



Environmental Data and Governance Initiative Website Tracking Report

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Changes to DOE's Office of Energy Efficiency & Renewable Energy Bioenergy Technologies Office Web Pages

April 19, 2017

This report is co-released with:

- [Changes to DOE's Office of Energy Efficiency & Renewable Energy Vehicle Technologies Office Web Pages](#)
- [Changes to DOE's Office of Energy Efficiency & Renewable Energy Wind Energy Technologies Office Web Pages](#)

Writing and review of this report was conducted and overseen by the members of EDGI's Website Monitoring Committee: Maya Anjur-Dietrich, Andrew Bergman, Gretchen Gehrke, and Toly Rinberg, with contributions from Liz Williams, Rebecca Lave, and Adam Wizon.

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Changes to DOE's Office of Energy Efficiency & Renewable Energy Bioenergy Technologies Office Web Pages

DOE's Office of Energy Efficiency & Renewable Energy (EERE) has made extensive changes to pages pertaining to the Bioenergy Technologies Office. There was a shift in stated office priorities and language referring to greenhouse gas emissions and dependence on fossil fuels was changed.

Description

Extensive changes and reorganizations occurred on pages in the Bioenergy Technologies Office (BETO) of the Department of Energy's Energy Efficiency and Renewable Energy (EERE) Office. This report focuses on a subset of the entire domain, analysing changes to the "About the Bioenergy Technologies Office: Growing America's Energy Future" page and two of its subpages, "Key Activities" and "Accomplishments and Successes". Of the listed changes, several fall into three main categories: (1) changes in emphasis on bioenergy fuels as a replacement for fossil fuels; removal of mention of "greenhouse gases"; and shift in emphasis on US jobs and economic growth.

For additional context, a similar analysis was applied to changes to EERE's [Vehicles Technologies Office](#) and [Wind Energy Technologies Office](#) pages. Significant changes were also identified in EERE pages, across multiple domains, outside the scope of these three reports and may be worth further investigation.

The most notable changes to the BETO pages in this report are summarized here:

- 1. Changes in emphasis on bioenergy fuels as a replacement for fossil fuels**
 - a. Changed "In addition, through our efforts to develop biobased products and increase biopower generation, we're helping to replace the whole barrel of oil" to "In addition, we're supporting the development of bioproducts, which enable biofuels, since the production of bioproducts relies on much of the same feedstocks, infrastructure, and technologies that are central to biofuel production" (Change 1.1d)
 - b. Language that previously suggested substitution of biofuels for petroleum was removed: "The reduction in petroleum imports and increase in domestic, renewable biomass use will help keep jobs in this country." (Change 1.3a)
 - c. The phrase "reduces U.S. oil dependence" was changed to "reduces dependence on foreign oil" (Change 2.1a). Note that the removed clause "reduces U.S. oil dependence" could possibly mean both domestic and foreign dependence on oil.
 - d. Language that previously suggested substitution of biofuels for petroleum was altered from "a sufficient quantity to displace approximately 30% of the

U.S. petroleum consumption without impacting food or feed needs" to "without impacting food, feed, and fiber needs" (Change 3.1a).

2. Removal of mention of "greenhouse gases"

- a. Removal of "greenhouse gas emissions" from the sentence "Office investigates the life-cycle impacts of bioenergy production on the reduction of greenhouse gas emissions, cleaner air, improved soil quality, enhanced water quality, biodiversity, and the use of marginal croplands." (Change 1.2e)
- b. The parenthetical phrase "e.g. reduced greenhouse gas emissions" was removed from the phrase "provides environmental benefits (e.g. reduced greenhouse gas emissions)". (Change 2.1b)
- c. Changed "Reducing greenhouse gases from the transportation sector" to "Reducing harmful emissions from the transportation sector." (Change 2.2e)
- d. The phrase "transportation-related greenhouse gas emissions" was changed to to "transportation-related emissions", removing the reference to GHGs from the introductory paragraph. (Change 3.1c)

3. Shift in emphasis on US jobs and economic growth

- a. Added sentence "The potential production could, in turn, directly generate \$30 billion in revenue and 1.1 million jobs in a variety of sectors including farming, plant operations, scientific research, and product and equipment design" (Change 3.1b).

4. Additional notable changes

- a. Removed citation section referencing six relevant documents at the bottom of the "About" page (Change 1.3g)

Detailed Description of Changes

Page 1: ABOUT THE BIOENERGY TECHNOLOGIES OFFICE: GROWING AMERICA'S ENERGY FUTURE

- URL:
<https://energy.gov/eere/bioenergy/about-bioenergy-technologies-office-growing-americas-energy-future>
- Side-by-side View: 1/17/2017 to 3/17/2017
- Change occurred between **Mar 16, 2017 10:18 PM ET** and **Mar 17, 2017 9:46 PM ET**

Screenshot 1.1

Changes to the “WHAT WE DO” Section:

(1.1a) Changed “The [Bioenergy Technologies Office Overview](#) and [Multi-Year Program Plan](#)” to “BETO’s web pages on [Key Activities](#), [Accomplishments](#), and [User Facilities](#)”

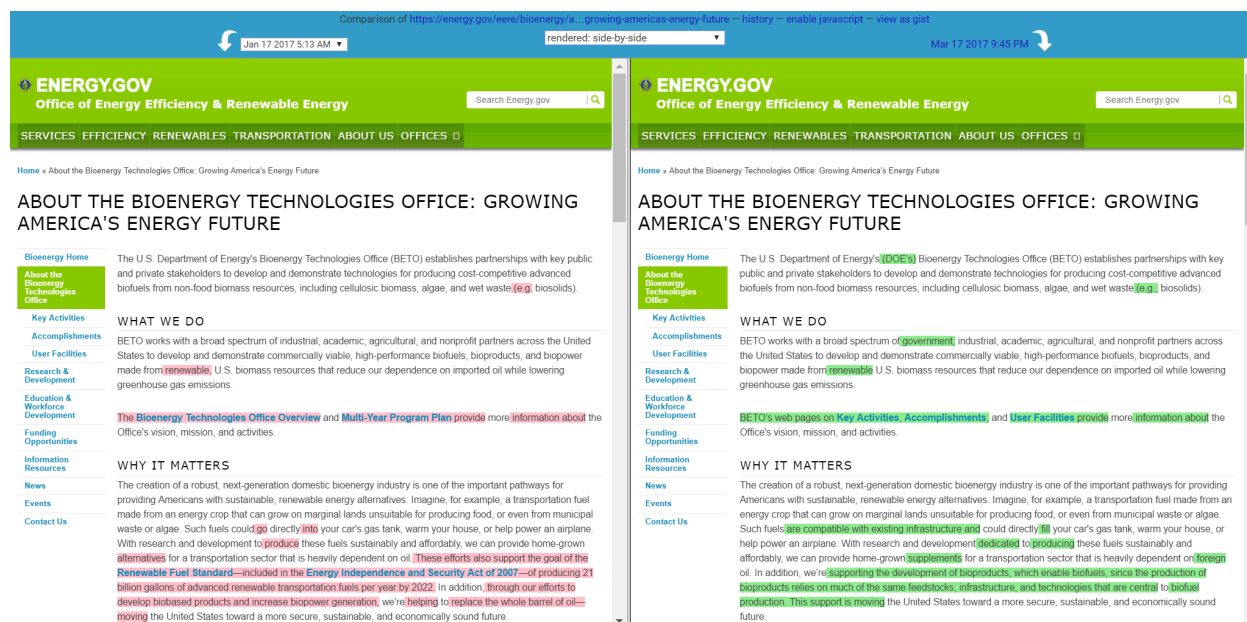
- “Bioenergy Technologies Office Overview” linked to page titled “REPLACING THE WHOLE BARREL TO REDUCE U.S. DEPENDENCE ON OIL”
- “Multi-Year Program Plan” linked to a page titled “BIOENERGY TECHNOLOGIES OFFICE MULTI-YEAR PROGRAM PLAN: MARCH 2016”

Changes to the Introduction of the “WHY IT MATTERS” Section:

(1.1b) Changed “Such fuels could go directly into your car's gas tank, warm your house, or help power an airplane.” to “Such fuels are compatible with existing infrastructure and could directly fill your car's gas tank, warm your house, or help power an airplane.”

(1.1c) Removed “These efforts also support the goal of the [Renewable Fuel Standard](#)—included in the [Energy Independence and Security Act of 2007](#)—of producing 21 billion gallons of advanced renewable transportation fuels per year by 2022.”

(1.1d) Changed “In addition, through our efforts to develop biobased products and increase biopower generation, we’re helping to replace the whole barrel of oil” to “In addition, we’re supporting the development of bioproducts, which enable biofuels, since the production of bioproducts relies on much of the same feedstocks, infrastructure, and technologies that are central to biofuel production”



Screenshot 1.2

Changes to the “Promoting national security [by] developing domestic sources of energy” Subsection:

(1.2a) Changed “The United States spends more than half a billion dollars per day on imported oil, and petroleum-related products accounted for about half of the nearly \$505 billion U.S. trade deficit in 2014.” to “In 2015, the United States imported more than [3.4 billion barrels](#) of petroleum from about 88 countries, amounting to approximately [one-quarter](#) of all petroleum used in the United States.”

(1.2b) Changed “In 2011, the Department signed a Memorandum of Understanding with the Departments of the Navy and Agricultural to advance research into military applications of advanced biofuels.” to “In partnership with the U.S. Navy and the U.S. Department of Agriculture, under the Defense Protection Act, DOE is co-funding the construction of three integrated biorefineries that will have the capacity to produce hydrocarbon fuels that meet military specifications”.

Changes to the “Growing a sustainable future with renewable biomass resources” Subsection:

(1.2c) Removed “Our analytical tools and data help support decision-making across a range of biofuels scenarios, focus research on pathways with the best potential for commercialization, and demonstrate progress toward goals.”

(1.2d) Added sentences “DOE focuses solely on non-food feedstocks ... to improve forest health and mitigate fire risk.”

(1.2e) Changed “Office investigates the life-cycle impacts of bioenergy production on the reduction of greenhouse gas emissions, cleaner air, improved soil quality, enhanced water quality, biodiversity, and the use of marginal croplands.” to “Office investigates the life-cycle contributions of bioenergy production to cleaner air, improved soil quality, enhanced water

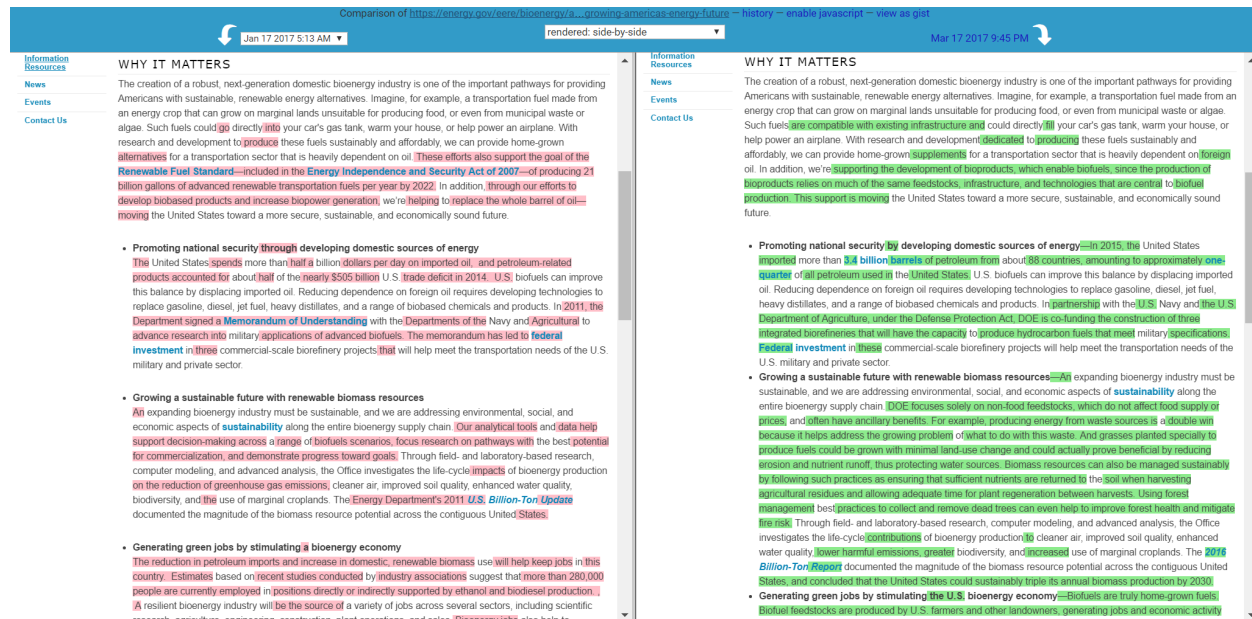
quality, lower harmful emissions, greater biodiversity, and increased use of marginal croplands.”

(1.2f) Changed text “[U.S. Billion-Ton Update](#)” linked to URL

<https://energy.gov/eere/bioenergy/downloads/us-billion-ton-update-biomass-supply-bioenergy-and-bioproducts-industry> to text “[2016 Billion-Ton Report](#)” linked to URL

<https://energy.gov/eere/bioenergy/2016-billion-ton-report>

(1.2g) Added continuation of last sentence in section “...and concluded that the United States could sustainably triple its annual biomass production by 2030.”



Screenshot 1.3

Changes to the “Generating green jobs by stimulating the U.S. bioenergy economy” Subsection:

(1.3a) Removed “The reduction in petroleum imports and increase in domestic, renewable biomass use will help keep jobs in this country.”

(1.3b) Removed “Estimates based on recent studies conducted by industry associations suggest that more than 280,000 people are currently employed in positions directly or indirectly supported by ethanol and biodiesel production”

(1.3c) Removed “Bioenergy jobs also help to stimulate the U.S. economy; a study by the Brookings Institution estimated that every job in the biofuels sector generates a significantly greater value of exports than the average U.S. job.”

(1.3d) Added “Biofuels are truly home-grown fuels ... Estimates based on a [recent study](#) led by DOE and the U.S. Department of Agriculture suggest that that if the United States were to triple its biomass production, we could potentially generate 1.1 million direct jobs and \$260 billion in direct revenue”

(1.3e) Added “Also, since the bioeconomy would draw on a variety of biomass sources, the United States would have greater flexibility to accommodate market fluctuations.”

Changes to Other Subsections:

(1.3f) Added “Leading global technology innovation” Section: “Breakthroughs in bioconversion technologies and successes in scaling up technologies for commercial operations promote U.S. leadership in global clean energy innovation. Advances can provide benefits in such related areas as agricultural production and food processing. Investments in bioprocessing will also help to reduce production costs, improve process and product reliability, and increase profitability. U.S. leadership in this growing sector will improve competitiveness in global markets.”

(1.3g) Removed citation section:

- ¹ U.S. Census Bureau (2015), “[U.S. Imports of Crude Oil](#).”
- ² U.S. Census Bureau (2015), “[U.S. Trade in Goods - Balance of Payments \(BOP\) Basis vs. Census Basis](#).”
- ³ Brown, J.P.; Weber, J.Q.; Wojan, T.R. (2013), “[Emerging Energy Industries and Rural Growth](#).” ERR-159. U.S. Department of Agriculture Economic Research Service.
- ⁴ National Biodiesel Board (2015), “[Production Statistics](#),” accessed March 26, 2015.
- ⁵ Urbanchuk, J.M. (2015), “[Contribution of the Ethanol Industry to the Economy of the United States in 2014](#),” prepared by ABF Economics for the Renewable Fuels Association, February 2015. Accessed March 26, 2015.
- ⁶ Muro, M.; Rothwell, J.; Saha D. (2011), “[Sizing the Clean Economy: A National and Regional Green Jobs Assessment](#),” The Brookings Institution, accessed May 28, 2015.

Comparison of <https://energy.gov/eere/bioenergy/a-growing-american-energy-future> — history — enable javascript — view as gist

Jan 17 2017 5:13 AM rendered: side-by-side Mar 17 2017 9:45 PM

Generating green jobs by stimulating a bioenergy economy

The reduction in petroleum imports and increase in domestic renewable biomass use will help keep jobs in this country. Estimates based on recent studies conducted by industry associations suggest that more than 280,000 people are currently employed in positions directly or indirectly supported by ethanol and biodiesel production. A resilient bioenergy industry will be the source of a variety of jobs across several sectors, including scientific research, agriculture, engineering, construction, plant operations, and sales. Bioenergy jobs also help to stimulate the U.S. economy; a study by the Brookings Institution estimated that every job in the biofuels sector generates a significantly greater value of exports than the average U.S. job.

¹ U.S. Census Bureau (2015), “[U.S. Imports of Crude Oil](#).”

² U.S. Census Bureau (2015), “[U.S. Trade in Goods - Balance of Payments \(BOP\) Basis vs. Census Basis](#).”

³ Brown, J.P.; Weber, J.Q.; Wojan, T.R. (2013), “[Emerging Energy Industries and Rural Growth](#).” ERR-159. U.S. Department of Agriculture Economic Research Service.

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⁶ Muro, M.; Rothwell, J.; Saha D. (2011), “[Sizing the Clean Economy: A National and Regional Green Jobs Assessment](#),” The Brookings Institution, accessed May 28, 2015.

Generating green jobs by stimulating the U.S. bioenergy economy—Biofuels are truly home-grown fuels. Biofuel feedstocks are produced by U.S. farmers and other landowners, generating jobs and economic activity across rural America. The money that the United States spends on the research, development, and use of biofuels recirculates in our economy, providing further indirect economic and trade benefits. Estimates based on a recent study led by DOE and the U.S. Department of Agriculture suggest that if the United States were to triple its biomass production, we could potentially generate 1.1 million direct jobs and \$260 billion in direct revenue. A resilient bioenergy industry will provide a variety of jobs across several sectors, including scientific research, agriculture, engineering, construction, plant operations, and sales. Also, since the bioeconomy would draw on a variety of biomass sources, the United States would have greater flexibility to accommodate market fluctuations.

Leading global technology innovation—Breakthroughs in bioconversion technologies and successes in scaling up technologies for commercial operations promote U.S. leadership in global clean energy innovation. Advances can provide benefits in such related areas as agricultural production and food processing. Investments in bioprocessing will also help to reduce production costs, improve process and product reliability, and increase profitability. U.S. leadership in this growing sector will improve competitiveness in global markets.

Internet Archive: [previous version from Mar 13, 2016](#) and [current version from April 15, 2017](#)

Page 2: KEY ACTIVITIES

- URL: <https://energy.gov/eere/bioenergy/key-activities>
- Side-by-side View: 1/17/2017 to 3/22/2017
- Change occurred between **Mar 20, 2017 5:54 AM ET** and **Mar 22, 2017 1:16 AM ET**

Screenshot 2.1

Changes to the Introduction Section:

(2.1a) The key activities of the U.S. Department of Energy's Bioenergy Technologies Office (BETO) are aimed at developing a viable, sustainable domestic biomass industry that produces renewable biofuels, bioproducts, and biopower; enhances U.S. energy security; reduces U.S. oil dependence..." to "The key activities of the U.S. Department of Energy's (DOE's) Bioenergy Technologies Office (BETO) are aimed at developing a viable, sustainable domestic biomass industry that produces renewable biofuels, bioproducts, and biopower; enhances U.S. energy security; reduces dependence on foreign oil..."

(2.1b) Removed parenthetical "e.g. reduced greenhouse gas emissions" from phrase "provides environmental benefits (e.g. reduced greenhouse gas emissions)"

(2.1c) Removed "Deployment" from text "Research, Development, Demonstration, and Deployment" linking to https://energy.gov/eere/bioenergy/key-activities#RDD_D

Changes to the "OFFICE SUMMARIES" Section:

(2.1d) Added bullet point: "BETO released its updated strategic plan in December 2016, titled [Strategic Plan for a Thriving and Sustainable Bioeconomy](#), which provides a blueprint on how best to tackle the challenges and opportunities that lie ahead in building the U.S. bioeconomy."

Changes to the "RESEARCH, DEVELOPMENT, AND DEMONSTRATION" Section:

(2.1e) Changed "...the most promising targets for follow-on industrial-scale demonstration and deployment" to "...the most promising targets for follow-on industrial-scale demonstration."

Comparison of https://energy.gov/eere/bioenergy/key-activities - history - enable javascript - view as gist

Jan 17 2017 10:13 AM rendered: side-by-side Mar 22 2017 1:16 AM

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KEY ACTIVITIES

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The key activities of the U.S. Department of Energy's Bioenergy Technologies Office (BETO) are aimed at developing a viable, sustainable domestic biomass industry that produces renewable biofuels, bioproducts, and biopower; enhances U.S. energy security; reduces U.S. oil dependence; provides environmental benefits (e.g., reduced greenhouse gas emissions); and creates nationwide economic opportunities. Meeting these goals requires significant and rapid advances in the entire biomass-to-bioenergy supply chain—from the farmer's field to the consumer.

Use the links below to jump to specific areas of interest:

- Office Summaries
- Research, Development, Demonstration, and Deployment
- Budget
- Partnerships

OFFICE SUMMARIES

- The Bioenergy Technologies Office Multi-Year Program Plan outlines BETO's strategy for research, development, and demonstration of various biomass technologies.
- The **overview publication, Replacing the Whole Barrel to Reduce U.S. Dependence on Oil**, provides highlights of BETO's major research, development, and demonstration activities to advance biomass conversion, technology integration in biorefineries, and supply logistics to provide a secure, sustainable supply of advanced biofuels.
- The Bioenergy Technologies Office **Overview presentation** is an interactive walk through of the Office's vision of advancing the next generation biofuels and bioproducts industry and highlights the research and development activities being performed in an effort to achieve it.
- The peer review process, a biennial requirement for **all programs** in DOE's Office of Energy Efficiency and Renewable Energy, helps to guide BETO's future research and development activities. BETO will be hosting the 2017 Project Peer Review on March 5–10, 2017. Information about the event and reports from previous peer reviews can be found on the **2017 Project Peer Review Web page**.
- More BETO publications and information are available in the **Information Resources** section.

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RESEARCH, DEVELOPMENT, AND DEMONSTRATION

BETO uses an integrated framework to manage its research, development, and demonstration activities. BETO down-selects the most promising opportunities through systematic investigation and evaluation of a broad range of emerging technologies across several technology readiness levels. This approach supports a diverse technology portfolio in applied research and development, and identifies the most promising targets for follow-on industrial-scale **demonstration and deployment**. For more information on specific activities within BETO's program areas, please view the **Research and Development** section of this website.

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BUDGET

BETO currently requests funding by activity through the **Office of Energy Efficiency and Renewable Energy**. Annual budgets guide BETO activities, including research opportunities and funding opportunity announcements and **awards**. Budget focal points for BETO over the last **five** fiscal years have been on the following activities:

- Conversion Technologies
- Demonstration and Market Transformation
- Analysis & Sustainability
- Cookstoves***
- Advanced Algal Systems

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KEY ACTIVITIES

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Use the links below to jump to specific areas of interest:

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- Budget
- Policy
- Partnerships

OFFICE SUMMARIES

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- Replacing the Whole Barrel to Reduce U.S. Dependence on Oil**, provides highlights of BETO's major research, development, and demonstration activities to advance biomass conversion, technology integration in biorefineries, and supply logistics to provide a secure, sustainable supply of advanced biofuels.
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BUDGET

BETO currently requests funding by activity through **EERE**. Annual budgets guide BETO activities, including research opportunities and funding opportunity announcements and **awards**. Budget focal points for BETO over the last **five** fiscal years have been on the following activities:

- Conversion Technologies
- Demonstration and Market Transformation
- Analysis & Sustainability

Screenshot 2.2

Changes to the “BUDGET” Section:

(2.2a) Removed “cookstoves*” in the bullet point summary. Note: Asterisk indicates: “*BETO is no longer funding Cookstoves activities as of fiscal year 2015.”

(2.2b) Removed “NREL Site-Wide Facilities” in the bullet point summary.

(2.2c) Changed presentation of BETO budget from a chart to a table

Changes to the “POLICY” Section:

(2.2d) Removed “aggressive” from the phrase “The Energy Independence and Security Act (EISA) of 2007 sets aggressive goals...”

(2.2e) Changed "Reducing greenhouse gases from the transportation sector" to "Reducing harmful emissions from the transportation sector"

(2.2f) Removed “EISA built on the goals of the [Renewable Fuel Standard Program](#) contained in the Energy Policy Act of 2005 to 22 billion gallons of advanced renewable fuels by 2022.”

Comparison of <https://energy.gov/eere/bioenergy/key-activities-history> — [enable javascript](#) — [view as gist](#)

Jan 17 2017 10:13 AM rendered: side-by-side Mar 22 2017 1:16 AM

BUDGET

BETO currently requests funding by activity through the **Office of Energy Efficiency and Renewable Energy**. Annual budgets guide BETO activities, including research opportunities and funding opportunity announcements and **awards**. Budget focal points for BETO over the last **five** fiscal years have been on the following activities:

- Conversion Technologies
- Demonstration and Market Transformation
- Analysis & Sustainability
- **Cookstoves***
- Advanced Algal Systems
- Feedstock Supply and Logistics
- **NREL Site-Wide Facilities**

The **chart** below shows annual budgets (dollars in thousands) for BETO activities beginning in fiscal year (FY) 2013, as well as the 2017 budget request.

BETO Annual Budgets

Fiscal Year	Conversion Technologies	Analysis & Sustainability	Advanced Algal Systems	Feedstock Supply and Logistics	Demonstration and Market Transformation	Total
FY 2013	\$1,057	\$15,830	\$31,659	\$4,487	\$1,057	\$53,080
FY 2014	\$1,111	\$12,154	\$30,000	\$2,000	\$1,111	\$46,248
FY 2015	\$95,800	\$11,000	\$25,000	\$0	\$95,800	\$127,600
FY 2016	\$85,300	\$11,000	\$30,000	\$0	\$85,300	\$111,300
FY 2017 REQUEST	\$140,300	\$75,000	\$30,000	\$0	\$140,300	\$385,600

*BETO is no longer funding Cookstoves activities as of fiscal year 2015.

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POLICY

Federal and state policies support and guide the development and use of advanced biofuels. These policies range from directing and funding biofuels research, development, and **demonstration**, to ensuring interagency coordination of biofuels-related **efforts**, to requiring assessments of existing biofuels policies and programs. The main policy driver that influences BETO's efforts is the Energy Independence and Security Act:

- The **Energy Independence and Security Act (EISA) of 2007** sets **aggressive** goals calling for transportation fuel sold or introduced into commerce in the United States (on an annual average basis) **to contain** at least the **mandated** volume of renewable fuel, advanced biofuel, cellulosic biofuel, and biomass-based diesel, which help direct BETO activities and initiatives, including the **following**:
 - Moving renewable fuels into the marketplace
 - Reducing the nation's dependence on foreign sources of energy
 - Reducing **greenhouse gas emissions** from the transportation sector.
- EISA built on the goals of the Renewable Fuel Standard Program contained in the **Energy Policy Act of 2005** to 22 billion gallons of advanced renewable fuels by 2022.

BUDGET

BETO currently requests funding by activity through **EERE**. Annual budgets guide BETO activities, including research opportunities and funding opportunity announcements and **awards**. Budget focal points for BETO over the last **5** fiscal years have been on the following activities:

- Conversion Technologies
- Demonstration and Market Transformation
- Analysis & Sustainability
- Advanced Algal Systems
- Feedstock Supply and Logistics

The **table** below shows annual budgets (dollars in thousands) for BETO activities beginning in fiscal year (FY) 2013, as well as the **FY 2017** budget request.

BETO ANNUAL BUDGETS, FY 2013-FY 2017

ACTIVITIES	FY 13 (\$K)	FY 14 (\$K)	FY 15 (\$K)	FY 16 (\$K)	FY 17 REQUEST (\$K)
Conversion Technologies	\$81,057	\$111,387	\$95,800	\$85,300	\$140,300
Demonstration and Market Transformation	\$46,248	\$47,381	\$79,700	\$75,100	\$75,000
Analysis & Sustainability	\$15,830	\$12,154	\$11,000	\$11,000	\$11,000
Cookstoves	\$4,487	\$2,000	\$0	\$0	\$0
Advanced Algal Systems	\$31,659	\$30,000	\$25,000	\$30,000	\$30,000
Feedstock Supply and Logistics	\$19,523	\$23,907	\$7,000	\$16,500	\$22,000
National Renewable Energy Laboratory	\$0	\$5,000	\$6,500	\$6,500	\$0
Site-Wide Facilities	\$0	\$0	\$0	\$0	\$0
Total	\$198,804	\$232,429	\$225,000	\$225,000	\$278,900

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POLICY

Federal and state policies support and guide the development and use of advanced biofuels. These policies range from directing and funding biofuels research, development, and **demonstration**, to ensuring interagency coordination of biofuels-related **efforts**, to requiring assessments of existing biofuels policies and programs. The main policy driver that influences BETO's efforts is the Energy Independence and Security Act:

- The **Energy Independence and Security Act of 2007** sets goals calling for transportation fuel sold or introduced into commerce in the United States (on an annual average basis) **to contain** at least the **mandated** volume of renewable fuel, advanced biofuel, cellulosic biofuel, and biomass-based diesel, which help direct BETO activities and initiatives, including the **following**:
 - Moving renewable fuels into the marketplace
 - Reducing the nation's dependence on foreign sources of energy
 - Reducing **harmful emissions** from the transportation sector.

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PARTNERSHIPS

BETO works with other federal agencies, **national laboratories**, industry, **nonprofit** organizations, and academia to share and learn from valuable insights and perspectives that can help identify the most critical challenges facing the biofuels industry. By **using** partnerships, BETO is able to better define and employ strategies with partners to overcome challenges in effectively deploying biofuels and bioproducts. Some key partnerships include the following:

- **National Laboratories**
 - Argonne **National Laboratory**
 - Idaho **National Laboratory**
 - Lawrence Berkeley **National Laboratory**
 - Los Alamos **National Laboratory**
 - National **Renewable Energy National Laboratory**
 - **Purdue University**

Internet Archive: [previous version from December 18, 2016](#) and [current version from April 6, 2017](#)

Page 3: ACCOMPLISHMENTS AND SUCCESSES

- URL: <https://energy.gov/eere/bioenergy/accomplishments-and-successes>
- Side-by-side View: 1/17/2017 to 3/22/2017
- Change occurred between **Mar 20, 2017 10:15 AM ET** and **Mar 22, 2017 6:12 AM ET**

Screenshot 3.1

Changes to Introduction Section:

(3.1a) Altered language from "a sufficient quantity to displace approximately 30% of the U.S. petroleum consumption without impacting food or feed needs" to "without impacting food, feed, and fiber needs".

(3.1b) Added sentence "The potential production could, in turn, directly generate \$30 billion in revenue and 1.1 million jobs in a variety of sectors including farming, plant operations, scientific research, and product and equipment design".

(3.1c) Changed "transportation-related greenhouse gas emissions" to "transportation-related emissions".

Changes to the "SUCSESSES" Section:

(3.1d) Renamed section from "Growing America's Energy Future: Bioenergy Technologies Office Successes of 2014" to "Bioenergy Technologies Office Fiscal Year 2016 Successes"

(3.1e) Text "Fact Sheet" linked to URL

<https://energy.gov/eere/bioenergy/downloads/growing-america-s-energy-future-bioenergy-technologies-office-successes> changed to link URL

<https://energy.gov/eere/bioenergy/downloads/bioenergy-technologies-office-fy-2016-successes>

(3.1f) Changed "Building on 2013 successes, 2014 was a year of many BETO achievements, including cellulosic ethanol biorefinery openings and reductions toward cost goals for hydrocarbon fuels." to "Fiscal year (FY) 2016 realized advances in renewable jet fuel and feedstocks research, as well as other hydrocarbon biofuel research and development breakthroughs."

(3.1g) Removed section: "2014 built on previous BETO successes"

(3.1h) Text "BETO Multi-Year Program Plan" linked to URL

<https://energy.gov/eere/bioenergy/downloads/bioenergy-technologies-office-multi-year-program-plan-march-2015-update> changed to link URL

<https://energy.gov/eere/bioenergy/downloads/bioenergy-technologies-office-multi-year-program-plan-march-2016>

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The Bioenergy Technologies Office (BETO) forms cost-share public-private partnerships to help sustainably develop cost-competitive biofuels and bioproducts in the United States from non-food biomass resources. The potential exists to sustainably produce at least one billion dry tons of non-food biomass resources by 2030—a sufficient quantity to displace approximately 30% of the present U.S. petroleum consumption without impacting food or feed needs. Biofuels are a major component of the U.S. Department of Energy's (DOE's) multipronged strategy to address energy security, transportation-related greenhouse gas (GHG) emissions, and U.S. job growth.

Read more about our accomplishments and successes by year:
2014
2013

To learn more about our approach to RD&D and our technology areas, visit the [Research and Development Web page](#). To learn more about the goals and structure of the Bioenergy Technologies Office, see the BETO Multi-Year Program Plan. See [news](#) and the [blog](#) for more recent accomplishments.

GROWING AMERICA'S ENERGY FUTURE: BIOENERGY TECHNOLOGIES OFFICE SUCCESSES OF 2014


Fact Sheet

Building on 2013 successes, 2014 was a year of many BETO achievements, including cellulosic ethanol biorefinery openings and reductions toward cost goals for hydrocarbon fuels.

2014 built on previous BETO successes:

- In 2012, BETO successfully demonstrated two biofuel pathways that can produce cellulosic ethanol at a modeled nth plant cost of approximately \$2 per gallon—a 77% reduction in cost from an estimated \$8.16 in 2001. This milestone was accomplished through DOE support of research and development (R&D) at national laboratories, academic institutions, and industry.
- In 2013, the nation's first cellulosic ethanol biorefinery, INEOS Bio's Indian River BioEnergy Center in Vero Beach, Florida, held its grand opening, made possible by \$50 million in cost-shared DOE funding.

POET-DSM & ABENGOA: GRAND OPENINGS OF CELLULOSIC ETHANOL BIOREFINERIES



In September and October 2014, POET-DSM's Project LIBERTY in Emmetsburg, Iowa, and Abengoa's Bioenergy Biomass of Kansas facility in Hugoton, Kansas, held their grand openings, becoming the first U.S. biorefineries to use corn stover (corn husks, cobs, stalks, and residue), as a feedstock and the second and third commercial-scale cellulosic ethanol plants in the nation. POET-DSM and Abengoa each received \$100 million in BETO cost-shared funding over seven years to design and construct their facilities. Abengoa also received a \$132 million loan

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The Bioenergy Technologies Office (BETO) forms cost-share public-private partnerships to sustainably develop cost-competitive biofuels and bioproducts. The United States has the potential to sustainably produce at least 1 billion dry tons of non-food biomass resources annually by 2030 without impacting food, feed, or fiber needs. This potential production could, in turn, directly generate \$200 billion in revenue and 1.1 million jobs in a wide range of sectors, including farming, plant operations, scientific research, and product and equipment design. Biofuels are a major component of the U.S. Department of Energy's multipronged strategy to address energy security, transportation-related emissions, and U.S. job growth.

Read more about our accomplishments and successes by year:
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BIOENERGY TECHNOLOGIES OFFICE FISCAL YEAR 2016 SUCCESSES

Fact Sheet

Fiscal year (FY) 2016 realized advances in renewable jet fuel and feedstocks research, as well as other hydrocarbon biofuel research and development breakthroughs.

AVIATION INDUSTRY INVESTS IN RENEWABLE FUELS MADE FROM WASTE GASES



Working with Pacific Northwest National Laboratory (PNNL), biofuel producer LanzaTech received \$4 million in funding from BETO to develop a process that not only provides a sustainable source of renewable jet fuel, but also offers an innovative solution to industrial waste management. Carbon-rich industrial waste gases like carbon monoxide are captured or derived from the gasification of biomass and fed to microbes, which consume the gas and produce ethanol. The ethanol is then upgraded into synthetic paraffinic kerosene, a renewable jet fuel compatible with existing engines. The team has successfully produced 1,500 gallons of jet fuel so far using this process. Moving forward, LanzaTech has partnered with Virgin Atlantic, Boeing, and a number of other industry colleagues to complete additional aircraft and engine testing with the hopes of making a "proving flight" as early as 2017. If successful, this will enable the partnership to seek approval to use the fuel on routine commercial flights.

Screenshots 3.2-3.4

Note: The "SUCCESES" section was changed from "Growing America's Energy Future: Bioenergy Technologies Office Successes of 2014" to "Bioenergy Technologies Office Fiscal Year 2016 Successes". Shown below is a complete list of title removals (red highlights) and additions (green highlights). See the side-by-side comparison for the full text.

Removed

1. POET-DSM & ABENGOA: GRAND OPENINGS OF CELLULOSIC ETHANOL BIOREFINERIES
2. FIRST U.S. CELLULOSIC ETHANOL COMMERCIAL SHIPMENT AND WOODY BIOMASS RINS
3. THREE YEARS OF ALGAE RESEARCH PUBLISHED
4. COMPLETED FEEDSTOCK LOGISTICS PROJECTS DEMONSTRATE SIGNIFICANT COST REDUCTIONS
5. DEFENSE PRODUCTION ACT BIOREFINERIES PROGRESS TO CONSTRUCTION STAGE
6. TOOL QUANTIFIES BIOFUEL WATER FOOTPRINT
7. CONVERSION COST TARGET REACHED

Added

1. AVIATION INDUSTRY INVESTS IN RENEWABLE FUELS MADE FROM WASTE GASES
2. WORLD'S LARGEST COMMERCIAL-SCALE CELLULOSIC ETHANOL FACILITY OPENS
3. 2016 BILLION-TON REPORT CONFIRMS U.S. POTENTIAL TO PRODUCE 1 BILLION TONS OF BIOMASS ANNUALLY
4. BENEFITS OF HIGH-OCTANE FUELS VERIFIED
5. PATHWAYS TO BIOFUELS AND BIOPRODUCTS EXPANDED
6. SIX YEARS OF ALGAL RESEARCH
7. NEXT-GEN BIOMASS CONVERSION TECHNOLOGY UNVEILED
8. SHRUB WILLOW PROVIDES RENEWABLE ENERGY AND ENHANCES ENVIRONMENTAL BENEFITS
9. PROCESS CONVERTS SEWAGE TO BIOFUEL
10. REGIONAL FEEDSTOCK PARTNERSHIP REPORT HIGHLIGHTS SEVEN YEARS OF WORK TO ENABLE BILLION-TON VISION
11. IMPROVED PROCESS BOOSTS ALGAL FUEL YIELD
12. NEW PILOT PLANT DEMONSTRATES THE POTENTIAL TO CO-PROCESS BIOMASS STREAMS WITH PETROLEUM

Screenshot 3.2


Comparison of <https://energy.gov/eere/bioenergy/ accomplishments-and-successes> — history — enable javascript — view as gist

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As of late 2014, all five BETO-funded high-tonnage feedstock logistics projects (2010 funding) have been completed, demonstrating significant cost reductions (\$13 per dry matter ton on average) for collecting, storing, and transporting cellulosic feedstocks. AGCO Corporation, FDC Enterprises, TennEra LLC, the State University of New York College of Environmental Science and Forestry, and Auburn University worked in partnership with original equipment manufacturers to develop commercial harvesting equipment for corn stover, switchgrass, and woody biomass feedstocks. Some of these technologies are already on the commercial market. Demonstrated cost reductions include

- AGCO Corporation: 29% reduction (\$51.54 per dry ton to as low as \$36.75 per dry ton) for single-pass harvesting, high-density baling, and modified trailers
- FDC Enterprises: 25% reduction (\$50.78 per dry ton to as low as \$37.89 per dry ton) for self-propelled balers, high-density balers, self-propelled bale pickup trucks, and self-loading/unloading trailers
- TennEra LLC: 7% reduction (\$56.38 per dry ton to \$52.34 per dry ton) for field chopping, bulk handling, and storage

DEFENSE PRODUCTION ACT BIOREFINERIES PROGRESS TO CONSTRUCTION STAGE



In 2011, the Secretaries of Agriculture, Energy, and Navy signed a Memorandum of Understanding to commit \$510 million (\$170 million from each agency) to produce renewable jet and diesel fuels in the near term. In September 2014, three biorefinery projects were selected to continue to construction stage with Phase II funding (up to \$70 million each): Emerald Biofuels (82 million gallons per year capacity from waste fats); Fulcrum BioEnergy (10 million gallons per year capacity from municipal solid waste); and Red Rock Biofuels (12 million gallons per year capacity from woody biomass).

TOOL QUANTIFIES BIOFUEL WATER FOOTPRINT

In partnership with BETO, Argonne National Laboratory released WATER, version 2.0, the first national-scale, U.S.-centered model for quantifying the water footprint of various biofuel pathways. This tool advances responsible deployment of bioenergy technologies under water constraints by providing analytical and decision-making support to researchers, feedstock producers, biorefineries, and federal and state policymakers. Sustainable bioenergy production relies on aligning water demands with water availability, protecting water supplies and aquatic ecosystems, and maximizing the use of impaired—rather than pristine—water for growing feedstocks. WATER 3.0 has since been released with additional features.


CONVERSION COST TARGET REACHED

BETO's thermochemical conversion R&D achieved a \$4.09 per gallon gasoline equivalent (GGE) modeled mature conversion cost of advanced biofuels, which translates to a fuel selling price of \$5.26 per GGE, based on an nth plant modeled price (a reduction of \$0.51 from fiscal year 2013).² Reaching this milestone keeps BETO on track to validate a modeled mature price of \$3 per GGE for advanced biofuel by 2017 for one technology route, reducing GHG emissions by at least 60%.

2016 BILLION-TON REPORT CONFIRMS U.S. POTENTIAL TO PRODUCE 1 BILLION TONS OF BIOMASS ANNUALLY

In July 2016, DOE and Oak Ridge National Laboratory (ORNL) jointly released the *2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy*, Volume 1, which concludes that the United States has the potential to sustainably produce at least 1 billion dry tons of non-food biomass resources annually by 2040. Specifically, models used for the report predict that the United States could increase its use of dry biomass resources from a current 400 million tons to 1.5 billion tons under a high-yield scenario. This report is the third in a series, preceded by the 2011 *U.S. Billion-Ton Update* and the 2005 *Billion-Ton Study*, and is split into two volumes. Volume 2 focuses on the environmental sustainability effects of scenarios presented in Volume 1. New to the 2016 report are novel assessments of potential biomass supplies from algae, new energy crops (miscanthus, energy cane, eucalyptus), and municipal solid waste. For the first time, the report also considers how the cost of pre-processing and transporting biomass to the biorefinery may impact feedstock availability.

BENEFITS OF HIGH-OCTANE FUELS VERIFIED




Researchers at ORNL, along with NREL and Argonne National Laboratory (ANL), verified a 5%-10% improvement in fuel efficiency using an optimized bio-based blend of gasoline with a modified car engine. This blend increases the octane rating of the fuel, which also translates to vehicle performance benefits such as faster acceleration and greater towing capacity. The ethanol in the gasoline blend increases the octane level, and the fuel's high octane rating offsets the lower energy density of the fuel. Increased concentrations of ethanol can also mean significant reductions in harmful tailpipe emissions. When using gasoline with 40% cellulosic ethanol—made from non-food biomass resources such as corn husks and stalks, grasses, forestry residues, organic wastes, and algae—researchers have found a way to reduce harmful tailpipe emissions by 30%. Cellulosic ethanol has become cost-competitive in the past few years, enabling a path to commercialization. Moving forward, national laboratory researchers are building off this work for the DOE's CoOptimization of Fuels and Engines Initiative.

PATHWAYS TO BIOFUELS AND BIOPRODUCTS EXPANDED

During 2016, BETO continued to focus on flexible conversion pathways for producing bioproducts alongside biofuels. Bioproducts can play an important role in enabling biofuel development, as profits from these value-added materials and diversification of market risks can help alleviate challenges with biofuel-related production costs. In March 2016, BETO competitively awarded funding to industrial biotechnology company Lygos, Inc. through the DOE Small Business Vouchers Pilot to further scale up its patented malonic acid fermentation pathway. In 2015, Lygos won an award for its bio-based method to produce malonic acid, which it demonstrated at the BETO-funded Advanced Biofuels Process Demonstration Unit at Lawrence Berkeley National Laboratory. In 2016, BETO also announced several funding opportunities to advance development of bio-based chemicals and products.

SIX YEARS OF ALGAL RESEARCH

Released in May 2016, the Consortium for Algal Biofuel Commercialization (CAB-Comm), led by the University of California, San Diego, released its final report, detailing the many accomplishments and impactful contributions it achieved in its six years of operation. CAB-Comm made substantial progress on three key aspects of algal biofuels production: (1) development of genetic tools, (2) crop protection, and (3) nutrient utilization and recycling. In addition to accomplishments in basic research, CAB-Comm engaged the commercial sector to develop and demonstrate the production of high-value, sustainable fossil fuel replacement products. Its education programs have trained more than 200 research scientists and laboratory technicians for employment in the algal biofuels industry. The results of CAB-Comm—together with feedback from public workshops and results from the National Alliance for Advanced Biofuels



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NEXT-GEN BIOMASS CONVERSION TECHNOLOGY UNVEILED

In June 2016, NREL researchers added new capabilities to its state-of-the-art Thermochemical Users Facility. Partnering with Particulate Solids Research, Inc., NREL installed a recirculating regenerating rear reactor (RCubed) in its pilot-scale Thermochemical Process Development Unit. Funded by BETO, this unique unit significantly improves the efficiency and reduces the costs associated with converting biomass into a finished fuel product. The front end of this innovative pilot-scale system makes use of fast pyrolysis—the rapid heating of biomass to 400–500°C in the absence of oxygen followed by cooling the resulting vapors into a liquid bio-oil. This bio-oil intermediate must then undergo additional processing in order to produce upgraded hydrocarbon “drop-in” fuel. However, these downstream upgrading steps are quite challenging, as bio-oil contains a variety of reactive oxygenated organic compounds. These challenges could be alleviated by improving the quality of the bio-oil intermediate by upgrading the vapors, prior to condensation—which is exactly what the RCubed reactor is designed to do. Pyrolysis vapors are fed to the unit, where they are exposed to a catalyst that reduces oxygen content and improves chemical stability. The result is an upgraded bio-oil that could more easily integrate into traditional petroleum refineries for further processing. The new capabilities of the recently outfitted Thermochemical Users Facility demonstrate promising pathways for “drop-in” hydrocarbon biofuel production and can be used in the coming years to produce hundreds of gallons of upgraded pyrolysis oil.

SHRUB WILLOW PROVIDES RENEWABLE ENERGY AND ENHANCES ENVIRONMENTAL BENEFITS

ANL partnered with the State University of New York, The Conservation Technology Information Center, the University of Michigan, and Southern Illinois University to examine the potential of energy crops like shrub willow to act as a buffer to intercept nitrate pollution to support its growth and improve water quality. Nitrogen is an important nutrient needed for plant growth. However, it can also pose environmental problems, particularly when heavy rains generate runoff, depositing these nutrients in nearby streams, lakes, and groundwater. By adding willow buffer strips in targeted locations in a corn field, ANL was able to reduce nitrate concentrations reaching shallow groundwater by over 30% relative to recorded losses from corn. ANL also determined that willow buffers could be cost competitive with commonly adopted nitrate-management conservation practices. This is a significant achievement that demonstrates that sustainable landscape design principles can be used to integrate bioenergy into existing farming systems in a way that improves ecosystem services, while maintaining food and feed production. Considering energy crops are projected to supply 41%–74% of the biomass in a billion-ton bioeconomy, studies like these can help the industry plan for the sustainable expansion of bioenergy systems.

PROCESS CONVERTS SEWAGE TO BIOFUEL

PNNL developed a process that uses high pressure and temperature to convert wet sewage sludge to biocrude oil in less than 60 minutes. The process eliminates the need to dry the sewage first, which is what made converting wastewater to fuel too expensive and energy intensive. Wastewater treatment plants in the United States treat enough sewage daily to produce approximately 30 million barrels of oil per year, and PNNL estimates that two to three gallons of biocrude per year could come from a single person. PNNL has licensed its hydrothermal liquefaction technology to Utah-based biofuel company Genfuel Corporation, which is working to build a demonstration plant with Metro Vancouver in British Columbia, Canada. PNNL first developed the technology in 2013. They also can use it to convert algae to biocrude.

REGIONAL FEEDSTOCK PARTNERSHIP REPORT HIGHLIGHTS SEVEN YEARS OF WORK TO ENABLE BILLION-TON VISION

The Regional Feedstock Partnership Summary Report, released in July 2016, summarized the accomplishments of the Regional Feedstock Partnership throughout the seven-year period of 2008 through 2014. The Regional Feedstock Partnership was established to address information gaps associated with enabling the vision of a sustainable, reliable, billion-ton bioenergy industry. The partnership is composed of representatives from land grant universities organized under the Sun Grant Initiative, DOE, the U.S. Department of Agriculture, and industry.

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IMPROVED PROCESS BOOSTS ALGAL FUEL YIELD

In 2016, NREL scientists developed a process known as Combined Algal Processing, which is highly effective at producing ethanol from algae when compared to traditional methods. Typically, algae produce lipids that are then converted into fuels. However, NREL determined that total ethanol yield could increase markedly by using all algal cellular components instead of just relying on the lipids. In addition to lipids, microalgal biomass can produce carbohydrates and proteins that can also be converted into fuel products. This new process exposes all algae components directly to the fermentation process. This resulted in 126 gallons gasoline equivalents per ton of biomass, 32% more than the yield from lipids alone.

NEW PILOT PLANT DEMONSTRATES THE POTENTIAL TO CO-PROCESS BIOMASS STREAMS WITH PETROLEUM

NREL partnered with leading petroleum refining technology supplier, W.R. Grace, and leading pilot plant designer, Zeton Inc., to build a unique pilot-scale facility that can produce biomass-derived fuel intermediates using existing petroleum refinery infrastructure. This pilot plant, constructed in part with BETO funding, combines biomass pyrolysis with fluid catalytic cracking—one of the most important conversion processes used in petroleum refineries—to demonstrate the potential to co-process biomass-derived streams with petroleum at an industrially-relevant pilot scale. There are 110 domestic fluid catalytic cracking units currently operating in the United States. Using them to co-produce biofuel could enable the production of more than 8 billion gallons of bio-derived fuels, without construction of separate bio-refineries.

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BETO's thermochemical conversion R&D achieved a \$4.09 per gallon gasoline equivalent (GGE) modeled mature conversion cost of advanced biofuels, which translates to a fuel selling price of \$5.26 per GGE, based on an nth plant modeled price (a reduction of \$0.51 from fiscal year 2013). Reaching this milestone keeps BETO on track to validate a modeled mature price of \$3 per GGE for advanced biofuel by 2017 for one technology route, reducing GHG emissions by at least 80%.

SHRUB WILLOW PROVIDES RENEWABLE ENERGY AND ENHANCES ENVIRONMENTAL BENEFITS

ANL partnered with the State University of New York, The Conservation Technology Information Center, the University of Michigan, and Southern Illinois University to examine the potential of energy crops like shrub willow to act as a buffer to intercept nitrate pollution to support its growth and improve water quality. Nitrogen is an important nutrient needed for plant growth. However, it can also pose environmental problems, particularly when heavy rains generate runoff, depositing these nutrients in nearby streams, lakes, and groundwater. By adding willow buffer strips in targeted locations in a corn field, ANL was able to reduce nitrate concentrations reaching shallow groundwater by over 30% relative to recorded losses from corn. ANL also determined that willow buffers could be cost competitive with commonly adopted nitrate-management conservation practices. This is a significant achievement that demonstrates that sustainable landscape design principles can be used to integrate bioenergy into existing farming systems in a way that improves ecosystem services, while maintaining food and feed production. Considering energy crops are projected to supply 41%–74% of the biomass in a billion-ton bioeconomy, studies like these can help the industry plan for the sustainable expansion of bioenergy systems.

PROCESS CONVERTS SEWAGE TO BIOFUEL

PNNL developed a process that uses high pressure and temperature to convert wet sewage sludge to biocrude oil in less than 60 minutes. The process eliminates the need to dry the sewage first, which is what made converting wastewater to fuel too expensive and energy intensive. Wastewater treatment plants in the United States treat enough sewage daily to produce approximately 30 million barrels of oil per year, and PNNL estimates that two to three gallons of biocrude per year could come from a single person. PNNL has licensed its hydrothermal liquefaction technology to Utah-based biofuel company Genfuel Corporation, which is working to build a demonstration plant with Metro Vancouver in British Columbia, Canada. PNNL first developed the technology in 2013. They also can use it to convert algae to biocrude.

REGIONAL FEEDSTOCK PARTNERSHIP REPORT HIGHLIGHTS SEVEN YEARS OF WORK TO ENABLE BILLION-TON VISION

The Regional Feedstock Partnership Summary Report, released in July 2016, summarized the accomplishments of the Regional Feedstock Partnership throughout the seven-year period of 2008 through 2014. The Regional Feedstock Partnership was established to address information gaps associated with enabling the vision of a sustainable, reliable, billion-ton bioenergy industry. The partnership is composed of representatives from land grant universities organized under the Sun Grant Initiative, DOE, the U.S. Department of Agriculture, and industry.

IMPROVED PROCESS BOOSTS ALGAL FUEL YIELD

In 2016, NREL scientists developed a process known as Combined Algal Processing, which is highly effective at producing ethanol from algae when compared to traditional methods. Typically, algae produce lipids that are then converted into fuels. However, NREL determined that total ethanol yield could increase markedly by using all algal cellular components instead of just relying on the lipids. In addition to lipids, microalgal biomass can produce carbohydrates and proteins that can also be converted into fuel products. This new process exposes all algae components directly to the fermentation process. This resulted in 126 gallons gasoline equivalents per ton of biomass, 32% more than the yield from lipids alone.

NEW PILOT PLANT DEMONSTRATES THE POTENTIAL TO CO-PROCESS BIOMASS STREAMS WITH PETROLEUM

NREL partnered with leading petroleum refining technology supplier, W.R. Grace, and leading pilot plant designer, Zeton Inc., to build a unique pilot-scale facility that can produce biomass-derived fuel intermediates using existing petroleum refinery infrastructure. This pilot plant, constructed in part with BETO funding, combines biomass pyrolysis with fluid catalytic cracking—one of the most important conversion processes used in petroleum refineries—to demonstrate the potential to co-process biomass-derived streams with petroleum at an industrially-relevant pilot scale. There are 110 domestic fluid catalytic cracking units currently operating in the United States. Using them to co-produce biofuel could enable the production of more than 8 billion gallons of bio-derived fuels, without construction of separate bio-refineries.

U.S. DEPARTMENT OF ENERGY

Office of Energy Efficiency & Renewable Energy
Forrestal Building
1000 Independence Avenue, SW
Washington, DC 20585

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