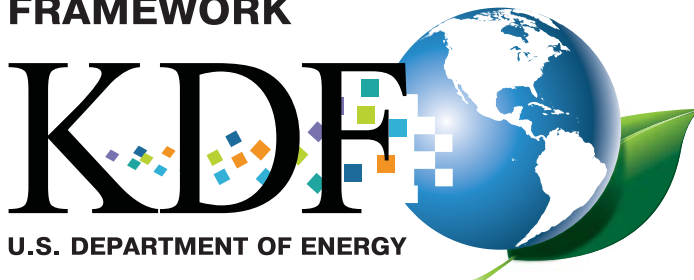


**BIOENERGY
KNOWLEDGE DISCOVERY
FRAMEWORK**

U.S. DEPARTMENT OF ENERGY

Mapping the future of bioenergy with Geographic Information Systems (GIS) and other cutting edge data and tools

Sustainable Future for Bioenergy

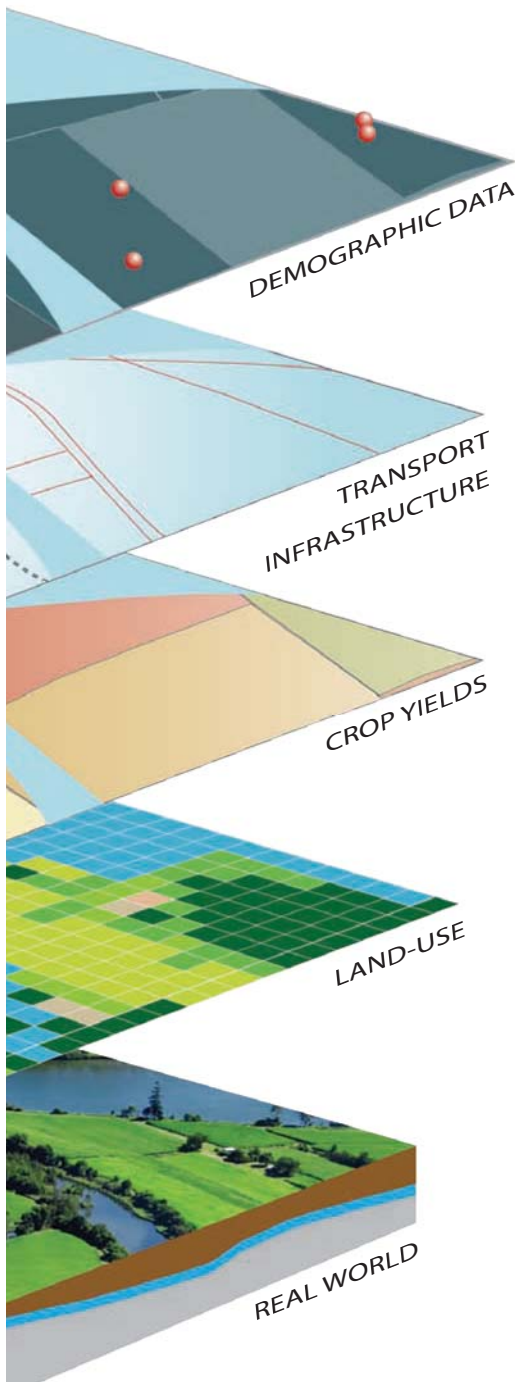
To meet the mandated national bioenergy goals, the evolving bioenergy industry in the United States must be efficient, reliable, and sustainable. A key challenge in achieving these goals is synchronizing all the steps in the biomass-to-biofuels supply chain—from biomass production and logistics to bioenergy production, distribution, delivery, and end use. Each current and proposed production system will be subject to economic, environmental, and infrastructure challenges unique to its region. While bioenergy demand and end use may be concentrated in highly populated areas, its production may be dispersed throughout the U.S. Determining the optimal sustainable solutions, therefore, requires considering a variety of regional factors, including climate, soils, transportation routes, and vehicle fleets.

**Achieving the Vision**

The development of a sustainable bioenergy industry requires thorough knowledge integration and decision-support. The [Bioenergy Knowledge Discovery Framework \(KDF\)](#) facilitates informed decision making by providing a means to synthesize, analyze, and visualize vast amounts of information in a spatially integrated manner. This GIS-based framework allows users to comprehensively analyze the economic and environmental impacts of various development options for biomass feedstocks, biorefineries, and infrastructure. Analysis and visualization of socioeconomic and industrial factors integrated with spatial data can be used for planning, development, and management decisions, ensuring reliable and sustainable bioenergy production.

What is a Geographic Information System?

Geographic Information Systems (GIS) are collections of data where every data point has an explicit spatial location. Essentially, a GIS can be thought of as a digital model of the physical world where every data point corresponds to a place. Modern GIS are suites of hardware, software, and electronic databases built from a variety of data sources that can range from remotely sensed measurements to waypoints collected in the field with handheld devices. Geographic information science is an advanced field that utilizes GIS to enable researchers to analyze, visualize, and synthesize vast amounts of information to help understand real world interactions and support decision making processes. GIS is a critical component in planning and deploying renewable energy technologies, including biomass production capabilities.



Data Framework

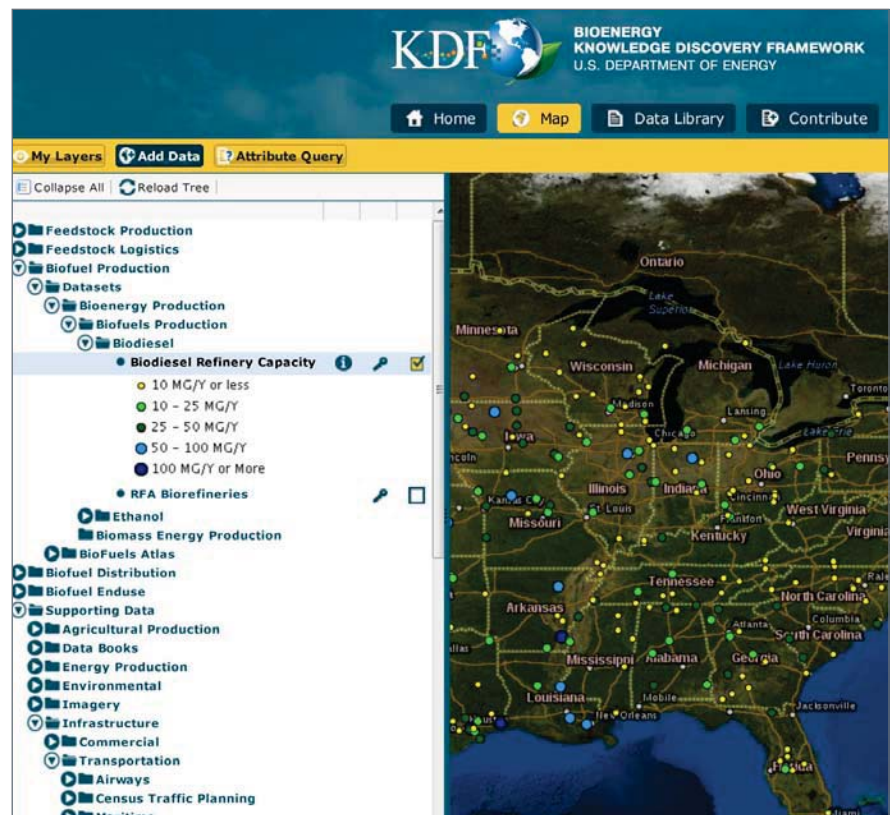
- Robust geospatial technology framework for data collection, integration, and management to ensure quality analysis and visualization
- Dynamic, distributed architecture that integrates data, models, and tools developed by DOE with those from other federal partners, industry, and academia
- Web-enabled and interactive access
- Role-based user access to relevant content, determined by security and data restrictions
- Standards-based technology framework that allows integration of data, models, and tools from distributed archives
- Components accessible through multiple platforms, from desktops to handheld devices

User Interface Features

- Easy labeling functions that allow users to associate related literature, data, and models
- Quick search function for rapid information access and easily accessible folder tree for more thorough data exploration
- Multi-site search for easy access to data and publications from external organizations, such as the U.S. Department of Agriculture or Open Energy Info
- Data uploading capabilities that allow users to keep data private, share with specific users, or make available to everyone who has an account on the KDF

A Framework Built Through Collaboration

Developed by Oak Ridge, Argonne, and Idaho National Laboratories and university partners under the direction of the Biomass Program, the KDF is helping achieve the vision of a biomass-based energy generation and delivery network that provides reliable, cost-effective, and sustainable bioenergy.

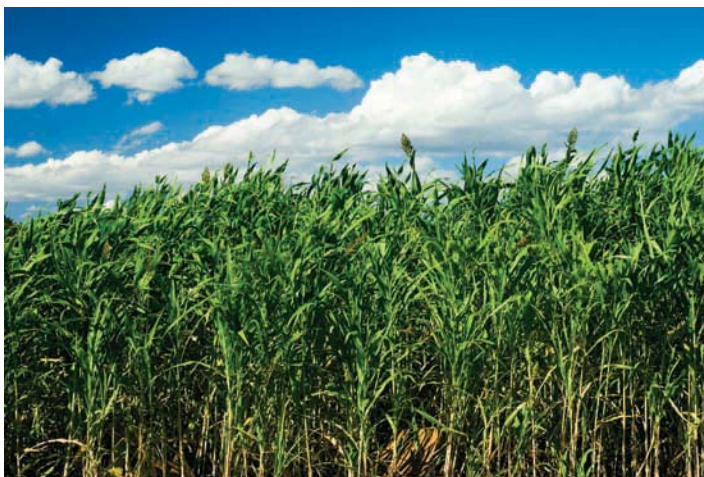
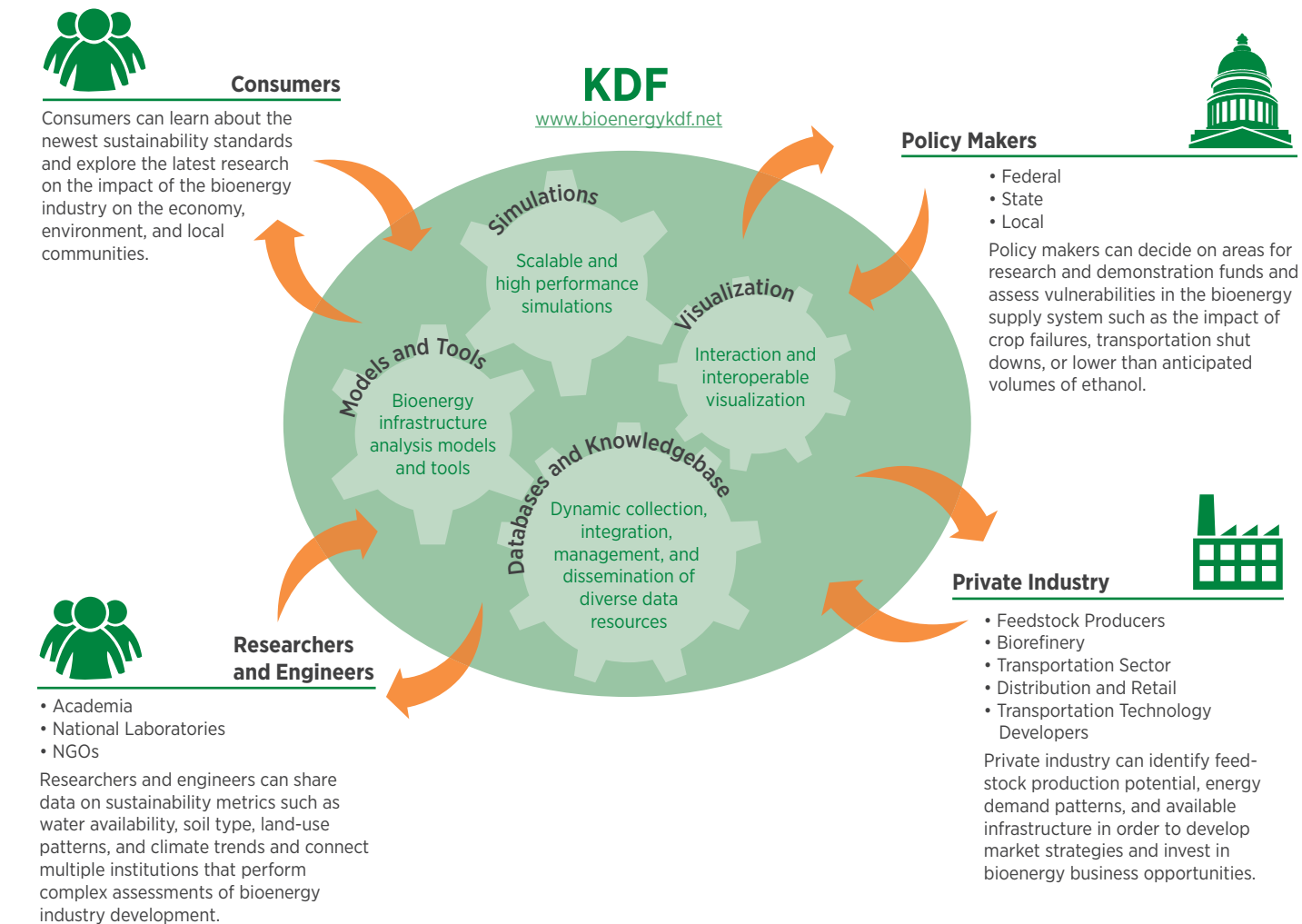


The online KDF interface (www.bioenergykdf.net) offers users news and research highlights, search functions, data access, mapping tools, and more.

Supporting complex decisions

As a national decision-support framework, the Bioenergy KDF unlocks the value of readily available and existing information to support the development of a sustainable and robust bioenergy industry. It helps individuals and organizations identify promising areas for feedstock production and processing, assess relevant infrastructure resources at multiple

scales, and evaluate the potential for biofuels to meet legislated renewable fuels targets. The decision-support provided by the KDF can also improve efforts to reach air quality, water resources, land conservation, and other environmental goals by fostering information exchange and collaboration between stakeholders.



Knowledge Discovery

Knowledge discovery, an advanced area of study at the intersection of computer and data sciences, enhances decision making through the analysis of dynamic and disparate databases of information and patterns. The Bioenergy Knowledge Discovery Framework (KDF) is a collaborative decision-support environment designed to foster the discovery of optimal bioenergy pathways and infrastructure solutions by integrating data, models, and visualization tools available from across government, private industry, and academia.

Integrating the Biomass Program’s research portfolio:

The KDF is the portal for bioenergy data from many GIS projects receiving support from the Biomass Program, including efforts to analyze algal growth potential, site integrated biorefineries, and understand land-use change.

Sun Grant Initiative Feedstock Partnerships GIS Resource Assessment

An integrated effort to collect energy crop field trial data from the Regional Feedstock Partnership program and develop regional GIS-based tools. These tools will advance understandings of regional differences in crop productivity and the nutrient and water requirements for growing dedicated energy crops.

Feedstock Supply Logistics Sustainability Analysis

An Idaho National Laboratory effort to couple a GIS-based crop resource model with a feedstock supply system model. The coupled model will help produce accurate and spatially explicit harvest assessment modeling.

Microalgae Biofuel Potential

A systematic, GIS-based national assessment of microalgae production potential throughout the United States led by the Pacific Northwest National Laboratory. The assessment will speed the development of economically feasible algal production schemes.

International Projects

The Program is partnering with Conservation International to identify and avoid siting biofuel crops in areas of biodiversity concern. In addition, Oak Ridge National Laboratory is documenting and modeling global systems of biofuels-driven land-use change.

National Biorefinery Siting Model

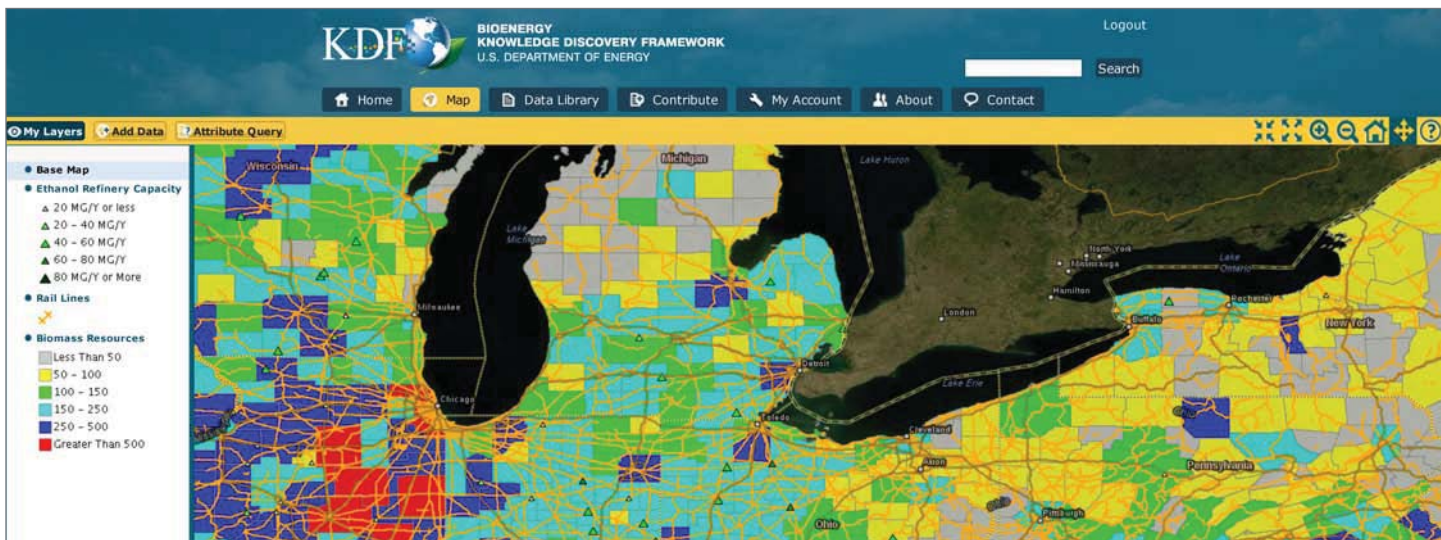
An initiative involving the Western Governors Association working with federal, national lab, and academic partners to develop a GIS-based, spatially resolved biomass supply and biorefinery optimization model for the United States.

Alternative Fuels and Advanced Vehicles Data Center

A National Renewable Energy Laboratory led initiative to support alternative fuels by providing interactive maps of infrastructure, alternative fueling stations, and biomass production. This outreach helps fleets and consumers make transportation decisions and helps educate the public about the accessibility of alternative fuels and advanced vehicles.

Regional Land-Use Change Modeling

An initiative at the Great Lakes Bioenergy Regional Center to link biogeochemical models of carbon dynamics, soil erosion, and nutrient loading to spatially explicit information on cropland in the United States. This project will help understand and model the role of biofuels and land management as they relate to carbon sources and sinks.



A KDF map showing biorefinery locations, rail lines, and biomass resource availability. Data from many Biomass Program projects can be combined with data from external sources and shared for analysis and visualization through the KDF (www.bioenergykdf.net).