CAPABILITIES IN ENERGY RESEARCH AT THE UNIVERSITY OF KANSAS

The capabilities documents that follow are provided to identify current strengths and interests of faculty and staff at The University of Kansas in energy research to facilitate 1) formation of research partnerships to expeditiously respond to large-scale energy research initiatives, and 2) provide information to help those outside of the university identify our strengths in energy research and technology transfer. Four documents included are focused around conventional fuels and fossil energy, carbon sequestration, unconventional gas, biofuels, and linked energy systems. In an attempt to be inclusive, areas such as biofuels was broadly interpreted. We welcome a dialog toward the refinement of these documents and addition of other areas of energy research. Any omissions were not intentional.

- **Petroleum Research and Technology Transfer**
- **Enhanced Oil Recovery and Carbon Sequestration from Industrial Sources**
- **Unconventional Gas Recovery and Utilization**
- **Biofuels and Linked Energy Systems**

Prepared by the KU Energy Research Center

Robert H. Goldstein and G. Paul Willhite, Co-Directors

Mission Statement

The KU Energy Research Center supports development of innovative research in fossil, unconventional, and alternative energy; in basic energy science; and in energy conservation at KU, and it facilitates partnering of KU faculty and staff with other research organizations in the private and public sectors. The KU ERC also provides a clearinghouse of capabilities in energy research at KU, supports technology transfer, and offers office support for contracts that are submitted through the center.

Values

The ERC seeks to enhance energy research and technology transfer for KU and its partners by: 1) matching KU's capabilities with opportunities, 2) identifying areas where expanded or new capabilities have the potential to develop new and productive research thrusts, 3) providing seed funds to cultivate new and creative ideas, 4) delivering support services to ensure that needs of researchers are satisfied in a timely manner, 5) create and participate in opportunities for technology transfer and information dissemination; 6) respond to and develop funding initiatives in appropriate research directions.

Overarching goals

1) identify strengths of faculty and staff on campus and possible outside collaborators. 2) develop major funding to stimulate significant new and sustained energy-related research programs at KU, 3) broaden the portfolio of energy research at KU, and 4) strategic investing in several major areas that have the most promise for funding in research that is consistent with expertise at KU and its collaborators.

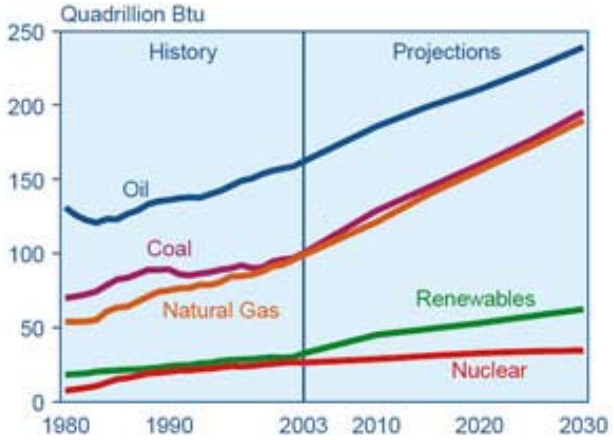
Prepared by *Energy Research Center*
March 2007

Capabilities in Petroleum Research and Technology Transfer at KU

THE UNIVERSITY AND THE PETROLEUM INDUSTRY

The KU Energy Research Center has facilitated significant collaborations between industry and university partners in oil and gas research and technology transfer since its re-organization in 1991. Research and development in petroleum will remain an essential component of KU's capabilities, recognizing the magnitude of this energy source in Kansas' economy, second only to agriculture and the sustained global demand for petroleum that will dominate other energy sources through this century. Kansas' future in petroleum is promising as new recovery options are exercised including carbon dioxide flooding and sequestration. Unconventional natural gas trapped in shale and coal harbor an unrealized resource made economic by higher prices and accessible using new technology. While Kansas' energy portfolio will continue to diversity, conventional oil and gas production will remain a vital business activity. Value-added strategies in petroleum production, such as linked-energy systems (e.g., use of CO2 from ethanol production from Kansas grain) and co-generation with biomass, will be realized through new partnerships with agriculture. Continued gains in efficient petroleum extraction will boost the economic health of Kansas and its rural areas and contribute toward domestic energy independence.

World Marketed Energy Use by Fuel Type, 1980-2030
Source: EIA



The University of Kansas **Department of Geology** was established in the first half of the last century, developing a tradition of excellence in sedimentary geology and paleontology with research that encompasses studies of modern and ancient environments. Today, that reputation has been greatly enhanced, through interdisciplinary broadening of the program, which includes collaborations with student and faculty researchers in the **Kansas Geological Survey**,

Departments of Chemical and Petroleum Engineering, and the **Tertiary Oil Recovery Project**. The programs related to petroleum geology and geophysics at the University of Kansas are on the cutting edge in research and training for students. KU provides diverse training in theory and practice and concentrates on both academic and applied research. It maintains a strong presence in the Industry. Participation at the American Association of Petroleum Geologists (AAPG) annual meeting, routinely involve dozens of faculty, students. and staff from the University of Kansas, 32 authored abstracts in previous meeting. The University of Kansas has maintained close connections with the Oil and Gas Industry over the years and has trained many of the leaders of petroleum geoscience and engineering. It continues to provide the same broad training to its students while working on cutting-edge research related to the Industry.

The Kansas Geological Survey conducts geological studies and research of the State's petroleum resource, collects and preserve data acquired by the petroleum industry, and disseminates information using the latest technology leading to a better understanding of Kansas' petroleum resources. Website is highly regarded with data on over 350,000 wells, production from over 11,000 gas leases and 45,000 oil leases, and interactive maps and web tools to view and analyze this information. The Survey participates routinely in technology transfer, field demonstration, and general servicing of Kansas' energy sector.

The **Tertiary Oil Recovery Project (TORP**) was established in 1974 by the State of Kansas to acquaint Kansas producers with the technical and economic potential of enhanced recovery methods for Kansas oil and gas fields. The project's objectives include identify and evaluate the potential for the application of enhanced recovery processes in Kansas reservoirs, provide research and development of processes that are applicable to Kansas reservoirs, investigate the application of reservoir engineering and geology for characterization of Kansas reservoirs, disseminate technical information to the Kansas oil industry, conduct a viable program of technology transfer for the industry, develop and provide technical assistance on field tests and demonstration projects, and educate students and operators in enhanced recovery processes and efficient reservoir and operations management.

AN EXCEPIONAL TRACK RECORD IN INDUSTRY

The academic programs continue to produce a constant flow of M.S. and Ph.D. students for work in the oil industry. Graduates include four presidents of the American Association of Petroleum Geologists (Pratt, Haas, Fisher, and Foster), three presidents of SEPM (the Society for Sedimentary Geology (Croneis, G. Dallas Hanna, and Marcus A. Hanna), five presidents of the Paleontological Society (Dunbar, Knight, Newell, Yochelson, and Lane), one of the Mineralogical Society of America (A.F. Rogers), and one of the Geological Society of America (Hedberg). Many have achieved positions as high officials in various oil companies, especially in Exxon (Merrill Haas, Richard Meek, H.H. Hall, Ray P. Walters). Others have included an Executive Vice President of Phillips (Rickards), a Chairman and Chief Executive Officer of Union Pacific Resources (Adams), a President of Shell Gas (Funk) and a President of Western Geophysical (Cramer) and high officials with Sun (Tyler), Getty (Carlos), Gulf (Hedberg), and Maraven (Hans Krause). Wallace Pratt was Vice President of Standard Oil Company of New Jersey (Now ExxonMobil) and a member of the Board of Directors and Executive Committee.

Dean McGee (Kerr-Mcgee) was one of the 400 richest people in the US, as listed by Fortune magazine.

WHY HAS KU TRAINED SO MANY SUCCESSFUL PROFESSIONALS FOR THE PETROLEUM INDUSTRY?

- A tradition of strength and diversity in sedimentary geology and petroleum engineering
- A curriculum of depth and breadth in Geology, Geophysics, and engineering
- An emphasis on helping students develop the skills useful for a successful career in the long-term, as opposed to training aimed at short-term goals.
- Verbal communication
- Writing
- Logic and geologic reasoning
- Broad field experiences
- Diverse course experiences
- Practical skills specifically related to oil exploration, development, and production
- Interaction between geologists, geophysicists, and engineers

RECOGNITION OF KU's CURRENT PROGRAM

- In the last ten years, members of KU's geology program have received more than sixteen awards, medals, or honorable mentions to acknowledge the impact of their research accomplishments.
- The program in geophysics was recognized for excellence recently by SEG.
-Evidence of high standing in Sedimentary Geology is seen in the US News and World Reports top-ten ranking of the sedimentary geology and paleontology programs; a distinction that places KU’s program among only a few top universities.
- G. Paul Willhite, Co-Director of the KU ERC and Co-Director of TORP, was elected to engineering academy, the fourth professor from KU to earn highest honor accorded to engineers.

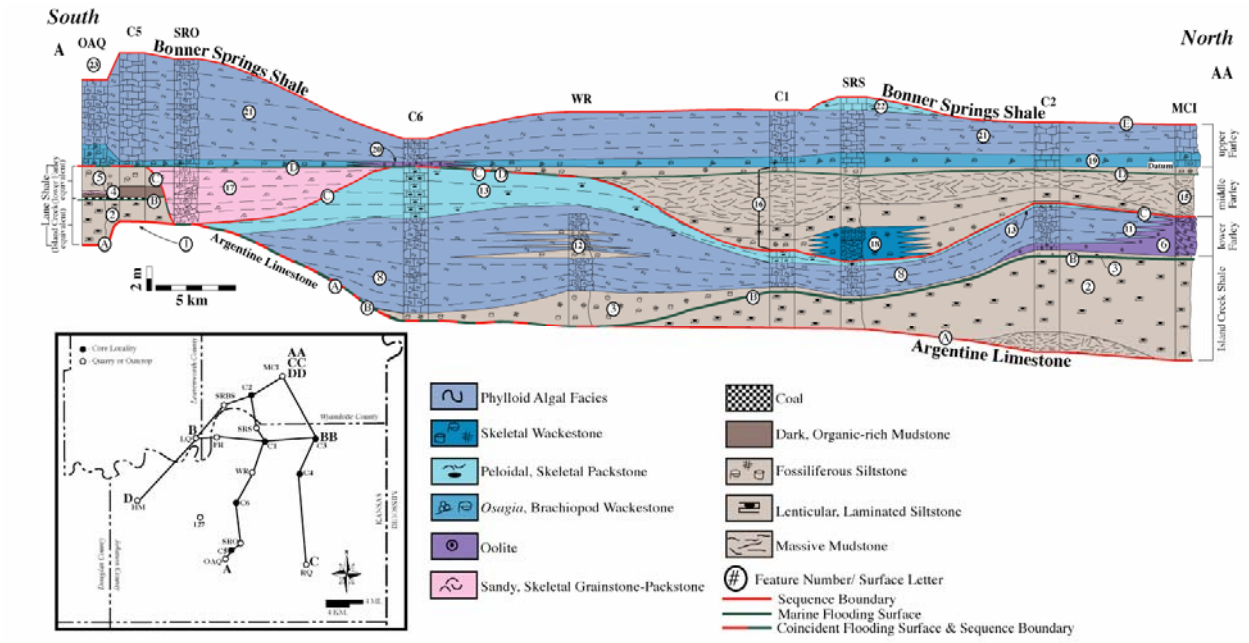
A DIVERSE FACULTY WORKING TOGETHER

Bob Buddemeier (Courtesy Professor-Dept. of Geog., Senior Scientist-KGS.)
Bob Goldstein (Distinguished Professor-Dept. of Geol.)
Bruce Lieberman (Associate Professor, Dept. of Geol)
Dan Stockli (Assistant Professor-Dept. of Geol.)
Diane Kamola (Associate Professor-Dept. of Geol.)
Don Steeples (Distinguished Professor, Dept. of Geol.)
Doug Walker (Professor-Dept. of Geol.)
Evan Franseen (Courtesy Professor-Dept. of Geol., Senior Scientist-Kansas Geol. Surv.)
George Tsoflias (Assistant Professor, Dept. of Geol.)
Mike Taylor (Assistant Professor, Dept. of Geol.)
Gwen Macpherson (Associate Professor-Dept. of Geol.)
Jennifer Roberts Rogers (Assistant Professor-Dept. of Geol.)
John Doveton (Courtesy Professor-Dept. of Geol., Senior Scientist-Kansas Geol. Surv.)
Lee Gerhard (Courtesy Professor-Dept. of Geol., Principal Geologist-Kansas Geol. Surv.)
Luis Gonzalez (Associate Professor, Dept. of Geol.)

Lynn Watney (Courtesy Professor-Dept. of Geol., Senior Scientist-Kansas Geol. Surv.)
Paul Enos (Emeritus Distinguished Professor-Dept. of Geol.)
Randy Van Schmus (Distinguished Professor-Dept of Geol.)
Roger Kaesler (Professor, Dept. of Geol.)
Ross Black (Associate Professor, Dept. of Geol.)
Steve Hasiotis (Assistant Professor, Dept. of Geol.)
Rick Miller (Associate Scientist, Kansas Geol. Survey)
Tim Carr (Courtesy Professor-Dept of Geol., Senior Scientist-Kansas Geol. Surv.)
Tony Walton (Associate Professor-Dept. of Geol.)
Saibal Bhattacharya (Assistant Scientist, Kansas Geol. Sur.)
Alan Byrnes (Assistant Scientist, Kansas Geol. Sur.)
Martin Dubois (Research Geologist, Kansas Geol. Sur.)
Bill Guy (Coordinator, Geology, Kansas Geol. Sur.)
K. David Newell (Assistant Scientist, Kansas Geol. Sur.)
Don W. Green (Professor, C&PE, Co-Director TORP)
G. Paul Willhite (Professor, C&PE, Co-Director TORP)
Stan McCool (Associate Scientist, TORP)
Jyun Syung Tsau (Associate Scientist, TORP)
Jenn-Tai Liang (Associate Professor, C&PE)
Rodney Reynolds (Junior Scientist, Director Technology Transfer, TORP)
Stephen Johnson (Research Scientist, TORP)

AREAS OF SPECIAL CAPABILITY

Sequence Stratigraphy



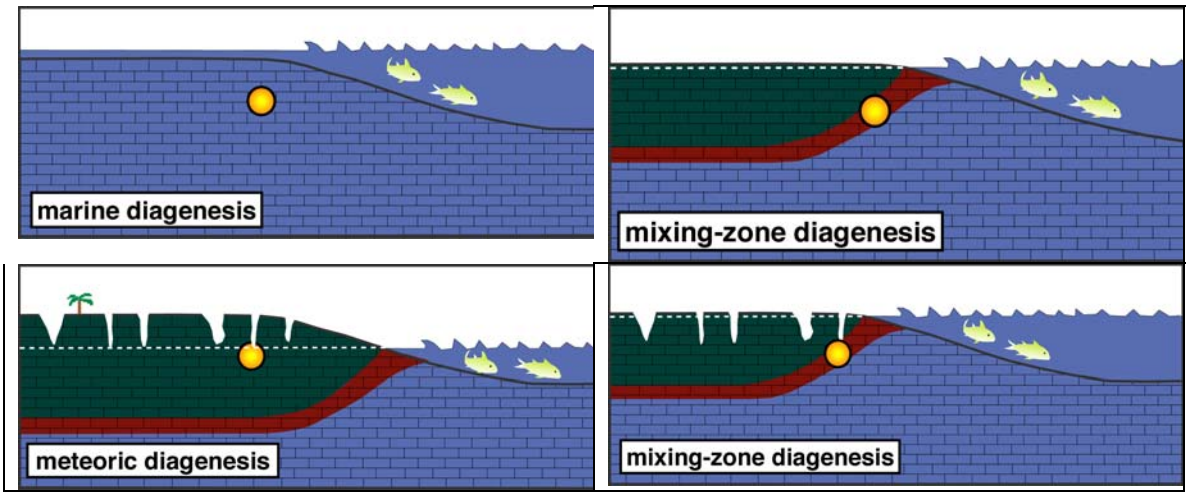
Researchers in sequence stratigraphy include a diverse group including Diane Kamola and Steve Hasiotis who work in clastic sequence stratigraphy, Bob Goldstein, Paul Enos and Evan Franseen who work in carbonate sequence stratigraphy, and Tim Carr and Lynn Watney who specialize in subsurface sequence stratigraphy and sedimentary modeling. The program in

sequence stratigraphy has been very active in recent years, hosting several international conferences.

Petroleum Geology

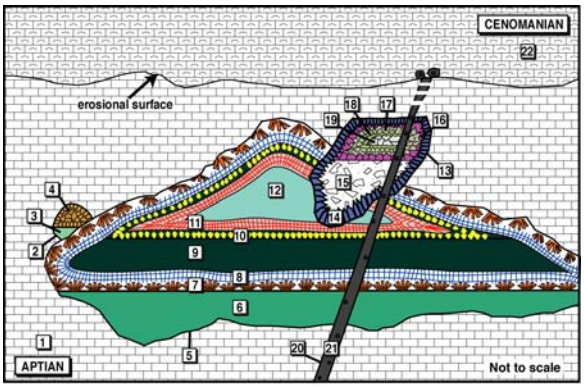
Many researchers are involved with studies directly relating to petroleum geology. These include Paul Enos, Evan Franseen and Bob Goldstein, who work extensively in carbonate reservoir systems, Tim Carr, Marty Dubois, and Lynn Watney who are experts in the subsurface of Kansas, Tony Walton and Diane Kamola, who specialize in sandstone reservoirs, and John Doveton and Alan Byrnes, who is an expert in log and rock petrophysics, respectively. Dave Newell brings an expertise in coal bed methane and carbonate diagenesis. Saibal Bhattacharya provides a unique ability to accomplish geoengineering collaborations with skills in reservoir modeling log analysis and software development. Many projects within the Department are done in conjunction with geologists at the Kansas Geological Survey and Tertiary Oil Recovery Project in the Department of Petroleum Engineering.

Geochemistry and Diagenesis



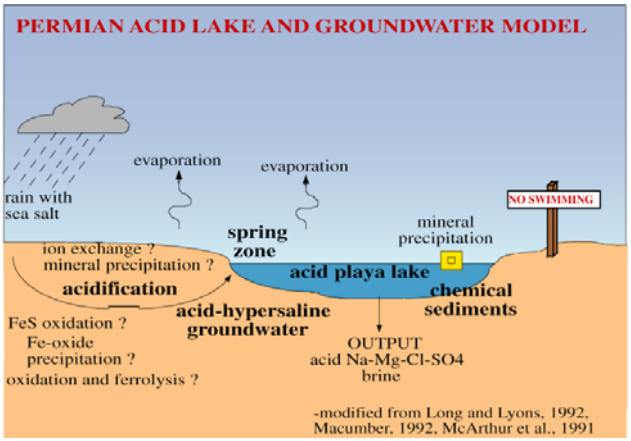
Researchers doing geochemical and diagenetic research include Tony Walton who works on the diagenesis of sandstone reservoirs and volcanic rocks, Bob Goldstein and David Newell who work on fluid inclusions and integrating diagenesis with sequence stratigraphy, Paul Enos who works on various projects in carbonate diagenesis, Luis Gonzalez who works on isotopic systems in carbonates, Jennifer Robert Rogers who specializes in microbial mediation of weathering reactions, and Gwen Macpherson who works on diverse projects in hydrogeochemistry.

Carbonate Geology



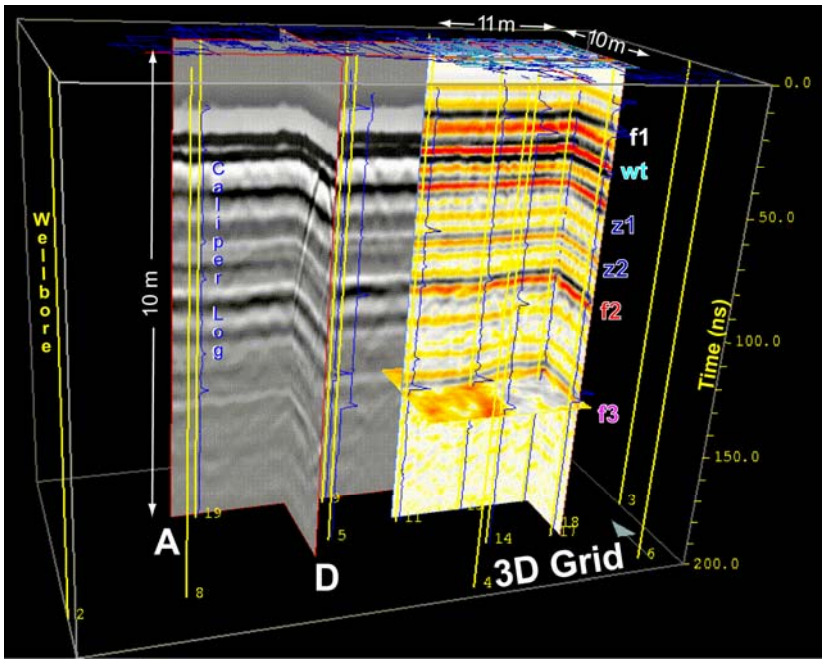
In carbonate studies, we have among the largest and most diverse group of faculty in the nation, including Paul Enos, Robert Goldstein, Luis Gonzalez, Evan Franseen, David Newell, Marty Dubois, Lynn Watney, Bob Buddemeier, Jennifer Roberts and Tim Carr. These researchers are involved in sequence stratigraphy of carbonate platform evolution, diagenetic variables affecting carbonate reservoirs and three-dimensional characterization of carbonate reservoir systems. Their students are working in highly diverse areas of research, some concentrating on field-based projects in sequence stratigraphy, others concentrating on diagenesis and fluid flow, and others focusing on subsurface geology and the controls on carbonate reservoir character.

Clastics



In clastic sedimentology, diagenesis, and stratigraphy, we have five faculty, Anthony Walton and Diane Kamola, teach courses in petroleum geology, basin analysis, and terrigenous depositional systems. Bob Goldstein and Lynn Watney work on the sedimentology and sequence stratigraphy of mixed carbonate/clastic/evaporite systems and also studies the diagenesis of clastic reservoirs. Steve Hasiotis integrates trace fossils with the sedimentology and stratigraphy of continental systems. Tim Carr is active in research into strata hosting coal-bed methane resources and incised valley fill sandstones in Kansas. Currently, many students do research in the areas of three-dimensional analysis of clastic reservoir systems and their outcrop analogs. Students are exceptionally well prepared for working in areas of quantitative three-dimensional visualization of clastic reservoirs, and others have carefully integrated clastic reservoirs and fluid flow.

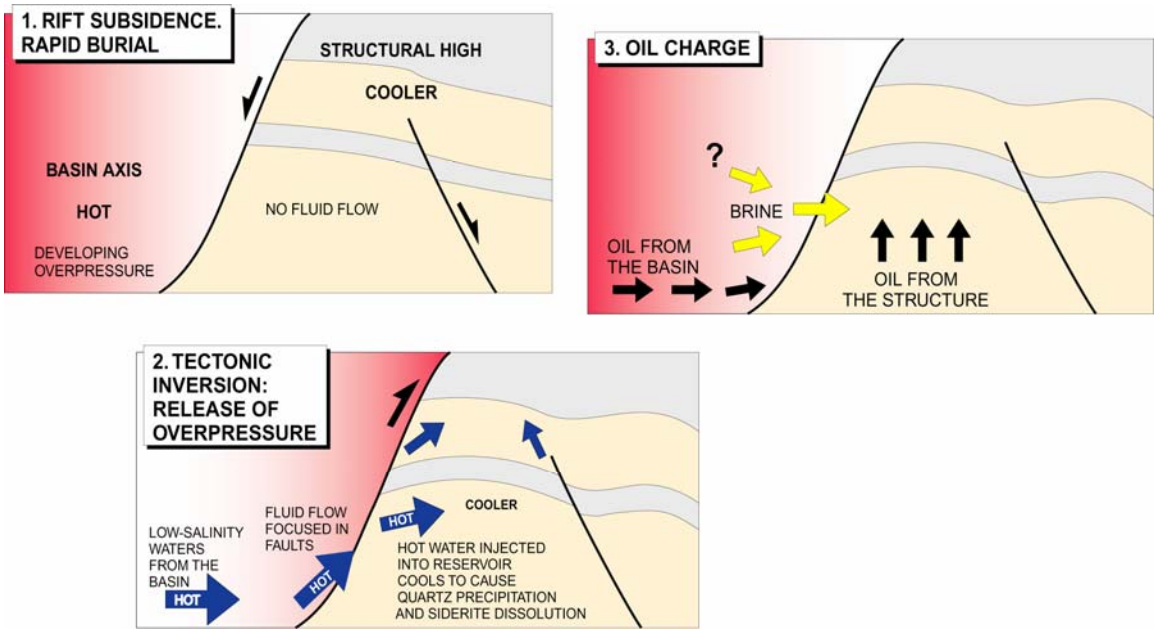
Geophysics



Geophysical research and teaching at the University of Kansas are centered in the Department of Geology and Department of Physics and Astronomy. Both departments have graduate programs leading to the Master of Science and Doctor of Philosophy degrees, with emphasis in geophysics. The Kansas Geological Survey, which is part of the university, contributes significantly in research, teaching, and student support through Rick Miller and the Exploration Services team. This cooperation is a real strength of the geophysics program at KU. Our graduate curriculum in geophysics provides students with a strong foundation in physics, geology, and geophysics, as well as advanced education, both in the classroom and in the field, and in theoretical and applied geophysics. The program consists of four faculty. Rick Miller has an active an innovative program applying seismic techniques to imaging the subsurface. Don Steeples concentrates on developing new high resolution seismic techniques. Ross Black is interested in processing, structure of the crust of the western US, and GIS techniques. George Tsoflias has broad interests

in application of 3-D seismic data to imaging of oil and gas reservoirs and GPS techniques applied to the near subsurface.

Structure/Tectonics



Faculty interested in the integration of tectonics with sedimentary processes and structure/tectonics include Doug Walker and Diane Kamola, who are evaluating tectonic controls on depositional sequence distribution, Dan Stockli and Bob Goldstein, who work on the thermal and pressure history of sedimentary basins, Randy Van Schmus who works on U/Pb dating of detrital zircons to discriminate tectonic history, and Mike Taylor interested in kinematics and mechanics of fault systems using cosmogenic isotopes, and geodetic and remote sensing applications.

Gelled Polymers

TORP has been conducting research on gelled polymer treatments for over twenty years. Most of the work has been fundamental and includes:

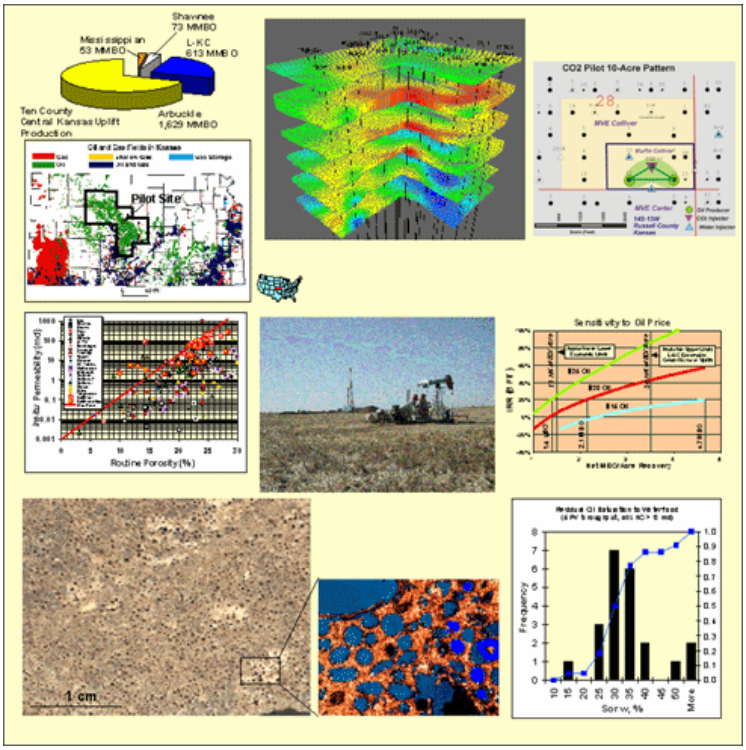
- Developing new gel systems
- Determining the effect of parameters, such as component concentrations and pH, on the gelation behavior
- Conducting kinetic studies of the gelation reactions
- Mathematical modeling of the polymer crosslinking reactions
- Investigating the gelation behavior during flow in porous media and fractures
- Examining the effect of fluid-rock interactions on gelation behavior
- Mathematical modeling of gelant injection in porous media (laboratory and field scales)
- Developing and validating a conceptual model of oil and brine flow through gel-treated media

Biosurfactants

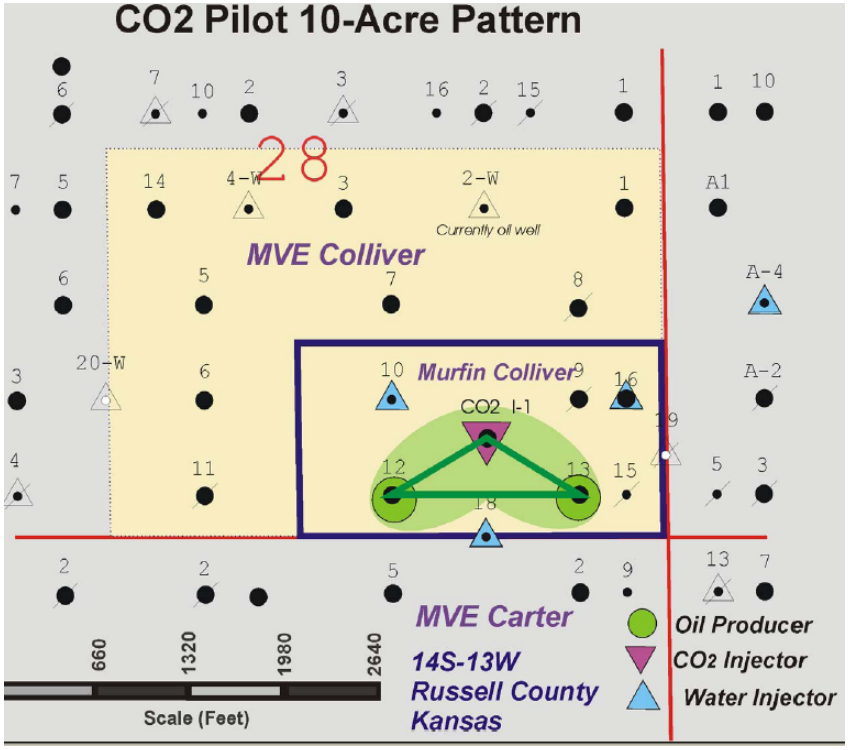
Using Biosurfactants Produced from Agriculture Process Waste Streams to Improve Oil Recovery in Fractured Carbonate Reservoirs -- Jenn-Tai Liang (TORP)

- The US domestic oil production has been in a steady decline for the past 30 years. Significant effort has been devoted to improving oil recovery by using various secondary and tertiary recovery methods. Although these efforts have resulted in a significant increase in recovery efficiency, **almost 2/3 (~350 billion barrels) of the US oil reserve still remains stranded and unproduced**. Previous research has demonstrated that the injection of surfactants into oil reservoirs can be very effective in mobilizing stranded oil.

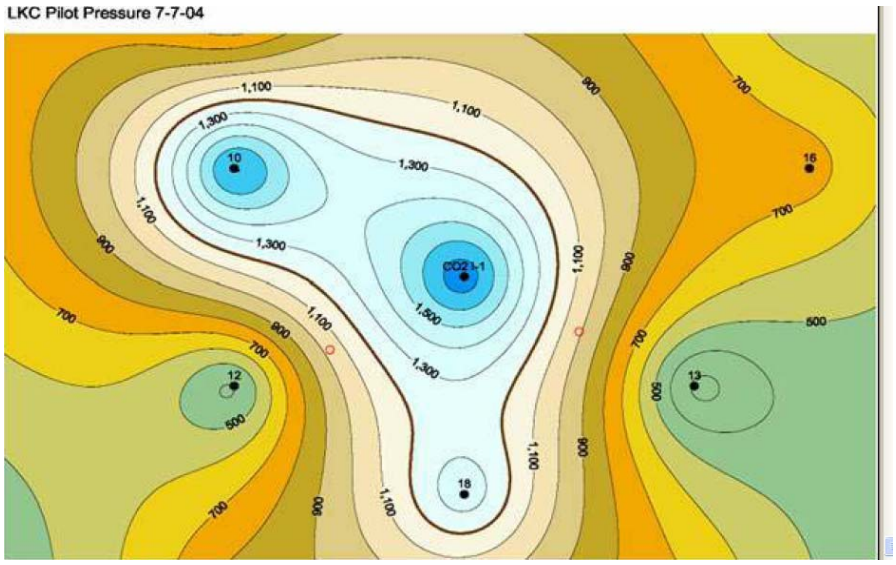
CO2 Miscible Flooding



CO2 Sequestration

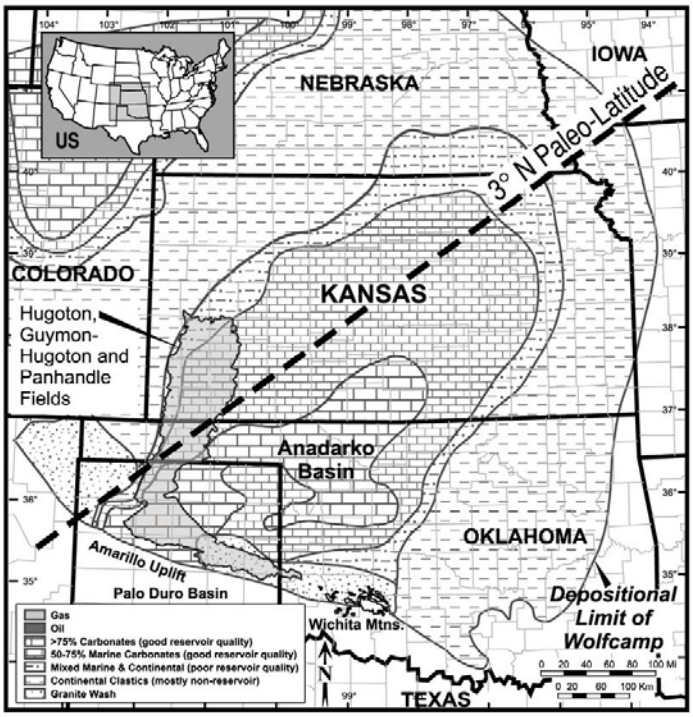


Reservoir Simulation

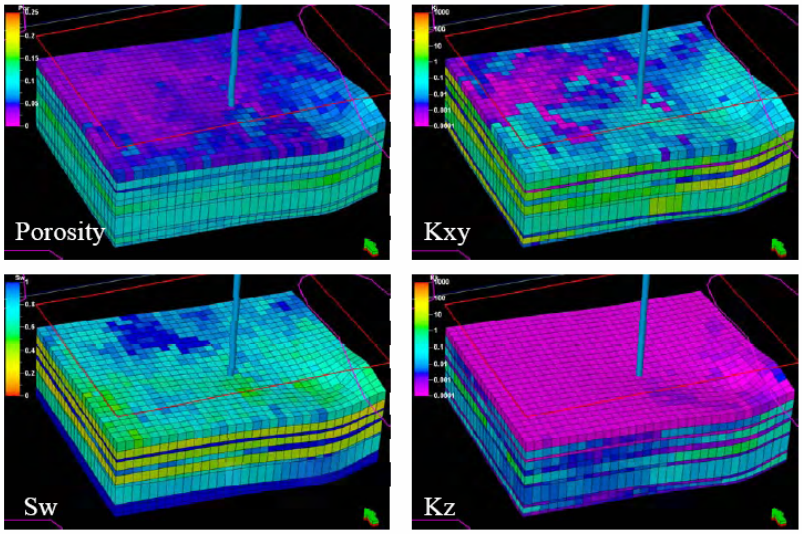


Management of A Giant Gas Field

One of the world's giants in natural gas production, the Hugoton Natural Gas Field in southwestern Kansas has seen production declines over the past decade. Study by the Kansas Geological Survey is helping operators extend the life of the field and more efficiently recover the gas that remains. Ten industry partners joined with KGS scientists to produce a computer model to help determine how much gas is left in the field and where it is located. Based on the model, researchers estimate 65% of the gas (35 trillion cubic feet) may have been removed from the field since its discovery in 1922. The Hugoton field has long been a major source of royalties, tax revenue, and other income generated in 10 counties of southwestern Kansas. Besides enriching the Hugoton's prospects, the studies findings can be applied to similar gas reservoirs worldwide. Most of the remaining natural gas is in less permeable rock layers where the gas moves more slowly and can be more difficult to produce. The Hugoton report is available on the Kansas Geological Survey Website at www.kgs.ku.edu/PRS/publication/2007/OFR07_06/index.html.



Hoobler 11-layer model – other properties



Technology Transfer to the Petroleum Industry

In connection with TORP's policy of dissemination of information to the oil operators, engineers, geologists, and regulatory personnel in the state, TORP , in cooperation with the Petroleum Technology Transfer Council (PTTC) and the Kansas Geological Survey, conducts technology transfer activities to assist the oil and gas industry in Kansas.

The North Midcontinent Regional Lead Organization of PTTC an effort led by TORP and the KGS, which is partially funded by TORP and the U.S. Department of Energy, is responsible for conducting the following technology transfer activities:

Maintain a regional resource center

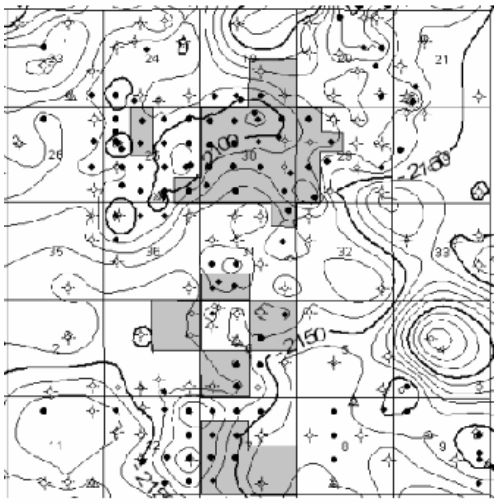
- Access to data/information resources
- Responses to inquiries
- Access to software

Conduct technology workshops
Maintain regional website
Written communication

- Regional newsletter

In addition to the above PTTC activities, TORP also conducts:

- Oil Recovery Conferences every other year in Wichita, KS
- Arbuckle Gel Polymer Database
- Field Demonstration Projects (jointly with KGS)
    - Zenith Field Project (KCC Funded)
    - Improved Oil Recovery in Fluvial Dominated Deltaic Reservoirs of KS (DOE Funded)
        - Savonburg Field Project
        - Stewart Field Project
    - Improved Oil Recovery in Mississippian Carbonate Reservoirs of KS (DOE Funded)
        - Schaben Field Project



Schaben Field demonstration site with structure on top of the Mississippian Limestone. The locations of the leases involved in demonstration area are indicated in gray

Prepared by KU Energy Research Center
March 2007

CAPABILITIES IN UNCONVENTIONAL GAS RECOVERY AND UTILIZATION AT *THE UNIVERSITY OF KANSAS*

Objective: KU has considerable expertise in unconventional gas recovery and utilization with funded projects and peered-reviewed results that involve disciplines of geology and engineering. Efforts in funding research are currently dispersed through multiple units on campus, and partners in industry federal labs, and academia. Due to these viable research projects, a significant opportunity presents itself to develop a major, interdisciplinary, externally-funded energy research program on ***Unconventional Gas Recovery and Utilization*** facilitated by the KU ERC. Natural gas and syngas will only continue to grow in importance as a clean fuel alternative for new combustion techniques and use in new technologies such as powering fuel cells. Kansas' abundant natural gas and agriculture resource factor strongly into this initiative, but can and should be examined at a national and international level of involvement.

Essential Elements -- Current Research and Funding Sources

1. Tight gas characterization and extraction in sandstone, shale, and carbonates worldwide (focus of current funding by Research Partnership to Secure Energy for America – RPSEA (www.rpsea.org); current contract on tight gas sandstones with DOE at KGS – project #41910);
2. Coal bed methane characterization and enhancement, particularly from use of coal beds in carbon sequestration (DOE-FE, coal research budgeted at $300 MM for FY07; three current contracts with DOE at KGS – project #35460, #38650, #39090);
3. Low BTU natural gas from impure natural gas reservoirs (existing industry partnerships and beyond; completed industry contract at KGS);
4. Novel simulation and recovery strategies applied to giant natural gas reserves (successful industry partnership in Hugoton Asset Management Project – HAMP at KGS - #35290);
5. Syngas from biomass, in particular catalytic enrichment of syngas for hydrogen production including use in fuel cells (DOE-EERE hydrogen technology and biomass and biorefining programs budgeted for $196 MM and $150 MM, respectively in FY07; also USDA collaborations with DOE; several related projects in C&PE, including #19213); (SEE BIOFUELS CAPABILITIES)
6. Methanogenesis/fermentation for natural gas production, involving surface and subsurface organic matter (potential funding by DOE - Office of Science with basic energy sciences program budgeted at $1.4 billion for FY07; also considerable interest and funding possible from industry such as current related funding in Department of Geology - #43720) (SEE BIOFUELS CAPABILITIES)

KU FACULTY/STAFF CAPABILITIES

Kansas Geological Survey

Bill Harrison
State Geologist/Director
KS Geological Survey
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Alan P. Byrnes
Kansas Geological Survey
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- Petroleum reservoir geology
- Rock petrophysical properties
- Carbon dioxide flooding
- 25 years of oil and gas industry experience involving core petrophysical analysis, reservoir characterization, and integration with engineering

K. David Newell
Kansas Geological Survey
864-2183
dnewell@kgs.ku.edu

- Stratigraphy
- Carbonate diagenesis and depositional environments
- Petroleum Geology
- Fluid inclusions in sedimentary diagenetic minerals
- Coal bed methane
- Low BTU Gas
- Analysis of physical and geochemical properties of coal for evaluating and predicting associated natural gas resources.

Martin K. Dubois
Kansas Geological Survey
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- Petroleum geology, reservoir modeling
- Linked energy systems
- Interdisciplinary reservoir analysis for Hugoton-Panoma Gas Areas.

- The Hugoton Asset Management Project (HAMP) was initiated in January 2004 as a two-year project with primary goals of modeling the Permian gas systems of the Hugoton and Panoma Fields in southwest Kansas and Oklahoma Panhandle
- Build a digital pools catalogue for the pre-Permian fields in southwest Kansas
- Collaboration between the Kansas Geological Survey and 10 industry partners with assets in the area
- Designed to provide the knowledge and technical base required for intelligent stewardship, identification of new opportunities, and continued improvement in recovery strategies in the Hugoton and Panoma Fields in Kansas and the Oklahoma Panhandle

John Doveton
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- Theory, teaching, and application of wireline log petrophysics
- Co-author of "*Reading the Rocks from Wireline Logs*" is made up of both a tutorial and and interactive excercise. The tutorial covers the basics of the geological interpretation of gamma-ray, photoelectric index, neutron-density porosity log overlays as a pattern recognition of the common sedimentary lithologies (Tutorial by John Doveton; Oz machine by Geoff Bohling.) http://www.kgs.ku.edu/PRS/ReadRocks/OzIntro.html
- Co-author of GEMINI, Geo-Engineering Modeling through Internet Informatics, http://www.kgs.ku.edu/Gemini/index.html -- web-based reservoir modeling
- Co-author of PfEFFER (Petrofacies Evaluation of Formations for Engineering Reservoirs**)** -- spreadsheet based log analysis software.

Geoff Bohling
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- Development of petrophysical data analysis techniques
- Assisting with development of a geologic model for a large gas field
  - Automating data processing procedures
  - Exploring combined application of neural network and Markov chain simulation to subsurface modeling
- Developing methodologies and software for petrophysical data analysis, including:
  - The Oz Machine, a Java applet for generation of synthetic stratigraphic sequences and corresponding log suites
  - Kipling.xla: An Excel add-in for nonparametric regression and classification
  - Petrophysical analysis and data mining components of GEMINI, web-based software for well log analysis and reservoir characterization
- Developed, documented, and presented software, including:
  - PfEFFER (well log analysis)

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- Carbon sequestration – sources and sinks inventory
  - ***National Carbon Explorer*** -- The process of sequestering carbon dioxide (CO2) involves identifying sources that produce CO2 and sinks where the CO2 can be stored. These web pages present interactive maps and background information on the process of storing CO2. This Atlas is created by the NatCarb project and sponsored by the U.S. Department of Energy's National Energy Technology Laboratory. -- http://www.natcarb.org/
- Coal bed methane
- Evaluation of Hugoton/Panoma Gas Area
- Digital Petroleum Atlas – online access to information about oil and gas fields of Kansas

Larry Brady
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- Coal bed methane
- Coal resources in Kansas

Richard D. Miller
Kansas Geological Survey
864-2091
rmiller@kgs.ku.edu

- Principal investigator on 57 grants/contracts dealing with high resolution seismic imaging including direct detection of natural gas
- 44 refereed journal articles and approximately 160 other published technical works
- Experience in applied shallow reflection research has included study areas in 29 US states and 5 foreign countries.

Chemical and Petroleum Engineering

Russell D. Ostermann
Associate Professor
C&PE
4150F Learned Hall
864-2907
ostermann@ku.edu

- Nutrient Enhancement for Coal Pre-Treatment and Biogenic Methane Production from Coal and Carbon Dioxide Sequestered in Coalbeds **(ERC Energy Development Grant)**

Jenn-Tai Liang
Associate Professor
C&PE
4148A Learned Hall
(785) 864-2669
jtliang@ku.edu

- CO2 Sequestration in Geologic Formations - Simulation and experimental studies of the sequestration of CO2 in depleted oil and gas reservoir, unminable coal seams, EOR applications.
- Coalbed Methane Recovery - Study methods for enhanced coalbed methane recovery, evaluate the environmental impacts of water disposal options for CBM produced water. With Jie Han **(ERC development grant)**

Civil, Environmental and Architectural Engineering

Jie Han
Associate Professor
Department of Civil, Environmental, & Architectural Engineering
Learned Hall
864-3714
Fax: 864-5631
jiehan@ku.edu

- Geomaterials
- Geomechanical modeling of **coal bed methane extraction** **(ERC development grant)**

Department of Geology

Robert Goldstein
Professor, Chairman
Co-Director ERC
Lindley Hall, room 120/313
864 2738
gold@ku.edu

- Sequence stratigraphy, diagenesis, and fluid-inclusion research
- Fluid history and diagenesis of the Midcontinent
- Diagenetic significance or brine reflux
- Diagenesis in sequence stratigraphy
- Fluid flow in foreland basins

Donald W. Steeples
Professor, Vice Provost
864-2730
don@ku.edu

- Shallow seismic reflection for cavity detection, groundwater exploration, engineering studies, and environmental remediation

Anthony W. Walton
864-2726
twalton@ku.edu

- Sedimentology with ernphasis on terrigenous clastic and volcaniclastic rocks.
- Effects of facies and diagenesis on oil production from sand stone reservoirs

Alison Allcott
Department of Geology

- Organic geochemistry of organic components in shales and limestones.

David A. Fowle
Department of Geology
Assistant Professor)
fowle@ku.edu
(785) 864-1955

- Environmental remediation, CO2 sequestration, methane production from lakes systems

J.A. Roberts
Assistant Professor
Department of Geology
jaroberts@ku.edu
(785) 864-4997

- Bacterial interactions with rock, hydrogeology, geochemistry
- Dolomite; methanogens
- Microbe:mineral interactions and the geological and ecological implications of these interactions in subsurface environments
- Three separate but interrelated thrusts--microbial attachment to mineral surfaces; nutrient-driven microbial silicate weathering, and low temperature-dolomite precipitation.

George Tsoflias
864-4584
tsoflias@ku.edu

- Near-surface geophysics and exploration seismology
- Investigation and development of ground-penetrating radar (GPR) and seismic methods for the characterization of fluid flow properties of geologic formations
- Geophysical characterization of fractures

Tertiary Oil Recovery Project

Don W. Green
Professor, Co-Director
Tertiary Oil Recovery Project
4146 Learned Hall
864-2911
Fax: 864-4967
dgreen@ku.edu

- Carbon Dioxide Flooding
  Reservoir Simulation
  In situ Permeability Modification Using Gelled Polymer

Capabilities in Energy Research at The University of Kansas

G. Paul Willhite
Professor, Co-Director
4146 Learned Hall
864-2911
Fax: 864-4967
willhite@ku.edu

- Enhanced Oil Recovery Processing Including Polymer Flooding
- Carbon Dioxide Miscible Flooding and Thermal Recovery
- Improved Oil Recovery Processes Ranging from Waterflooding to Application of Gelled
- Polymer to Control Water Movement in Petroleum Reservoirs
- Management of Petroleum Reservoirs and Simulation of Oil Production Using Reservoir Simulators
- Transport Processes in Porous Media
- Expansion of Energy Research at the University of Kansas

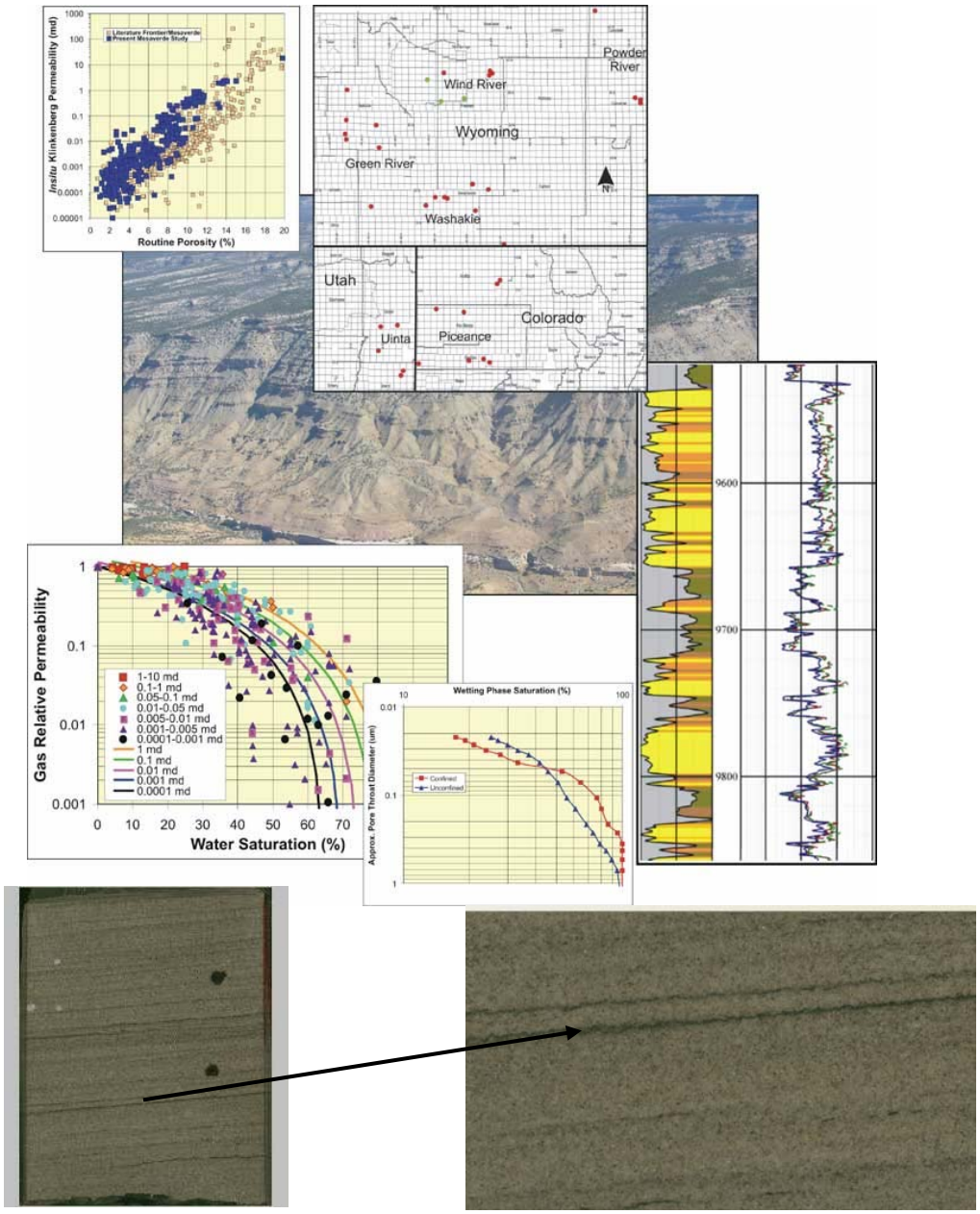
Tight Gas Sandstones

ANALYSIS OF CRITICAL PERMEABLITY, CAPILLARY PRESSURE AND ELECTRICAL PROPERTIES FOR MESAVERDE TIGHT GAS SANDSTONES FROM WESTERN U.S. BASINS

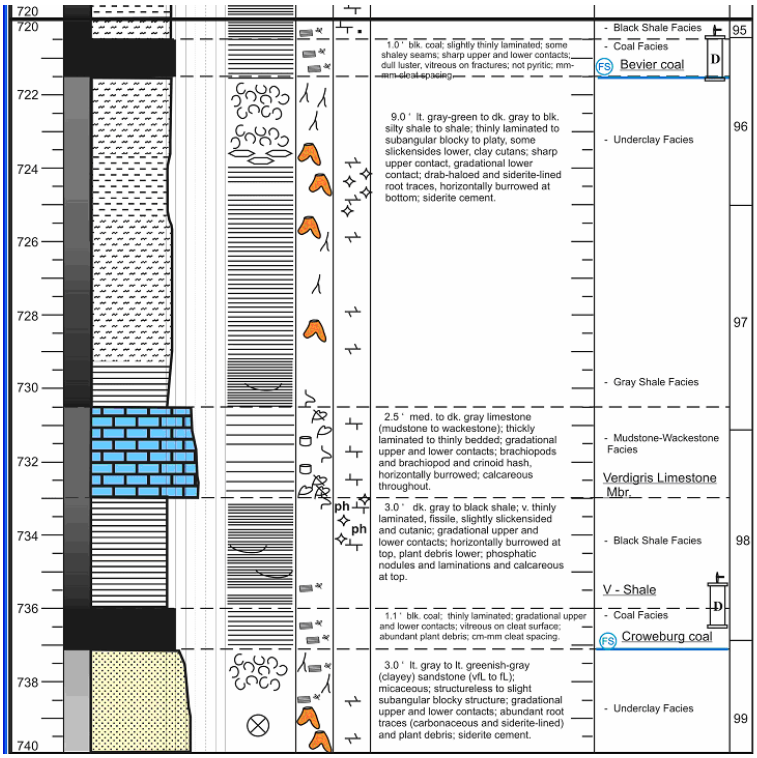
DOE Contract No. DE-FC26-05NT42660

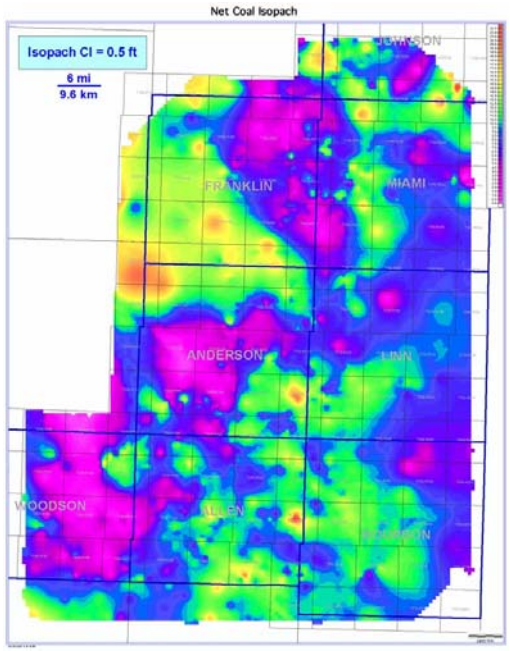
http://www.kgs.ku.edu/mesaverde/

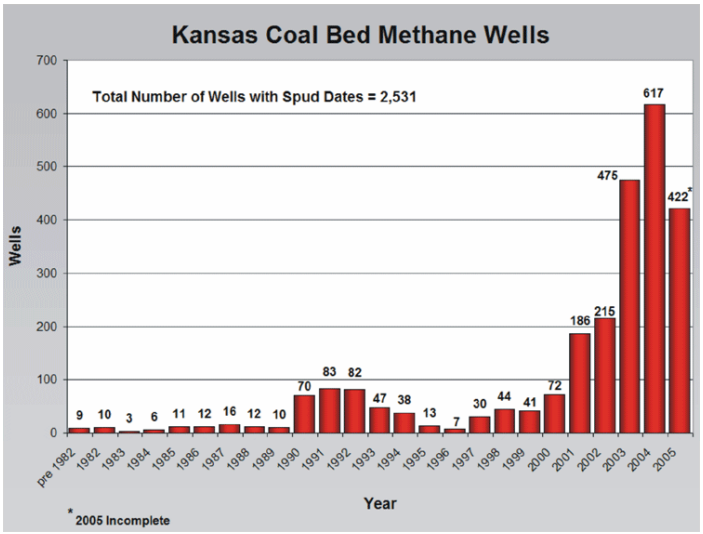
Alan P. Byrnes (KGS), Project Manager, is a petrophysicist with over 25 years of oil and gas industry experience involving core petrophysical analysis, reservoir characterization, and integration with engineering. Alan manages the project and is responsible for supervision and measurement of petrophysical properties.



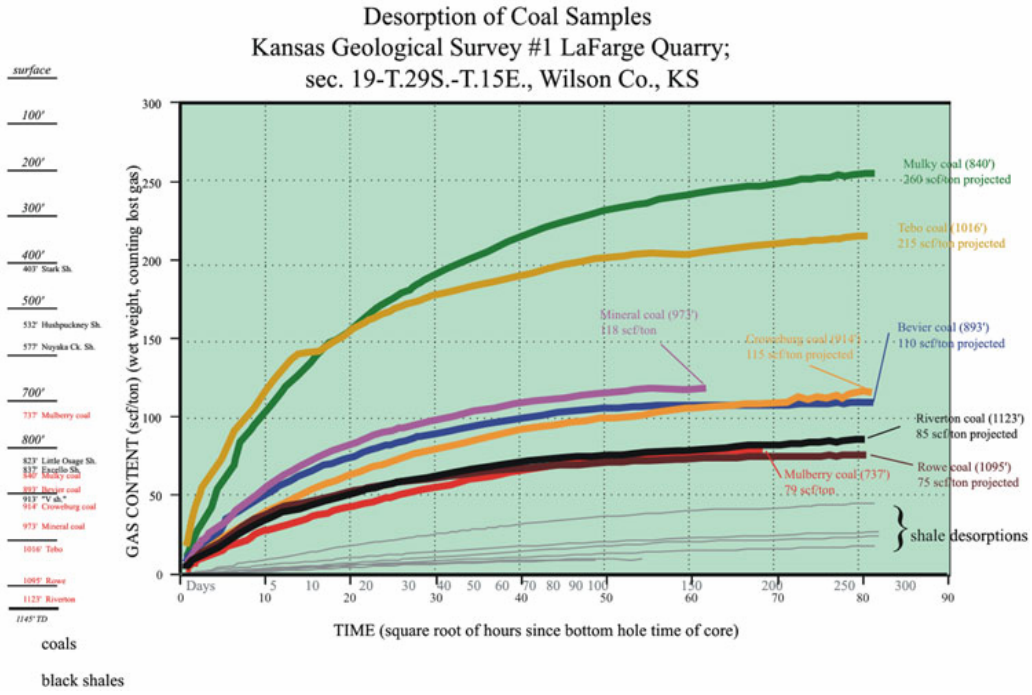
Coal Bed Methane

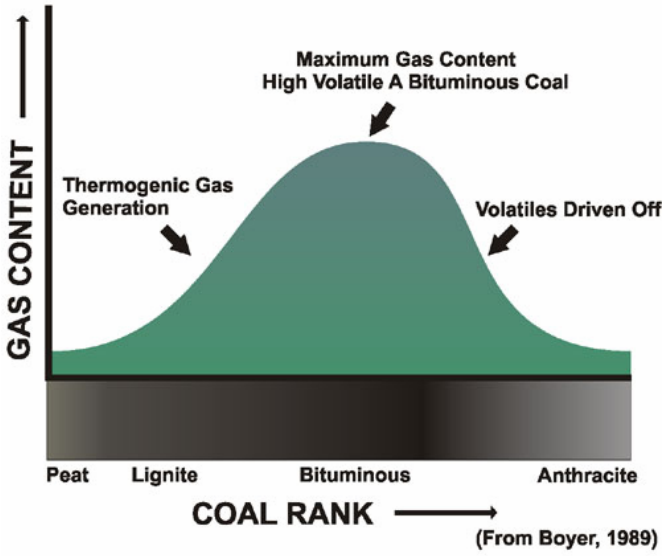




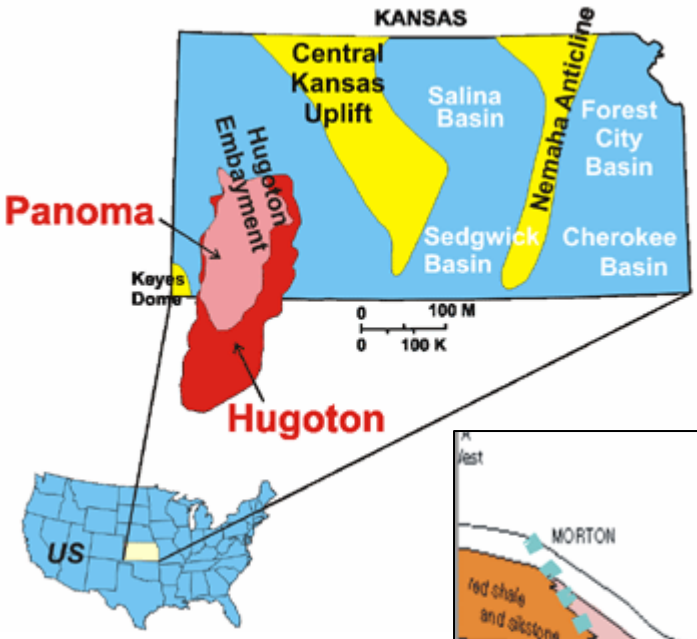


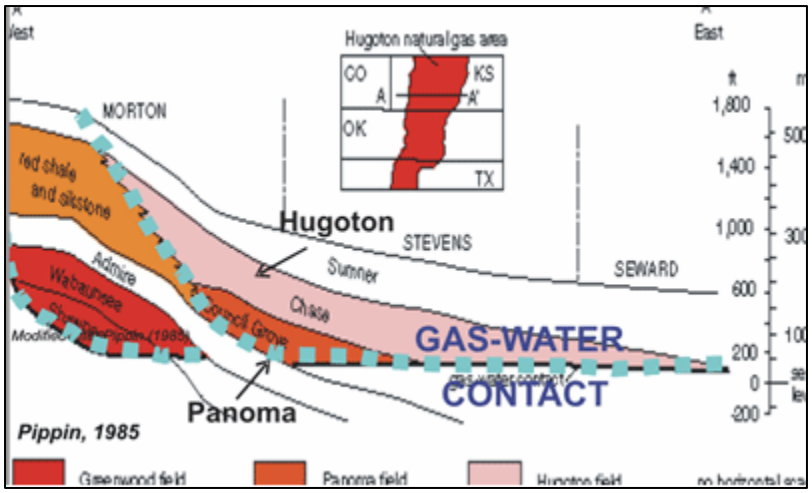
Coal Bed Methane (continued)



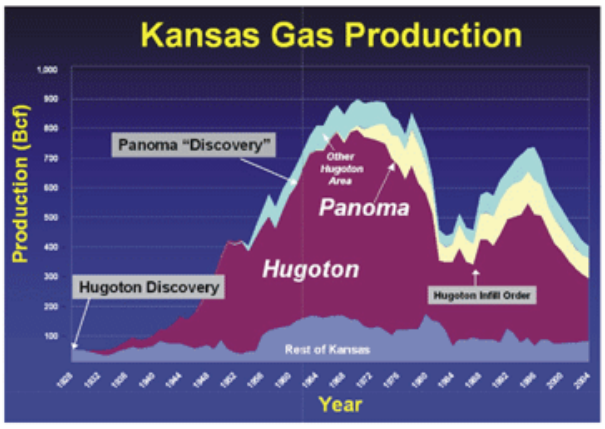


Tight Carbonate Reservoirs
Giant Hugoton Gas Area





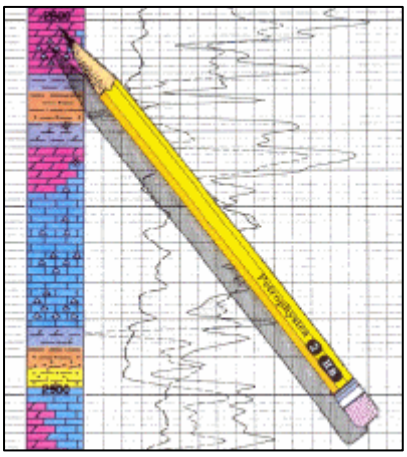
KANSAS	Hugoton	Panoma	Combined
Discovery	1928	1958	
Development	1948	1970	
Infill Drilling	1990	?	
Depth	2,500	2,750	
Wells	7,536	2,345	9,881
Cum. Gas (TCF)	24.7	3.0	27.7
BCF/well	3.3	1.3	2.8
Annual (BCF-2003)	239.9	62.5	302.4
MMCF/Well	31.8	26.7	30.6



Wireline Log Analysis Tools

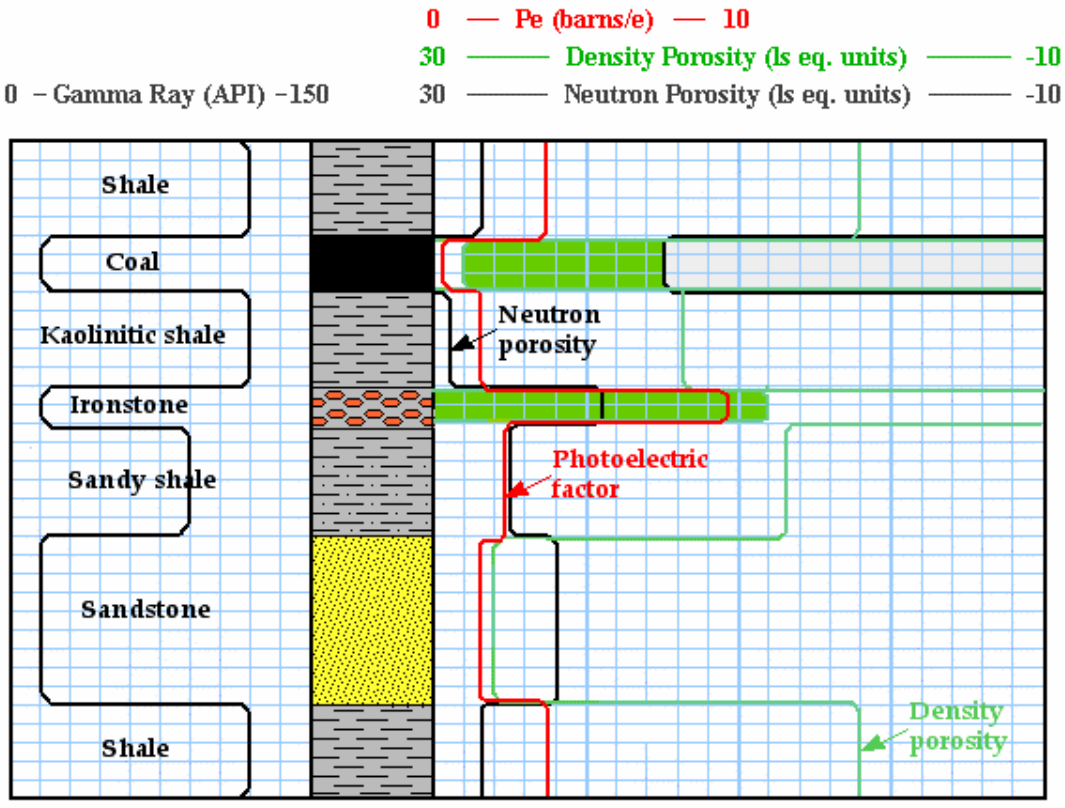
Research and Continuing Education for Industry

READING THE ROCKS FROM WIRELINE LOGS



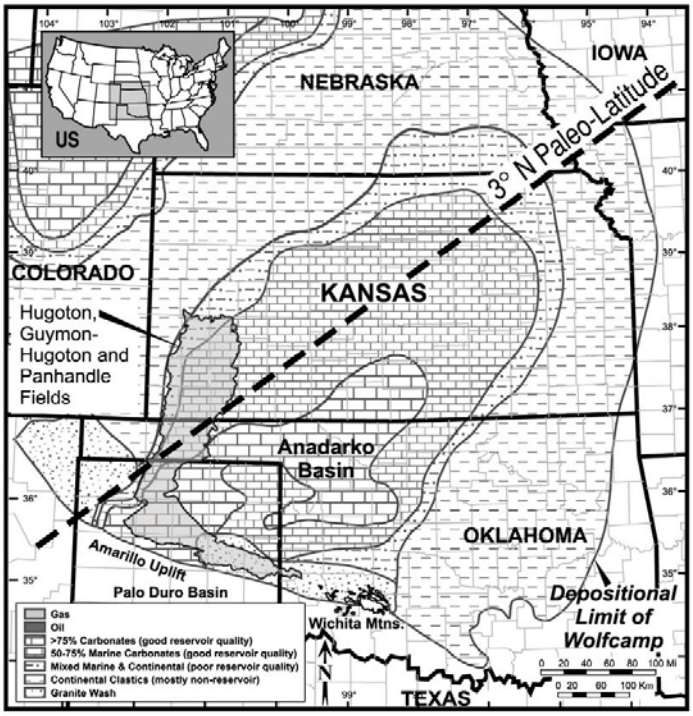
The Oz Machine

http://www.kgs.ku.edu/PRS/ReadRocks/OzIntro.html

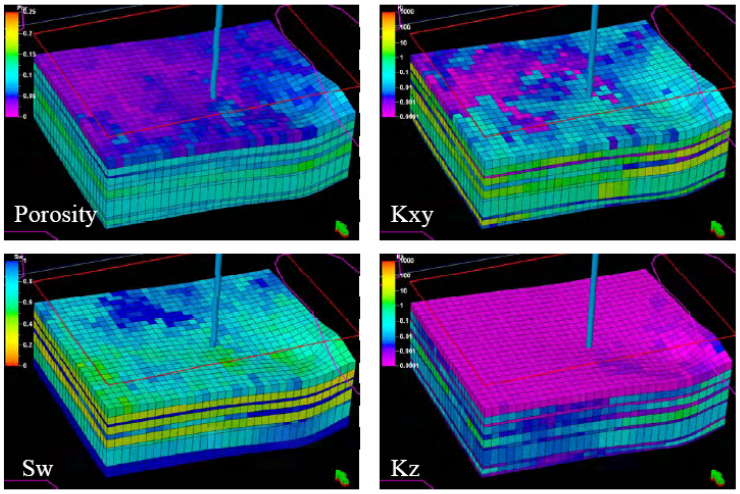


Management of A Giant Gas Field

One of the world's giants in natural gas production, the Hugoton Natural Gas Field in southwestern Kansas has seen production declines over the past decade. Study by the Kansas Geological Survey is helping operators extend the life of the field and more efficiently recover the gas that remains. Ten industry partners joined with KGS scientists to produce a computer model to help determine how much gas is left in the field and where it is located. Based on the model, researchers estimate 65% of the gas (35 trillion cubic feet) may have been removed from the field since its discovery in 1922. The Hugoton field has long been a major source of royalties, tax revenue, and other income generated in 10 counties of southwestern Kansas. Besides enriching the Hugoton's prospects, the studies findings can be applied to similar gas reservoirs worldwide. Most of the remaining natural gas is in less permeable rock layers where the gas moves more slowly and can be more difficult to produce. The Hugoton report is available on the Kansas Geological Survey Website at www.kgs.ku.edu/PRS/publication/2007/OFR07_06/index.html.



Hoobler 11-layer model – other properties



Prepared by *Energy Research Center* *February 2007*

ENHANCED OIL RECOVERY AND CARBON SEQUESTRATION FROM INDUSTRIAL SOURCES

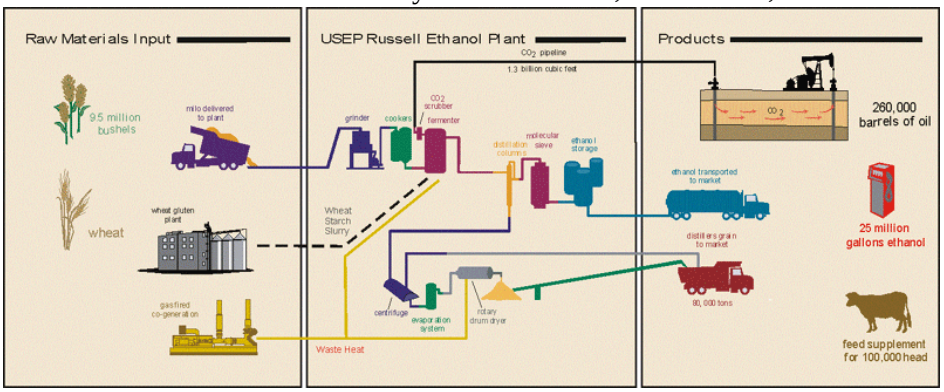
Overview:

Fossil fuels will be used well into the 21st Century and research on carbon management and sequestration will remain an issue and opportunity for federal, state, and industry. CO_2 emissions could be reduced from point sources such as power plants that currently contribute approximately 1/3 of U.S. CO_2 emissions. Injection of CO_2 into geologic sinks (underground) offers the potential to use CO_2 in enhanced oil recovery (EOR) providing economic gain and reduction of foreign oil imports. Kansas has significant oil reserves with over $3 billion annually in Gross Sate Product (No. 2 industry in the state) offering considerable opportunity for CO_2 sequestration and storage from ethanol and utility plants and other industrial sources. With over 6.6 billion barrels of oil produced in Kansas and at least 50% of the oil remaining in the ground, the potential for EOR from CO_2 is large. KU is a leader in research addressing this opportunity: 1) demonstrate cost effective recovery of oil from CO_2 derived from industrial sources, 2) seismic and remote monitoring to ensure stable, long term storage, 3) develop tools and databases to facilitate decision making for carbon sequestration.

Capabilities:

A. Demonstrate cost effective recovery of oil from CO2 derived from industrial sources.

1. The Tertiary Oil Recovery Project and the Kansas Geological Survey provide leadership in developing and demonstrating applicability of CO_2 sequestration in Kansas petroleum reservoirs at Hall-Gurney Field CO_2 pilot in Russell County:
   - utilize CO_2 from an ethanol plant at Russell, KS
   - model and implement recovery process with MV Energy, ICM, and Department of Energy
   - KU Staff and Faculty: Alan Byrnes (KGS, Co-Mgr.), Paul Willhite (TORP, Co-Mgr.), Martin Dubois, Lynn Watney, Tim Carr, John Doveton, Bill Guy, Don Green, Shapour Vossougi, Rodney Reynolds
2. Integrated Subsurface Processing of Landfill Gas and Carbon Sequestration
   - Collaborative project with Oak Ridge National Lab, Deffenbaugh Industries and Kansas City LFG, KGS http://www.kgs.ku.edu/PRS/publication/2006/OFR06_02/index.html
   - KU Staff and Faculty: David Newell (PI) and Tim Carr (KGS)
3. Develop concept of "Linked Energy Systems" -- Co-generation, Ethanol Production and CO_2 Enhanced Oil Recovery -- http://www.kgs.ku.edu/PRS/Poster/2002/2002-6/
   - KU Staff and Faculty: Martin Dubois, Scott White, and Tim Carr



From: Co-generation, Ethanol Production and CO_2 Enhanced Oil Recovery: a Model for Environmentally and Economically Sound Linked Energy Systems, Martin K. Dubois, Scott W. White, and Timothy R. Carr

4. Integrated Subsurface Carbon Sequestration and Enhanced Coalbed Natural Gas Recovery Using Cement Kiln Emissions, Wilson County, Kansas
   - http://www.kgs.ku.edu/PRS/publication/2006/2006-13/index.html
   - Collaboration between KGS and Oak Ridge National Lab
   - KU Staff and Faculty: David Newell and Tim Carr (KGS)

B. Seismic monitoring to ensure stable, long term storage

1. 4-D High-Resolution Seismic Reflection Monitoring of Miscible CO2 Injected into a Carbonate Reservoir - http://www.kgs.ku.edu/Geophysics/4Dseismic/index.html
   - Acquire, process, and interpret multiple high-resolution 3-D compressional wave and 2-D, 2-C shear wave seismic data to observe changes in fluid characteristics in an oil field before, during, and after the miscible carbon dioxide (CO_2) flood
   - KU Staff: Richard Miller (PI), Abdelmoneam Raef, Alan Byrnes, William Harrison, Lynn Watney, Evan Franseen (KGS) – collaboration with Murfin, NETL-DOE

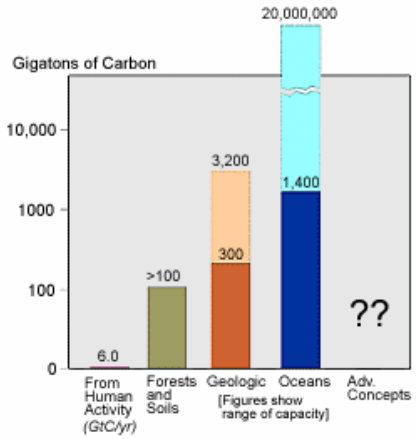
C. Develop tools and databases to facilitate decision making for carbon sequestration

1. MIDCARB -- Midcontinent Interactive Digital Carbon Atlas and Relational DataBase, http://www.midcarb.org/
   - Power plant emissions in Midcontinent U.S.
   - Collaboration with NETL-DOE and Illinois, Indiana, Kentucky, Ohio
   - KU Staff: Tim Carr, Scott White, Larry Brady, Dana Adkins-Heljeson, Melissa Moore, John Victorine (KGS)

2. NATional CARBon Sequestration Database and Geographic Information System (NATCARB) – http://www.natcarb.org/
   - Integrated database and tools on national source and sinks for CO_2
   - National partnerships between states managed at KGS sponsored by NETL-DOE
   - KU Staff: Tim Carr, Scott White, Larry Brady, Dana Adkins-Heljeson, Melissa Moore, John Victorine (KGS)

3. PfEFFER Log Analysis -- http://www.kgs.ku.edu/PRS/software/pfeffer1.html
   - Internationally distributed spreadsheet log analysis for refined reservoir characterization; supported by KTEC, industry, DOE
   - KU Staff: Geoff Bohling, John Doveton, Bill Guy, Saibal Bhattacharya, Lynn Watney (KGS)

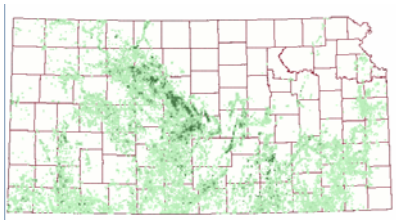
4. GEMINI web analysis tools -- http://www.kgs.ku.edu/Gemini/Tools/Tools.html
   - Web-based interactive analysis and modeling of petroleum reservoirs and plays.
   - KU Staff: Lynn Watney, John Doveton, John Victorine, Geoff Bohling, Saibal Bhattacharya, Alan Byrnes, Martin Dubois, Tim Carr, Melissa Moore, Ken Stalder (KGS)



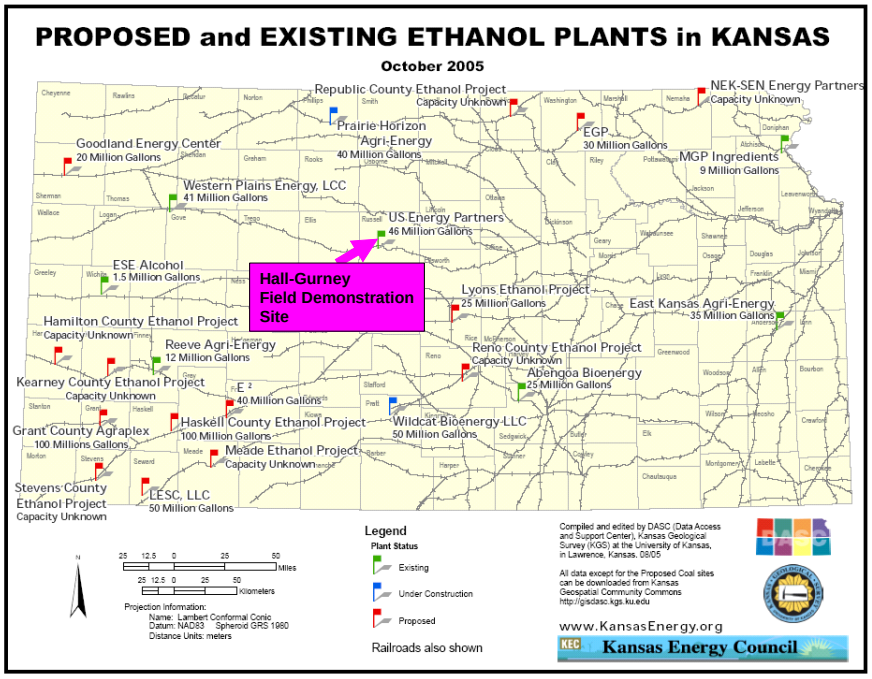
Potential Sinks for CO2

Source: http://www.fossil.energy.gov/sequestration/overview.html

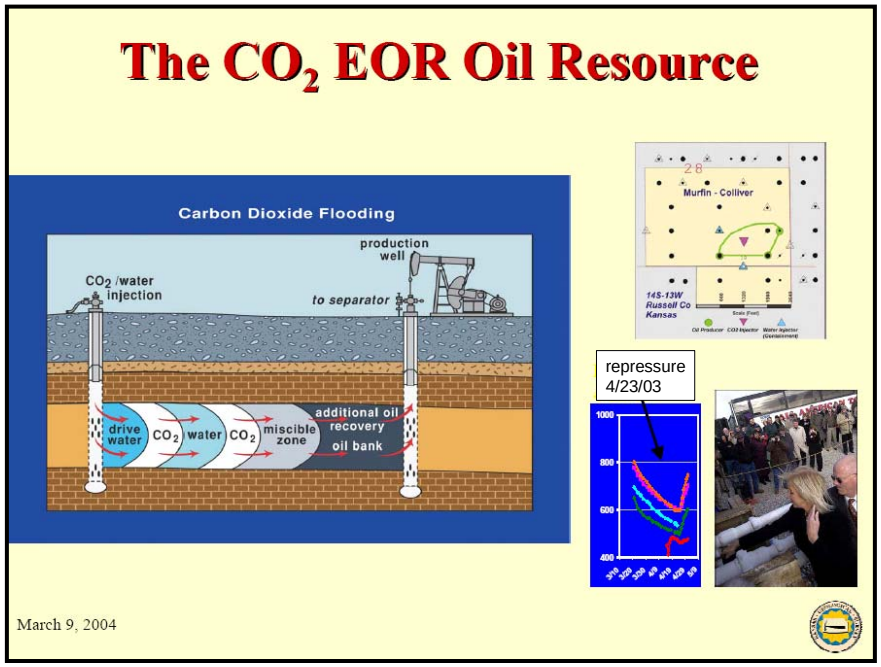
Oil wells in Kansas



Contact Information:
Robert H. Goldstein, Co-Director, ERC gold@ku.edu
G. Paul Willhite, Co-Director, ERC willhite@ku.edu



http://www.kansasenergy.org/KEC/documents/EthanolProjects.pdf



Energy and Carbon Dioxide Conversion Factors

Energy and Carbon Dioxide Factors
(including U.S. electricity mix, 1999)

	Energy (Btu per unit)	CO_2 (lbs per unit)	CO_2 (lbs/million Btu)
Natural Gas	1,027 Btu/ft^3	0.1164 lbs CO_2/ft^3	117 lbs
Heating Oil	138,700 Btu/gallon	22.38 lbs CO_2/gallon	161 lbs
Propane	91,333 Btu/gallon	12.67 lbs CO_2/gallon	139 lbs
Electricity	10,346 Btu/kWh	1.43 lbs CO_2/kWh	419 lbs

http://www.rmi.org/sitepages/pid343.php

CO2 contribution from electricity has increased 10% since 1999 based on current fuel mix.

Prepared by *Energy Research Center*
February 2007

CAPABILITIES IN BIOFUELS AND LINKED ENERGY SYSTEMS

Biomass (hydrogen, ethanol, methanol, syngas and biodiesel), fermentation and catalytic process, fuel cells, wind and solar energy, unconventional natural gas (shale, coal, tight carbonates), carbon sequestration and CO2 improved petroleum recovery

Overview

Biomass

Biomass in organic matter is derived from plant and animal matter. The state of Kansas has the 4th largest potential for biomass feedstock in the United States. It is first in production of wheat and sorghum and 2nd in livestock. Ethanol production in Kansas, derived from corn grain, is rapidly increasing with 8 existing plants and 12 under construction and in planning (map of ethanol plants -- Kansas Energy Council, 2007, www.kansasenergy.org/documents/EthanolProjects.pdf). Total U.S. ethanol production was 100 million barrels in 2005 compared to 7 billion barrels of crude oil produced in the same time period (factor of 70x). Realistically replacing a significant fraction of the petroleum consumption by ethanol will require use of *cellulosic plant material* such as corn stubble and wheat straw, switchgrass and bluestem grasses, but new technology is needed. This process would also improve the energy efficiency to produce *bioethanol*. Oilseed crops including soybean, sunflower, and canola; beef and poultry tallow; and waste greases could provide a significant source for *biodiesel*, of rapidly growing interest in the Kansas agricultural community. Also, landfills and livestock manure are providing *methane* through natural fermentation. Wood wastes abundant in eastern Kansas could also supply *syngas* (mixture of CO and H2), *synfuel* such as *methanol*, or *hydrogen*, many of the reactions mediated by catalysis. The major issues are 1) upscaling the processing and refining of a spectrum of biofuels for diverse uses and 2) developing cost effective, environmentally safe processes to produce biofuels and safe emissions in the consumption of biofuels.

Plant sugars from biomass containing sugar, starch, or cellulose is currently transformed to *ethanol* through an inefficient fermentation process (presently 90% from corn starch) creating substantial opportunities for new methods. *Hydrogen* can be produced from methane, methanol, and gasoline by reforming and can be used in *fuel cells*. *Methane* can also be produced from organic matter through fermentation and catalytic processes, a relatively clean burning fossil fuel.

Fuel Cells

Fuel cells which can provide efficiencies from 40 to 70 percent compared to 30% efficiency for internal combustion engines provide an attractive alternative in both transportation and

distributed electrical generation. Associated research at KU in energy production from biofuels ranging from *syngas* and *biodiesel*, and improved fermentation and *catalytic processes* to aid in conversion of biomass to gas and liquid fuels compliment research on fuel cells at KU.

Linked-Energy Systems

Linked energy systems involves an integration of conventional petroleum and coal recovery and biofuels production. Linked energy systems is a natural activity for Kansas, e.g., linking ethanol production from agricultural biomass (corn grain) and using byproduct of CO_2 to remove residual oil from depleting oil fields. This involves Kansas 1st and 2nd largest industries, agriculture and petroleum. A combined demonstration of this linked energy system and use of oil fields in the effective sequestration CO_2 was led by KU at site near Russell, Kansas. Demonstration involved a collaboration between geology, geophysics, and petroleum engineering at KU. Other linkages between fossil and alternative energy are possible, e.g, 1) solar and wind power linked to oil and gas leases, 2) wind power linked to natural gas storage in salt beds beneath central Kansas, and 3) combining coal (including waste) to produce synfuels. Linked-energy systems have the potential to achieve required economics as value-added products or to meet scale requirements utilizing available infrastructure and investment. The synergy represented by linked-energy systems should play an important role during the transition toward a renewable energy economy, helping Kansas and the nation strive toward energy independence.

Opportunities in Biofuels and Linked Energy Systems at KU

The major issues in biofuels development include 1) upscaling the processing and refining of a spectrum of biofuels and chemicals for diverse uses, 2) developing cost effective, environmentally safe processes to produce biofuels, and 3) ensuring that resulting emissions released during the consumption of biofuels are environmentally safe.

KU has considerable expertise in engineering and science that can lead to collaborative opportunities in research, development, and testing/demonstration of biofuels and linked energy systems. A recent survey combined with an existing ERC database have identified individuals, departments, programs, and centers that could participate in collaborations and partnerships to respond to extending funding opportunities in biofuels, including *Chemical and Petroleum Engineering; Civil, Environmental and Architectural Engineering; Mechanical Engineering; Chemistry; Ecology and Evolutionary Biology; Geography; Geology; Kansas Biological Survey; Kansas Geological Survey; Molecular Biosciences; Physics and Astronomy; and several centers including Center for Advanced Scientific Computing, Center for Bioinformatics, Center for Environmentally Beneficial Catalysis, Center for Science Education, Transportation Research Institute, and the Energy Research Center.*

Areas of biofuels and linked energy systems research have been identified under several broad headings, first a list by capabilities followed by a list of departments and individual capabilities and interests.

KU's strengths in technologies that could be applied to biofuels and linked energy systems are listed in Table 1. Table 2 summarizes seven broad capabilities that could serve as the basis for collaborations to develop a campus-wide research in biofuels and linked energy systems.

Table 1. Technology Strengths
1. Polymer Chemistry
2. Catalysis
3. Nanomaterials
4. Computational Chemistry
5. Chemical Processing, Biorefining
6. Fuel Cells
7. Energy Modeling and Management
8. Microbial procesess, fermentation
9. Emissions
10. Environmental Impact
11. Linked Energy Systems
12. Aquifers and Water Resources
13. Field demonstration and tech transfer

Table 2. Summary of capabilities in biofuels and linked energy systems
1. Recovery of biofuels and chemicals from biomass feedstocks
A. Hydrogen enrichment
B. Fuel additives
C. Synthesis gas from methane
D. Biorenewable feedstocks
E. Catalysis for Alternative fuel production
2. Emissions from biofuels consumption
A. Plants and soil microbial activity
B. Plant sequestratation
C. Emission characterization
3. ASTM certification of biofuels
A. Moderized procedures tailored to biofuels
4. Fuel cells and batteries
A. Selective oxygen permeable
B. microbial fuel cells
5. Linked energy systems
A. Wind power, aquifers, coal bed methane and synfuel
B. Microbial enhanced oil recovery
C. Carbon sequestration and enhanced oil recovery
D. Gas,air cavern storage
E. Unconventional natural gas recovery
6. Technology transfer and information handling
A. Kansas Energy Information Network (KEIN)
B. National carbon sequestration network (NatCarb)
7. Energy Policy
A. Contributions to Kansas Energy Council
B. Senator Roberts Energy Task Force
C. Oil and Gas production forcasts

List of KU Faculty-Staff Capabilities in Biofuels and Linked Energy Systems

1) Recovery of biofuels and chemicals from biomass feedstocks:

- *Hydrogen enrichment in biomass* – Wonpil Im (Center for bioinformatics), Liang Tang (Molecular Biosciences), Daryle H. Busch (CEBC, Chemistry)
- *Hydrogen storage* -- Kristin Bowman-James (Chem)
- *Polymers, energetic materials/fuel additives* -- Kyle V. Camarda (C&PE), Joseph A. Heppert (CHEM)
- *Biomolecular structures to harvest energy* -- Mario Rivera (Chem)
- *Heterogeneous catalysis for the production of alternative fuels* – Susan Stagg-Williams (C&PE), Kristin Bowman-James (Chem)
    - *transition metal catalysis, reactions involving* hydrogen -- Jon Tunge (Chem)
    - *salvation and biocatalysis* -- Krzysztof Kuczera (Chem)
    - *catalytic hydrogenation, hydroformylation, and oxidation reactions* -- Michael Rubin (Chem)
- *Nanomaterials* –
    - *nano materials and solid phase acid catalysts* -- Mikhail V. Barybin (Chem)
    - *nanoscopically modified surfaces/materials* -- Cindy L. Berrie (Chem)
    - *Investigation of catalytic behaviors of nanomaterials under light and other E&M wave radiation* – Judy Wu (Physics Astron)
- *Computational chemistry* -- Shih-I Chu (Chem), Brian B. Laird (Chem)
    - *calculations describing catalytic processes, nanoscience* -- Ward Thompson (Chem)
- *Synthetic organic chemistry* -- Helena Malinakova (Chem)
- *Production of biodiesel* -- Susan Stagg-Williams (C&PE)
- *Synthesis gas from methane, and biorenewable feedstocks such as ethanol, soybean oil, and sunflower oil* -- Susan Stagg-Williams (C&PE)
- *Fundamental studies on the WGS and CO oxidation reactions, steam reforming, coal gasification and ammonia synthesis* -- Susan Stagg-Williams (C&PE)
- *Chemical process units* -- Colin S. Howat (C&PE)
- *Reactor efficiency for ethanol production* -- Russell D. Ostermann (C&PE)
- *Value-added soybean oil products* -- Kyle V. Camarda (C&PE)
- *Phase change insulation (possible bioengineered materials)* – Mario Medina (CEAE)
- *Energy modeling* -- Mario Medina (CEAE), Wai Kiong (Oswald) Chong (CEAE)
- *Energy management* -- Peter Tenpas (ME)
- *Microbial and mineralogical controls on methane generation and oxidation* -- Roberts and Fowle (Geology)
- CEBC activities –
    - *Biorefining, green catalysis and reaction engineering, hydrogen and liquid fuels* -- Bala Subramaniam (CEBC, C&PE); Daryle H. Busch (CEBC, Chemistry)
    - *Processes which use benign solvents such as carbon dioxide or water*
    - *Replacement of conventional acids with benign solid acid catalysts*
    - *Atom-economical use of raw materials and utilization of renewable feedstocks*
    - *Highly selective industrial-scale biocatalytic transformations*

  - *Production of fuels and synthetic chemicals from alternate feedstocks such as coal and biomass*
  - *Process intensification for energy efficiency and safety*
- TRI activities --
  - *include funding for research on electric buses, diesel-powered aircraft, hydrogen-powered vehicles, and alternative fuels*

2) Research on emissions from biofuels consumption:

- *Effects on plants and soil microbial activity* – Sharon Millings (EEB, Kansas Biological Survey), Joy Ward (EEB)
- *Energy related pollution* – Val Smith (EEB), James Thorp (EEB, KBS)
- *Plant carbon sequestration* – Craig Martin (EEB)
- *Characteristics and environmental impacts of atmospheric deposition, development of standard operating procedures for the sampling, analysis, and monitoring of volatile organic compounds (VOCs) in ambient air; and air pollution emissions from transportation sources* – Dennis Lane (CEAE, TRI)

3) ASTM certification of biofuels:

- *Pilot, new procedures* -- Susan M. Stagg-Williams (C&PE)

4) Fuel cells and batteries:

- *Basic research* -- Trung Van Nguyen (C&PE)
- *Fabrication of Selective Oxygen Permeable Membrane Reactors* -- Susan M. Stagg-Williams (C&PE)
- *Fundamental studies on the WGS and CO oxidation reactions for fuel cell cost effectiveness and efficiency* -- Susan M. Stagg-Williams (C&PE)
- *Microbial Fuel Cells. Iron reduction, conductive extracellular pili, and the generation of energy* -- Fowle, Gorby, and Roberts (Geology)

5) Linked energy systems, hydrogen, methane, coal gas, carbon sequestration, gas storage, environmental impact, field demonstration

- *Biofuels, windfarm siting* -- Xingong Li (Geog); Scott White (ERC, KGS)
- *Aquifers and water resources*
  - *Computational methods and tools for hydrological modeling and water resources management* -- Xingong Li (Geog)
  - *Hydrogen production from PRBs in aquifers* -- J.F. Devlin (Geology)
  - *Linkages between microbial ecology, using culture and molecular based techniques, and iron and trace element cycling* -- J.F. Devlin (Geology)
  - *Groundwater monitoring and modeling* – staff of KGS
- *Environmental impact*
  - *Intensive agriculture for biofuels production* – Geology
  - *A role for microbes in the long term stability of spent nuclear fuel* – David A. Fowle (Geology)
  - *Bacterial interactions with rock, hydrogeology, geochemistry* -- J.A. Roberts (Geology)

  - *Remediation* -- David A. Fowle (Geology)
- *Coal – synfuels, benign energy conversion (using fuel cells)* Trung Van Nguyen (C&PE) -- coal gasification and ammonia synthesis -- Susan Stagg-Williams (C&PE)
- *Organic geochemistry of organic components in shales and limestones* -- Alison Allcott (Geology), David Newell (KGS)
- *Methane production*
  - *Methane production from lakes systems* -- David A. Fowle
  - *Extraction of coal –*
    - *Process and simulation* -- Russell D. Ostermann (C&PE), Jenn-Tai Liang (C&PE)
    - *Geomechanical modeling* – Jie Han (CEAE)
- *Microbial Enhanced Oil Recovery using agricultural biosurfactants* -- Jenn-Tai Liang (C&PE)
- *CO2 sequestration in geologic formations, carbonate, ultramafic* -- Jenn-Tai Liang (C&PE); Gwen Macpherson (Geology); Alan Brynes, Marty Dubois, Saibal Bhattacharya, Rick Miller (KGS); David Fowle (Geology)
  - *Tools to identify "leakage" of CO2 out of the sequestration reservoirs*
    - *Geochemistry* -- Gwen Macpherson (Geology)
    - *Seismic monitoring* – Rick Miller (KGS)
    - *Remote sensing imaging of leakage of CO2 to surface and surface deformation* associated with CO2 sequestration -- Mike Taylor (Geology)
- *Carbon dioxide enhanced oil recovery* www.kgs.ku.edu/ERC/CO2Pilot -- staff of KGS, TORP, and C&PE
- *Linked Energy Systems -- Co-generation, Ethanol Production and CO2 Enhanced Oil Recovery: Model for Environmentally and Economically Sound Linked Energy Systems* www.kgs.ku.edu/PRS/Poster/2002/2002-6 -- staff of KGS, TORP, and C&PE
- *CO2 sequestration – landfill gas, sewage treatment for feedlots* www.midcarb.org/ - staff of KGS
- *Evaluating targets for horizontal drilling* www.kgs.ku.edu/PRS/publication/OFR99_22/horzdrill.html -- staff of KGS
- *Cost-efficient 3-D seismic modeling* -- Rick Miller (KGS)
- *Shallow gas storage issues,* www.kgs.ku.edu/Hydro/Hutch -- staff of KGS
- *Unconventional natural gas recovery - Hugoton Gas Field Initiative* -- www.kgs.ku.edu/Hugoton; http://www.kgs.ku.edu/General/News/2007/hugoton.html -- staff of KGS

6) Technology transfer and information handling

- Petroleum technology transfer -- Tertiary Oil Recovery Project, KGS, Dept. of Geology
- *Kansas Energy Information Network (KEIN), www.kansasenergy.org* – Scott White (ERC, KGS)
- *Broadening base for energy studies between Regents Institutions and Kansas Corporation Commission, Kansas Energy Council, KCC- Kansas Energy Office* - ERC

- *MIDCARB -- Midcontinent Interactive Digital Carbon Atlas and Relational DataBase, www.midcarb.org/ and NATCARB – National Carbon Sequestration Database www.natcarb.org/* -- staff of KGS
- *GEMINI – Geo-engineering Modeling through INternet Informatics, www.kgs.ku.edu/Gemini/index.html* - staff of KGS
- *Class taught on energy and sustainability* -- Cornelis J Van der Veen (Geog)

7) Energy policy

- *Collaborate on development and dissemination of Kansas Energy Plan, Kansas Energy Council* – KGS, ERC
- *Participation in Senator Roberts Energy Task Force* – KGS, ERC
- *Kansas Oil and Gas Production Forecasts* – KGS, ERC

Department and Staff with Capabilities in Biofuels Research

Biological Sciences

Wonpil Im
Assistant Professor
Department of Molecular Biosciences
Center for Bioinformatics
200E MRB
(785) 864-1993
wonpil@ku.edu

- ion transport through biological channels
- developing new nano-pores (experimentally and computationally) to transport ions selectively in application to bio-energy
- research programs in our group focus on the applications of theoretical/computational methods to chemical and physical problems in biology and material science.
- modeling of membrane proteins and physicochemical aspects of molecular biology
- Recipient of the prestigious fellowship award from the Alfred P. Sloan foundation.

Department of Ecology and Evolutionary Biology

Sharon Billings
Assistant Professor
EEB
Kansas Biological Survey
Higuchi Hall
Phone: (785) 864-1560 (office)
Fax: (785) 864-1534
sharonb@ku.edu

- Global change effects on plants and soil microbial activity

We use a combination of laboratory and field techniques to explore these issues, ranging from established soil science methods and microbiological assays to plant physiological techniques. A significant part of my research uses stable isotopes as a tool, both at natural abundance levels and as tracers in soils and plants.

Val H. Smith
Professor
EEB
864-4565
FAX864-5321
vsmith@ku.edu

- Ecosystem Ecology
- Effects of energy-related pollution on aquatic and terrestrial systems
- Mechanisms that regulate the biogeochemical cycles of carbon, nitrogen, and phosphorus
- Microbial ecology
- Empirical and experimental investigations of the relationships between host nutrition and the outcome of disease in both plants and animals.

James H. Thorp
Professor
EEB
Senior Scientist Kansas Biological Survey
864-1532
Fax: 864-1537
thorp@ku.edu

- Efects of energy-related pollution on aquatic systems
- Aquatic systems of the Great Plains (especially the Kansas and Missouri Rivers) and midwestern USA (particularly the Mississippi River).

Craig Martin
Professor and Chair
EEB
864-3645
ecophys@ku.edu

- Ecological plant physiology
- Carbon sequestration by plant ecosystems

Joy Ward
Assistant Professor
EEB
864-5218
Fax: 864-5860
joyward@ku.edu

- Evolutionary plant ecophysiology
- Global change effects on plants

Liang Tang, Ph.D.
Assistant Professor
Molecular Biosciences
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Fax: 864-5294
tangl@ku.edu HTTP://carbon.bio.ku.edu/

- Use of enzyme complex called hydrogenase, which catalyzes the conversion between H_2 and H+ plus electron. The enzyme can be used as a bio-catalyst for fuel cell.
- Molecular assembly using cryoEM, with promising results.

  Hydrogenase is the key enzyme in H2 metabolism in many microorganisms, and serves as an important player in global biological hydrogen cycling. It catalyzes reversible oxidoreduction of molecular hydrogen according to the reaction H2 = 2H+ + 2e-. Understanding the assembly and catalytic mechanisms of the enzyme can help design bio-catalysts for cleaning, environment-friendly fuel cells. We are using electron cryo-microscopy and image reconstruction to inspect the three-dimensional structure of the hydrogenase.

- Lipid metabolism in cultured cells or model organisms in addition to basic cellulosic technologies

Chemical and Petroleum Engineering

Trung Van Nguyen
Professor
C&PE
4150E Learned Hall
864-3938
Fax: 864-4967
cptvn@ku.edu

- Fuel cells and batteries and mathematical modeling of electrochemical systems. **(ERC Energy Development Grant)**

- Interfacial phenomena at the electrode/membrane and membrane/membrane interfaces
- Theoretical and experimental studies of spatiotemporal behavior and two-phase transport in porous electrodes and flow channels of proton exchange membrane fuel cells
- Heat, gas and water management in proton exchange membrane fuel cells
- Optimization of the micro-structures the catalyst layers used in PEM fuel cells for two phase flow
- Development of electrode and membrane assemblies for PEM fuel cells for specific applications
- Direct Conversion of Coal to Electricity Using… Fuel Cell Technology **(funded through ERC)**

Kyle V. Camarda
Associate Professor
C&PE
4132E Learned Hall
864-2908
Fax: 864-4967
camarda@ku.edu

- New pharmaceuticals, polymers, or *fuel additives*
- Computational molecular design is being applied to the search for new pharmaceutical drug formulations, novel catalytic materials, polymer adhesives, and many other molecular systems.
- Alkylation Processes – Sola Lawal with Kyle and Bala Subramaniam
- K.V. Camarda and P. Sunderesan, "Computer Aided Molecular Design of Value-Added Soybean Oil Products," Ind. Eng. Chem. Res. 44(12) 4361-4367 (2005).

Susan M. Stagg-Williams
Associate Professor
C&PE
212 Burt Hall
864-2919
Fax: 864-4967
smwilliams@ku.edu

- Heterogeneous catalysis for the production of alternative fuels
- Fabrication of Selective Oxygen Permeable Membrane Reactors **(ERC Energy Development Grant)**
- Production of Biodiesel
    - Alternative solid acid and base catalysts for the esterification of free fatty acids in a fatty acid-methanol-oil system to make inexpensive feedstocks viable without pretreatments via corrosive liquid acids or high pressures.

- Exploit CO2 to increase the viability of smaller pore solid acids by reducing mass transfer limitations typically present with such large chain, branched higher hydrocarbons. This work is being performed as part of the Center for Environmentally Beneficial Catalysis.

- Production of Synthesis Gas
  - Efficient and economical technology for production of synthesis gas from methane, and biorenewable feedstocks such as ethanol, soybean oil, and sunflower oil.
- Production of Hydrogen for use as a Fuel Cell Feedstock
  - Fundamental studies on the WGS and CO oxidation reactions are critical to the development of more efficient and cost effective fuel cell technology and will benefit other industrial processes where these reactions appear, such as steam reforming, coal gasification and ammonia synthesis.

Colin S. Howat
Associate Professor
C&PE
4148B Learned Hall & Kurata Thermodynamics Laboratory
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- Primary research interests are concerned with the design and operation of chemical process units.

Russell D. Ostermann
Associate Professor
C&PE
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ostermann@ku.edu

- A problem with ethanol production is that alcohol is toxic to the yeast that produces it at concentrations over about 5%. Removal of alcohol directly from the reactor during fermentation will increase reactor efficiency.
- Studies reveal that biodiesel can be used as an extractant -- 1) forms a separate phase, 2) does extract at least some ethanol from water solution, and 3) is not toxic to yeast.
- Biodiesel may be marketable with ethanol contained in it and offer a way to slightly decrease the cost of ethanol production.
- Coal bed methane **(ERC Energy Development Grant)**

Marylee Z. Southard
Associate Professor
C&PE

4150D Learned Hall
864-3868
Fax: 864-4967
marylee@ku.edu

- Design and analysis of chemical transport processes, specifically those in which bioactive agents are released.
- Phase change insulation **(in collaboration with ERC)**

Jenn-Tai Liang
Associate Professor
C&PE
4148A Learned Hall
(785) 864-2669
jtliang@ku.edu

- Microbial Enhanced Oil Recovery – Biosurfactants produced from high-starch agriculture process waste stream to improved oil recovery in fractured carbonate reservoirs.
- CO2 Sequestration in Geologic Formations - Simulation and experimental studies of the sequestration of CO2 in depleted oil and gas reservoir, unminable coal seams, EOR applications.
- Water Shutoff and Conformance Control - Develop next-generation crosslinking agents with built-in controlled-release mechanisms for water shutoff and conformance control in both fractured and unfractured reservoirs.
- Coalbed Methane Recovery - Study methods for enhanced coalbed methane recovery, evaluate the environmental impacts of water disposal options for CBM produced water. With Jie Han **(ERC development grant)**

Civil, Environmental and Architectural Engineering

Dennis Lane
Professor
(see TRI)

Jie Han
Associate Professor
Department of Civil, Environmental, & Architectural Engineering
Learned Hall
864-3714
Fax: 864-5631
jiehan@ku.edu

- Geomaterials

- Geomechanical modeling of **coal bed methane extraction (ERC development grant)**

Mario Medina
Associate Professor
CEAE Department
2150 Learned Hall
864-3604
mmedina@ku.edu

- Area of Study: Energy Systems
- Specialization: Thermal Analysis of Buildings (**ERC development grant)**
- Transient Heat and Mass Transfer Modeling
- Phase Change Materials for insulation **(ERC development grant)**

Wai Kiong (Oswald) Chong
Assistant Professor
Construction and Architectural Engineering
CEAE Department
2150 Learned Hall
864-2891
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oswald@ku.edu

- Energy modeling **(ERC development grant)**

KU Energy Research Center

KU ERC has supported projects through Energy Development Funds and participated in energy-related projects:

Alternative Energy, Energy Conservation

- Fuel cell research – Energy Development Funds – Trung Nguyen, Susan Williams
- Electric motors and batteries – Trung Nguyen
- Energy efficient building design – Mario Medina, Oswald Chong
- Transportation efficiency – Mario Medina & Ray Taghavi
- Biomass utilization – Susan Williams
- Wind Power in Kansas (Kansas Energy Information Network) www.kansasenergy.org/ wind.htm – Scott White

Fossil Energy

- Carbon dioxide enhanced oil recovery www.kgs.ku.edu/ERC/CO2Pilot -- KGS, TORP, C&PE

- Linked Energy Systems -- Co-generation, Ethanol Production and CO2 Enhanced Oil Recovery: Model for Environmentally and Economically Sound Linked Energy Systems www.kgs.ku.edu/PRS/Poster/2002/2002-6 -- KGS, TORP, C&PE
- CO2 sequestration – landfill gas, sewage treatment for feedlots www.midcarb.org/ - KGS
- Polymer gelled systems in IOR -- TORP
- Hugoton Gas Field Initiative -- www.kgs.ku.edu/Hugoton -- KGS
- Coal-bed methane www.kgs.ku.edu/PRS/publication/2003/ofr2003-28 - KGS, Jie Han
- Shallow gas storage issues, www.kgs.ku.edu/Hydro/Hutch -- KGS
- Cost-efficient 3-D seismic modeling www.kgs.ku.edu/PRS/publication/2000/ofr84 -- KGS
- Evaluating targets for horizontal drilling www.kgs.ku.edu/PRS/publication/OFR99_22/horzdrill.html -- KGS

Energy Informatics and Technology Transfer

- Kansas Energy Information Network (KEIN), www.kansasenergy.org. – Scott White
- Broadening base for energy studies between Regents Institutions and Kansas Corporation Commission (funded by KCC Energy Office)
- MIDCARB -- Midcontinent Interactive Digital Carbon Atlas and Relational DataBase, www.midcarb.org/ and NATCARB – National Carbon Sequestration Database www.natcarb.org/ -- KGS
- GEMINI – Geo-engineering Modeling through INternet Informatics, www.kgs.ku.edu/Gemini/index.html - KGS

Energy Policy

- Collaborate on development and dissemination of Kansas Energy Plan, Kansas Energy Council
- Participation in Senator Roberts Energy Task Force
- Kansas Oil and Gas Production Forecasts

Center for Environmentally Beneficial Catalysis

- Processes which use benign solvents such as carbon dioxide or water
- Replacement of conventional acids with benign solid acid catalysts
- Economical use of raw materials and utilization of renewable feedstocks
- Highly selective industrial-scale biocatalytic transformations
- Production of fuels and synthetic chemicals from alternate feedstocks such as coal and biomass
- Process intensification for energy efficiency and safety

Bala Subramaniam
Professor and Director CEBC
C&PE
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- **Biorefining** is a concept that converts biomass, including materials derived from plants, into biofuels, biomaterials and biopower (heat and electricity).
- Green catalysis and engineering. Current projects include exploiting green solvents such as carbon dioxide and water in catalytic oxidations, hydroformylations and alkylations; and pharmaceutical processing with near-critical carbon dioxide.
- Environmentally Beneficial Catalysis and Reaction Engineering, Near-critical Processing, Mathematical Modeling.

Daryle H. Busch
Professor and Assoc. Director CEBC
Department of Chemistry
KU Life Sciences Research Laboratories
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- inorganic chemistry/catalysis – biomass, hydrogen and non-petroleum derived liquid fuels, alternative energy sources
- Supramolecular species in bioinorganic chemistry
- Green inorganic chemistry: transition metal coordination chemistry, bioinorganic chemistry focused on dioxygen, its reduction products and their interaction with metal complexes, environmentally benign oxidation catalysis by transition metal compounds, and supramolecular chemistry, especially new materials derived from advanced molecular topologies.

Mechanical Engineering

Peter Tenpas
Associate Professor
ME
785-864-2986
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- Mechanical Engineering: Turbines
- Basic Engineering Thermodynamics

- Fluid Mechanics
- Thermal System Design
- Gas Turbines
- Advanced Topics in Fluid Mechanics
- Energy Management
- Introduction to the Thermal Sciences
- Computational Fluid Mechanics and Heat Transfer
- Numerical Analysis of Mechanical Engineering Problems

Stuart R. Bell
Professor
Dean of the School of Engineering
Mechanical Engineering
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- Alternative fuels for internal combustion engines
- Modeling of engine and engine processes
- Innovative engine designs
- Fundamental and applied combustion topics

Department of Chemistry

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Also, Kansas NSF EPSCoR

- Inorganic chemistry/catalysis--hydrogen storage.
- Inorganic chemistry: biomimetic and supramolecular chemistry, design and synthesis of selective receptors for ions (particularly anions) of biological and environmental relevance, synthesis of structural and functional models for metalloproteins, with emphasis on those with multimetallic active sites.

Daryle H. Busch *(see CEBC)*

Krzysztof Kuczera
Associate Professor
Department of Molecular Biosciences
Department of Chemistry
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- Modeling of molecular transport processes, salvation and biocatalysis
- Relate the detailed microscopic information provided by the simulations to observable, macroscopic physical, chemical and biological properties.
- Provide basic understanding of biologically important molecules
- Provide predictions on how to manipulate molecular properties for practical purposes
- Utilize existing simulation programs and development of new methods and algorithms for molecular modeling

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- Synthetic Organic Chemistry and Transition Metal-Mediated Asymmetric Reactions
- *Synthetic Organic Chemistry*: development of methodology for total synthesis of natural products, transition metal mediated C-C bond formation, asymmetric synthesis, cascade reactions, metal-induced C-H bond activation.

Mikhail V. Barybin
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- Nanomaterials – molecular conductors, photonics, solid phase acid catalysts
- Organometallic, Coordination, and Supramolecular Chemistry

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- Nanoscopically modified surfaces/materials – materials, conductors, photonics

Shih-I Chu
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Director of the Kansas Center for Advanced Scientific Computing
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- Computational chemistry – interactions of matter with high fluxes of photons

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Professor
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- Organic photochemistry – design of molecules to have specific interactions with light

Joseph A. Heppert
Professor and Chair, and Director of the Center for Science Education
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Chair's Office:864-4673
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- Inorganic synthesis and catalysis -- preparation of energetic materials/fuel additives from renewable precursors

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- Computational chemistry – molecular and materials interactions at phase interfaces

Mario Rivera
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- Bioanalytical chemistry – the use of biomolecular structures to harvest energy

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Chem
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- Transition metal catalysis – preparation and investigation of novel catalysts
- Catalytic hydrogenation, hydroformylation, and oxidation reactions

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- Computational chemistry – calculations describing catalytic processes, nanoscience

Jon Tunge
Assistant Professor
Chem
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- Transition metal catalysis – preparation and investigation of novel catalysts, including expertise with reactions involving hydrogen

Department of Geography

Cornelis J Van der Veen
Associate Professor
Lindley Hall
1475 Jayhawk Boulevard
Lawrence, KS 66045-7613
cjvdv@mail.ku.edu

- Research on "Peak Oil"
- teaching class on Energy in Fall '07
- Sustainability and Earth's resources: the role of population growth.

Xingong Li
Department of Geography
Assistant Professor
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Phone: 785-864-5545
Email: lixi@ku.edu

- Windfarm siting
- Finding suitable sites for other types of energy such as biofuels.
- Geographic information management, visualization, analysis
- Developing computational methods and tools for hydrological modeling and water resources management
- Developing analysis frameworks for spatio-temporal hydro-meteorological datasets
- Calibrating water quality models in the Midwest agriculture watersheds
- Estimating snowmelt runoff in mountain watersheds in western China

Department of Geology

Large Group Interest:

- Environmental impact of intensive agriculture for biofuels Production
- Microbial and mineralogical controls on methane generation and oxidation. (Roberts and Fowle)
- Microbial Fuel Cells. Iron reduction, conductive extracellular pili, and the generation of energy (Fowle, Gorby, and Roberts)
- A role for microbes in the long term stability of spent nuclear fuel. (Fowle)
- Carbon sequestration: Gwen to take the lead on this.. although I think we should consider looking at both carbonate and ultra-mafic reservoirs.

Robert Goldstein
Professor, Chairman
Co-Director ERC
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- Sequence stratigraphy, diagenesis, and fluid-inclusion research
- Controls on depositional sequence architecture of the Spanish Miocene
- Fluid history and diagenesis of the Midcontinent
- Diagenetic significance or brine reflux
- Permian paleoclimate, ancient acid groundwater
- Diagenesis in sequence stratigraphy
- Fluid flow in foreland basins
- New fluid inclusion techniques for solving geologic problems

Donald W. Steeples
Professor, Vice Provost
864-2730
don@ku.edu

- Shallow seismic reflection for cavity detection
- Groundwater exploration
- Engineering studies
- environmental remediation

Anthony W. Walton
864-2726
twalton@ku.edu

- Sedimentology with ernphasis on terrigenous clastic and volcaniclastic rocks
- Effects of facies and diagenesis on oil production from sand stone reservoirs
- Deposition and diagenesis of sediments in volcanic terranes.

Alison Allcott
Department of Geology

- Organic geochemistry of organic components in shales and limestones.

J.F. Devlin
Associate Professor)
fdevlin@ku.edu
(785) 864-4994

- Hydrogen production from PRBs in aquifers
- Quantitative geochemical modeling of bacterial-metal sorption reactions
- Biomineralization and its effects on contaminant mobility in the subsurface;
- Bioavailability and diagenesis of metals in aquatic ecosystems
- Microbially-promoted mineral dissolution
- Biogeochemical interactions in wetlands and soil systems
- Investigation of the linkages between microbial ecology, using culture and molecular based techniques, and iron and trace element cycling.

David A. Fowle
Department of Geology
Assistant Professor)
fowle@ku.edu
(785) 864-1955

- Environmental remediation, CO2 sequestration, methane production from lakes systems

Gwen L. Macpherson
Associate Professor
Department of Geology
glmac@ku.edu
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- Target potential CO2 sequestration reservoirs based on the aqueous geochemistry and predicted gas-water-rock interactions that will occur.
- Tools to identify "leakage" of CO2 out of the sequestration reservoirs using geochemistry
- Hydrogeology with emphasis on low-temperature aqueous geochemistry
- Distribution and source of trace elements from the Gulf of Mexico basin
- Time series analysis of the hydrochemistry of shallow carbonate and alluvial aquifers

J.A. Roberts
Assistant Professor
Department of Geology
jaroberts@ku.edu
(785) 864-4997

- Bacterial interactions with rock, hydrogeology, geochemistry
- Dolomite; methanogens

- Microbe:mineral interactions and the geological and ecological implications of these interactions in subsurface environments
- Three separate but interrelated thrusts--microbial attachment to mineral surfaces; nutrient-driven microbial silicate weathering, and low temperature-dolomite precipitation.

Mike Taylor
Assistant Professor
Department of Geology
mht@ku.edu
(785) 864-5828

- Remote sensing imaging of leakage of CO2 to surface and surface deformation associated with CO2 sequestration

George Tsoflias
864-4584
tsoflias@ku.edu

- Near-surface geophysics and exploration seismology
- Investigation and development of ground-penetrating radar (GPR) and seismic methods for the characterization of fluid flow properties of geologic formations
- Geophysical characterization of fractures

Kansas Geological Survey

William Harrison
Director and State Geologist
Moore 301
864-2070
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- Petroleum geochemistry
- Cathrates (methane hydrates)

Robert Buddemeier
buddrw@kgs.ku.edu

- Water resources, geohydrology, hydrology, climate, biochemistry

Alan Byrnes
abyrnes@kgs.ku.edu

- Core petrophysics, carbon sequestration, unconventional gas

Tim Carr
tcarr@kgs.ku.edu

- Geology and geophysics of oil and gas reservoirs – carbon sequestration
- Stratigraphy and Paleontology
- Quantitative Techniques
- Information handling in sequestration
- Regional Stratigraphy and Petroleum Geology of the Hugoton Embayment

John Doveton
doveton@kgs.ku.edu

- Wireline geophysical logging, geostatistics
- Petrophysical properties of aquifers and petroleum reservoirs

Evan Franseen
evanf@kgs.ku.edu

- Carbonate petroleum reservoirs, sequence stratigraphy, sedimentology

Bill Guy
bguy@kgs.ku.edu

- Emeritus: Wireline petrophysics logging and petrophysical reservoir

Dave Newell
dnewell@kgs.ku.edu

- Reservoir characterization, improved oil recovery, unconventional gas distribution and quality, carbonate diagenesis, sedimentary depositional systems

Al McFarlane
mcfarlane@kgs.ku.edu

- Hydrology in aquifers intimately associated with oil and gas activity

Rick Miller
rmiller@kgs.ku.edu

- High resolution seismic imaging, remediation site characterization

Scott White
whites@kgs.ku.edu

- Kansas Energy Information Network, Carbon sequestration, Wind Power Sitting
  http://www.kansasenergy.org/kein.htm

Marios Sophocleous
marios@kgs.ku.edu

- Thermal energy storage, water resources, hydrocarbon migration, simultaneous fluid/heat movement, geothermics

Lynn Watney
lwatney@kgs.ku.edu

- reservoir characterization, sequence stratigraphy, integrated reservoir modeling, and web-based reservoir modeling

Don Whittemore
donwhit@kgs.ku.edu

- Typing and correlation of brines, saltwater contamination

Department of Physics and Astronomy

Judy Wu
Phys-Astron
2067 Malott Hall
864-3240
FAX: 864-5262
jwu@ku.edu

- Growth and characterization of nano-materials including nanoparticles, nanotubes and nanowires of various materials
- Investigation of catalytic behaviors of the nanomaterials under light and other E&M wave radiation

Tertiary Oil Recovery Project

- Identify and evaluate the potential for the application of enhanced recovery processes in Kansas reservoirs;
- Research and development of processes that are applicable to Kansas reservoirs
- Investigate the application of reservoir engineering and geology for characterization of Kansas reservoirs
- Technology transfer

Don W. Green
Professor, Co-Director
Tertiary Oil Recovery Project
4146 Learned Hall
864-2911
Fax: 864-4967
dgreen@ku.edu

- Carbon Dioxide Flooding
- Reservoir Simulation
- In situ Permeability Modification Using Gelled Polymer

G. Paul Willhite
Professor, Co-Director
4146 Learned Hall
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Fax: 864-4967
willhite@ku.edu

- Enhanced Oil Recovery Processing including Polymer Flooding Carbon Dioxide Miscible Flooding and Thermal Recovery
- Improved Oil Recovery Processes Ranging from Waterflooding to Application of Gelled Polymer to Control Water Movement in Petroleum Reservoirs
- Management of Petroleum Reservoirs and Simulation of Oil Production Using Reservoir Simulators
- Transport Processes in Porous Media
- Expansion of Energy Research at the University of Kansas

Transportation Research Institute

- TRI has awarded approximately $1.3 million in funding coupled with money matched by external and in-kind funds of approximately $2 million to fund research on everything from electric buses, diesel-powered aircraft, hydrogen-powered vehicles, alternative fuels and back strain of truck drivers.

Robert Honea
Director, TRI
Learned Hall, room 3111
864 1828
bobh253@ku.edu

- Transportation, remote sensing, environmental and economic modeling, energy technology development, industrial location theory, national security, and defense deployment systems.

Dennis Lane
Associate Director of Research Operations, TRI
CEAE Department
2150 Learned Hall
864-2942
lane@ku.edu

- Characteristics and environmental impacts of atmospheric deposition;
- Source-receptor relationships for atmospheric deposition
- Noncriteria air pollutant monitoring
- Development of standard operating procedures for the sampling, analysis, and monitoring of volatile organic compounds (VOCs) in ambient air
- Air pollution emissions from transportation sources

Patricia Weaver
Associate Director, TRI
Learned Hall, room 2151
864-2595
weaver@ku.edu

- Transportation technology development

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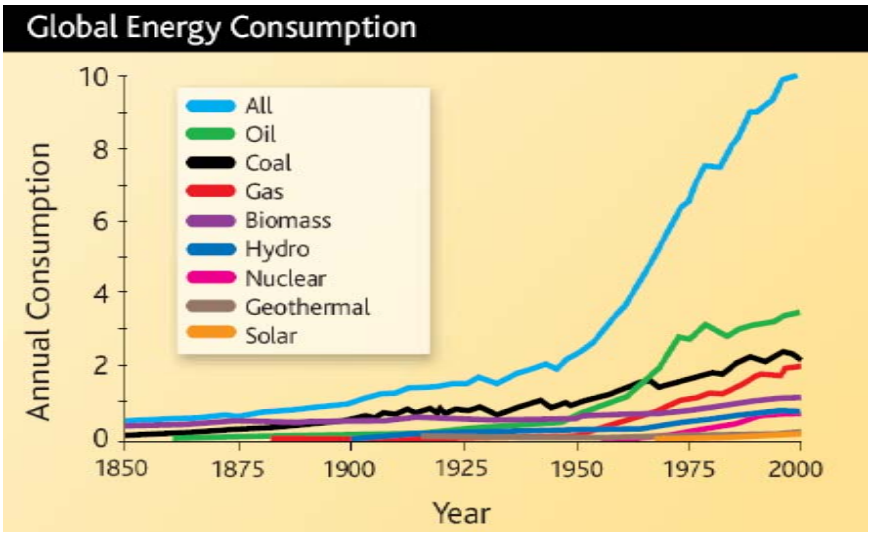
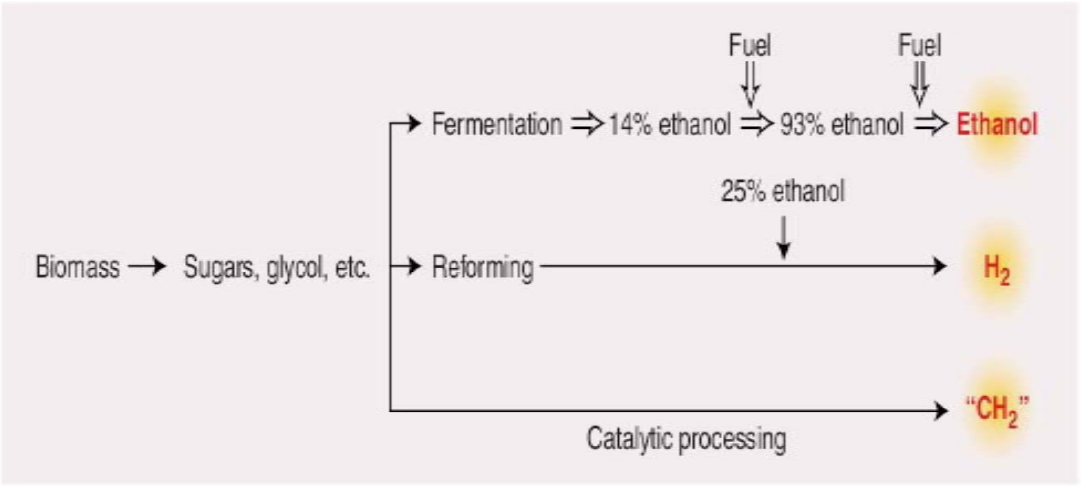
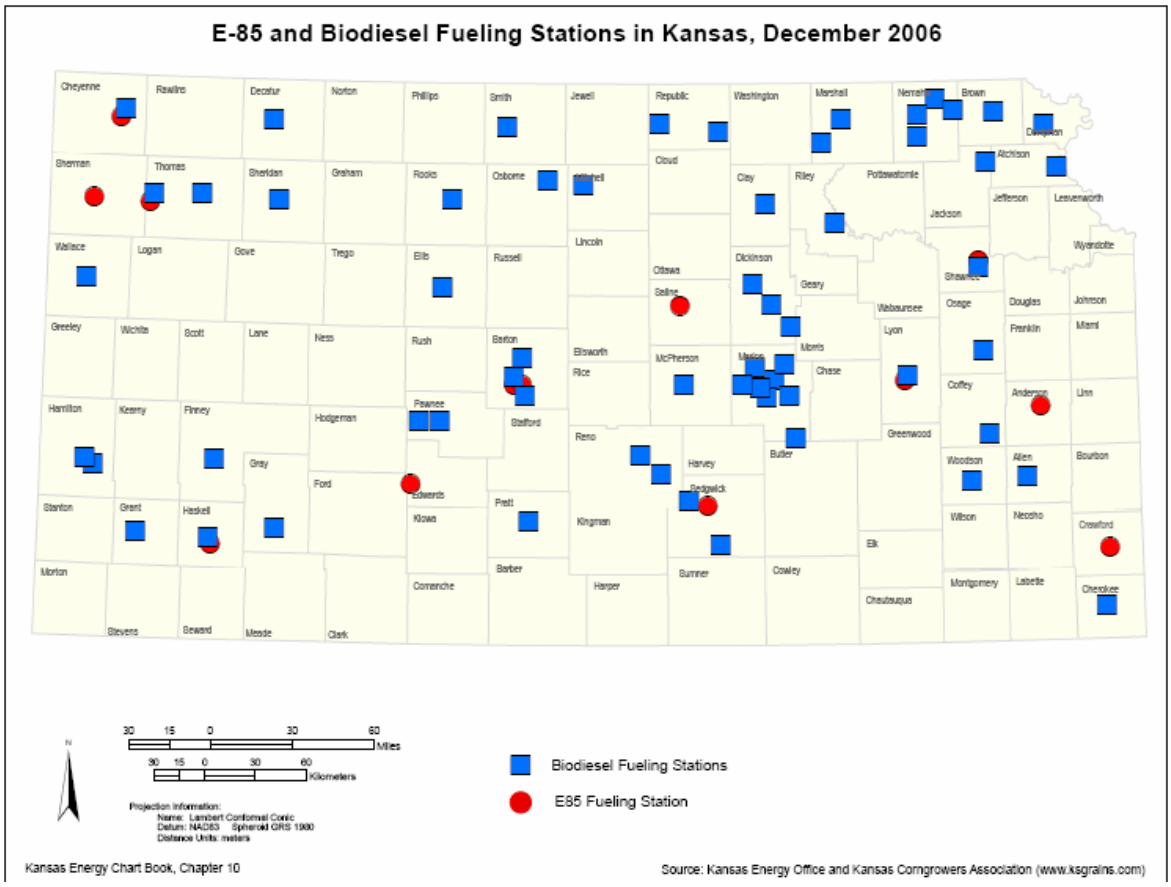


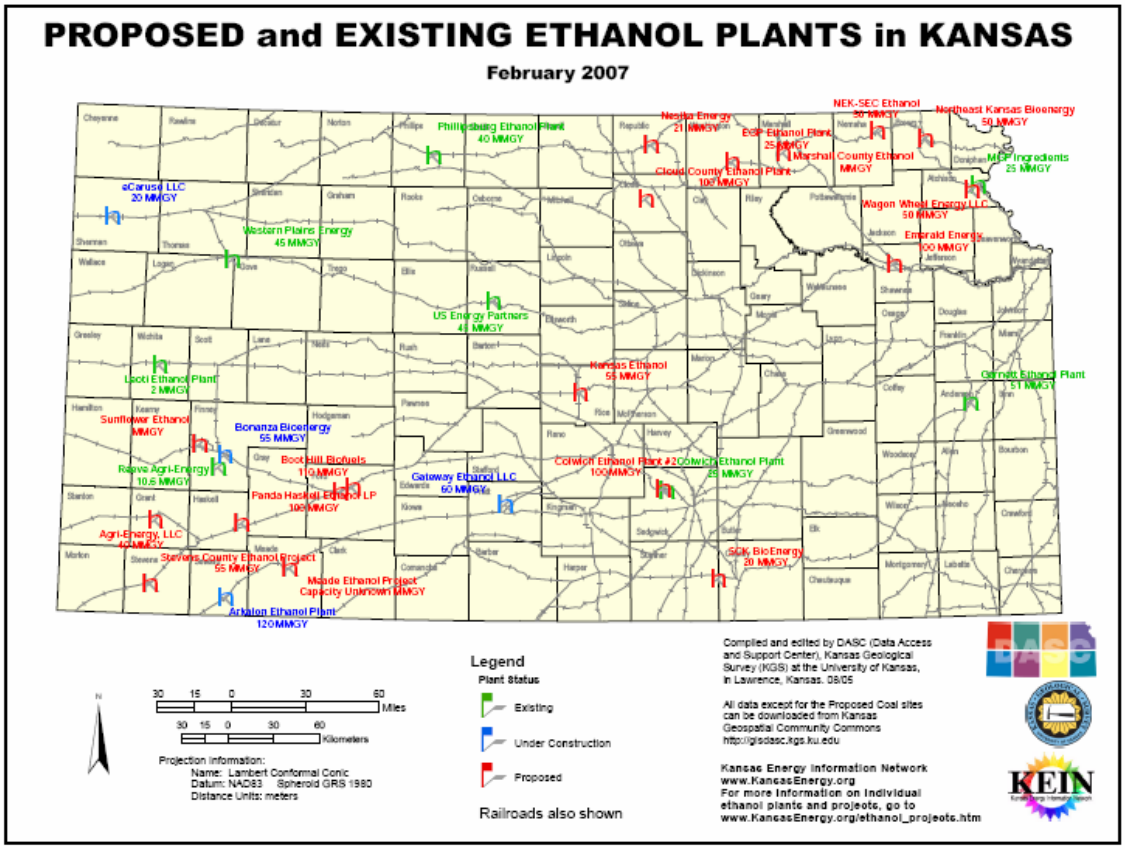
http://www.sciencemag.org/cgi/reprint/309/5734/548.pdf



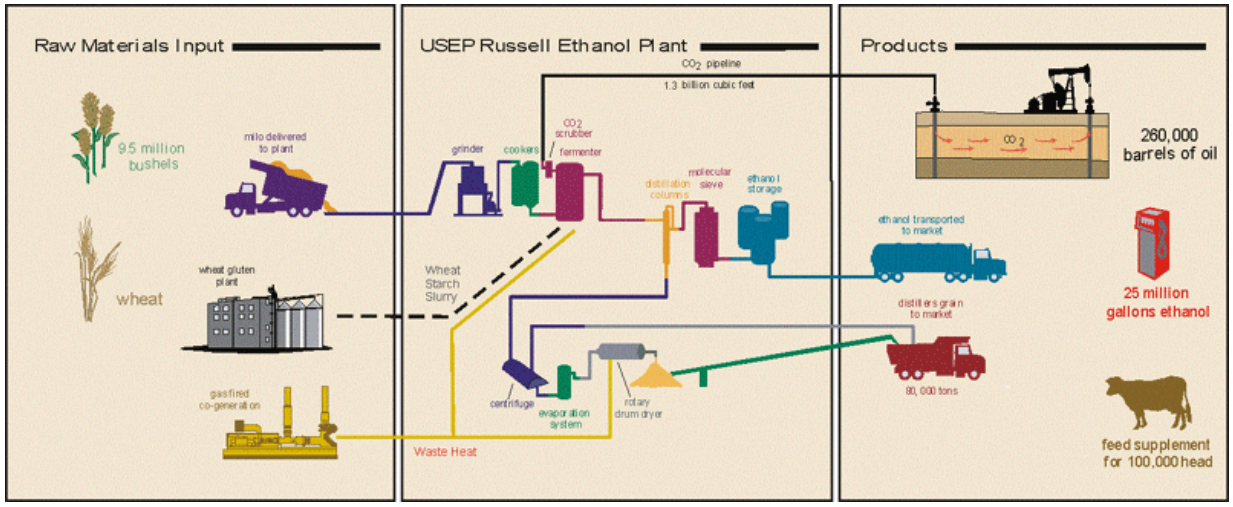
Process routes for conversion of carbohydrates to fuels. These routes include ethanol via fermentation and distillation (**top**), hydrogen via ethanol or directly by liquid-phase steam reforming (**middle**), and hydrocarbons ("CH_2") by the process described by Huber *et al.* (*1*) (**bottom**).

http://www.sciencemag.org/cgi/reprint/308/5727/1421.pdf

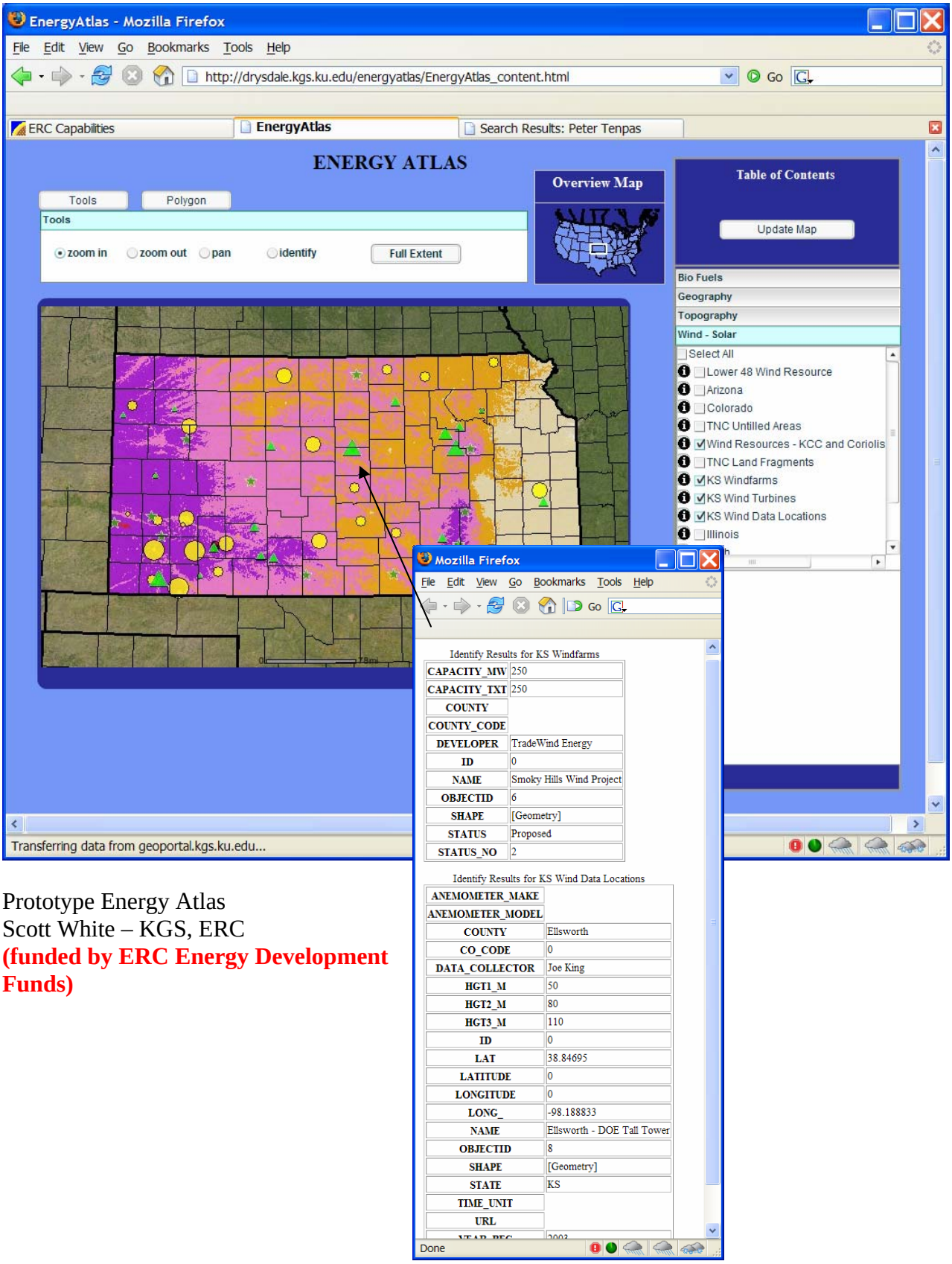

E-85 and Biodiesel Fueling Stations in Kansas, December 2006
Cheyenne
Rawlins
Decatur
Norton
Phillips
Smith
Jewell
Republic
Washington
Marshall
Nemaha
Brown
Doniphan
Sherman
Thomas
Sheridan
Graham
Rooks
Osborne
Mitchell
Cloud
Clay
Riley
Pottawatomie
Atchison
Jackson
Jefferson
Leavenworth
Wyandotte
Wallace
Logan
Gove
Trego
Ellis
Russell
Lincoln
Ottawa
Dickinson
Geary
Shawnee
Wabaunsee
Osage
Douglas
Johnson
Miami
Greeley
Wichita
Scott
Lane
Ness
Rush
Barton
Ellsworth
Saline
McPherson
Marion
Morris
Lyon
Franklin
Hamilton
Kearny
Finney
Hodgeman
Pawnee
Stafford
Rice
Chase
Coffey
Anderson
Linn
Greenwood
Gray
Ford
Edwards
Reno
Harvey
Butler
Woodson
Allen
Bourbon
Stanton
Grant
Haskell
Kiowa
Pratt
Kingman
Sedgwick
Wilson
Neosho
Crawford
Elk
Morton
Stevens
Seward
Meade
Clark
Comanche
Barber
Harper
Sumner
Cowley
Chautauqua
Montgomery
Labette
Cherokee
30 15 0 30 60
Miles
30 15 0 30 60
Kilometers
Projection Information:
Name: Lambert Conformal Conic
Datum: NAD83 Spheroid GRS 1980
Distance Units: meters
Biodiesel Fueling Stations
E85 Fueling Station
Kansas Energy Chart Book, Chapter 10
Source: Kansas Energy Office and Kansas Corngrowers Association (www.ksgrains.com)



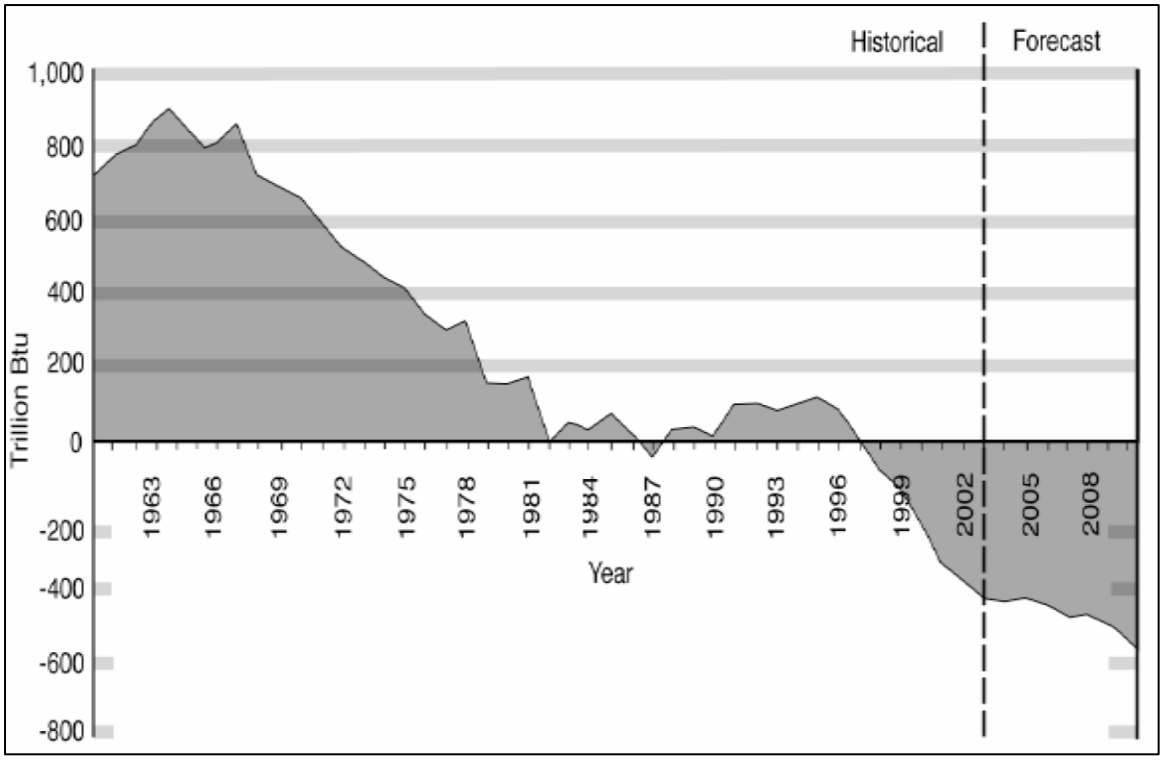
KEIN stands for Kansas Energy Information Network
(initiated by the KU Energy Research Center)



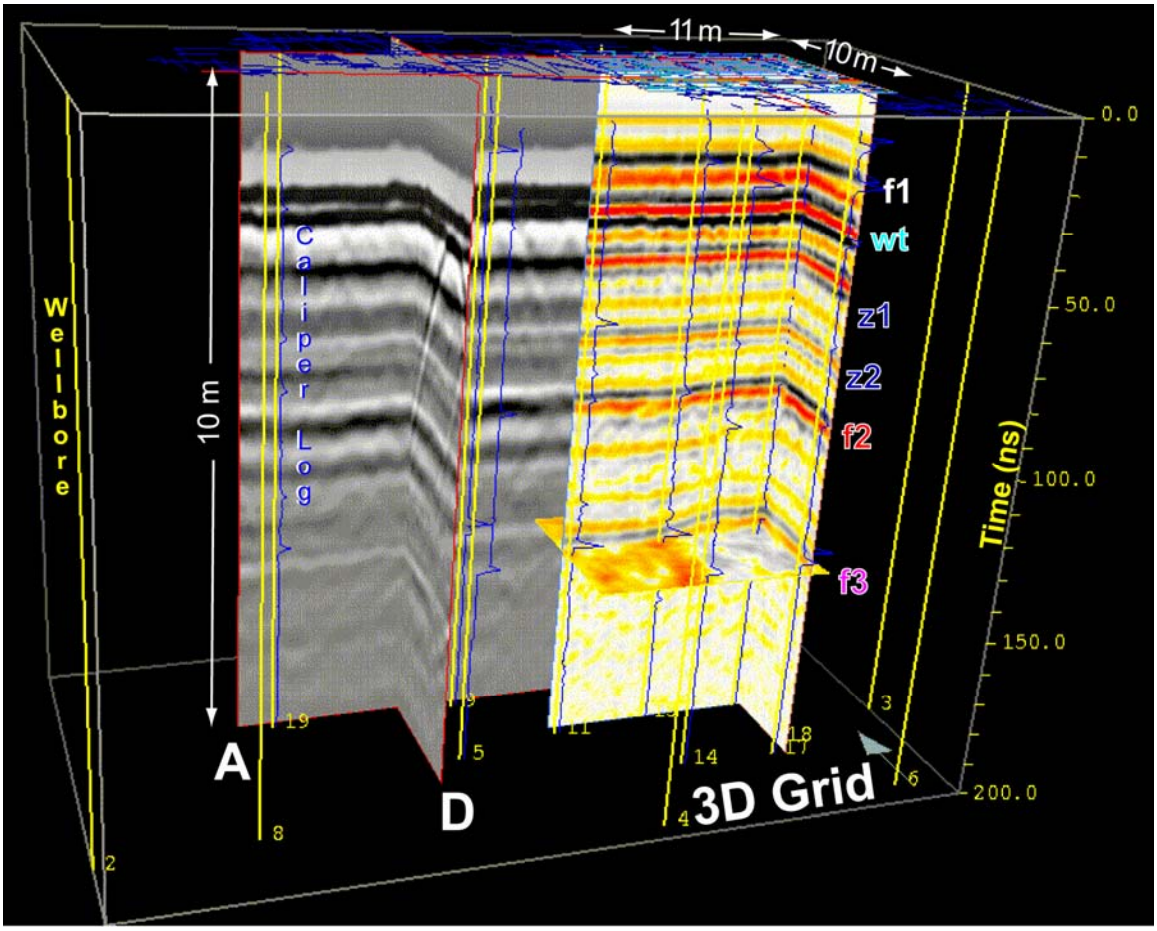
From: Co-generation, Ethanol Production and CO_2 Enhanced Oil Recovery: a Model for Environmentally and Economically Sound Linked Energy Systems, Martin K. Dubois, Scott W. White, and Timothy R. Carr



Prototype Energy Atlas
Scott White – KGS, ERC
(funded by ERC Energy Development Funds)



A goal is for Kansas to again become a net energy producing state
Source: Kansas Energy Information Network, KEIN – maintained by Scott White (KGS, ERC) http://www.kansasenergy.org/



3D Seismic imaging used in environmental and petroleum exploration and development