Bioenergy Knowledge Discovery Framework

Daniel Getman

Geographic Information Science

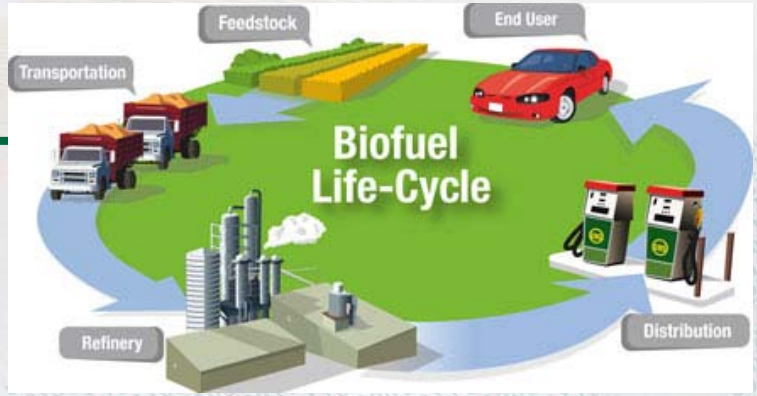
and Technology Group

Oak Ridge National Laboratory

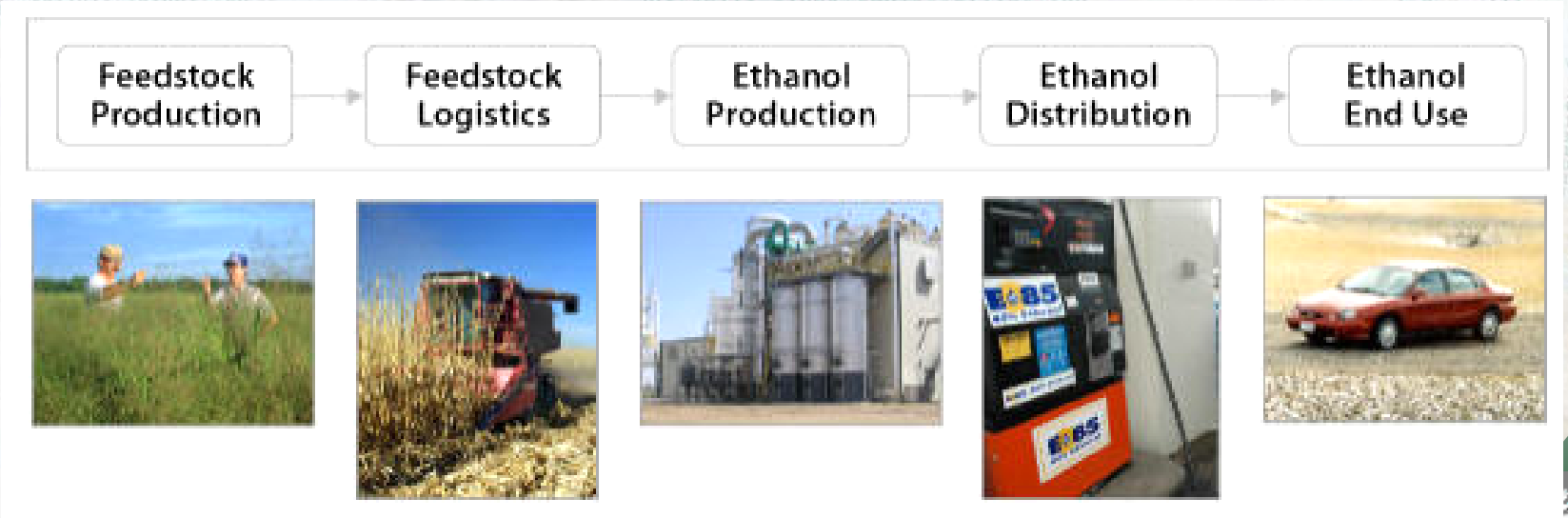
March, 2009

Bioenergy Grid definition

Geographic Information Science and Technology



- **The physical and socioeconomic components and their interconnections of a bioresource driven supply-chain network that sustains the reliable generation and delivery of energy to the nation**



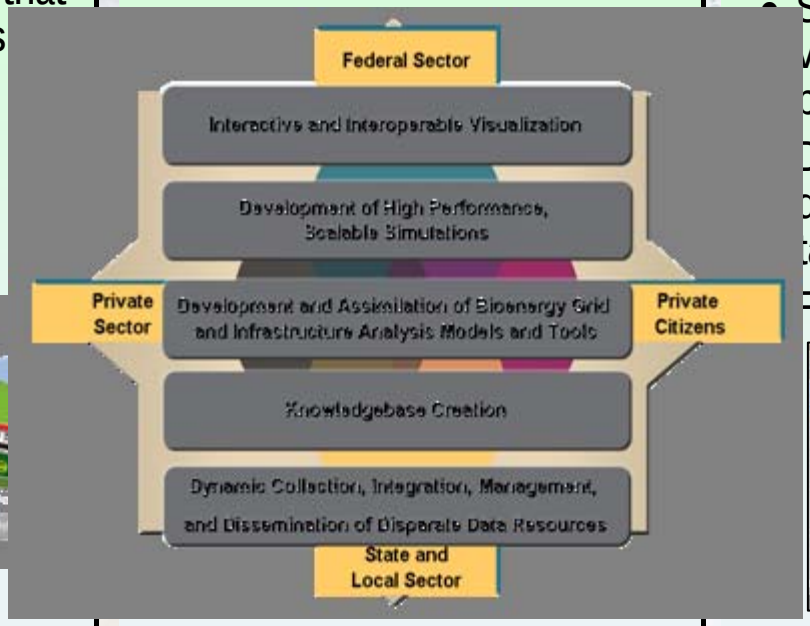
Bioenergy Knowledge Discovery Framework

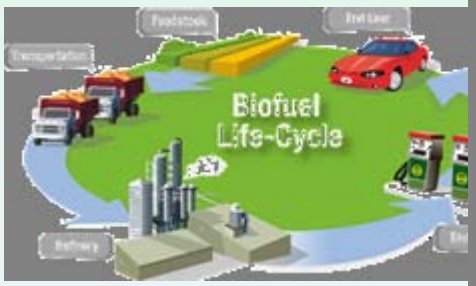
Goal:

- Provide analytical and visualization capabilities for efficient planning, development, and management of the US bioenergy infrastructure.
- Allow analysis, synthesis, and visualization of data that facilitates informed decis making.

Strategy:

- Design and develop a robust geospatial technology framework that
  - Offers guidance and access to comprehensive data, modeling, and visualization resources
  - Standards based





Benefit:

- 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

Outcome: A national decision support framework for addressing the overall sustainability and security of bioenergy infrastructure

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Knowledge Discovery

Knowledge discovery is an advanced area of study in the field of computer and data sciences that facilitates enhanced decision making through the analysis of dynamic and disparate databases of information and patterns. The Bioenergy KDF is a collaborative decision-support environment designed to foster the discovery process across data held by the government, private industry, and academia. The Bioenergy KDF will allow access to comprehensive data, modeling, and visualization resources and the discovery of appropriate bioenergy infrastructure solutions.

BioKDF System Login

User Name:

Password:

Login | Account Request

National Vision of a Sustainable Future for Bioenergy

To meet the mandated national bioenergy goals, the evolving U.S. bioenergy industry needs to be efficient, reliable, and sustainable. A key challenge to achieving these goals is the synchronization of biomass production, biomass logistics, bioenergy production, bioenergy distribution and delivery, and bioenergy end use. Bioenergy production will be dispersed throughout the United States, while demand and end use will be concentrated in highly populated areas. Current and proposed viable production systems each will pose unique economic, environmental, and infrastructure challenges. These systems vary regionally throughout the United States and a variety of considerations—from climate and soils to transportation routes and vehicle fleets—determine the choice of appropriate, sustainable solutions.

Achieving the Vision

Integrating Knowledge for Informed Decision Making The Bioenergy Knowledge Discovery Framework (KDF) will facilitate informed decision making by providing a means to synthesize, analyze, and visualize vast amounts of information in a relevant and succinct manner. This GIS-based framework is under development to analyze the economic and environmental impacts of various development options for biomass feedstocks, biorefineries, and infrastructure. The Biomass Program is directing the Oak Ridge, Argonne, and Idaho National Laboratories, in conjunction with university partnering, in carrying out this goal. To ensure a future of sustainable bioenergy production, planning, development, and management decisions will be based on the analysis and visualization of large volumes of spatial data in conjunction with socioeconomic and industrial factors. The development of a framework for this purpose will speed the adoption of a biomass-based energy generation and delivery network that provides reliable, cost-effective, and sustainable transportation biofuels.

Benefits of the KDF

The Bioenergy KDF will unlock the value of readily available and existing information to support the emerging bioenergy industry. The KDF will: Provide access to industry status throughout the United States. Distribute necessary data for project

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Knowledge Tree

- Literature
  - Feedstock Production
  - Feedstock Logistics
  - Biofuel Production
  - Biofuel Distribution
  - Biofuel Enduse
- Bioenergy Modeling Efforts
  - Feedstock Production
  - Feedstock Logistics
  - Biofuel Production
  - Biofuel Distribution
  - Biofuel Enduse

Knowledge Compendium Query

KD Item Name: Query Text

KD Item Type:

KD Item Origin:

Added Since: 03/05/2009

Added Before:

March 2009

S	M	T	W	T	F	S
22	23	24	25	26	27	28
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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	1	2	3	4

Today

Knowledge Compendium Item Summary

Knowledge Compendium Item Security

Knowledge Compendium Item Metadata

Knowledge Compendium Item Other

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http://www.eere.energy.gov/

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Knowledge Tree

- Literature
  - Feedstock Production
  - Feedstock Logistics
    - Feedstock Harvesting and Preprocessing
      - Atchison, Joseph E. (2003)
  - Forest Other Production
  - Biofuel Production
  - Biofuel Distribution
  - Biofuel Enduse
- Bioenergy Modeling Efforts
  - Feedstock Production
  - Feedstock Logistics
  - Biofuel Production
  - Biofuel Distribution
  - Biofuel Enduse

Atchison, Joseph E. (2003)
Innovative Methods for Corn Stover Collecting, Handling, Storing and Transporting

Knowledge Compendium Query

KD Item Name:	Query Text
KD Item Type:	
KD Item Origin:	
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Refresh Data tree

Knowledge Compendium Item Summary
Knowledge Compendium Item Security
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Knowledge Compendium Item Other

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http://gistext.ornl.gov/BioKDFDemo/#

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    - Biomass Feedstock Cultivation
      - POLYSYS
      - ORNLS
      - FASOM
      - GREET
      - IBSAL
      - EBAMM
      - APAM/ISAM
      - SABRe-Gen
      - HyDRA
      - Biorefinery Siting
      - Jatropha Plant Agent-Based Mod...
      - ESIM & LEITAP Biofuel Market M...
      - GLUE
      - Willamette Valley Biodiesel Fe...
      - DSS4Ag
      - EPA NonCO2
      - GTM
      - ObjECTS MiniCAM
      - SGM

POLYSYS
The model uses policy variables along with land use and crop production data to provide a regional econometric model of biofuels feedstock production and pricing. Developed at the University of Tennessee and Oak Ridge National Laboratory.

Knowledge Compendium Query

KD Item Name:	Query Text
KD Item Type:	
KD Item Origin:	
Added Since:	03/05/2009
Added Before:	

Refresh Data tree

Knowledge Compendium Item Summary
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Data Tree

- Environmental
- Imagery
- Infrastructure
- Political
- Population
- Production
- Dan Getman

Dataset Query

Dataset Name: Model Name

Dataset Type:

Dataset Origin:

Added Since: 03/05/2009

Added Before:

March 2009

S	M	T	W	T	F	S
22	23	24	25	26	27	28
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Today

Dataset Summary

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Dataset Metadata

Dataset Create Map Service

Dataset Other

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Data Tree

- Environmental
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  - Weather and Climate
- Imagery
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  - Raster
  - Satellite
  - SRTM
- Infrastructure
  - Commercial
    - Consumer
    - Production
  - Transportation
    - highways
    - interstate
    - Census Traffic Planning
    - Maritime
    - Pipelines
    - Railroads
    - Waterways
  - Utilities
    - Electric
    - Water
- Political
- Population
  - Conus
- Production
  - Agriculture
- Dan Getman

Dataset Summary
Click to display a summary of this dataset in the Dataset Summary Panel

Dataset Query

Dataset Summary

A Summary of the highways dataset will be provided here.

Dataset Security

Dataset Metadata

Dataset Create Map Service

Dataset Other

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Dataset Security
Click to display a summary of the security parameters for this dataset in the Dataset Security Panel

Dataset Query

Dataset Summary

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A Summary of the Security Parameters for the highways dataset will be provided here.

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Dataset Create Map Service

Dataset Other

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Create Map Service
Click to create a map service with this dataset

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Dataset Summary
Dataset Security
Dataset Metadata
Dataset Create Map Service

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Open Dataset
Click to open this dataset in a new window

Dataset Query
Dataset Summary
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Dataset Metadata
Dataset Create Map Service

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    - interstate
    - Census Traffic Planning
    - Maritime
    - Pipelines
    - Railroads
    - Waterways
  - Utilities
    - Electric
    - Water
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- Population
  - Conus
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Download Dataset
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Dataset Metadata
Dataset Create Map Service

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Data Tree

- Environmental
  - Landcover
  - Surfacechar
  - Weather and Climate
    - Climate
    - Weather
      - US Daily Surface Data
      - GOES East
      - GOES West
      - NEXRAD Level II
      - NEXRAD Level III CONUS WSR-88D
      - NWS Precipitation Analysis Dat...
      - National Digital Forecast Data...
- Imagery
- Infrastructure
  - Commercial
    - Consumer
    - Production
  - Transportation
    - highways
    - interstate
    - Census Traffic Planning
    - Maritime
      - Ports
    - Pipelines
    - Railroads
      - Intermodal_Fac
      - Raillines
      - Railnodes
    - Waterways
  - Utilities

Add Dataset To Map
Click to add this dataset to the data available in Map Exploration

Dataset Query
Dataset Summary
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Dataset Metadata
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Legend | Layer Position

- Imagery
  - Satellite
- Environmental
  - Landcover
  - Surfacechar
  - Weather and Climate
- Population
- Production
  - Agriculture
  - Billion Ton Study
- Sun Grant Initiative
- Political
- Infrastructure
  - Commercial
    - Consumer
    - Production
  - Transportation
    - Highways
      - Highways
      - Ramps
    - Interstates
    - Census Traffic Planning
    - Maritime
    - Pipelines
    - Railroads
    - Waterways
  - Utilities
    - Electric
    - Water

Add Dataset to the Map
Click to add this dataset to the map

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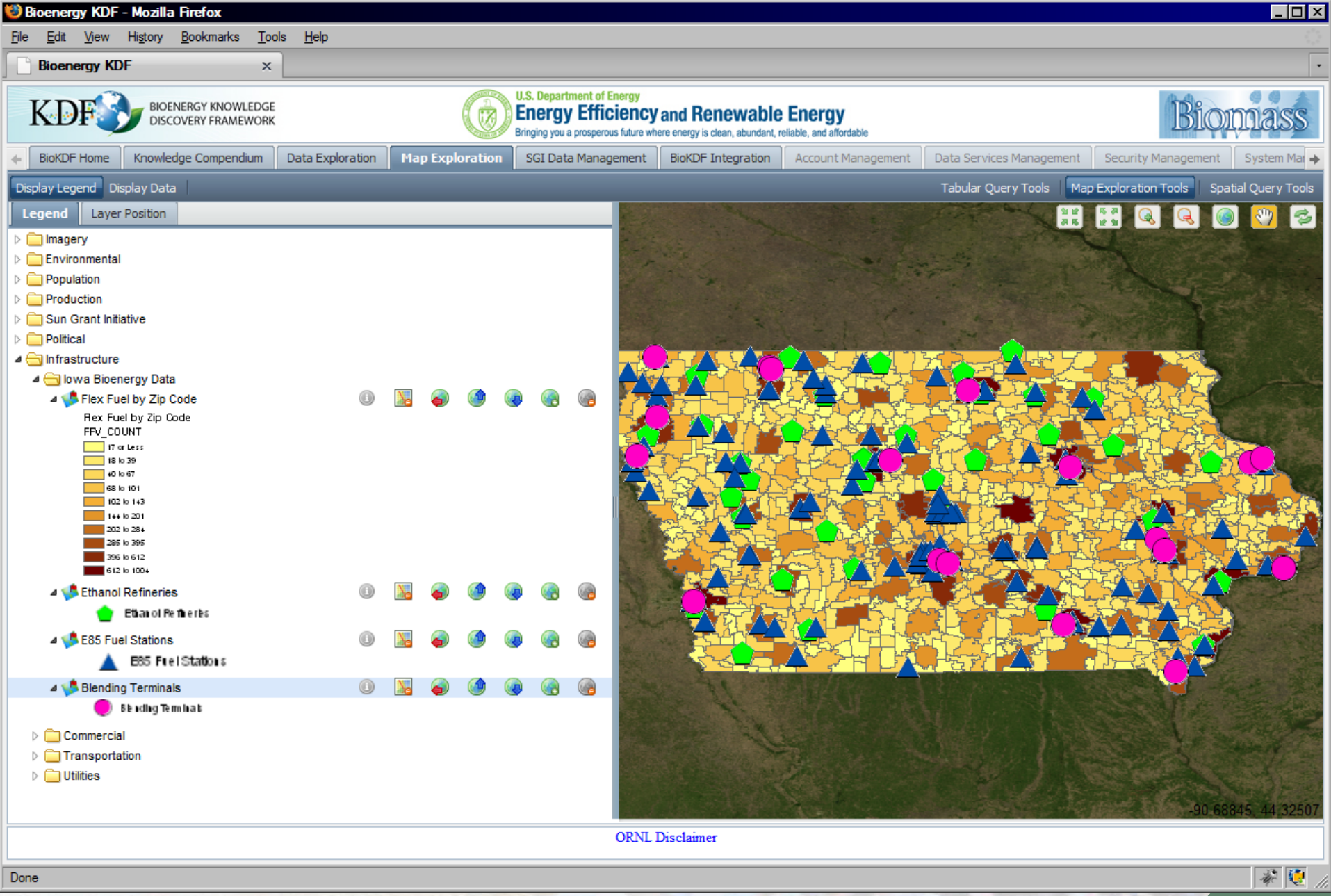
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Infrastructure
Iowa Bioenergy Data
Flex Fuel by Zip Code
Flex Fuel by Zip Code
FFV_COUNT
17 or Less
18 to 39
40 to 67
68 to 101
102 to 143
144 to 201
202 to 284
285 to 395
396 to 612
612 to 1004
Ethanol Refineries
Ethanol Refineries
E85 Fuel Stations
E85 Fuel Stations
Blending Terminals
Blending Terminals
Commercial
Transportation
Utilities
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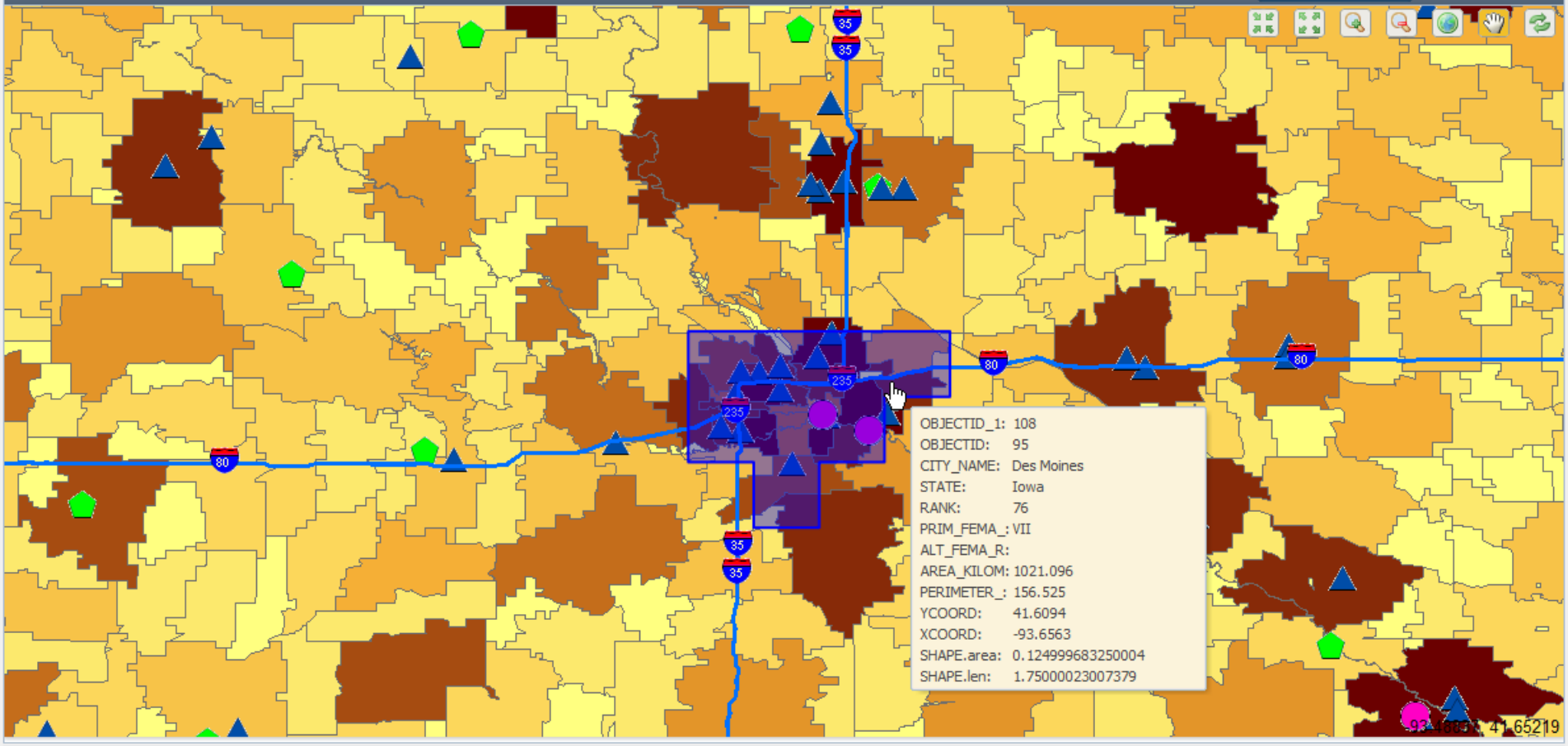
Display Legend | Display Data | Tabular Query Tools | Map Exploration Tools | Spatial Query Tools



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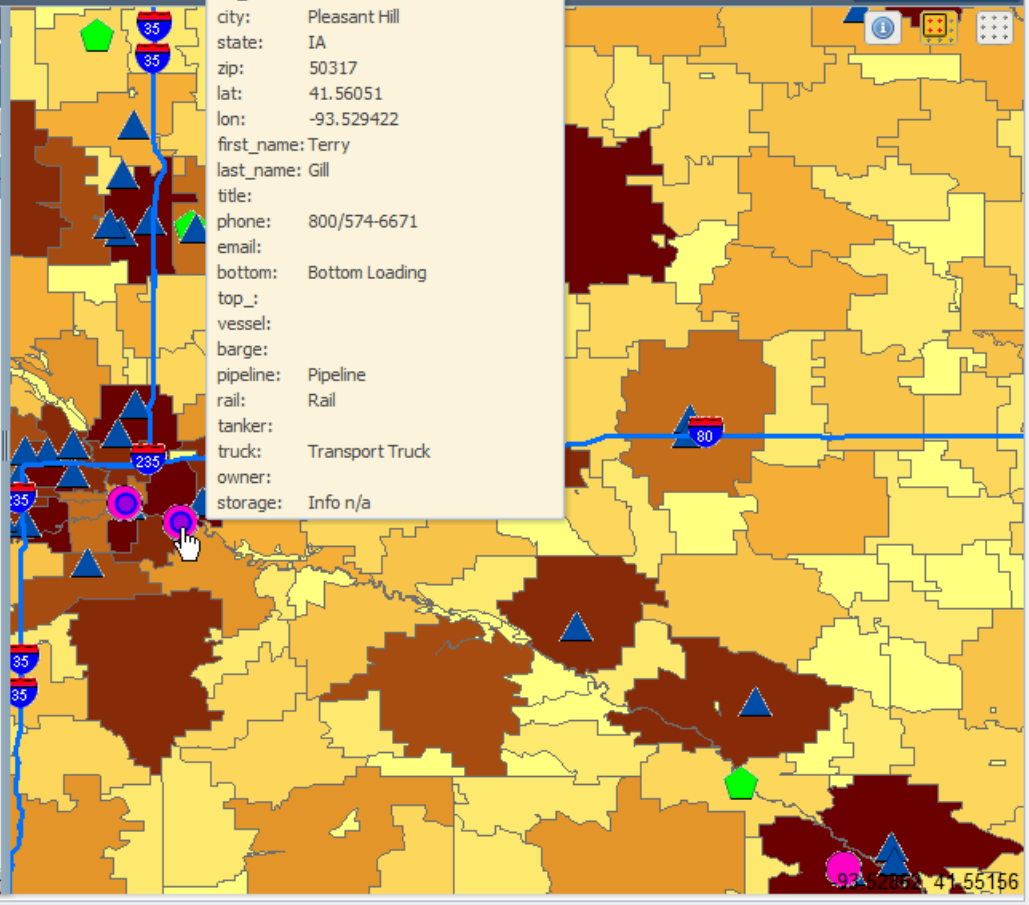
Display Legend | Display Data | ery Tools | Map Exploration Tools | Spatial Query Tools

DataDisplay

company	address	alt addres	city	s
BP Products North America, Inc.	1501 Northwest 86th Street		Des Moines	I
Magellan Pipeline Company, L.L.C. - Des Moines	2503 Southeast 43rd Street		Pleasant Hill	I

OBJECTID: 8
company: Magellan Pipeline Company, L.L.C. - Des Moines
address: 2503 Southeast 43rd Street
alt_addres:
city: Pleasant Hill
state: IA
zip: 50317
lat: 41.56051
lon: -93.529422
first_name: Terry
last_name: Gill
title:
phone: 800/574-6671
email:
bottom: Bottom Loading
top_:
vessel:
barge:
pipeline: Pipeline
rail: Rail
tanker:
truck: Transport Truck
owner:
storage: Info n/a



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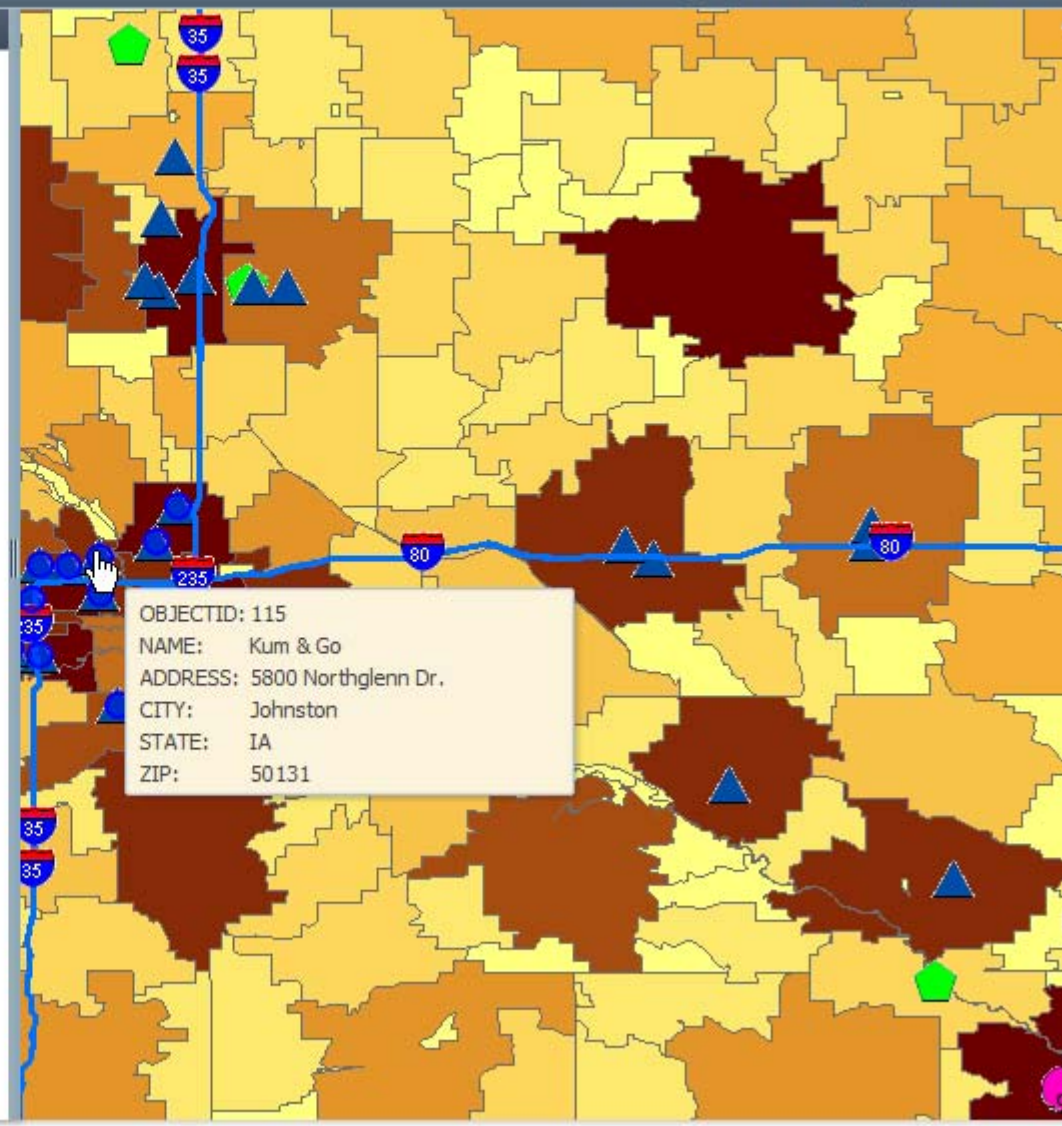
Knowledge Compendium | Data Exploration | Map Exploration | SGI Data Management | BioKDF Integration | Account Management | Data Services Management | Security Manager

ay Data | Tabular Query Tools | Map Exploration Tools

	ADDRESS	CITY	STATE	ZIP
e Dispatch	301 E. 7th St.	Des Moines	IA	50310
	1910 S.W. White Birch	Ankeny	IA	50023
	4341 Merle Hay Road	Des Moines	IA	50310
	665 S. 51st St.	West Des Moines	IA	50265
	141 S. Jordan Creek Parkway	West Des Moines	IA	50266
	6130 N.W. 86th St.	Johnston	IA	50131
	5970 Morning Star Ct.	Pleasant Hill	IA	50317
	1950 Princeton Dr.	Grimes	IA	50111
	2991 Sunset Dr.	Norwalk	IA	50211
	12041 Douglas Pkwy.	Urbandale	IA	50323
	1825 N. Ankeny Blvd.	Ankeny	IA	50021
	5800 Northglenn Dr.	Johnston	IA	50131



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Bioenergy KDF Integration and Interoperability

Geographic Information Science and Technology

- **Leveraging Bioenergy KDF Data Services**
  - **Once data is referenced in the Bioenergy KDF it is available, with appropriate security restrictions, to almost any other spatial data application including:**
    - **NASA WorldWind**
    - **Google Earth**
    - **Google Maps**
    - **Microsoft Virtual Earth**
    - **ESRI Developed Products**
    - **Any standards based mapping product**
  - **This flexibility allows data referenced in the Bioenergy KDF to be used directly and with no additional effort within other DOE projects including the VERDE project.**

- **Leveraging Externally Available Data Services**
  - **The data that is being used within the Bioenergy KDF is split between data that is locally stored and data that is served from others. The capability to use a variety of data services is a key benefit of the system design in that it allows the users of this system to bring in data from anywhere, in any volume, without needing to store and serve it from the Bioenergy KDF itself. Currently, it is planned to allow data services in the following formats to be loaded by users of the system and made available through the various interfaces**