

Bioenergy Knowledge Discovery Framework

KDF



Collaboration, Data Management,
Data Management, Analysis, and Visualization Tools
Designed to Support Bioenergy
Infrastructure Research

Presented to the
Technical Advisory Committee
Biomass Research and Development Board

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Our Commitment to Sustainability



The U.S. DOE Biomass Program is committed to developing the resources, technologies, and systems needed for biofuels to grow in a way that enhances the health of our environment and protects our planet. To that end, we are working to...

- Develop diverse, non-food feedstocks that require little water, fertilizer, or new land
- Foster sustainable forestry practices
- Harvest biomass components selectively, leaving adequate soil nutrients
- Assess life-cycle impacts of major scale-up in biofuels production, from feedstocks to vehicles, addressing:
 - land use and soil health
 - water use
 - air quality issues
 - impacts on greenhouse gas (GHG) emissions





Broad issues to consider

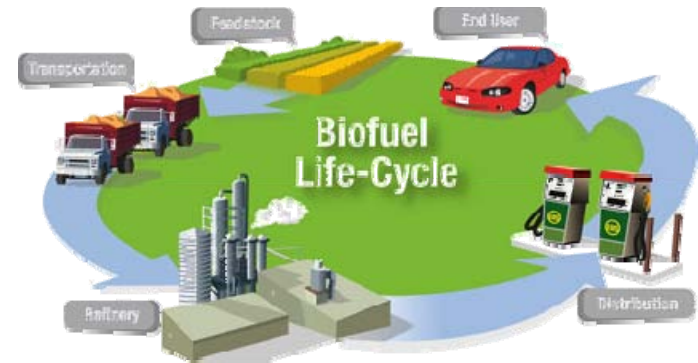
- Availability, reliability, security, and sustainability of biomass feedstocks
- Generation distribution and delivery of biofuels
- Unanticipated consequences of developing bioenergy supply chain
- Effect of bioenergy on climate change, economic (rural) development, national security
- Grower practices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



We need reliable answers to ensure a sustainable bioenergy industry



- 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?



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**

Credible data and knowledge provide the foundation for success



- 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

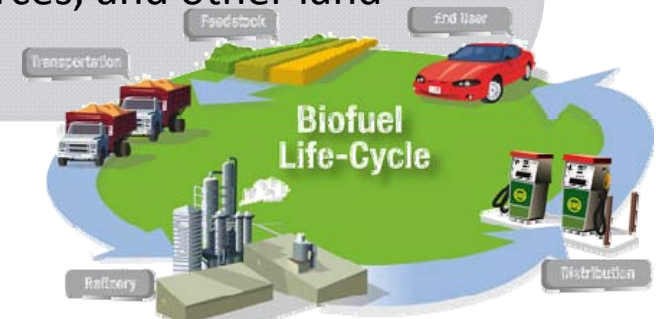


Goal

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

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

- Example use of spatially-referenced decision support framework include:
- Assessing resources and infrastructure across local to 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



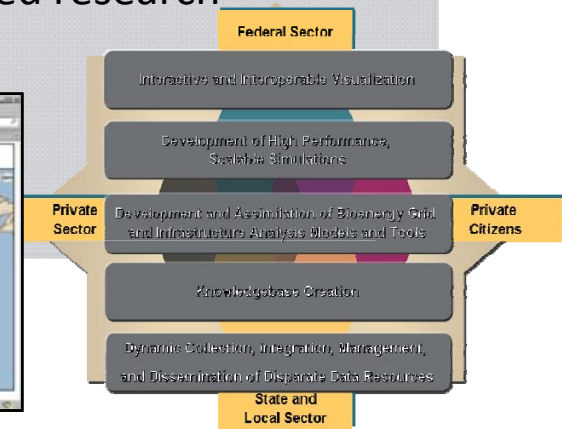


Strategy

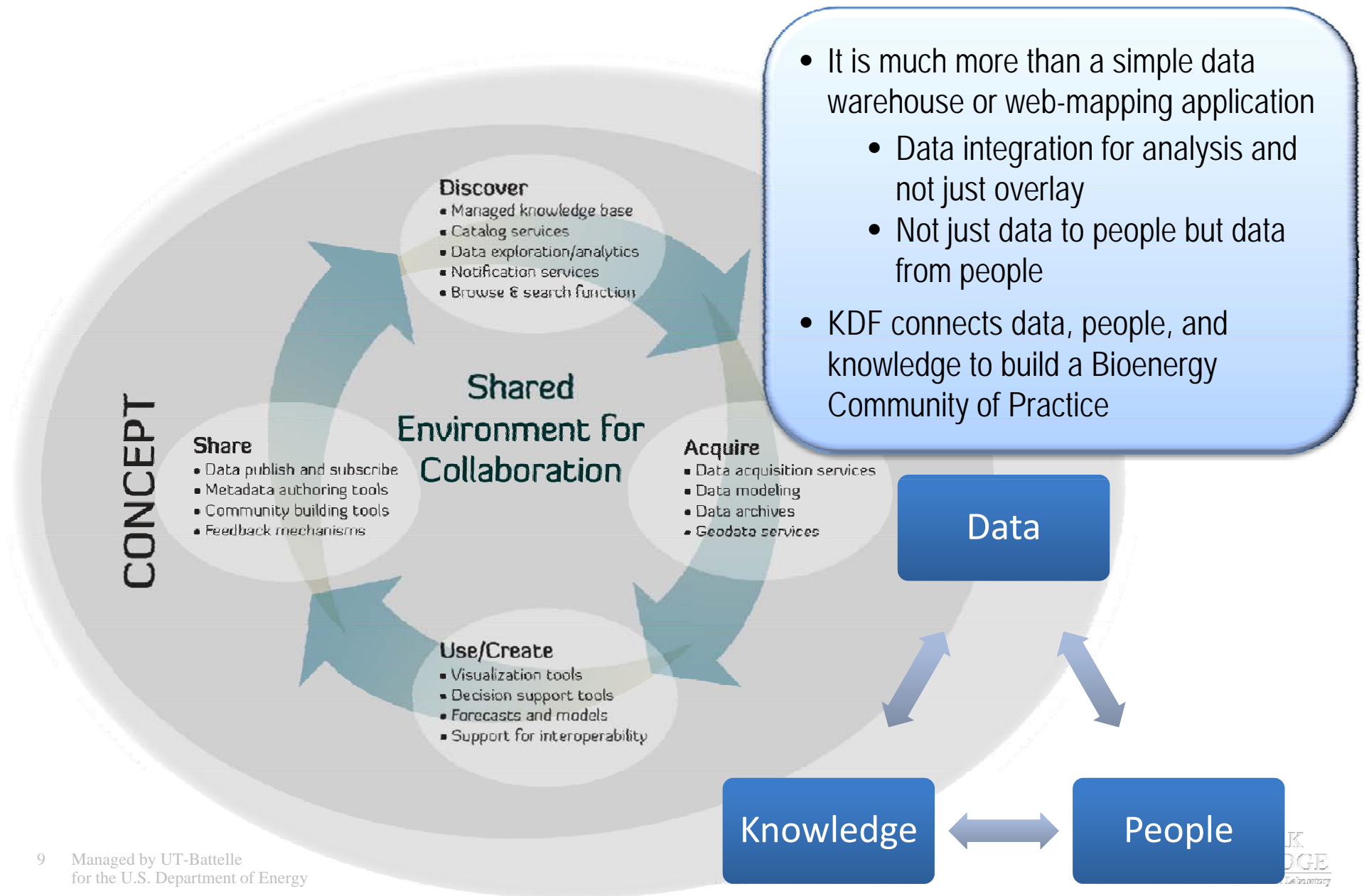
Design and develop a robust geospatial technology and informatics framework

Collaboration through partnerships and shared resources

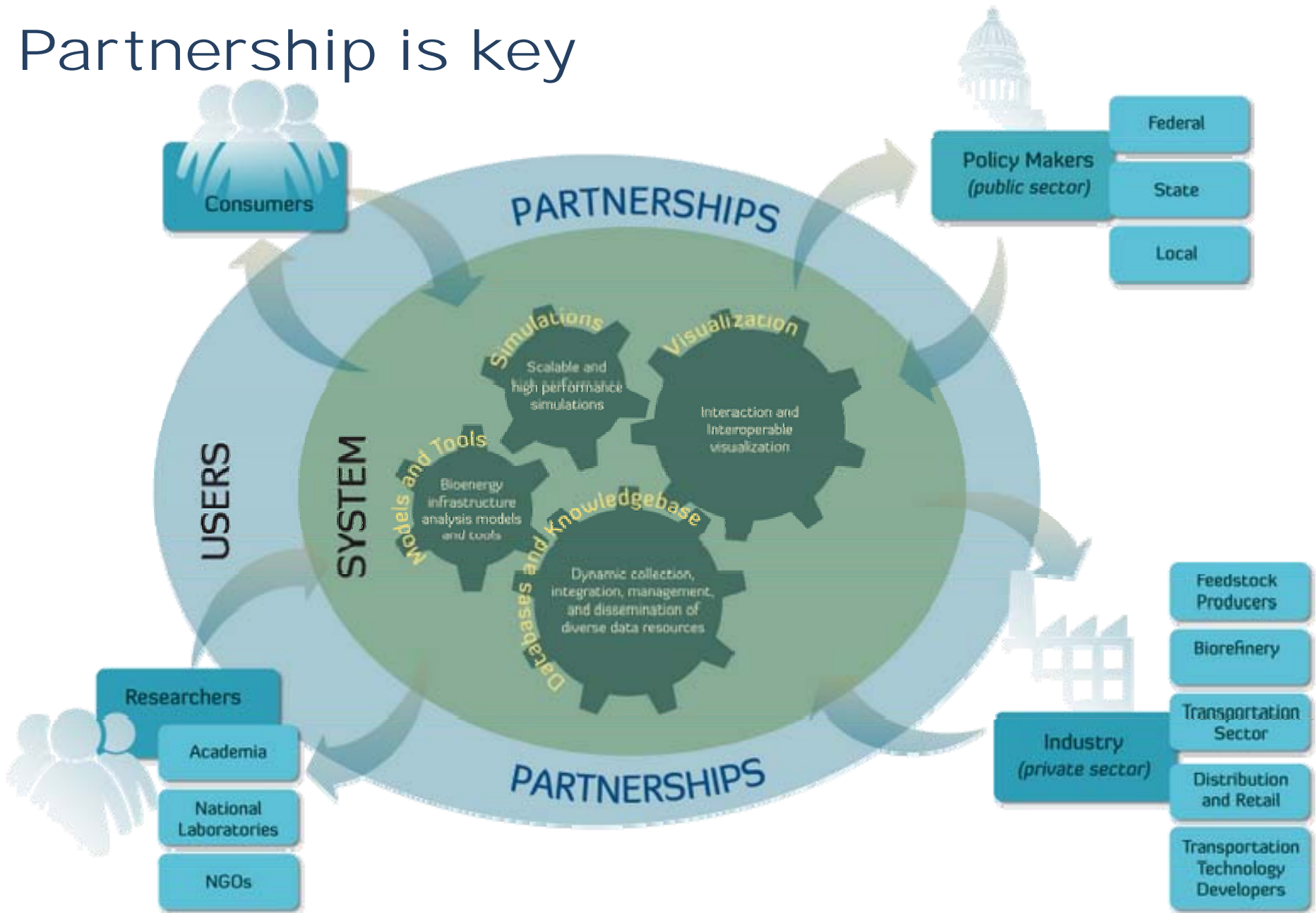
- Promote sharing and integration of distributed resources
- Engage various stake holder communities
- Offer guidance and access to comprehensive data, modeling, and visualization resources
- Incorporate DOE-OBP and partner funded research
- Standards based



Bioenergy KDF is a novel capability



Partnership is key





All stakeholders benefit



locations are now available to exploit as a business opportunity.



modify information and share data.



- 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.



Bioenergy Knowledge Discovery Framework

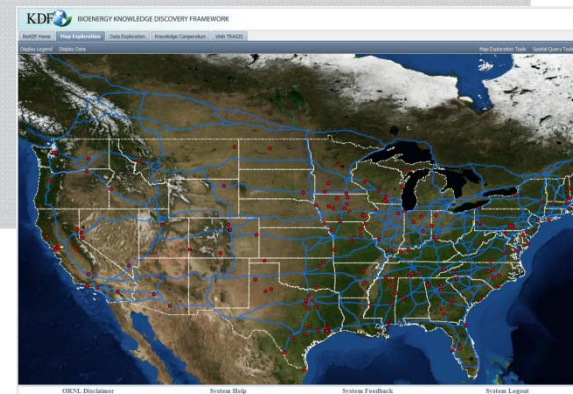


Benefit

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

Enable research, development, and commercialization

- 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

Ability to share (upload and download) data and information

Analysis, synthesis, and visualization for informed decision making



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

Bioenergy KDF Functionality



- 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

Example components for analysis



- 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