

## American funding for biofuel/biorefinery research & development\*

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### INTRODUCTION

The United States is once again investing in biofuel research after a roller coaster ride in energy funding for sustainable energy sources in the past two years. After the reelection of President Obama in 2012, research related to all types of sustainable energy has increased. The President has requested a \$2 billion fund exclusive for clean energy research, in addition to all current grant funding totaling \$144.1 billion (Fiscal Year 2014).

### FUNDING OPPORTUNITIES

Although the U.S. Energy Department (DOE) is the leading agency for accumulating data related to biofuels, through its Alternative Fuels Data Center, it is also providing a funding commitment in biofuel research to three research centers for the next five years as part of a \$125million proposal. These centers are: the Great Lakes Bio Energy Research Center led by the University of Wisconsin-Madison (Wisconsin), the Bio Energy Research Center led by Oak Ridge National Labs (Tennessee) and the Joint Bio Energy Institute led by Lawrence Berkeley National Laboratory (California). The agency is working to achieve the three presidential goals for energy:

- (1) Reducing dependence on oil by more than two million barrels a day by 2025;
- (2) Doubling renewable electricity production from wind, solar and geothermal by 2020 and
- (3) Doubling energy productivity by 2030.

The overall driver of biofuel use in the United States has been the *Energy Independence and Security Act of 2007*, which mandated increased use of biofuels in gasoline under the Renewable Fuel Standard (RFS2). The United States, after only six years of this mandate, is number one in the world in the global production of biofuels at 45% because of the approximately 300 million cars and trucks on its roads. Brazil was second with 22% and European countries such as France and Germany reported 3% and 5% respectively. However, the original goal of introducing a 15% ethanol mixture in gasoline by 2013 was severely impacted by extreme weather changes in the Midwest, which has endured severe droughts. Furthermore, production challenges in the original mission of increasing use of cellulosic biofuels by 2013 has furthered impacted national policy and created what is being described as a “blend wall” by the Environmental Protection Agency (EPA). Currently, the EPA has approved 15.55 billion gallons of renewable fuels to be blended into the US fuel supply creating a 9.74% blend. It also calls for 1.28 billion

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\* Delia Gallinaro, MPA, has moderated the American Grant Funding in Biorefinery Research and Development Workshop, which constituted a part of The Fourth International Environmental Best Practices Conference, 8-12 September 2013, Olsztyn, Poland

gallons of biomass-based diesel fuel, 2.75 billion gallons of advanced biofuels and 6 million gallons of cellulosic biofuels.

Funding has not increased for the U.S. Department of Agriculture (USDA) although the President mandated that the agency fund \$881million for energy programs. The agency funds *applied* research grants that include support for small business biofuels and bio-based product enterprises, mostly in rural areas. The mandated funding includes guarantee loans to commercial-scale biorefineries that produce advanced biofuels. Focus has shifted away from the use of food crops, such as sugar cane and corn as feed stocks to third generation biofuels made from algae and other microbes. Through strategic relationships, the USDA has entered into a partnership with the U.S. Navy and the Federal Aviation Administration to research and eventually produce advanced drop-in aviation and marine biofuels to power military and commercial transportation. This NEWBio Consortium will focus on non-food biomass sources of willow, miscanthus and switch grass, which can be grown on former strip mines and marginal floodplains. The U.S. Navy has set the goal of 50% of all fuel to be from alternative sources by 2020. Research grants for achieving this goal have focused on energy creation and storage with environmentally benign processes. The National Program Leader for the USDA is the Institute of Bioenergy, Climate and Environment, Division of Bioenergy. More information on funded research can be found on the website: [www.nifa.usda.gov/](http://www.nifa.usda.gov/).

Contrary to the USDA, the National Science Foundation (NSF) funds only *basic* research and has allocated \$355.38M for all clean energy research. Biofuel research crosses several of the NSF's directorates (e.g. chemistry, biology, engineering, etc.) and many of its programs. Funded research focuses from chemical reactions that produce biofuels from organic materials to micro-laboratory for microalgae in wastewater to chemical commodities and Diatom-based Photosynthetic Bio refinery. Additionally, NSF is increasingly funding educational programs to create a workforce in each of the sustainable energy areas and has allocated considerable funding to this endeavor, including transforming undergraduate education for biofuel related careers. For more information on identifying U.S. researchers involved in any aspect of NSF's bioenergy and biorefinery projects, foreign scientists can go to [www.nsf.gov](http://www.nsf.gov) and click on "awards" where the database can be searched by keyword, institution, PI or co-PI. A recent search by the author for those topics under NSF's active awards database revealed 50 projects for biorefineries. The database includes PI name, co-PI name, academic affiliation, and project start date so that a colleague to colleague connection can be made by interested parties. NSF is the only American funding agency that requires that Principal Investigators be American; foreign scientists can be co-PIs, consultants, subcontractors or international collaborators.

Research and development (R&D) to produce biofuels is led by the Department of Defense (DoD), which receives almost half of the U.S. R&D national budget, or \$69.5 billion. The Department's aim is to develop plans for bio refineries that could scale up to 150 million gallons at a cost target of less than \$4 per gallon. Three companies were awarded a total of \$16million to plan production of fuels around drop-in aviation and marine diesel fuel specifications in 2012. Phase two of the grants will award \$180million for constructing at least one bio refinery capable to meet "Great Green Fleet" expectations. The three companies awarded grants are: Emerald Biofuels, Chicago (Illinois); Natures BioReserve, Omaha (Nebraska) and Fulcrum Biofuels, Pleasanton (California).

Due to the fast pace of research in this area, technical and market information that can make foreign scientists aware of research activities in the U.S. can be accessed through the publication database of national laboratories. Those individuals interested in pursuing American R&D funding opportunities for their project involving biofuels or biorefineries, should conduct a literature review at DOE's National Renewable Energy Laboratory (NREL) [www.nrel.gov/biomass/publications.html](http://www.nrel.gov/biomass/publications.html). DOE also houses the Office of Energy Efficiency & Renewable Energy (EERE) and its web site contains a bioenergy newsletter which may be useful to researchers outside of the U.S. for a list of upcoming events, publications, databases, webinars and grants relevant to bioenergy topics. Together EERE and NREL have, for the past 37 years, conducted research and development of various energy concepts. Recently their efforts have focused on biorefinery research that relates to advanced fuels, which the President has targeted for mass production. The laboratory has extensive collaborations worldwide and foreign scientists wishing to collaborate with the NREL can contact Dr. Robert Baldwin, 303-384-6858, [robert.baldwin@nrel.gov](mailto:robert.baldwin@nrel.gov).

In addition to NREL, DOE also has three Bioenergy Research Centers (BRCs) that focus exclusively on the fundamental science and research that is multidisciplinary among physical, chemical, biological and computational sciences. This includes microbial and plant biology, genomics, analytical chemistry, bioinformatics and engineering. It is very advantageous for foreign scientists to link to their American counterparts in these research centers and aim to leverage global research expertise. The brochure for these centers includes past awards' descriptions, contact information and very specific information pertinent to all interested scientists. The brochure can be obtained at: <http://genomicscience.energy.gov/centers/brcbrochure/>.

Looking at the future and how bioenergy research and development as well as biorefinery research will be funded, the new proposed FY2015 request for this area is shown in Figure 1.

The Bioenergy Technologies Office (BETO) continues to work on developing a domestic capability to mass market a price-competitive renewable fuel from non-food sources. In

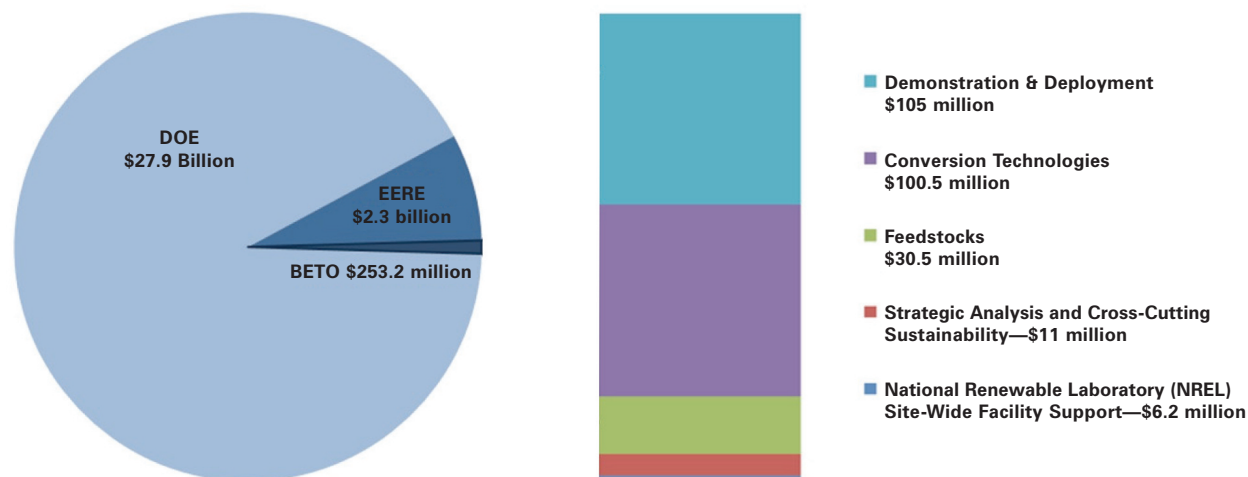


Figure 1. The new request for funding bioenergy and biorefinery research and development proposed for Fiscal Year (FY)2015.

this regard, it met its technical research targets in FY2013 and 2014 for the thermochemical conversion pathway—reaching a minimum fuel selling price of \$5.6 gasoline gallon equivalent for a gasoline and diesel blendstock. In FY2015, BETO will continue to work toward a \$3/biofuel target cost and at least two target pathways will be selected for validation at integrated bench and pilot scales in FY2017. BETO will issue funding opportunities for consortia to integrate bio-oils into petroleum refineries, to develop biological and chemical catalysts and clean sugar production, and to resolve issues with gasification and gas to liquids identified in FY2014 workshops. The proposed budget also puts greater emphasis on demonstration and deployment than previous years. In 2013 a Florida integrated biorefinery developed by INEOS Bio and partially funded by BETO began producing the first commercial-scale cellulosic ethanol in U.S. history. This year (2014), two other cellulosic ethanol biorefineries that are commercial scale are designated to be built. These two facilities are located in Emmetsburg (Iowa) and Hugoton (Kansas). Together they are expected to produce 50 million gallons per year. BETO will also continue to support the jet fuel specification for the Department of Defense.

In addition to these refineries, Louisiana arguably possesses the most capacity for renewable diesel production but the decade old strategy to expand this capacity has not yet been fully realized. Most of the state's renewable fuels originate from animal fats and grease rather than energy crops.

All entities, including non-American nationals, can apply for DOE, USDA, NSF and other funding although it is highly advantageous to collaborate with an American academic or research institution. Submission of all grant proposals has to be completed using the government portal [www.grants.gov](http://www.grants.gov). An excellent resource for scientists outside the United States to learn about research funding is through the American Association for the Advancement of Science (AAAS). Only by working cooperatively to solve major issues on energy, climate change, environmental impact and sustainable development can science diplomacy play a major part in shaping the future.

## SOURCES

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