

Bioenergy Knowledge Discovery Framework (Bioenergy KDF)

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Analysis and Sustainability
Platform Review

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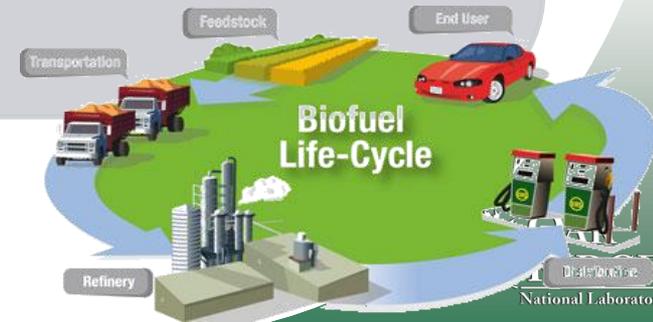
Credible data and knowledge provide the foundation for success

Goal

Efficient planning, development, and management of the U.S. bioenergy infrastructure

Provide data analysis, synthesis, and visualization capabilities that facilitates informed decision making

- All agencies make large investments in collecting and producing data and developing institutional knowledge
 - Little effort goes towards making this data and knowledge searchable, accessible and usable
 - “Reinventing the wheel” becomes a norm and not exception
- Isolated data silos leads to “information fragmentation”
 - Large data volumes, distributed sites
 - Limited access to data, information, tools
 - Difficult to form a holistic view



Guidance for Analysis and Decisions

- **What models are available for siting biorefineries?**
 - Community models available?
- **Which model should I chose and why?**
 - Appropriate spatial and temporal scales?
- **How do I find data to support the model(s)?**
 - Quality assurance for data? Currency?
- **How do I validate my results?**
 - Model output meaningful?
 - Reasons for difference?
- **Has this been done already?**
 - Publications exist? Lessons learnt?
- **Who else is interested? Who can help?**
 - SME database? Services available?

Interactive and Interoperable Visualization

**Development of High Performance,
Scalable Simulations**

**Development and Assimilation of Bioenergy Grid
and Infrastructure Analysis Models and Tools**

Knowledgebase Creation

**Dynamic Collection, Integration, Management,
and Dissemination of Disparate Data Resources**



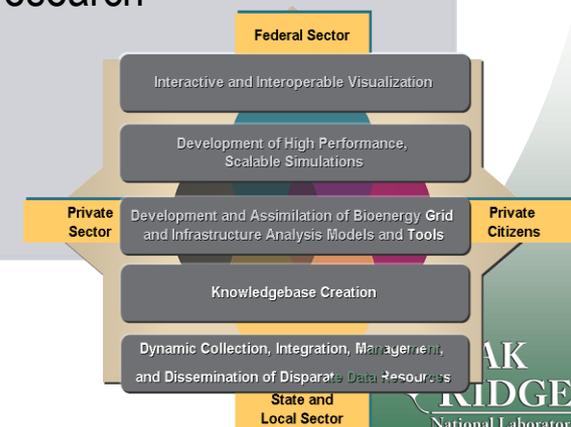
Bioenergy Knowledge Discovery Framework

Approach

Design and develop a robust geospatial technology and informatics framework

Collaboration through partnerships and shared resources

- Promote sharing and integration of distributed resources
- Engage various stake holder communities
- Offer guidance and access to comprehensive data, modeling, and visualization resources
- Incorporate DOE-OBP and partner funded research



Develop Capabilities for Bioenergy Infrastructure Modeling and Analysis

- User requirement analysis
 - Assessing the needs for data and analysis functionalities of DOE and other agencies
- Design a scalable system architecture
 - Design a secure, reliable, system for wide adoptability and usage
- Efficient biomass resource assessment
 - Evaluate data resources
 - Serve Billion Ton Update
 - Develop GIS based analytical approaches for resource assessment and sustainable production
- Optimizing geospatial data and models
 - Develop data categorization and organization
 - Optimal transport of biomass and biofuel
- Development of KDF interface
 - Develop user friendly and interactive interface for data integration, analysis, synthesis, and visualization
- Develop comprehensive data and modeling resources
 - Gather information across the bioenergy community
- Develop knowledgebase of previous R&D
 - Strategies for resource allocation

What's in the Bioenergy KDF?

Databases

- ~1400 curated spatial data sources
- 1206 downloadable data, 1147 Map Services
- Billion Ton update (coming soon)

Knowledge Bases

- ~ 200 curated resources describing models and important journal articles
- 113 Web resources

Models

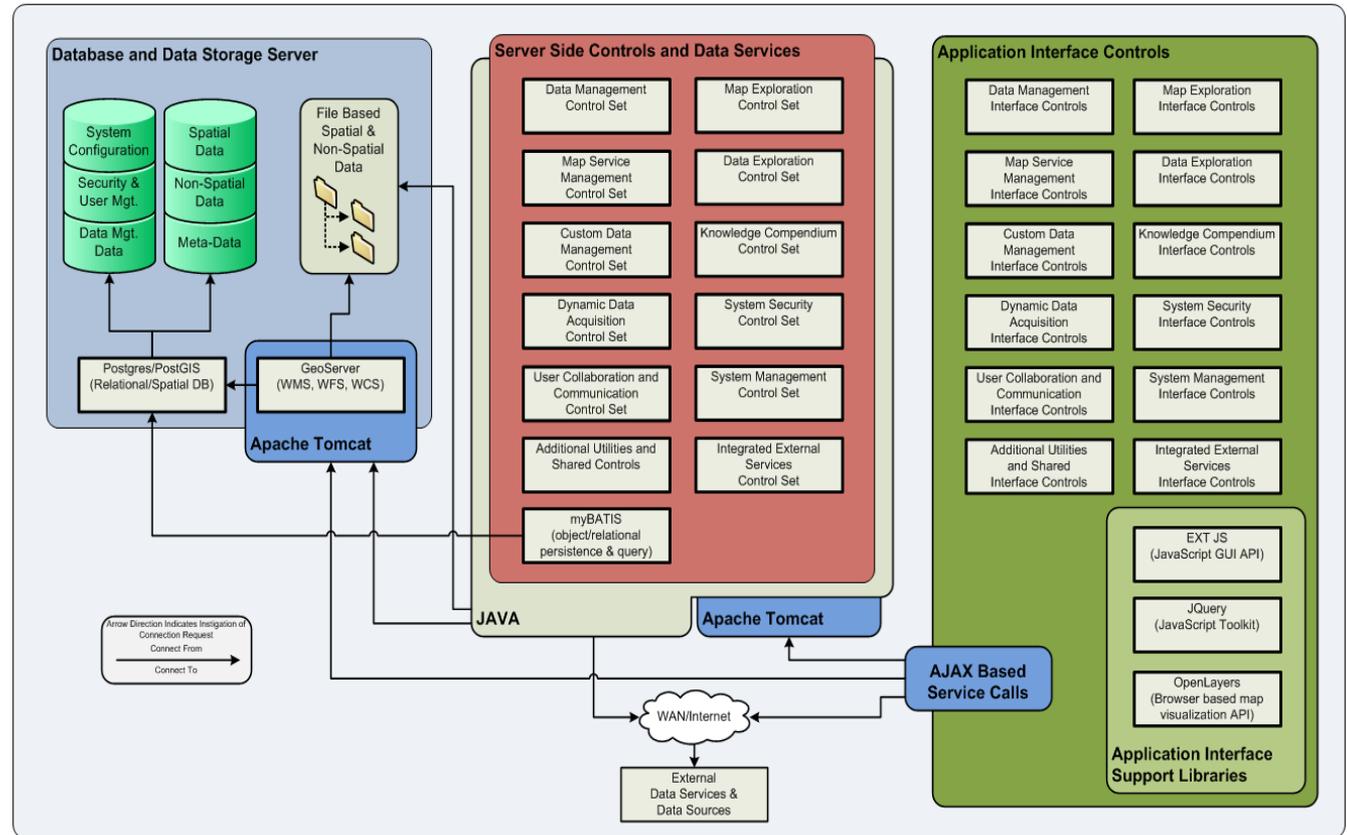
- Resources links to 38 domain models
- Commodity routing model
- Infrastructure planning model

Tools

- Geospatial and Graphical Visualization
- Spatial Analysis and Querying
- Faceted Search

Technical Accomplishments

- Robust Service Oriented Architecture based reusable, flexible framework design using mature open source components
- Open Geospatial Consortium (OGC) standards compliant implementation to ensure interoperability with other system



- User workshops and active engagement with stakeholders to solicit feedback
- User feedback used to guide the development effort

What can one do with Bioenergy KDF?

Search

- Data, publications, documents, and models
- Subject matter experts*

Contribute

- Data, publications, documents, and models
- Provide feedback and requirements

Associate

- Data, knowledge, and people (publications with data; documents with documents)

Analyze

- Spatial analysis with geographic data
- Scenarios with domain specific models

Share

- Data or analysis results with everyone, selected users (groups), or individuals based on contributor's preference

Visualize

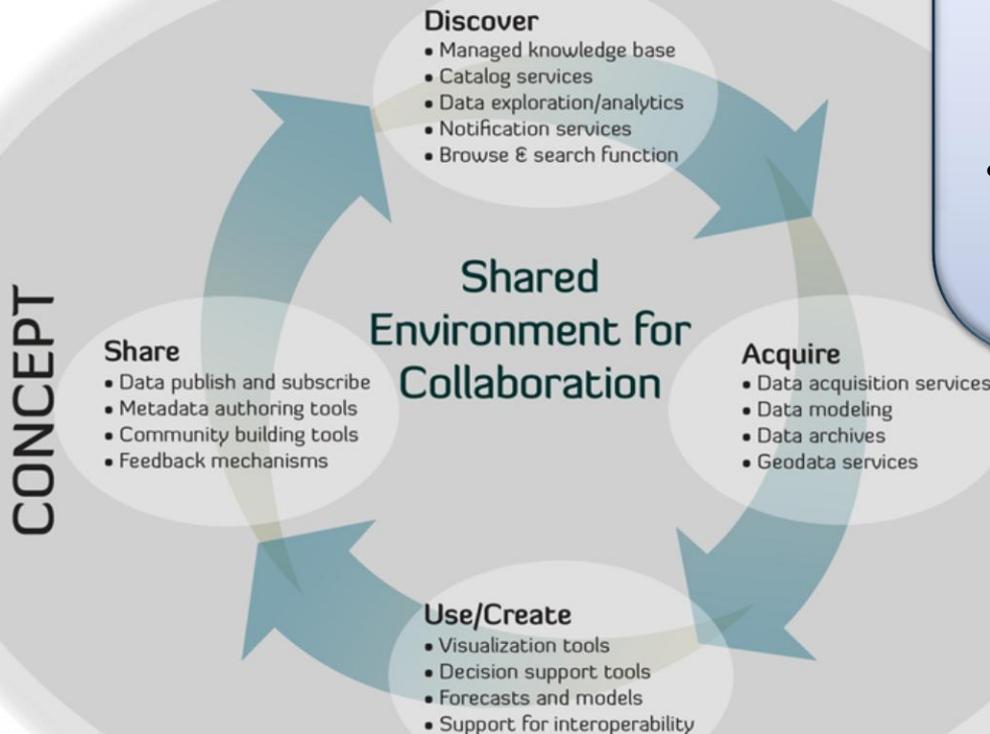
- Spatial overlays and geographic visualization
- Conventional visualization (Tables, graphs, and charts)

Collaborate

- Organize special interest groups
- Communicate on a forum*

Bioenergy KDF is a novel capability

“Scientific progress depends on efficient and open sharing to generate maximum value. The traditional paradigm of sharing scientific data and results through the published literature is no longer effective where new technologies produce large volumes of diverse types of data”



- It is much more than a simple data warehouse or web-mapping application
 - Data integration for analysis and not just overlay
 - Not just data to people but data from people
- KDF connects data, people, and knowledge to build a Bioenergy Community of Practice

Data

Knowledge

People

"The contents of the new generation of data and bioresources are continuously being enhanced and augmented by the community of user-producers..."

[Schofield et al., Science 2010]

Benefits: Enable research, development, and commercialization



Policy Makers-*Decide*

- The latest research data on biomass production projections, locations are now available to exploit as a business opportunity.



Private Sector- Invest

- The latest research data on biomass production projections, locations are now available to exploit as a business opportunity.



Researchers- Connect, Share, Analyze

- Researchers from national laboratories, academia and industry can virtually collaborate and are given special privileges to upload files, modify information and share data..



Public- Learn

- Be a valuable resource for information. Can your community benefit from this form of renewable energy source? Learn this and more as by exploring the data using maps and asking questions.

Critical Success Factors and Challenges

- Success Factors

- Accounting for the latest information on technical status, barriers, and markets in order to weigh benefits against costs and risks
- Serve as a critical resource for the evolving industry by providing detailed data and analyses of life-cycle costs and benefits, sustainability metrics, and environmental impacts
- Ease of use through Web 2.0 and social networking technologies
- Ability to share data and analytical results across platforms
- Technology infusion and transfer

- Challenges

- Effective outreach and visibility
- Maintaining currency and relevancy
- Variable data QA standards

Demonstration

The screenshot shows the BioKDF website interface. At the top left is the logo: "BIOENERGY KNOWLEDGE DISCOVERY FRAMEWORK U.S. DEPARTMENT OF ENERGY KDF". To the right are links for "Login", "Request Account", and "Getting Started", followed by a search bar. Below the header is a navigation menu with "Home", "Map", "Data Library", "About", and "Contact". The main content area features an "Explore" section with a description: "Use your browser to explore a comprehensive catalog on biomass feedstock production, biofuel production, distribution and related information". To the right of this text are three buttons: "Map Points", "Documents", and "Websites", with a "Try It!" callout. Below this are four featured sections: "Public" (Learn how your community can benefit from renewable energy), "Private Industry" (Identify opportunities and inform business strategies), "Researchers" (Collaborate, upload data, customize information, and share maps), and "Policy Makers" (Utilize renewable bioenergy in your community). A "Partners" section lists the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) and mentions support from national laboratories, universities, and agencies. Logos for U.S. DEPARTMENT OF ENERGY, INL (Idaho National Laboratory), OAK RIDGE National Laboratory, and NREL (National Renewable Energy Laboratory) are displayed. At the bottom, there are three columns: "Coming Soon" (Billion Ton Update, Enhanced Charting, Spatial Collaboration Tools, High Resolution Imagery, Frequently Asked Questions), "Getting Started" (Request an Account, Search Data Library, Upload New Data, Add Data to Map, Query Spatial Datasets), and "Share this on:" (Twitter, Facebook, Email, More...). A small footer note states: "Bioenergy Knowledge Discovery Framework (BioKDF) is powered by GeoKDF, a customizable Geospatial Knowledge Discovery Framework appliance, developed by GIST.ORNL."

<https://bioenergykdf.net/>

Future Work

- Enable and support OBP researchers to contribute research results
- “Apps” Store will provide a list and access to models and tool to explore scenarios and explore data.
- Advanced spatial querying capabilities utilizing multiple layers
- Integration with a content management system to provide stakeholders ability to dynamically add content via comments, discussion forums, annotate and share maps.
- Dynamic content aggregation from online resources such as latest commodity prices, news articles relevant to Bioenergy, latest publications etc.
- Dynamic views on selected Bioenergy topics automatically filtering and presenting only the most relevant resources
- Data citation mechanism using unique identifiers such as DOIs for ‘benchmark’ datasets to address data quality issues

Responses to Previous Reviewers' Comments

- Who are the users?
 - Stakeholders clearly identified and targeted
 - 266 registered users
- How will one know about the data quality?
 - Easy identification of non-authoritative datasets
 - Social curation
 - Use of Unique Identifier such as DOIs under consideration
- How will it be maintained?
 - Flexible framework design allows repurposing for other programs and subsequent resource leveraging opportunity

Publications and Presentations

An active outreach for Bioenergy KDF

- Workshop with government stake holders (USDA, EPA, and DOT) (2009)
- Workshop with the Department of Transportation (DOT) (2009)
- Presentations to the Department of Agriculture (USDA)(2009 and 2010)
- Presentations to the Biomass R&D Board and the Technical Advisory Committee (TAC) (2009 and 2010)
- Presentation at Biomass 2009 and Biomass 2010
- Presentations at the AIChE annual spring meetings (2010 and 2011)
- Presentation at the annual meeting of the American Association of Geographers (AAG) (2010 and 2011)
- Presentation at the annual meeting of the Psychological Society of America (2010)
- Presentation at the Homeland Infrastructure Foundation level Database (HIFLD) Working Group meeting (summer 2010)