



# Developing Innovative Tools for Geospatial Analysis of Bioenergy

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**ESIP Federation Winter  
Meeting**

January 4, 2011



**Biomass is a sustainable, near-term opportunity to reduce U.S. reliance on fossil fuels.**

The Department of Energy is strategically investing in the science, technology, and infrastructure needed to support the emerging U.S. biofuels industry.

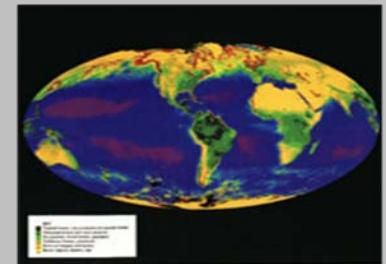
## Science and Discovery



## Clean, Secure Energy



## Economic Prosperity



## Climate Change

Developing the next generation of biofuels will help end dependence on foreign oil, offer clean and competitive fuels, reduce greenhouse gas emissions, create new jobs, and encourage rural development.

**The Biomass Program is working to advance biomass technologies in support of DOE's mission to strengthen America's energy security, environmental quality, and economic vitality through:**



## Feedstocks

Developing lower cost feedstock logistics systems



## Conversion technologies

Improving conversion efficiencies and costs



## Integrated biorefineries

Systematically validating and deploying technology at first-of-a-kind facilities



## Infrastructure

Evaluating vehicle emissions, performance, and deployment options



## Biopower

Providing a clean, domestic, dispatchable renewable source of power



## Advanced biofuels

Expanding portfolio beyond cellulosic ethanol to hydrocarbon fuels

- Availability, reliability, security, and sustainability of biomass feedstocks
- Generation, distribution, and delivery of biofuels
- Unanticipated consequences of developing bioenergy supply chain
- Effect of bioenergy on climate change, economic (rural) development, national security
- Grower practices and crop dynamics/land use change
- Competition for feedstock (uses besides biofuel)



- How can we sustainably produce and deliver future energy crops?
- What are the water requirements for different feedstock pathways, including feedstock production and conversion?
- How do we assess proposals for biorefinery locations based on the availability of existing resources and distribution infrastructure?
- What feedstocks can each region contribute with current infrastructure?
- What is the state of the existing biofuel distribution infrastructure?
- What are the best strategies for market penetration of biofuels?



- 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**

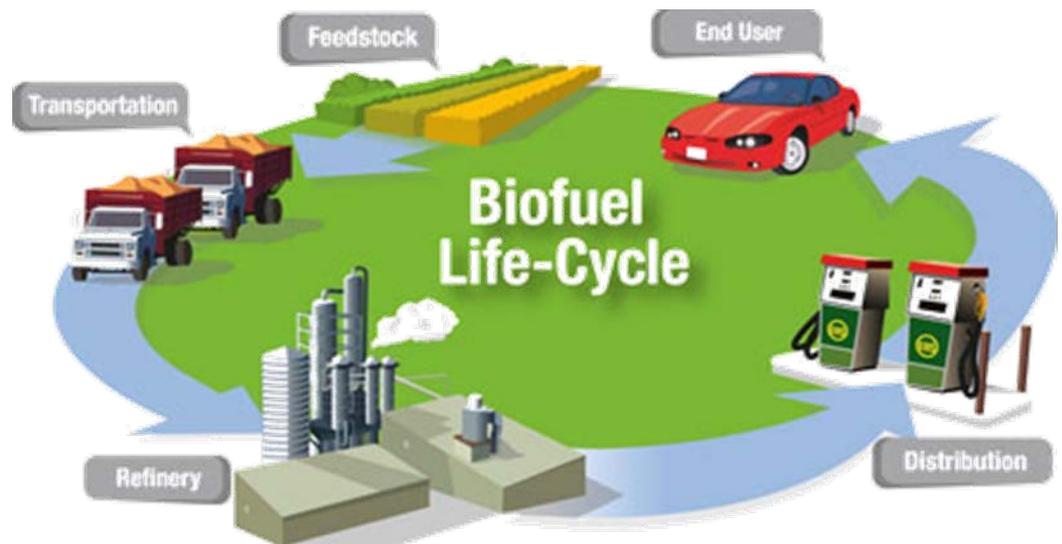
**Development of High Performance,  
Scalable Simulations**

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

**Knowledgebase Creation**

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

- 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





- Access to collaboration, data management, analysis, and visualization tools designed to support bioenergy infrastructure research
- Integrating bioenergy spatial data with socioeconomic and industrial factors will improve planning, development, and management decisions

*Release planned for January 12, 2011  
at [www.bioenergykdf.net](http://www.bioenergykdf.net)*



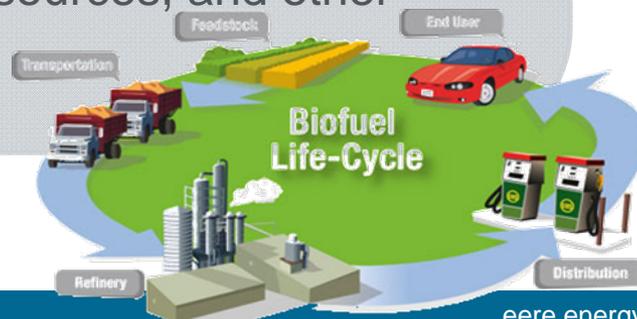
- Project started in FY08
  - To facilitate information sharing among DOE/OBP funded national laboratories for feedstock research
- Project expanded in FY09
  - To address cross platform collaboration in OBP
  - Distribution infrastructure platform
- Expanding stakeholder community
  - Other federal agencies
  - State and local governments
  - Private sector
- Market Challenges
  - Feedstock production, assembly, and integration
  - Resource availability and cost
  - Sustainable production
  - Feedstock transport
  - Lack of biofuels distribution infrastructure
  - Availability of biofuels-compatible vehicles
  - Industry and consumer acceptance and awareness
- Partnerships
  - National Laboratories
  - Sun Grant Institutes
  - Government agencies
  - Governors Ethanol Coalition
  - Industry

## Goal

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

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

- Assessing resources and infrastructure across local national scales
- Location selection new feedstock production and infrastructure facilities (e.g., biorefinery)
- Evaluating the potential contribution of biofuels to the EISA 2007 goal and beyond
- Identifying distribution infrastructure gaps and requirements
- Protecting air quality, water resources, and other land use requirements



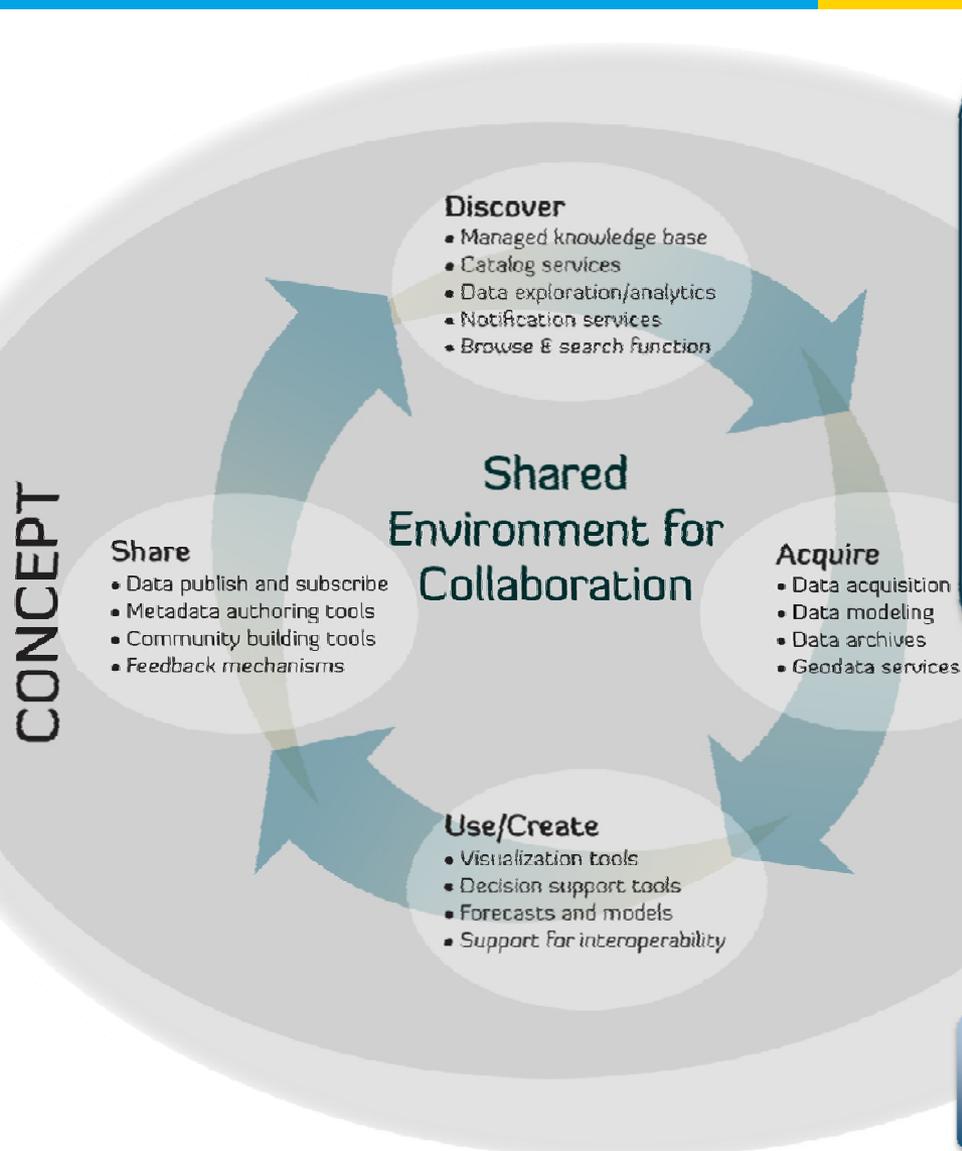
## Strategy

Design and develop a robust geospatial technology and informatics framework

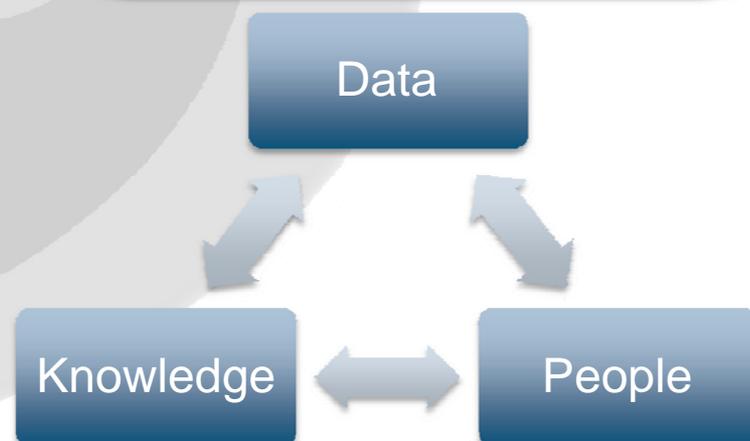
## Collaboration through partnerships and shared resources

- 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
- Standards based





- 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



# Partnerships are key



## Consumers

Consumers can learn about the newest sustainability standards and explore the latest research on the impact of the bioenergy industry on the economy, environment, and local communities.



## Policy Makers

- Federal
- State
- Local

Policy makers can decide on areas for research and demonstration funds and assess vulnerabilities in the bioenergy supply system such as the impact of crop failures, transportation shut downs, or lower than anticipated volumes of ethanol.



## Private Industry

- Feedstock Producers
- Biorefinery
- Transportation Sector
- Distribution and Retail
- Transportation Technology Developers

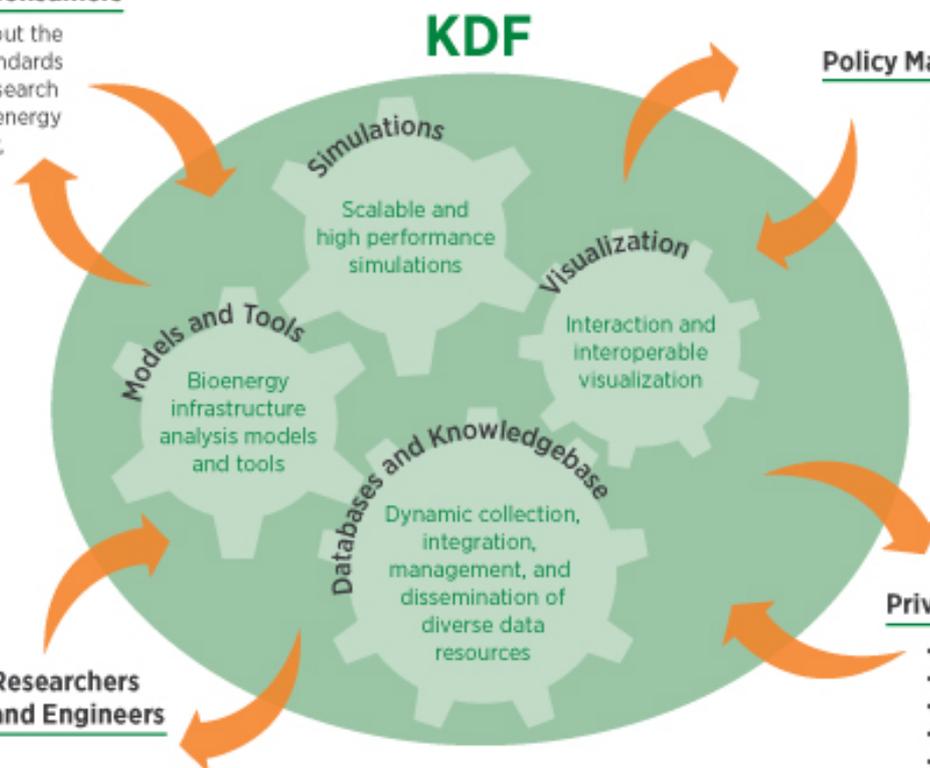
Private industry can identify feedstock production potential, energy demand patterns, and available infrastructure in order to develop market strategies and invest in bioenergy business opportunities.



## Researchers and Engineers

- Academia
- National Laboratories
- NGOs

Researchers and engineers can share data on sustainability metrics such as water availability, soil type, land-use patterns, and climate trends and connect multiple institutions that perform complex assessments of bioenergy industry development.





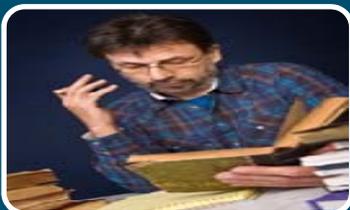
## Policy Makers – Assess and Decide

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



## Private Industry – Identify and Invest

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



## Scientists and Engineers – Connect and Share

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



## Consumers – Explore and Learn

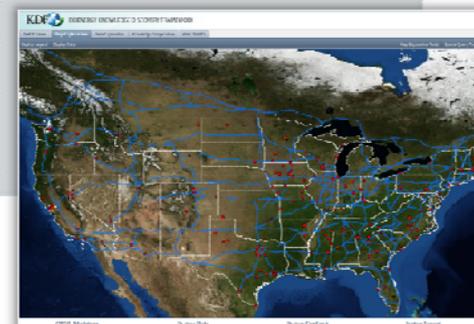
- Be a valuable resource for information. Can your community benefit from this form of renewable energy source? Learn this and more as by exploring the data using maps and asking questions.

## Benefit

### Enable research, development, and commercialization

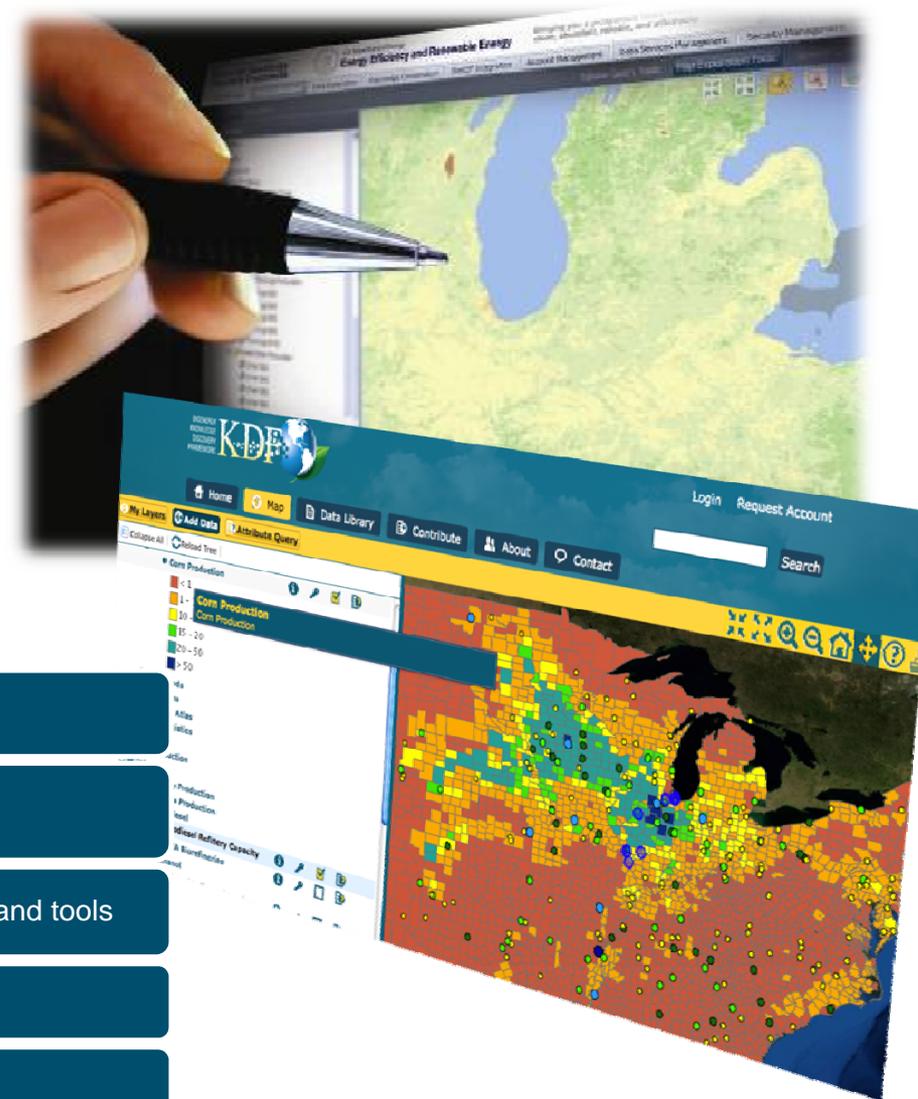
**A national decision support framework for overall sustainability and security of bioenergy infrastructure**

- Provide ready access to status of bioenergy in the US
- Distribute data needed for assessments
- Support emerging bioindustry by providing an integrative perspective
- Support policymaking by visualizing the outcomes of proposed policies
- Defining where research or demonstration funds should be targeted
- Foster education and outreach



# Bioenergy KDF Highlights and Benefits

- Expedites Data Life Cycle
  - Faster data integration
  - Dynamic status awareness
- Provides transparency and efficiency across OBP platforms
  - Identifies benchmark data and modeling requirements
  - Allows communication, collaboration, and synchronization of efforts



Web-enabled and interactive access

Role-based user levels to allow access to most relevant content

Provides easy access to best available and authoritative data, models, and tools

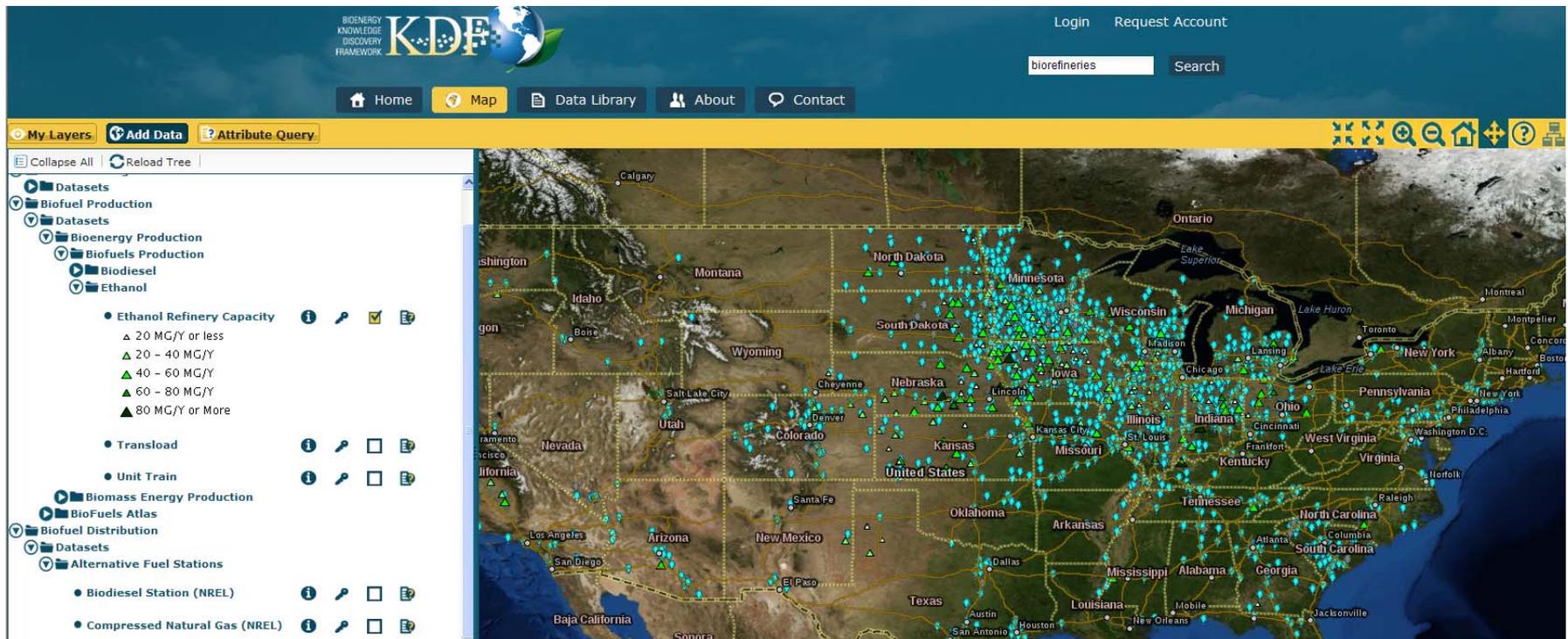
Ability to share (upload and download) data and information

Analysis, synthesis, and visualization for informed decision making

Presentation\_name

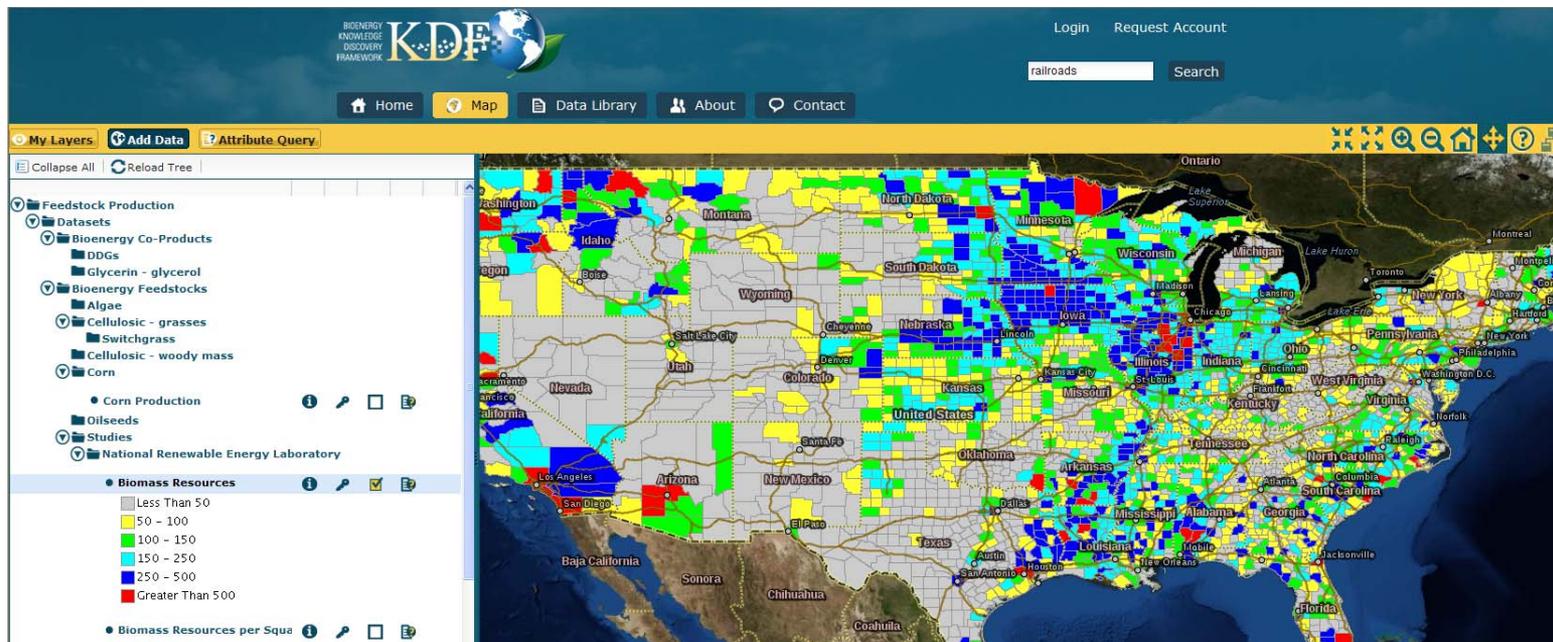
# Infrastructure modeling and analysis capabilities

- 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



# Infrastructure modeling and analysis capabilities, cont.

- 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

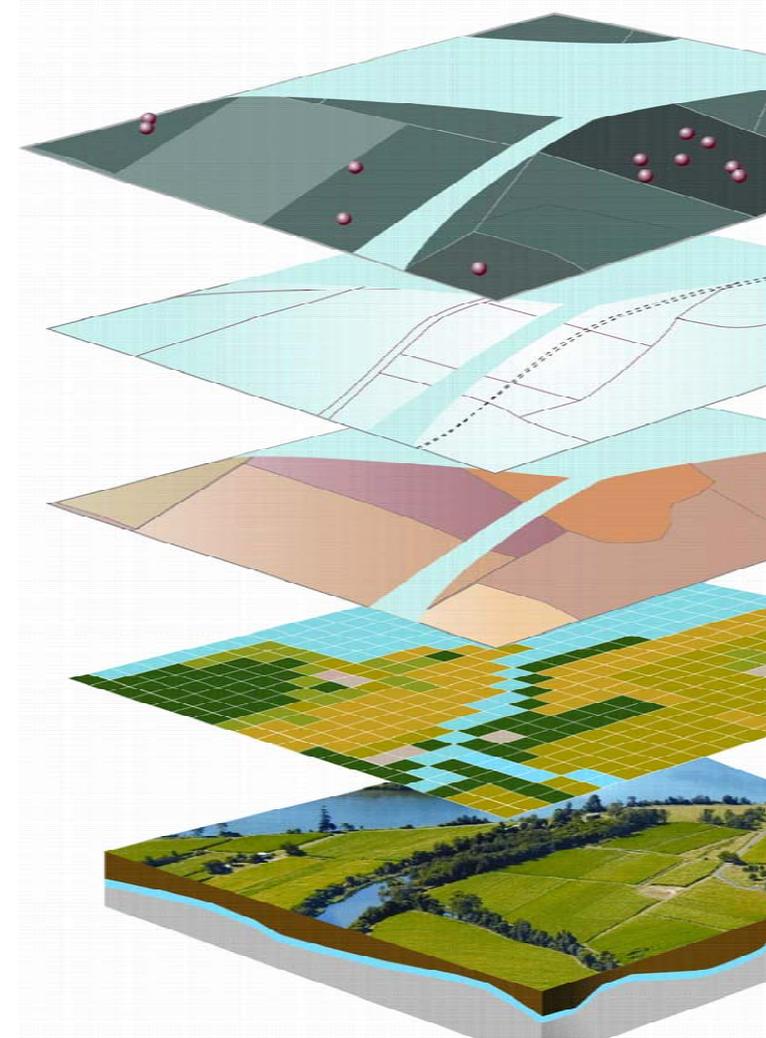


- Information management (local and externally served data)
  - Published papers, whitepapers, deliverables, models, concepts
- Data management (local and externally served data)
  - Spatial data, tabular data, services
- Spatial and tabular visualization (local and externally served data)
- Spatial and tabular querying (local and externally served data)
- User managed correlation and organization of data and literature
- Feedback and collaboration tools
  - Map notes and map sharing
  - Comments for data and literature
- Modeling and analysis API

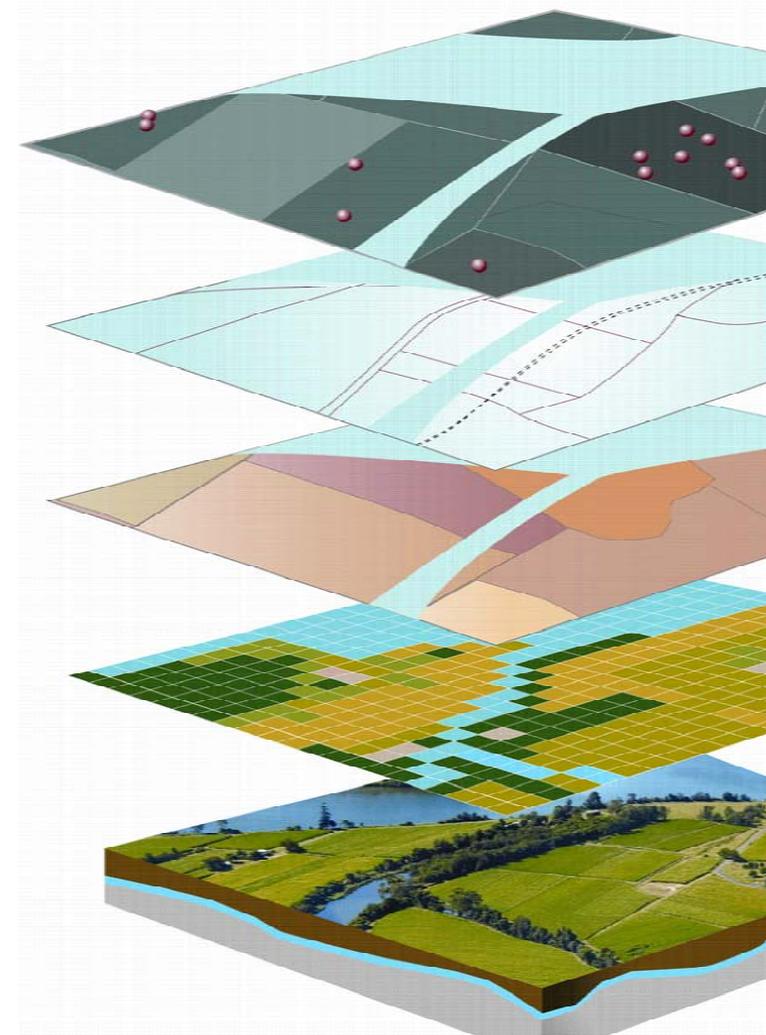
- Analysis and visualization of biomass resources
  - Billion Ton study update
- Development and Integration of Features and Attribute Enrichment for Biofuel Distribution Infrastructure for Routing Analysis
  - Collection of infrastructure data on biofuels production locations, transportation networks, transfer and storage locations, as well as blending facilities
  - Leverage DOE investments in Transportation Routing Analysis GIS (TRAGIS) modeling platform
- Capacity Analysis for Ethanol Transport
  - Develop capacity assessment model for transportation scenarios
- Integration of National Infrastructure Databases for Analysis and Visualization
  - Identify and integrate transportation and socioeconomic data

The KDF is the portal for bioenergy data from many GIS projects receiving support from the Biomass Program:

- Feedstock resource assessment through the Sun Grant Initiative
- Feedstock supply logistics and sustainability analysis (Idaho National Laboratory)
- Microalgae biofuel potential (Pacific Northwest National Laboratory)
- National biorefinery siting model (Western Governors Association)



- Global biodiversity and ecosystem services conservation (Conservation International)
- Alternative Fuels and Advanced Vehicles Data Center (National Renewable Energy Laboratory)
- Regional land-use change modeling (Great Lakes Bioenergy Research Center)
- International land-use change modeling and analysis (Oak Ridge National Laboratory)



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**THANK YOU**