

# DOE Bioenergy Technologies Office (BETO) 2021 Project Peer Review

## 6.3.0.2 – Bioenergy Knowledge Discovery Framework (KDF)

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Analysis and Sustainability

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ORNL is managed by UT-Battelle, LLC for the US Department of Energy

# Project Overview

- *Provide access to bioenergy knowledge, data, and tools via a single access point*
- *Build on an open-source, customizable, and scalable infrastructure*
- *Bring bioenergy researchers and stakeholders together*
- *Optimize access to high priority data, models, and information*
  - *Ex. Billion-Ton 2016, Marine Biofuels, Sustainability Standards, Sun Grant Initiative (SGI Data)*



# 1 – Management

- Team Structure
  - KDF System Development – ORNL
    - Aaron Myers
    - Lee Walker
  - Content Management/Graphics – BETO
  - Media – BETO
- Pre-Release Weekly Meetings
  - KDF Development Team and Content Teams have weekly teleconference to track progress, discuss direction, and strategize for new capabilities as new capabilities are available for release
- Quarterly Updates
  - BETO Check-Ins: Quarterly conversations with BETO about project status, recent updates and deliverables
  - Reports: KDF Development Team summarizes progress, issues, challenges overcome, and upcoming focus in Quarterly Report
- Collaboration
  - Work with other labs to facilitate new capabilities

## 2 – Approach

- Building from and customizing existing open-source software to create a Government owned web-based collaboration framework for knowledge management and data visualization
- Using well established software development paradigms to collect user requirements and implement them in an easy-to-use application
- Data Access
  - Easy access to critical bioenergy data and information
  - Most relevant data is quickly accessible
- Community Engagement
  - Interacting with the KDF team to develop novel capabilities and ensure access to data
  - Establishment of stakeholder engagement plan and focus groups to guide technical development tasks and priorities
- Success Factors
  - Relevant, up-to-date content
  - Easy access to priority content and data
  - Engagement from user community

## 4 – Impact

- The fundamental objective of the KDF is to provide researchers with access to the tools, data, and information needed to help further research
- Brings together data from across the supply chain
- Access to Billion-Ton 2016 Data and Visualizations
  - 12,000 Unique Page Views
- Quick access to Key Topics (Sustainability Standards, High Octane Fuel Study, Sun Grant Data and other BETO funded research and analytics results
  - 1,200 Unique Page Views
- Technology developed and lessons learned from the KDF can be extended to other research domains within the Department of Energy



# 4 – Progress and Outcomes

- Application Upgrade
- Migrated the base software to Drupal Version 8 along with all data and content
- Moved to a curated content model
  - Only users that are contributing curated content can authenticate
  - All other data is publicly accessible
- Ability for real-time content management to reduce blockers from development team

The screenshot displays the Bioenergy Knowledge Discovery Framework (KDF) website. The header features the KDF logo and the text "BIOENERGY KNOWLEDGE DISCOVERY FRAMEWORK" and "U.S. DEPARTMENT OF ENERGY". Navigation links include "Key Topics", "Bioenergy Library", "Overview", and "Models & Tools".

The main content area includes:

- About the Bioenergy KDF:** A text block explaining the KDF's role in supporting a sustainable domestic bioeconomy, with an "Overview" button.
- Bioenergy Library:** A text block describing the library's contents, with a "Search" button.
- Bioenergy Data:** A section with a cornfield image and a list of links: Bioenergy Library, DOE Funded Research, Models & Tools, and Techno-Economic Analysis Database.
- Key Topics:** A section with a hay bale image and a list of links: High Octane Fuel Study, Short Rotation Woody Biomass Project, Sustainability Standards, and View All Key Topics.
- Billion-Ton Study:** A section with a colorful map image and a list of links: Billion-Ton 2016 Vol. 1, Billion-Ton 2016 Vol. 2, Billion-Ton 2016 Data Download, and Billion-Ton Update (2012).
- Associated Research:** A section with a wood chip image and a list of links: Bioenergy Research Centers, Biomass R&D Board, DOE National Labs, User Facilities, and View All.
- Bioenergy Technologies Office:** A section with the U.S. Department of Energy logo and a list of links: Bioenergy Technologies Office, Consortia, and News.
- Connect with Us:** A section with the KDF logo and social media links for Contact, Facebook, LinkedIn, and Twitter.

## 4 – Progress and Outcomes

- New Key Topic Pages
  - Short Rotation Woody Crops
  - Aviation Biofuels
  - Marine Biofuels
- Highlight Key Research
- Link directly to existing content within the KDF



### Project Summary


This DOE BETO-funded research project examined the environmental effects of short-rotation loblolly pine (*Pinus taeda*) production for bioenergy in the southeastern US using a watershed-scale experiment in a before-after, control-impact design. Environmental measurements included water and soil quality, hydrology, tree productivity, and stand-level ecophysiology. Most of these environmental metrics were measured before (for ~2 years) and after (for ~6 years) harvest, planting, and managing short-rotation loblolly pine for bioenergy on more than 50% of two treatment watersheds. These measurements were also collected in one mature timber reference watershed. The three study watersheds were located in the Upper Fourmile Creek watershed at the Savannah River Site in the Coastal Plain of South Carolina, USA. All silviculture practices in the two treatment watersheds followed South Carolina's Best Management Practices (BMPs) for forestry.



Aerial image of the two treatment watersheds and the harvested areas where loblolly pine seedlings were planted. Satellite image from the National Agricultural Imagery Program, US Department of Agriculture. Image from Griffiths et al. 2019.

# 4 – Progress and Outcomes

- Associated Research Content
- Grouping of related information to create connections between to KDF and related research that may not exist on the KDF
  - Consortia
  - Biomass R&D Board
  - National Labs
  - User Facilities



**BIOENERGY**  
KNOWLEDGE DISCOVERY FRAMEWORK

U.S. DEPARTMENT OF ENERGY

[Key Topics](#) | [Biomass Library](#) | [Overview](#) | [Models & Tools](#)


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**Associated Research**

Associated Research Category:  Apply

### Argonne National Lab


Argonne National Laboratory leverages scientific competencies in modeling and technology development to enable a carbon sparing, environmentally friendly economy through the integrated development of biofuels, bioproducts and ecosystem services.



### Idaho National Laboratory


The INL Bioenergy Program's mission is to support DOE in achieving their vision by developing processes and technologies through applied science and engineering that remove the barriers associated with accessing a sustainable, efficient feedstock supply.

INL is the nation's leading laboratory for bioenergy feedstock research. Specifically, INL's research is focused on addressing barriers associated with efficiently, economically, and sustainably supplying large quantities of quality feedstock to future biorefineries. This effort includes improving feedstock preprocessing technologies, understanding feedstock variability and its implications on conversion processes, feedstock supply system design and analysis, and at-scale equipment testing and design. INL feedstock research and development occurs at several scales, ranging from laboratory-scale, to bench-scale prototyping, to pilot-scale testing and demonstration in partnership with other national labs, industry, and academia.




### National Renewable Energy Laboratory

NREL's bioenergy research and development activities advance the technologies to produce bio-based energy, fuels, and products.




### Oak Ridge National Laboratory

Oak Ridge National Laboratory brings together experts from across scientific disciplines to analyze all aspects of the bioenergy supply chain—from biomass resources to the environmental sustainability of a fully developed bioeconomy. Current research focuses on conducting resource assessment and analysis, investigating methods to reduce logistics costs for the bioenergy industry, determining best management practices for socioeconomic and environmental sustainability, ensuring infrastructure and biorefinery materials are compatible with bio-oils, developing biocomposites for 3D printing, and developing new technologies to enable lower-cost conversion of biomass to biofuels and bioproducts.




### Pacific Northwest National Laboratory

PNNL bioenergy research and development focuses on processes that convert biomass and wastes into chemicals and biofuels that are infrastructure ready (e.g., gasoline, diesel and jet fuel). Researchers with technical expertise in advanced biotechnology, catalysis, and thermal processing enable these advances to take place.



### Biomass Research and Development Board

The Biomass Research and Development (BR&D) Board coordinates research and development activities concerning bio-based fuels, products, and power across federal agencies, and aims to maximize the benefits of federal programs and bring coherence to federal strategic planning. The BR&D Board oversees the interagency Bioeconomy Initiative, a coordinated federal effort to expand the sustainable use of the nation's abundant biomass resources for biofuels, bioproducts, and biopower. The vision of the Bioeconomy Initiative is a vibrant U.S. bioeconomy that





# Future Work

- Integration of new tools
  - BioSTAR
- Enhanced Geospatial data search
- Identify and create new key topic pages
- Explore integrations for other data
  - Techno-Economic Analysis Database

# Summary

- **Approach**

- Design and develop a robust, collaborative informatics framework

- **Technical Accomplishments**

- System Upgrade
- Content Curation
- New Key Topic Pages
- Associated Research Content

- **Impact**

- Providing access to most up-to-date Bioenergy Data

# Quad Chart Overview

## Timeline

- Start: FY2007
- End: FY2022

	FY20	Active Project
<b>DOE Funding</b>	(10/01/2019 – 9/30/2022)	\$200K

## Project Partners\*

- Include National Lab Partners

## Barriers addressed

- At-C Data Availability
- At-A Comparable, Transparent, and Reproducible Analysis

## Project Goal

Bring the latest relevant bioenergy data to research community, industry, and the public.

## End of Project Milestone

Provide a well maintained, up-to-date, bioenergy data repository for archival and sharing with stakeholders.

## Funding Mechanism

Annual AOP Funding

# Additional Slides



# Responses to Previous Reviewers' Comments

- Question: Relative site analytics (compared to previous years or peer review cycles) would be helpful to see if usage is growing over time.
- Answer: Setting the proper criteria to understand impacts in a web application like the KDF can be difficult. Just looking at number of page views or user accounts doesn't tell the full story. The value of the KDF is easing the access to high value data and exploration tools that were previously difficult to obtain. An example used with the Billion-Ton Update was that in a given year having the data accessible on the KDF saved DOE around \$1 million because researchers were no longer having to field requests for data access or to subset the data for their specific needs this was done for them on the KDF.

# Responses to Previous Reviewers' Comments

- Question: It was not clear how much guidance there is for users accessing data on the KDF. Also, it appears that the main uses of the KDF are to visualize results from the BT16. KDF developers may want to think about how to expand the use of this resource. Sustainability is one of those topics that everyone has their own take on the concept, so you should probably acknowledge some of the other more established approaches or make clear that the ORNL focus is intentional.
- Answer: The high priority topic areas (Billion-Ton 2016, Sustainability Standards, High Octane Fuel Study, etc.) are the key draw to the KDF. Reviewing user interaction of these areas and how to promote the data better is something the KDF team is aware of and plans to address as the KDF moves forward.

# Publications, Patents, Presentations, Awards, and Commercialization

- "Bioenergy KDF: Enabling Spatiotemporal Data Synthesis and Research Collaboration"
  - Second place for best paper at the ACM SIGSPATIAL Conference, November 4–7, 2014 in Dallas, Texas.
- The underlying architecture developed for the Bioenergy KDF is supporting a similar capability for DOE SFWD and for Energy-Water Nexus KDF