgenic genetic manipulation.

- Colorado State University - Fort Collins, Colorado

AN INTEGRATED APPROACH TO IMPROVING PLANT BIOMASS PRODUCTION

Goal: Expedite discovery of genes controlling biomass productivity in switchgrass by leveraging results from rice, a well-studied model grass. Switchgrass and other perennial grasses are promising candidates for bioenergy feedstocks; however, the genetic resources necessary to develop these species are currently limited. This work will greatly expand the research toolbox for switchgrass and advance its improvement as an energy crop.

- Plant Science Center - St. Louis, Missouri

MODULATION OF PHYTOCHROME SIGNALING NETWORKS FOR IMPROVED BIOMASS ACCUMULATION USING A BIOENERGY CROP MODEL

Goal: Identify genes involved in light perception and signaling in the model grass Brachypodium distachyon to increase yield and improve the composition of bioenergy grasses. The light environment affects plant growth and development, and biomass accumulation. Finding key genes involved in modulating light perception could be useful in targeted breeding or engineering efforts for improved bioenergy grass crops.

- University of Illinois at Urbana – Champaign, Illinois

QUANTIFYING PHENOTYPIC AND GENETIC DIVERSITY OF MISCANTHUS SINENSIS AS A RESOURCE FOR KNOWLEDGE-BASED IMPROVEMENT OF M. X GIGANTEUS (M. SINENSIS X M. SACCHARIFLORUS)

Goal: Facilitate development of Miscanthus as a bioenergy crop by acquisition of fundamental information about genetic diversity and environmental adaptation. Miscanthus is among the most promising cellulosic biofuel crops, but its improvement as a feedstock will require a broader genetic base. Identification of molecular markers associated with traits of interest will improve Miscanthus breeding efforts.

- University of Florida – Gainesville, Florida

DISCOVERING THE DESIRABLE ALLELES CONTRIBUTING TO THE LIGNOCELLULOSIC BIOMASS TRAITS IN SACCHARUM GERMPLASM COLLECTIONS FOR ENERGY CANE IMPROVEMENT

Goal: Improve energy cane by identifying the genetic components contributing to biomass production. Energy cane (Saccharum complex hybrids) holds great potential as a bioenergy feedstock in the southern United States. The project will produce foundational genetic resources allowing energy cane breeders to develop cultivars with increased biomass production and reduced input requirements efficiently.

NIFA Project Summaries

The following is a summary of 15 projects that address the research and development of jet fuels. Most of the projects highlighted do not have jet fuel as the specific objective, but as a potential product.

- University of Kentucky, Plant and Soil Sciences - Lexington, Kentucky

ENGINEERING HIGH-VALUE OIL PRODUCTION INTO BIOFUEL CROPS

NON-TECHNICAL SUMMARY: We are proposing to engineer optimized production of long, branched-chain hydrocarbon biosynthesis into plants suitable as biofuel crops. Branched chain hydrocarbons, like methylated triterpenes, are readily cracked into paraffins and naphthenes that can either be distilled to combustible fuels (gasoline, jet fuel, and diesel), or can be used directly for the synthesis of plastics, nylons, paints, and other oil-derived products manufactured by diverse chemical industries.

- University of California - Davis, California

CO-PRODUCTION OF GLUCONIC ACID AND ISOBUTANOL FROM CELLULOSIC BIOMASS CO-PRODUCTION

NON-TECHNICAL SUMMARY: Here we propose a novel route for converting cellulosic biomass to isobutanol and gluconate. The overall goal of this project is to develop the new route for co-production of isobutanol and gluconate using poplar as the feedstock. The project goal will be addressed using the following objectives: (1) construction and characterization of the engineered N. crassa strains; (2) construction and characterization of the engineered E. coli strains; (3) development of an aerobic fermentation process for producing calcium oligosaccharide aldonates; and (4) development of an anaerobic fermentation process for producing isobutanol and gluconate.

- University of Minnesota, Bioproducts & Biosystems Engineering - St. Paul, Minnesota

DEVELOPMENT AND ASSESSMENT OF TURPENTINE AS A BIOFUEL FOR AVIATION

NON-TECHNICAL SUMMARY: There are several research efforts underway (NREL, 2006) that are testing the use of bioaviation fuels derived from algae. The drawback of this route is the fact that the oils have to be separated from the algae and the large volumes of water required for algal fuel cropping. The use of turpentine-derived fuels has not been investigated, which is surprising given the similarities between kerosene and turpentine. Naval Stores harvesting and production studies were carried out by the USFS and reported by Zinkel and Russell (1989).

- Mississippi State University, Forest and Wildlife Research Center - Mississippi State, Mississippi

PRODUCTION OF HYDROCARBONS FROM BIO-OILS PRODUCED FROM WOOD

NON-TECHNICAL SUMMARY: Bio-oil upgrading to a hydrocarbon mix is a potential route to high-quality hydrocarbons that can be distilled to gasoline, diesel, or jet fuel and blended in current petroleum products. Bio-oil can be produced at 65 percent or greater yield from wood and upgraded by hydrodeoxygenation (HDO) to a water-clear hydrocarbon mix with properties that will allow combustion in current engines. Bio-oils will be produced with the MSU auger pyrolysis reactor from various wood types. Hydrodeoxygenation will be performed with various catalysts to produce a hydrocarbon mix. Catalysts will be tested for selectivity to produce a higher proportion of gasoline or diesel or jet fuel depending on user needs. Both batch and

continuous hydrotreaters will be employed. Standard petroleum hydrocarbon tests will be performed to determine hydrocarbon quality.

- Wayne State University, Center for Renewable Transportation Fuel - Detroit, Michigan

PRODUCTION OF BIOFUELS FROM PLANT-DERIVED BIOMASS

Our ultimate goal is to develop a sustainable algal system for photosynthetic production of hydrocarbons and their conversion to biofuels that can be used in existing national infrastructure and transportation systems. Sustainable energy production has become a high priority in addressing the economic and strategic impacts of limited fossil fuel resources. Moreover, fossil fuel consumption has taken a toll on the environment and global climate.

- Velocys, Inc. - Plain City, Ohio

IMPROVING BIOREFINERY ECONOMICS THROUGH MICROCHANNEL HYDROPROCESSING

NON-TECHNICAL SUMMARY: The goal of the project is to develop novel cost-effective hydroprocessing reactor technology, a key unit operation in the production of biofuels and biobased chemicals. The core technology advances being pursued to achieve process intensification of hydroprocessing are in the field of microchannel reactor technology.

- Texas A&M University, Biological & Agricultural Engineering - College Station, Texas

NANOSCALE BIOLOGICAL ENGINEERING APPROACHES FOR BIORENEWABLE MATERIAL CONVERSION TO ENERGY

NON-TECHNICAL SUMMARY: Successful development of biomass (terrestrial and aquatic) based biofuels-production processes require a focused effort to resolve key challenges associated with feedstock separation, upgrading, and conversion. The overall focus of the research program is to produce conventional liquid fuels that include gasoline, diesel and jet fuel.

- University of North Dakota - Grand Forks, North Dakota

BIOBASED POLYMERIC MATERIALS FROM CRACKED CANOLA OIL

NON-TECHNICAL SUMMARY: This project focuses on the development of methods to produce several plastic materials from crop oils, rather than from petroleum or natural gas. Using a process called catalytic cracking, we will convert canola oil into a mixture of chemicals, which will be separated into its individual components. The components will be used to produce kerosene-type fuels and specialty fuel additives. This integration of fuel and polymer production will increase operational efficiencies and make these products cost competitive with their petroleum-based equivalents.

- South Dakota State University, Biology & Microbiology - Brookings, South Dakota

IMPROVING THE PERFORMANCE OF CYANOBACTERIA ENGINEERED TO PRODUCE THIRD GENERATION BIOFUELS

NON-TECHNICAL SUMMARY: We propose production of infrastructure-compatible, third generation biofuels such as green gasoline, diesel, and aviation fuel, using glucose or carbon dioxide as the feedstocks.

- Washington State University, Institute of Biological Chemistry - Pullman, Washington

PRODUCT DIVERSIFICATION STRATEGIES FOR A NEW GENERATION OF BIOFUELS/BIOPRODUCTS

NON-TECHNICAL SUMMARY: DOE was recently directed by Congress to identify technology to produce biofuel annually (e.g. 60 billion gallons of bioethanol) to replace 30 percent of petroleum-derived gasoline by 2030. The work proposed offers utilization of renewable biomass resources, whether of agricultural and/or forestry origin.

- Washington State University, Sun Grant Initiative - Pullman, Washington

NON-TECHNICAL SUMMARY: Through leadership provided by Washington State University, the Sun Grant Initiative has been involved in the development of the Farm to Fly initiative from its inception. With funding support from NIFA, the Sun Grant Initiative has selected peer-reviewed projects targeted to the development of oil crops for use in the production of aviation fuels that will be supportive of the Farm to Fly goals.

- Ohio State University, Animal Sciences - Wooster, Ohio

PRODUCTION OF BUTANOL FROM LIGNOCELLULOSICS

NON-TECHNICAL SUMMARY: Butanol is an important chemical with many applications such as adhesives/scalants, industrial coatings, surface coatings, fibers, paints, paint thinners, hard-surface cleaners, plastics, resins, hydraulic and brake fluids, leather and paper finishing, alkaloids, flocculants, super absorbents, camphor, emulsifiers, deicing fluid, dental products, detergents, elastomers, and textiles. In addition, butanol is potential fuel extender for both auto and aviation fuels.

- Texas A&M University, Biological & Agricultural Engineering - College Station, Texas

ADVANCED BIOENERGY AND ENVIRONMENTAL QUALITY RESEARCH FOR SUSTAINABLE AGRICULTURE

NON-TECHNICAL SUMMARY: The goal of this research work is to focus on researchable aspects of biofuels that have the potential to play a larger role in the future economy of the United States. The leading biofuel candidate in the U.S. today is ethanol. The research studies

outlined in this proposal will build on a solid science-based approach in all aspects of biofuels production and environmental quality to address the needs of biorefineries in the future.

- Texas A&M University, Texas Engineering Experiment Station - College Station, Texas

DEMONSTRATION OF THE COMMERCIAL FEASIBILITY OF ANAEROBIC FERMENTATION FOR THE PRODUCTION OF ACID SALTS AND THEIR CONVERSION TO KETONES

NON-TECHNICAL SUMMARY: The MixAlco process produces fuels and industrial chemicals from biodegradable wastes, such as manure, agricultural residues, and residues from alcohol production facilities. The focus of this particularly study is to produce ketones, which are commonly used as industrial solvents. Alternatively, the ketones can be chemically converted into alcohol or hydrocarbon fuels. The ultimate objective is to perfect the process both technically and economically. This involves studies at both the demonstration scale (tonnage quantities) and laboratory scale (gram quantities).

- Gevo, Inc. - Englewood, Colorado

CELLULOSIC ISOBUTANOL FERMENTATION BIOCATALYST: Alcohol-to-Fuels

NON-TECHNICAL SUMMARY: Increasing utilization of renewable feedstocks such as cellulosic biomass to produce transportation fuels and industrial chemicals will be a significant factor in efforts to reduce the world's consumption of non-renewable oil. Gevo is proposing to develop a novel process that will produce isobutanol from cellulosic biomass feedstocks efficiently. The hydrocarbon fuels and chemicals produced from isobutanol are exact replacements of petrochemicals. Fuels made from isobutanol will fit exactly into existing production, storage, and distribution infrastructure maximizing the environmental benefits and reducing costs to refiners. These attributes make isobutanol a highly advantageous biofuel.

2010 USDA-NIFA-AFRI Regional Approaches to Sustainable Bioenergy Systems Coordinated Agricultural Projects (CAP) (A6101)

Numbers in Brief – Proposals:

- 63 Letters of Intent
- 37 Full Proposals, 30 Accepted for Review
- All states except Alaska , Massachusetts, New Hampshire, Rhode Island, and Wyoming

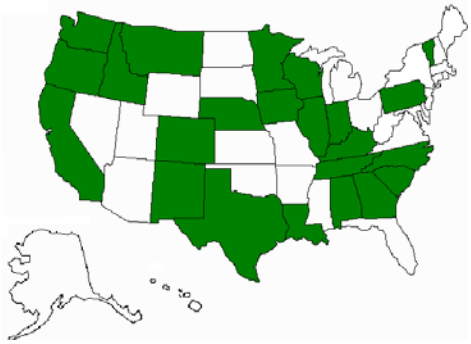
Institutions included in Funded Partnerships:

- 23 States
- 28 Land-Grant Universities (including 5 minority-serving institutions)
- 4 Non Land-Grant Public Universities
- 1 Private Non-Profit
- 9 Federal Partnerships
- 11 Industrial Partnerships

Reviewed Proposal Funding Summary:

	Applications	Funded
Number:	30	5
Requesting:	$1,218,507,361	$136,143,166

State Participation in CAP Proposals



State Participation in Funded CAP Projects

Review Summary – All funded grants

Phase I Panels	Number of Proposals:	Percent:
Outstanding	0	0.0%
High Priority	14	46.7%
Medium Priority	11	36.7%
Low Priority	5	16.7%
TOTAL	30	100.0%

Phase II Panels	Number of Proposals:	Percent:
Outstanding	2	25.00%
High Priority	3	37.50%
Medium Priority	3	37.50%
Low Priority	0	0.00%
% Funded of Phase II Proposals:		
TOTAL	8	62.5%

Percent Success of All Proposals: 17 percent

Coordinated Agricultural Project (CAP) Feedstocks:

Gustafson, University of Washington:	Poplar / Alder
Lewis, Washington State University:	Douglas Fir / Western Red Hemlock Poplar / Alder
Moore, Iowa State University:	Switchgrass, Big Bluestem, Indian grass
Kochergin, Louisiana State University:	Sweet Sorghum, Energy Cane
Rials, University of Tennessee:	Switchgrass, Pine, Eucalyptus

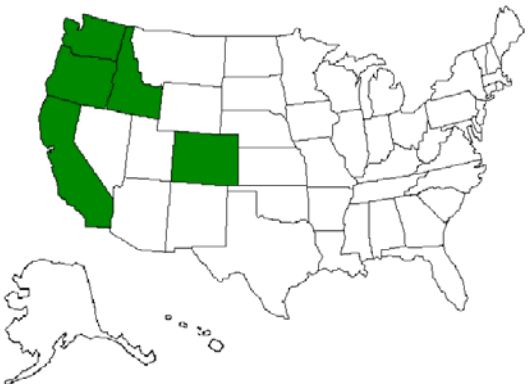
Proposal 2010-05080

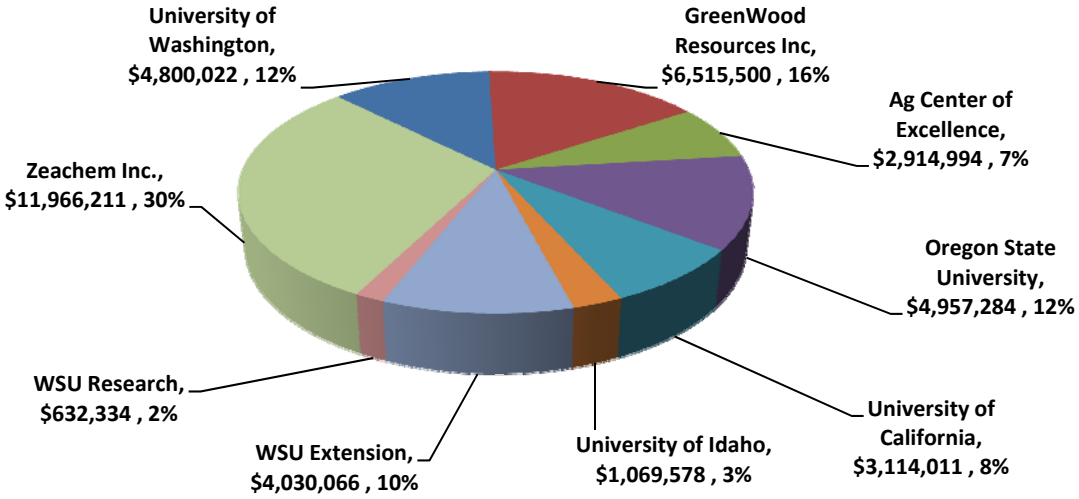
System for Advanced Biofuels Production from Woody Biomass in the Pacific Northwest

Principal Investigator: University of Washington, $40,000,000 (5 years)

Numbers in Brief: 27 Key Personnel from five Universities, a Community College Consortium, and two Industrial Partners from five States:

WA: University of Washington ($4,800,022)
Washington State University Extension ($4,030,066)
Agriculture Center of Excellence – Consortium of Community Colleges ($2,914,994)
Washington State University ($632,334)
OR: GreenWood Resources ($6,515,500)
Oregon State University ($4,957,284)
ZeaChem Inc. ($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

- Commercial Tree Farm Development starting with four complexes of fuel plants and elite hybrid poplar energy farms, and two 100-acre demonstration plantations to establish intercropped poplar/alder farming methods to assess site quality, optimize yields, operating costs, harvesting and processing technology and environmental impacts.
- Classical hybridization methods will be used to improve crop adaptability on marginal lands for low impact silvicultural methods, using nitrogen-fixing endophytes to increase water efficiency and disease resistance of poplar.
- In combination with a USDA Biotechnology Risk Assessment Grant (BRAG), Greenwood will assess the sterility of transformed poplar subjected to basic zinc finger mutagenesis (ZFN) RNAi knock-outs of the LEAFY and AGAMOUS genes in poplar under accelerated flowering conditions in the laboratory. If successful, experiments to increase the efficiency of ZFN mutation will lead to field testing of a commercial genotype.
- Conduct NIR Screening and insect challenge tests to characterize defensive compounds in hybrid poplar for the development of NIR-models to screen hybrid offspring for wood chemical composition and defensive phytochemicals.
- Field trials of harvesting, processing, densification, and storage equipment on upland sites to optimize equipment for use on sloped terrain.
- Expand the functionality of the 10 ton/day Boardman plant to include 100% infrastructure compatible hydrocarbon fuel blend stocks from biomass resources to produce the first 8,000 gallon truck load of jet/diesel and gasoline.
- 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.
- Washington State University and Greenwood will coordinate a rigorous stakeholder outreach program to educate landowners and land managers.
- Regional K-12 and college (university and community college) curricula will be developed to foster workforce development opportunities across the supply chain.

Proposal 2010-05066

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

Principal Investigator: Washington State University, $40,000,000 (5 years)

Numbers in Brief

Forty-one key personnel representing nine Universities, three Federal Partners, and four Industrial Partners from nine States:

WA: Washington State University (WSU) ($13,016,111)
University of Washington ($3,642,727)
Weyerhaeuser ($4,819,602)
Catchlight Energy (Unpaid)

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)

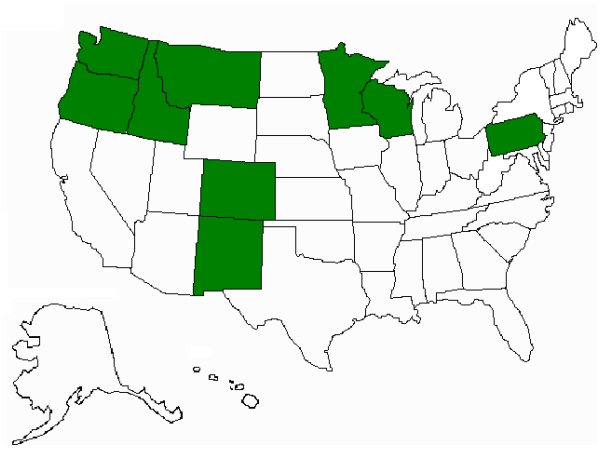
WI: USDA-USFS- Forest Products Laboratory ($1,125,509)

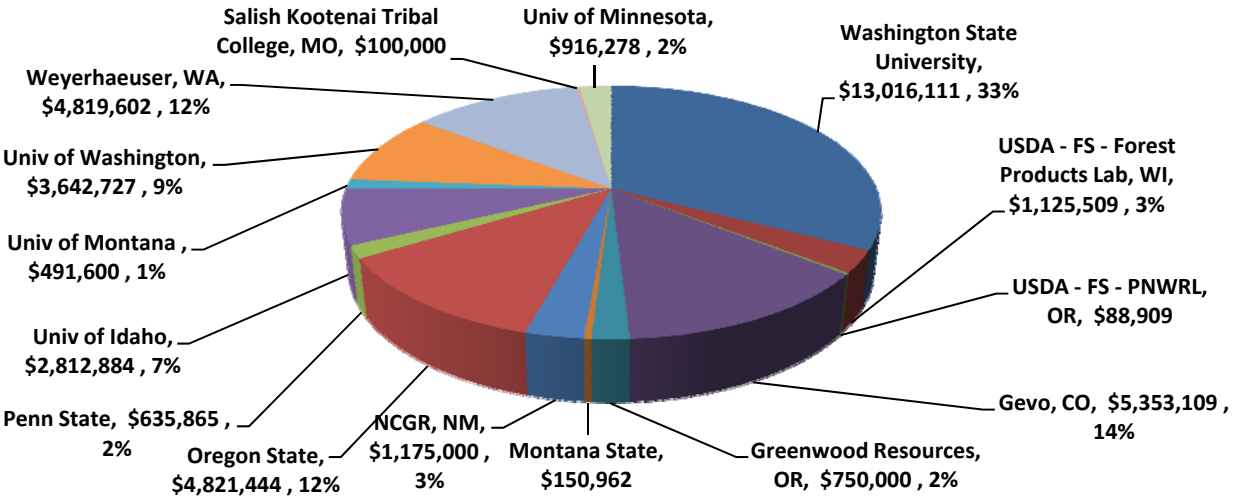
MT: University of Montana ($591,600)
Montana State University ($150,962)
Salish Kootenai Tribal College ($100,000)

CO: GEVO ($5,353,109)

MN: University of Minnesota ($916,278)

PA: Penn State University ($635,865)





CAP Outcomes

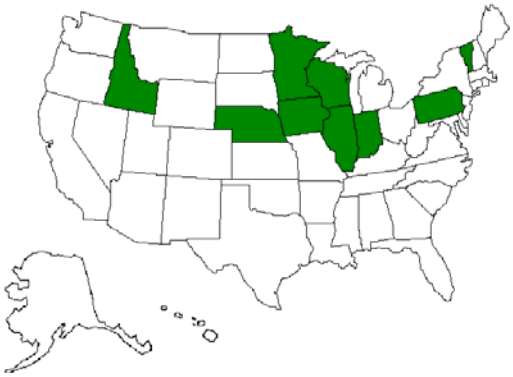
Northwest Advanced Renewables Alliance (NARA): A New Vista for Green Fuels, Chemicals, and Environmentally Preferred Products (EPPs) has been created to both address and develop regional sustainable solutions for aviation fuel and key petrochemical replacements from sustainable woody-based resources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

- The project will develop and improve Douglas-fir/Western red hemlock and poplar/red alder for aviation fuel and bioproduct production.
- The integrated effort will evaluate sustainable forestry techniques and logistics to produce and move wood materials 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.
- The effort will also evaluate the potential of various hardwood lines for plantation culture and as starting materials for aviation fuel and polymer replacements.
- 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 bioaviation 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.
- Staff will develop comprehensive biofuels literacy programs for citizens from the K-12 through university level and move them into the workforce. 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) will be supporting this near-term effort with research and technology aimed at long-term sustainability of the industry.

Agro-ecosystem Approach to Sustainable Biofuels Production Via the Pyrolysis-Biochar Platform (AFRI-CAP)

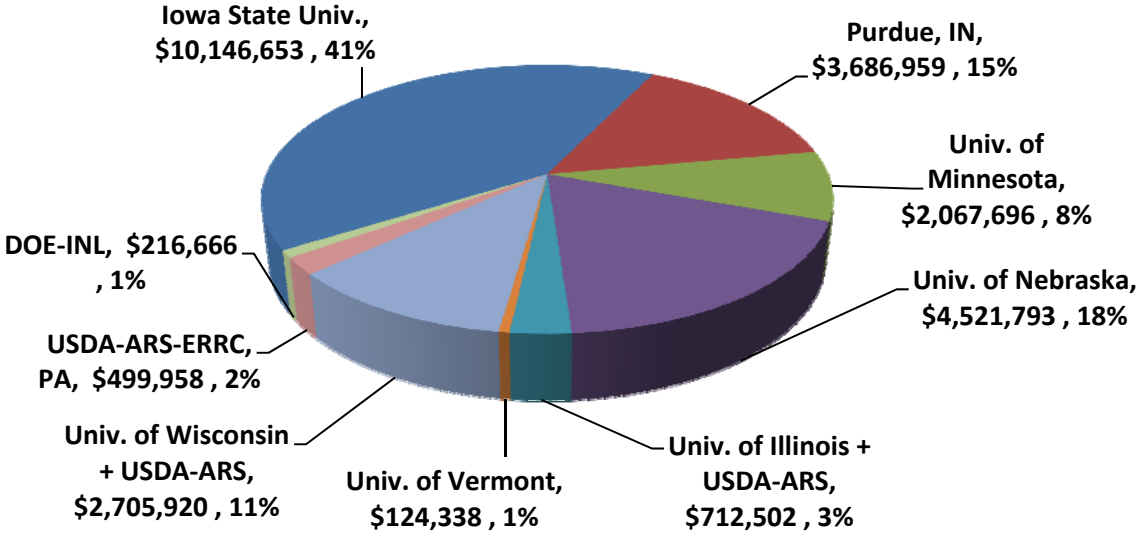


Principal Investigator: Iowa State University of Science & Technology, $25,000,000 (5 years)

Numbers in Brief: 19 Key Personnel from seven 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)
NE: Univ. of Nebraska ($1,916,143)
WI: Univ. of Wisconsin ($1,063,458)
VT: Univ. of Vermont ($124,338)
WI: USDA - ARS Madison ($1,642,462)
NE: USDA - ARS Lincoln ($2,605,650)
IL: Univ. of Illinois ($211,232)
USDA - ARS Peoria ($501,270)
ID: DOE Idaho National Lab ($216,666)
PA: USDA – ARS- Wyndmoor ($499,958)

Advisory Board Members:
CO: The Keystone Center (Unpaid)
IA: Iowa Farm Bureau Federation (Unpaid)
IA: Vermeer Corporation (Unpaid)
IL: Archer Daniels Midland (Unpaid)
USDA – NRCS (Unpaid)
KS: ICM, Inc. (Unpaid)
NE: Stock Seed Farms (Unpaid)
NE: State of Nebraska - Nebraska Game & Parks Commission (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 lifecycle analysis (LCA) methods coupled with the opportunity cost of land, evaluate systemwide greenhouse gas impacts of alternative production systems.
- Deliver science-based knowledge and informal education programs to 4-H and Future Farmers of America 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 develop 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.

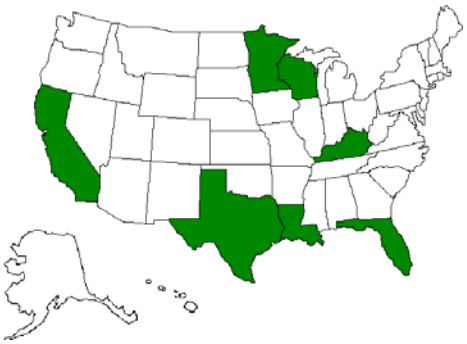
Proposal 2010-05069

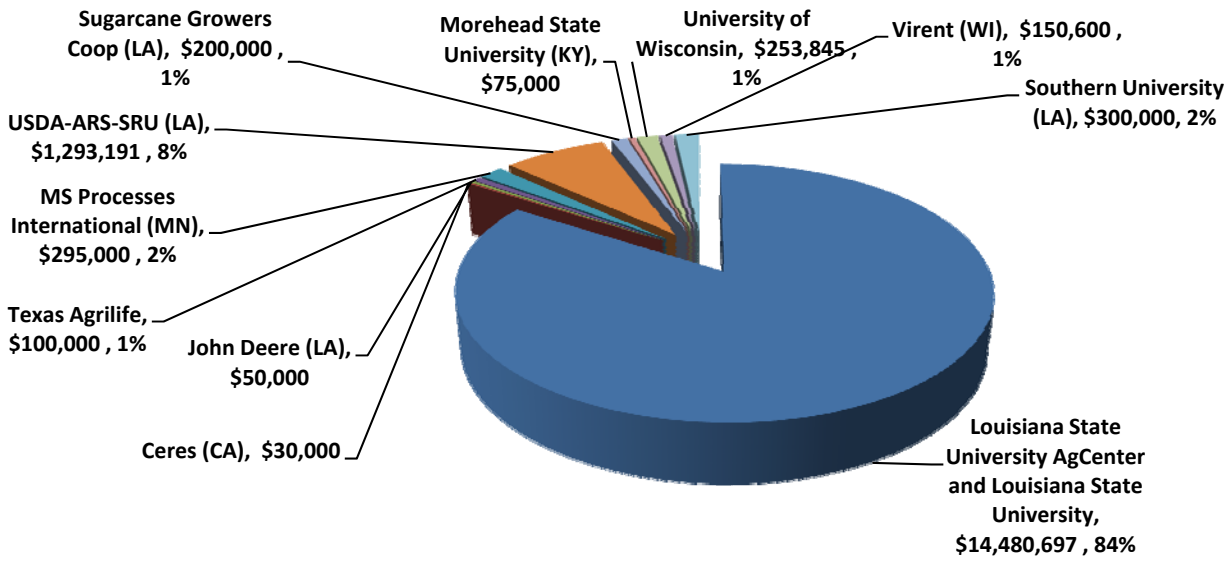
A Regional Program for Production of Multiple Agricultural Feedstocks and Processing to Biofuels and Biobased Chemicals

Principal Investigator: Louisiana State University Agricultural Center, $17,228,335 (5 years)

Numbers in Brief: 37 Total Key Personnel from five Universities, one Federal Partner, and seven Industry Partners in seven 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 biobased fuels and chemicals.

Louisiana State University 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 state-of-the-art processing technologies to demonstrate butanol, gasoline, isoprene, and specialty chemicals.

- Development of regionally appropriate business-marketing models that integrate biobased 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.

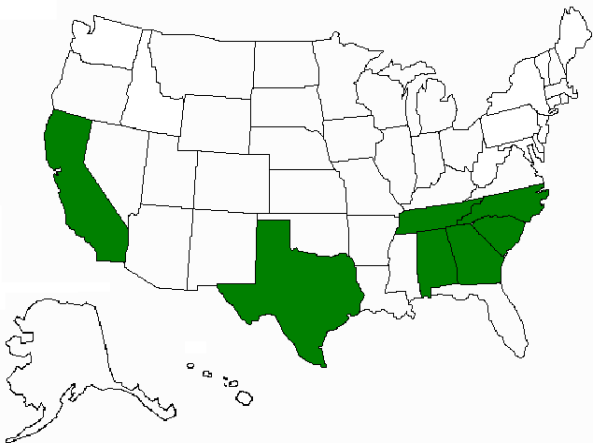
Proposal 2010-05061

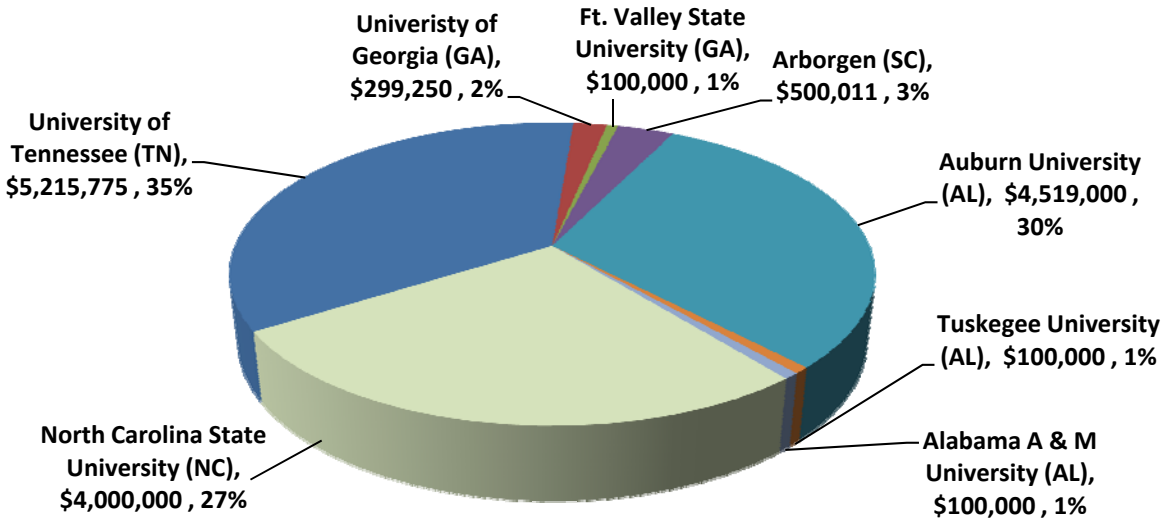
Southeast Partnership for Integrated Biomass Supply Systems

Principal Investigator: University of Tennessee, $15,000,000 (5 years)

Numbers in Brief: 48 Total Key Personnel from four Universities, and four Industrial Partners located across seven 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)
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 combined heat and power 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.

USDA Commercial Programs

Biorefinery Assistance Program

The Biorefinery Assistance Program provides loan guarantees to viable commercial-scale facilities to develop new and emerging technologies for the development of advanced biofuels from renewable biomass.

- Project Summary: Sapphire Energy

USDA issued a loan guarantee, which will support the construction of a facility in New Mexico to produce "green crude" oil from algae, which will be refined into transportation fuel. The project intends to advance American efforts to provide renewable, commercial-scale biofuels, increasing energy security and reducing dependence on foreign oil. The project is expected to create 60 jobs in the community of Columbus, New Mexico, with the overall goal of demonstrating that algal oil to biofuel process scales with favorable economics.

The guaranteed loan recipient, Sapphire Energy, Inc., will design, build, and operate a $135 million integrated algal biorefinery (IABR) for the production of advanced biofuel that functions as a "drop-in" replacement for petroleum-derived diesel and jet fuel. The IABR will be capable of producing 100 barrels of refined algal oil per day, equivalent to over one million gallons per year of finished fuel product. The oil will be shipped to the United States Gulf Coast to be refined by Sapphire's refinery partner, Dynamic Fuels, located in Geismar, Louisiana.

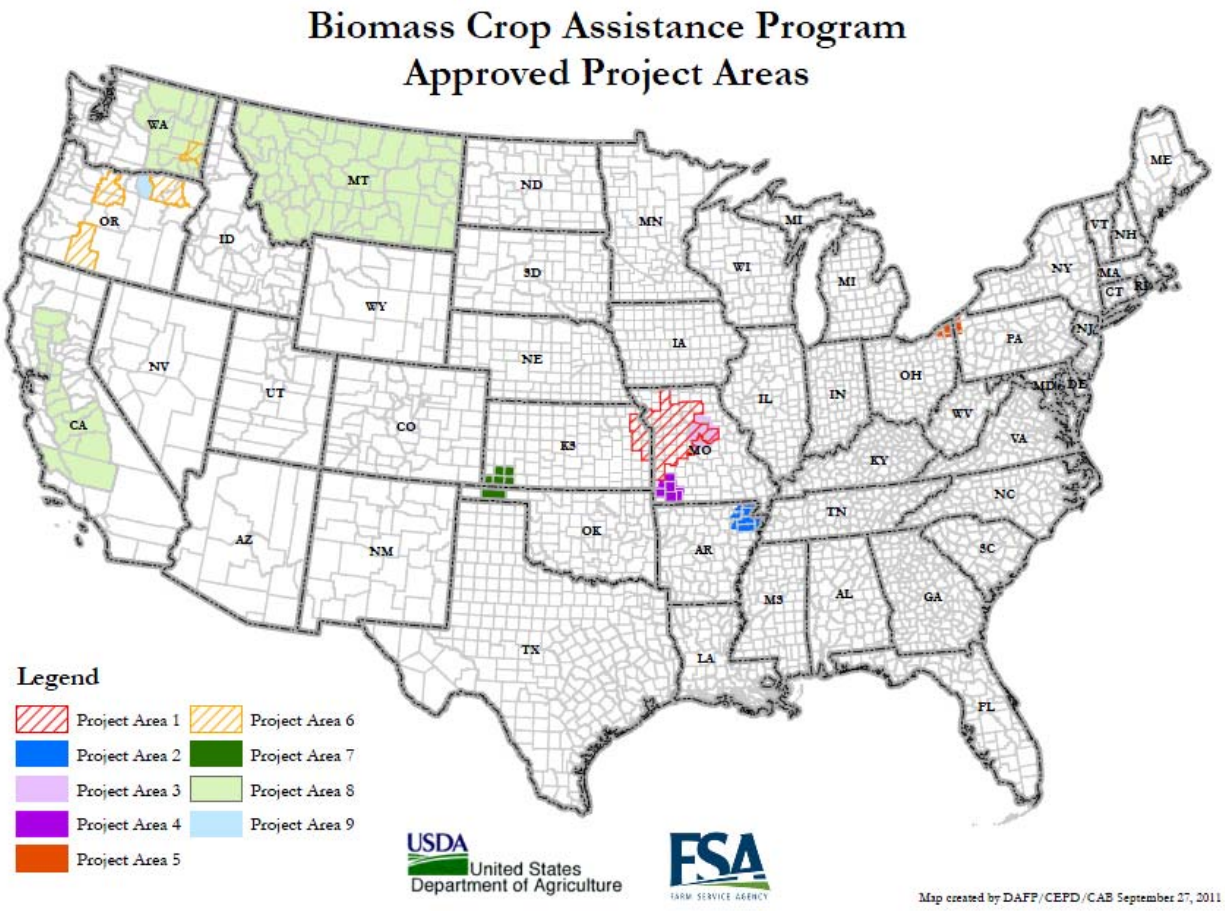
USDA provided the guaranteed loan funding through the Biorefinery Assistance Program. The loan was closed, and USDA issued the Loan Note Guarantee for $54.5 million (80 percent guarantee) on October 21, 2011. Further, in December 2009, the Department of Energy also awarded $50 million in grant funds toward the project. Funding from USDA and DOE helped to leverage program dollars and technical assistance across Agencies.

Energy Crop Feasibility Study

Energy crops have tremendous potential to reduce our dependence on foreign oil and create jobs in rural America. USDA’s Risk Management Agency (RMA) is expanding its efforts to develop new insurance products for the producers of renewable, clean energy crops grown in the United States. Research has been completed for energy cane, switchgrass, and camelina produced as a biofuel feedstock.

The Biomass Crop Assistance Program (BCAP)

The following is a summary of BCAP program projects, administered by the Farm Service Agency (FSA), which provides financial assistance to owners and operators of agricultural and non-industrial private forestland who establish, produce, and deliver biomass feedstocks for energy production.



Map 2 – Biomass Crop Assistance Program (BCAP)
Source: Farm Service Agency[8]

PROJECT AREA 1
Location: Thirty-nine counties in Kansas and Missouri
Feedstock: Switchgrass, Big Bluestem, Illinois Bundleflower, Purple Prairie Clover; suitable native grasses, legumes and forbs; and native grass located on expired Conservation Reserve Program (CRP) fields

PROJECT AREA 2
Location: Eight counties in Arkansas
Feedstock: Giant Miscanthus

PROJECT AREA 3
Location: Nine counties in Missouri
Feedstock: Giant Miscanthus

PROJECT AREA 4

[8] http://www.fsa.usda.gov/FSA/webapp?area=home&subject=ener&topic=bcap

Location: Seven counties in Missouri
Feedstock: Giant Miscanthus

PROJECT AREA 5
Location: Four counties in Ohio and three counties in Pennsylvania
Feedstock: Giant Miscanthus

PROJECT AREA 6
Location: Five counties in Oregon and one county in Washington
Feedstock: Camelina

PROJECT AREA 7
Location: Five counties in Kansas and one county in Oklahoma
Feedstock: Switchgrass, Big Bluestem, Illinois Bundleflower and Purple Prairie Clover

PROJECT AREA 8
Location: Seventeen counties in California, seventeen counties in Washington, and fifty-six counties in Montana
Feedstock: Camelina

PROJECT AREA 9
Location: One county in Oregon
Feedstock: Hybrid poplar trees

Section IV: Milestones

January 2010
Agriculture Secretary Vilsack and Navy Secretary Mabus sign advanced biofuels Memorandum of Understanding.

April 2010
U.S. Navy test-flies the "Green Hornet" (F/A-18 Super Hornet), the first supersonic jet with afterburners to fly on fifty percent biofuels blend.

July 2010
USDA Secretary Vilsack hosts the “FARM to FLY” roundtable with aviation industry leaders.

October 2010
FAA and USDA sign the Feedstock Readiness Tool Memorandum of Understanding.

October 2010
Secretary Vilsack announces the Biomass Crop Assistance Program (BCAP).

January 2011
The Boeing Company and Air China announced an agreement to initiate planning of an inaugural international flight using sustainable aviation biofuels.

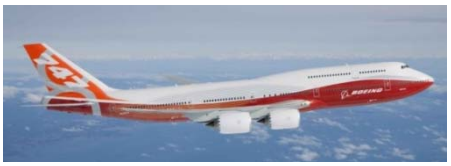
March 2011
The Obama Administration releases its "Blueprint for A Secure Energy Future" initiative that outlines a comprehensive national energy policy.

March 2011
The United States and Brazil sign a Memorandum of Understanding to advance the development of aviation biofuels.

May 2011
Alaska Airlines, Boeing, the Port of Seattle, the Port of Portland, and Spokane International Airport complete the year-long Sustainable Aviation Fuels Northwest (SAFN) project, and release the roadmap report.

June 2011
Seven A4A member airlines sign letters of intent with Solena Fuels, LLC ("Solena") for a future supply of jet fuel derived exclusively from biomass to be produced in northern California.

June 2011
Agriculture Secretary Vilsack announces the Department of Agriculture's efforts to support the development of biobased aviation fuels at the 2011 Paris Air Show.



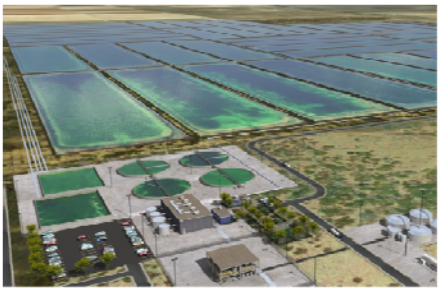
June 2011
A Boeing 747-8 Freighter, powered by a camelina-based/kerosene biofuel, arrives at the 2011 Paris Air Show.

July 2011
ASTM International formally issues the new edition of ASTM D7566-11, permitting renewable fuels to be blended with conventional commercial and military jet (or gas turbine) fuel.

August 2011
President Obama announces a partnership between the private sector, USDA, DOE, and U.S. Navy to produce advanced drop-in aviation and marine biofuels.

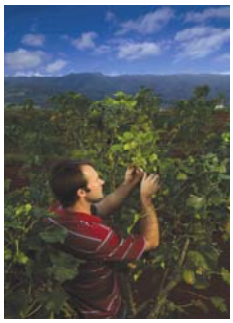
September 2011
Secretary Vilsack announced $136 million in research and development grants for diesel, gasoline, and renewable jet biofuels.

September 2011
U.S. Navy test-flies a Seahawk helicopter powered by a 50-50 algal biofuel and jet fuel blend.



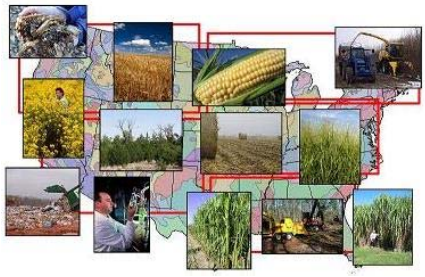
October 21, 2011
USDA provided loan note guarantee through the Biorefinery Assistance Program for $54.5 million for Sapphire Energy, Inc. The integrated algal biorefinery will produce one million gallons per year of drop-in replacement for petroleum-derived diesel and jet fuel.

November 2011
United Airlines and Alaska Airlines complete the first-ever biojet-powered commercial-service airline flights in the United States, using fuel produced by Solazyme, Inc. and Dynamic Fuels, LLC.



November 2011
On the eve of the Asia Pacific Economic Conference (APEC) CEO Summit, Boeing and Hawai'i BioEnergy announce a collaborative agreement to work on renewable energy sources and enabling technologies for producing sustainable jet fuel in Hawaii, supporting regional U.S. military operations and energy planning.

November 2011
USDA Secretary Vilsack announces new crop insurance pilot program beginning with the 2012 crop year for biofuel-friendly oilseed crop, camilina. Camelina is a short season plant which can be grown as a rotation crop for wheat and established on marginally productive land.



December 2011
USDA and FAA present the Feedstock Readiness Level Tool (FRLT) at Commercial Aviation Alternative Fuel Initiative winter meeting.

USDA and U.S. Navy Sign Renewable Energy Agreement

On January 21, 2010, Agriculture Secretary Thomas J. Vilsack and Secretary of the Navy Ray Mabus sign a key Memorandum of Understanding (MOU) to encourage the development of advanced biofuels and other renewable energy systems. The agreement complements existing renewable energy programs and efforts of the USDA, U.S. Navy, and U.S. Marine Corps. The goal of the energy agreement is to reduce America's reliance on fossil fuels that come from volatile areas of the world.

Navy Tests Biofuel-Powered "Green Hornet"

On April 22, 2010, the U.S. Navy celebrated Earth Day by showcasing a flight test of the "Green Hornet," an F/A-18 Super Hornet multi-role fighter jet, powered by a biofuel blend. The Naval Air Systems Command at the Naval Air Station in Patuxent River, Maryland, was the site of the flight test. The "Green Hornet" runs on a 50-50 blend of conventional jet fuel and a biofuel that comes from camelina, a hardy U.S.-grown plant that can thrive in good and poor soil conditions.

The Defense Energy Support Center, which oversees procurement of biofuel for the Navy, recently awarded a $2.7 million contract to Sustainable Oils of Seattle and Bozeman, Montana, for 40,000 gallons of camelina-based fuel. The Navy's ultimate goal is to develop protocols to certify alternative fuels for use in its aircraft and ships. Secretary of the Navy Ray Mabus has made the exploration and adoption of alternative fuels a priority for the Navy and Marine Corps.

USDA Hosts the Farm to Fly: Sustainable Aviation Biofuel Roundtable

On July 14, 2010, Secretary Vilsack held the Farm to Fly: Sustainable Aviation Biofuel Roundtable, a high-level meeting of aviation industry leaders who will work together to accelerate the availability of sustainable aviation biofuel supplies in the United States.

USDA and FAA Sign Feedstock Readiness Tool Memorandum of Understanding

On October 10, 2010, Agriculture Secretary Vilsack announces renewable energy initiatives to spur rural revitalization throughout the country. USDA and FAA signed a Feedstock Readiness Tool Memorandum of Understanding. The new agreement with the FAA will promote production and demand for biofuels, which a USDA report shows will benefit the economy.

The FAA will work with USDA to develop alternatives to jet fuel. Together, these departments will assess the availability of different kinds of feedstocks available for processing by biorefineries to produce jet fuels. The development and deployment of alternative fuels is critical to achieving carbon neutral aviation growth by 2020. This agreement leverages the expertise and resources of USDA, enabling aviation to play a key role in expanding renewable fuel while improving the environment.

Agriculture Secretary Vilsack Announces Renewable Energy Initiatives to Spur Rural Revitalization Throughout the United States

On October 21, 2010, as part of the Obama Administration's effort to promote production of fuel from renewable sources, create jobs and mitigate the effects of climate change, Secretary Vilsack announced a series of measures, designed to achieve these goals, during a speech to the National Press Club in Washington, D.C.

BCAP provides assistance for the establishment and production of eligible renewable biomass crops within specified project areas. Producers who enter into BCAP contracts may receive payments of up to 75 percent of the cost of establishing eligible perennial crops. Further, they can receive payments for up to 5 years for annual or non-woody perennial crops and up to 15 years for woody perennial crops. FSA is accepting project area proposals, and eligible producers may participate by enrolling at their FSA county office.

In addition, BCAP also assists agricultural and forest landowners and operators by providing matching payments for the transportation of certain eligible materials that are sold to qualified biomass conversion facilities. The facilities convert the materials into heat, power, biobased products, or advanced biofuels.

Boeing, Honeywell, and Pratt & Whitney -Air China Aviation Biofuels MOU

On January 19, 2011, during Chinese President Hu's visit to the United States, the Boeing Company and Air China announced an agreement to initiate planning of an inaugural international flight using sustainable aviation biofuels. Furthermore, Boeing, Honeywell, and Pratt & Whitney announced an agreement on the details of the technical support they will offer to Air China in the planning, execution, and analysis of the inaugural biofuel flight. This demonstrates the strong link between the U.S. and China Sustainable Aviation Biofuels industries and aviation's significant contribution to trade between the U.S. and China. This agreement will highlight the future of the aviation industry, which contributes an estimated $4 trillion to the global economy annually.

The Obama Administration Releases Its Blueprint for a Secure Energy Future

On March 30, 2011, President Obama announced his "Blueprint for a Secure Energy Future" (Blueprint) report that outlines the steps the Administration believes are necessary to reduce America's dependence on foreign oil by a third by 2021.

During an address at Georgetown University in March, President Obama discussed his plans for weaning America off foreign oil dependence and reducing the impact and cost of America's energy needs. During the announcement, the President outlined realistic goals in developing a comprehensive national energy policy to decrease energy costs while boosting domestic supply.

The Blueprint will help expand safe and responsible domestic oil and gas development and production. It will also lead the world toward safer and more secure energy supplies, reduce consumers costs at the pump with more efficient cars and trucks, cut energy bills with more

efficient homes and buildings, create markets for clean energy, conduct clean energy research and development, and model best practices and clean energy technology.

The United States and Brazil Sign Memorandum of Understanding to Advance the Development of Aviation Biofuels

On March 22, 2011, President Obama and Brazilian President Dilma Rousseff expanded a Memorandum of Understanding on biofuels, agreeing that the two countries have converging interests in energy-related matters, including in oil, natural gas, biofuels and other renewables. President Obama stated that the United States seeks to be a strategic energy partner of Brazil. They praised the Working Group on Energy and the Memorandum of Understanding to Advance the Cooperation on Biofuels and decided that their work will be carried out under the umbrella of a bilateral Strategic Energy Dialogue.

The leaders added language to the 4-year-old aviation biofuels development MOU that includes support for the Commercial Aviation Alternative Fuels Initiative (CAAFI) and the Brazilian Alliance for Aviation Biofuels.

Sustainable Aviation Fuels Northwest (SAFN) Report Released

Sustainable Aviation Fuels Northwest, a regional road mapping study, was sponsored by Alaska Airlines, Boeing, the Port of Seattle, the Port of Portland, Spokane International Airport, and Washington State University. Boeing initiated and co-funded the project. A diverse stakeholder group looked at the feasibility of developing regionally sourced, sustainable aviation fuel supply chains in a four-state region, through a series of workshops spread over 10 months. A final report released in May 2011 is available at http://www.safnw.com/. Since the release of the report, the region has begun commercial biofuel flights and received multiple Federal funding grants for research and development of aviation biofuels.

Seven A4A Member Airlines Sign Letters of Intent to Negotiate Purchase of Biomass-Derived Jet Fuel from Solena Fuels, LLC

On June 20, 2011, in conjunction with the opening of the Paris Air Show, a core group of airlines signed letters of intent with Solena Fuels, LLC ("Solena") for a future supply of jet fuel derived exclusively from biomass. The production facility will be in northern California. American Airlines and United Continental Holdings led the development of the agreement with Solena and were joined by five additional A4A member airlines—Alaska Airlines, FedEx, JetBlue Airways, Southwest Airlines, and US Airways—and A4A associate member Air Canada in signing the letters of intent, as well as Frontier Airlines and Lufthansa German Airlines. Solena's "GreenSky California" biomass-to-liquids (BTL) facility in Northern California (Santa Clara County) will utilize post-recycled urban and agricultural wastes to produce up to 16 million gallons of neat jet fuel (as well as 14 million gallon equivalents of other energy products) per year by 2015 to support airline operations at Oakland (OAK), San Francisco (SFO), and/or San José (SJC). The project will divert approximately 550,000 metric tons of waste that

otherwise would go to a landfill while producing jet fuel with lower emissions of greenhouse gases and local pollutants than petroleum-based fuels.

Agriculture Secretary Vilsack Promotes Biobased Aviation Fuels at Paris Air Show

On Wednesday, June 22, 2011, Agriculture Secretary Vilsack earned the distinction as the first U.S. Agriculture Secretary to attend a Paris Air Show, the largest gathering of the world aerospace industry. The Secretary spoke at the Alternative Aviation Fuels Showcase to a crowd of about 75 aviation business leaders about how USDA is among the forefront of U.S. Federal efforts to support the development of biobased fuels. USDA has established memoranda of understanding with several government and aviation-related agencies, including the Department of Energy, the Air Transport Association, the Federal Aviation Administration, and the U.S. Navy, on efforts to research and develop renewable energy and the infrastructure to support it.

The Secretary also highlighted USDA's commitment to the development of alternative fuels to improve economic opportunities across rural America, decrease dependence on foreign oil, and increase environmental benefits of flying. The Secretary said that for aviation biofuels to really "take off," the government needs to support the private sector in the form of loan guarantees and research and development (R&D) grants to mitigate risk. Across the United States, USDA supports five research stations committed to the development of next-generation advanced biofuels. Other renewable energy programs from USDA help to increase domestic energy security, establish regional supply chains, and promote rural development and jobs in the United States.

ASTM Aviation Fuel Standard Amended to Allow Bioderived Components

On July 1, 2011, ASTM International formally issued its new edition of ASTM D7566-11, permitting the blending of renewable fuels with conventional commercial and military jet (or gas turbine) fuel. Through the new provisions included in ASTM D7566, producers can add up to 50 percent bioderived synthetic blending components to conventional jet fuel. These renewable fuel components, called hydroprocessed esters and fatty acids (HEFA), are identical to hydrocarbons found in jet fuel, but come from vegetable oil-containing feedstocks such as algae, camelina or jatropha, or from animal fats called tallow.

President Obama Announces Advanced Biofuels to Fuel Military and Commercial Transportation

On Tuesday, August 16, 2011, President Obama announced that the U.S. Departments of Agriculture, Energy, and Navy will invest up to $510 million during the next 3 years in partnership with the private sector to produce advanced drop-in aviation and marine biofuels to power military and commercial transportation. The initiative responds to a directive from President Obama issued in March as part of his Blueprint for A Secure Energy Future, the Administration's framework for reducing dependence on foreign oil. The biofuels initiative is being steered by the White House Biofuels Interagency Work Group and Rural Council, both of which are enabling greater cross-agency collaboration to strengthen rural America.

To accelerate the production of biobased jet and diesel fuel for military and commercial purposes, Secretary of Agriculture Thomas J. Vilsack, Secretary of Energy Steven Chu, and Secretary of the Navy Ray Mabus have developed a plan to jointly construct or retrofit several drop-in biofuel plants and refineries. This effort will help address energy security and national security challenges, and will provide economic opportunities in rural America. The partnership also aims to reduce U.S. reliance on foreign oil and create jobs while positioning American companies and farmers to be global leaders in advanced biofuels production.

USDA Awards $136 Million for Advanced Biofuel Development

On Wednesday, September 28, 2011, U.S. Agriculture Secretary Vilsack announced five major agricultural research projects today aimed at developing regional, renewable energy markets, generating rural jobs, and decreasing America's dependence on foreign oil. Altogether, the five-year program will deliver more than $136 million in research and development grants to public and private sector partners in 22 states. University partners from the states of Washington, Louisiana, Tennessee, and Iowa will lead the projects, which focus in part on developing aviation biofuels from tall grasses, crop residues, and forest resources. Vilsack made the announcement with partners from private industry, research institutions, and the biofuels industry at the Seattle-Tacoma International Airport.

U.S. Navy Test-Flies Algal Biofuel Powered Military Helicopter

A U.S. Navy's Seahawk helicopter has become the first military helicopter in history to fly on a 50-50 algal biofuel and jet fuel blend. This new fuel, called Solajet HRJ-5, is an algal biofuel developed by San Francisco-headquartered Solazyme, Inc. The project is in accordance with the U.S. Military's stated goal of powering all its vehicles with biofuels in the future. Solazyme developed the advanced biofuel Solajet HRJ-5 in active association with the U.S. Navy and DLA Energy. The Seahawk flew on a 50-50 blend of petroleum-derived jet fuel and the Solajet HRJ-5. The success of the Seahawk flight demonstrated the viability of the microbially derived fuel as a fuel alternative, with a potential to free the U.S. armed forces from dependence on imported oil.

United Airlines Flies First U.S. Commercial Advanced Biofuel Flight, Signs Letter of Intent to Negotiate the Purchase of 20 Million Gallons of Biofuel Per Year

On November 7, 2011, United Continental Holdings subsidiary Continental Airlines operated the first U.S. commercial flight powered by advanced biofuels. Flight 1403, a Boeing 737-800, departed Houston's Bush Intercontinental Airport at 10:30 a.m. for Chicago O'Hare International Airport, making United the first U.S. airline to fly passengers using a blend of sustainable, advanced biofuel and traditional petroleum-derived jet fuel. Solazyme, working with Honeywell's UOP process technology, developed the algae oil that was refined into jet fuel to power today's commercial flight. Solazyme produced the world's first 100-percent algae-derived jet fuel for both commercial and military applications. Also, United announced it has signed a letter of intent with Solazyme to negotiate the purchase of 20 million gallons of jet fuel per year, derived exclusively from algae oil, for delivery as early as 2014. Solazyme, headquartered in south San Francisco, manufactured the algae oil used on today's flight through

its proprietary fermentation process. The resulting product was then refined outside Houston using renewable jet fuel processing technology from Honeywell's UOP.

Alaska Airlines Launches 75 Biofuel-Powered Flights in Commercial Service

On November 9, 2011, Alaska Airlines began the first of its 75 commercial passenger flights, over a multiweek period, in the United States, powered by biofuel. Two maiden biofuel-powered flights left Seattle on November 9 for Washington, D.C., and Portland, Oregon, on Alaska Airlines and its sister carrier, Horizon Air, using a 20-percent blend of sustainable biofuel made from used cooking oil. SkyNRG, an aviation biofuels broker, supplied the fuel, which was made by Dynamic Fuels, a producer of next-generation renewable, synthetic fuels made from used cooking oil and a joint venture between Tyson Foods Inc. and Syntroleum Corp.

USDA Announces New Insurance Pilot Program for Biofuel-Friendly Oilseed Crop with Potential to Create Jobs, Stimulate Rural Economies

On November 30, 2011, The U.S. Department of Agriculture's Risk Management Agency announced a new pilot program of insurance for camelina beginning with the 2012 crop year. Camelina is an oilseed crop with the potential to create new renewable energy markets in the United States, generate rural jobs here at home, and decrease America's dependence on foreign oil. The new pilot program will be available in selected counties in Montana and North Dakota for the 2012 crop year, with a sales closing date of February 1, 2012. Only spring-planted camelina grown under contract with a processor will be eligible for coverage.

Camelina, an oilseed, is a rotation crop for wheat that can be established on marginally productive land. It is an annual, short season plant. Biofuel from camelina is an ideal jet fuel substitute. USDA's Agricultural Research Service (ARS) scientists have long-term studies underway to examine ways to use camelina as a bioenergy crop for producing jet fuel for the military and the aviation industry. In addition, earlier this year USDA announced two Biomass Crop Assistance Program (BCAP) project areas devoted to developing camelina as biofuel in several states, including Montana.

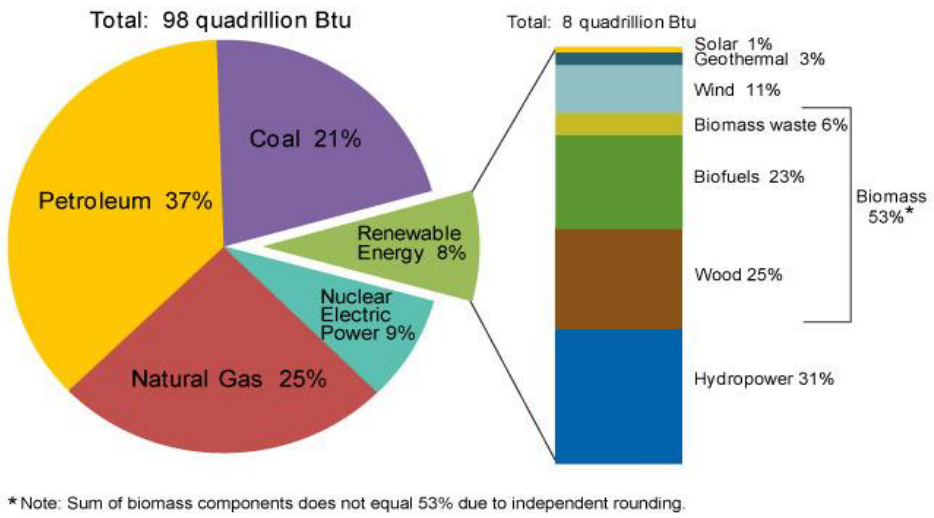
USDA and FAA Completes Development of the Feedstock Readiness Level (FSRL) Tool

The USDA's ARS and Office of Energy Policy and New Uses and FAA's Research and Innovative Technology Administration and Office of Environment and Energy designed this tool to track progress on the availability of the agricultural and forest-based feedstocks needed to produce alternative jet fuels so aviation fuel users could understand and evaluate the readiness of biofuel feedstocks separately from the readiness of a technical fuel conversion process.

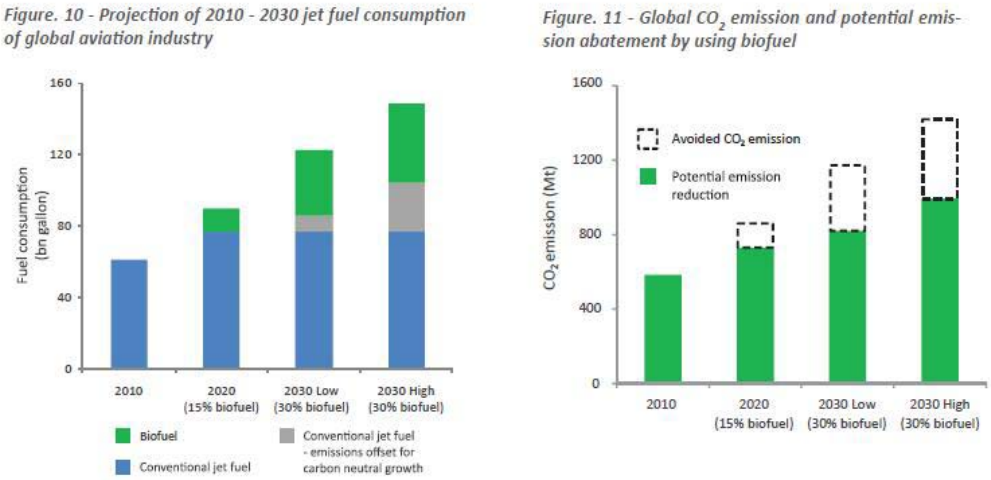
This tool complements the internationally recognized Fuel Readiness Tool (FRL). The use of the FSRL and FRL together can identify gaps in aviation biofuel supply chains due to delays in the development of either the feedstocks to supply a particular conversion process or the development of a fuel conversion process as a market for a feedstock. This joint effort is a deliverable under the USDA-FAA MOU which was announced October 21, 2010.

Section V: Appendix

Today, most of the energy consumed in the United States comes from fossil fuels—coal, petroleum, and natural gas, with crude oil-based petroleum as the dominant source of energy. Renewable energy resources supply a relatively small but steady portion, about 8 percent of U.S. total energy consumption.



Graph 1—U.S. Energy Consumption by Energy Source, 2010
Source: U.S. Energy Information Administration Monthly Energy Review (June 2011) [9]



Graph 2—Global Jet Fuel Consumption and CO_2 Emissions
Source: EQ2 Report on Aviation Biofuel [10]

[9] http://www.eia.gov/energyexplained/index.cfm?page=us_energy_home
[10] http://www.eq2.us.com/Document/EQ2_Report_Aviation_biofuel.pdf