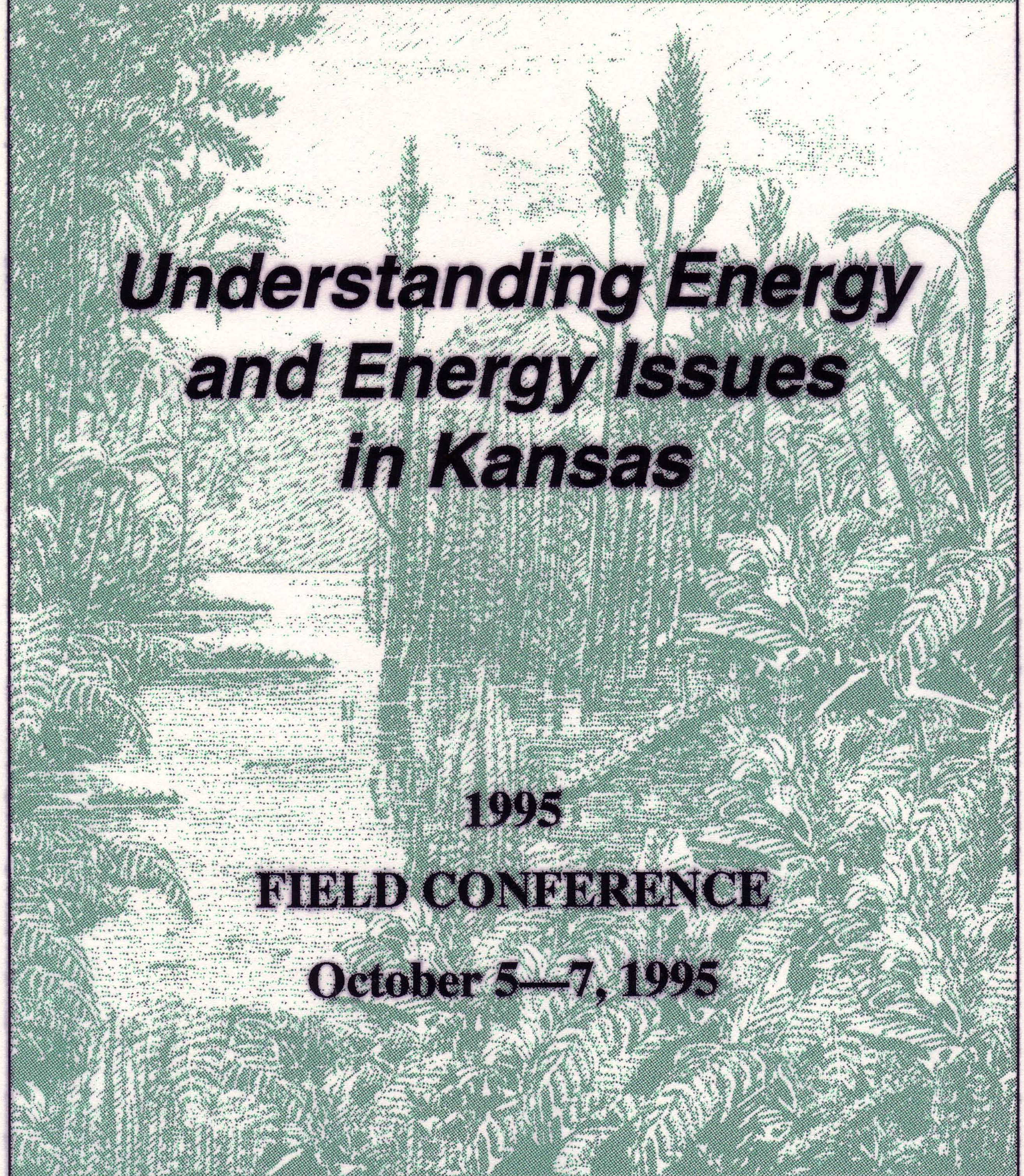
Kansas Earth Resources Field Project



Understanding Energy and Energy Issues in Kansas

1995

FIELD CONFERENCE

October 5—7, 1995

Sponsored by Kansas Geological Survey, Lawrence, Kansas

Kansas Earth Resources Field Project

FIELD GUIDE

1995 FIELD CONFERENCE

"Understanding Energy and Energy Issues in Kansas"

October 5-7, 1995

Edited by

Robert S. Sawin
and
Rex C. Buchanan

KGS OPEN-FILE REPORT 95-52

KANSAS GEOLOGICAL SURVEY
Geology Extension
1930 Constant Ave. - Campus West
Lawrence, Kansas 66047-3726
Telephone: (913) 864-3965

KANSAS EARTH RESOURCES FIELD PROJECT

"Understanding Energy and Energy Issues in Kansas"

1995 FIELD CONFERENCE

October 5-7, 1995

SCHEDULE & ITINERARY

Thursday October 5, 1995

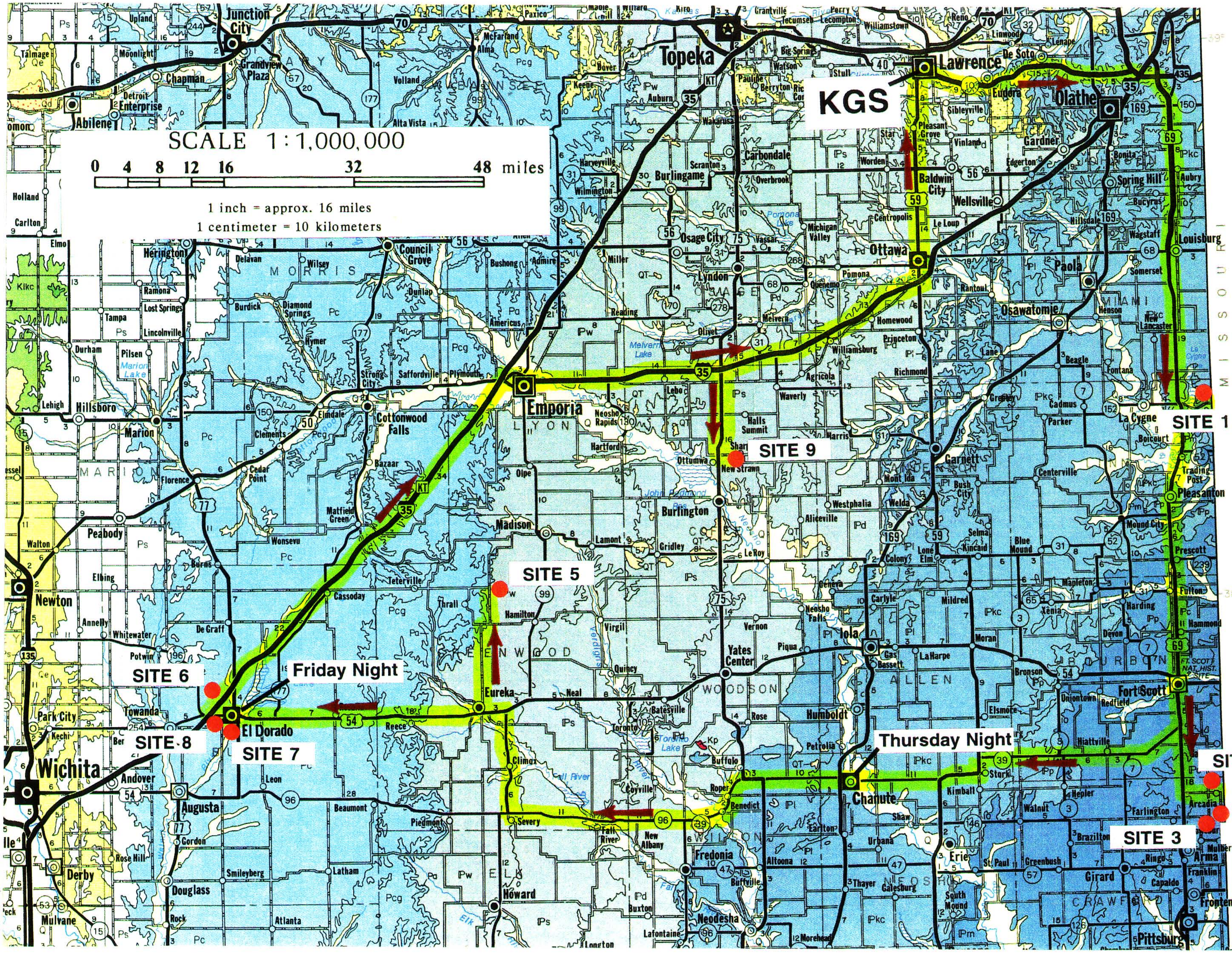
7:15 am	Coffee and Donuts - Kansas Geological Survey
7:30 am	Greetings and Conference Overview
7:45 am	Bus to La Cygne Generating Station
9:30 am	**SITE 1** - Tour La Cygne Generating Station
11:45 am	Lunch at Ft. Scott National Historic Site
1:00 pm	Bus to Clemens Coal Mine 22
1:30 pm	**SITE 2** - Tour Clemens Coal Mine 22 and Tipple
3:15 pm	**SITE 3** - Visit Coal Mine Reclamation Sites
4:15 pm	**SITE 4** - Visit Proposed Jayhawk Energy Project Site
5:00 pm	Bus to Chanute
6:15 pm	Check-in at the Holiday Park Motel, Chanute
7:00 pm	Dinner at the Holiday Park Motel
8:00 pm	Evening Session - Oil and Gas in Kansas

Friday October 6, 1995

6:30 am	Bus to Burkett Field
7:45 am	Rest Stop - Eureka C-Mart
8:30 am	**SITE 5** - Tour Burkett Field
11:00 am	Bus to El Dorado
12:00 am	Lunch and Oil Museum
1:15 pm	Bus to El Dorado Field
1:30 pm	**SITE 6** - Tour El Dorado Field
2:45 pm	**SITE 7** - Tour Texaco Refinery
4:45 pm	**SITE 8** - Transportation - Chase Pipeline and Groendyke Transport
5:30 pm	Check-in at the Best Western Red Coach Inn, El Dorado
6:15 pm	Trolley leaves for Reception and Cookout Dinner
8:00 pm	Evening Session - Energy Alternatives and Renewable Energy

Saturday October 7, 1995

7:00 am	Bus to Wolf Creek Generating Station
8:30 am	**SITE 9** - Tour Wolf Creek Generating Station
12:30 pm	Lunch - Wolf Creek Environmental Education Area
1:15 pm	Bus to Lawrence
2:30 pm	Arrive Kansas Geological Survey


KGS
SITE 1
SITE 2
SITE 3
SITE 4
SITE 5
SITE 6
SITE 7
SITE 8
SITE 9
Thursday Night
Friday Night
SCALE 1:1,000,000
0 4 8 12 16 32 48 miles
1 inch = approx. 16 miles
1 centimeter = 10 kilometers
Topeka
Lawrence
Olathe
Ottawa
Emporia
El Dorado
Wichita
Chanute
Fort Scott
Pittsburg
Junction City
Newton
Eureka
MISSOURI

KANSAS EARTH RESOURCES FIELD PROJECT

"Understanding Energy and Energy Issues in Kansas"

1995 FIELD CONFERENCE

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KANSAS EARTH RESOURCES FIELD PROJECT

"Understanding Energy and Energy Issues in Kansas"

1995 FIELD CONFERENCE

October 5-7, 1995

PARTICIPANTS LIST

Name	Title	Affiliation	Business Address
Wayland Anderson	Assistant Chief Engineer	Ks. Dept. of Agriculture Div. of Water Resources	901 S. Kansas Ave. Topeka, KS 66602 913/296-3718
Jim Clark	Science Instructor	Wichita High School North	1437 Rochester Wichita, KS 67203 316/833-3000
Dyan Conway	Vice President	Mercantile Investment Services	9063 E. Gregory Kansas City, MO 64133 816/743-6280
David Corbin	Senator	Kansas Senate	645 State St. Augusta, KS 67010 316/775-1888
Kent Crisler	Director	Kansas Geological Society	Pickrell Drilling Co. 110 N. Market, Ste. 205 Wichita, KS 67202 316/262-8427
Vaughn Flora	Representative	Kansas House of Representatives/ House Energy and Natural Res. Comm.	431 Woodland Ave. Topeka, KS 66607 913/232-5147
Frank Gaines	Former State Senator	Independent Producer	Rural Route 1 Hamilton, KS 66853 316/678-3493
David Heinemann	General Counsel	Kansas Corporation Commission	1500 SW Arrowhead Topeka, KS 66604-4027 913/271-3162
Jerry Karr	Senate Minority Leader	Kansas Senate	1155 N. Highway 99 Emporia, KS 66801 913/296-3245
Robert Krehbiel	Representative	Kansas House of Representatives/ House Energy and Natural Res. Comm.	P.O. Box 7 Pretty Prairie, KS 67570 316/459-6464
Wayne Lebsack	Chairman	The Nature Conservancy Kansas Chapter	603 S. Douglas Lyons, KS 67554 316/938-2396

Al LeDoux	Director	Kansas Water Office	109 SW 9th St., Ste. 300 Topeka, KS 66612-1249 913/296-3185
Janis Lee	Senator	Kansas Senate/ Senate Energy and Natural Res. Comm.	Rural Route 1, Box 145 Kensington, KS 66951 913/476-2294
Laura McClure	Representative	Kansas House of Representatives/ House Energy and Natural Res. Comm.	202 S. 4th Osborne, KS 67473 913/346-2715
David Nance	City Commissioner	Pittsburg, Kansas	601 W. Quincy Pittsburg, KS 66762 316/231-1365
John Prather	Vice President Northern Region	Groendyke Transport, Inc.	2318 W. Central El Dorado, KS 67042 316/321-6378
Randy Rose	President	Kansas Earth Science Teachers Association	Blue Valley North H. S. 12200 Lamar Overland Park, KS 66209 913/345-7300
Tom Stiles	Assistant Director	Kansas Water Office	109 SW 9th St., Ste. 300 Topeka, KS 66612-1249 913/296-4094
David Stutt	District Environmental Administrator	Kansas Department of Health and Environment	Southeast District Office 1500 West 7th Chanute, KS 66720 316/431-2390
David Williams	Supervisor of Production	Kansas Corporation Commission	130 S. Market, Ste. 2078 Wichita, KS 67202-3758 316/337-6200

KANSAS GEOLOGICAL SURVEY STAFF

Lee Gerhard	Director and State Geologist	1930 Constant Ave. Campus West Lawrence, KS 66049 913/864-3965
Larry Brady	Deputy Director	
Rex Buchanan	Assistant Director, Publications and Public Affairs	
Pieter Berendsen	Acting Chief, Geologic Investigations Section	
Tim Carr	Chief, Petroleum Research Section	
John Charlton	Research Assistant, Publications and Public Affairs	
Jim McCauley	Assistant Scientist, Geologic Investigations Section	
Bob Sawin	Research Assistant, Geology Extension	

BIOGRAPHICAL INFORMATION

Wayland Anderson
Title
Assistant Chief Engineer
Affiliation
Kansas Department of Agriculture
Division of Water Resources
Address and Telephone
901 S. Kansas Ave.
Topeka, KS 66602
913/296-3718
Current Responsibilities
Daily overview of DWR and 4 field offices.
Experience
Assistant State Engineer, WY; Water Resource Engineer, Wright Water Engineers, Denver; Water Development Engineer, WY
Education
University of Wyoming - BS, 1971
University of Wyoming - MS, 1973

James C. Clark, Jr.
Title
Science Instructor
Affiliation
Wichita High School North;
Ks. Earth Sci. Teachers Assoc. (Past Preident)
Address and Telephone
1437 Rochester
Wichita, KS 67203
316/833-3000
Current Responsibilities
Physical and Earth Science Instructor
Experience
Teaching, 8 years; Petroleum Geologist, 13 years.
Education
Wittenberg University - BA 1974
Wichita State University - MSE 1990

Dyan Conway
Title
Vice President
Affiliation
Mercantile Investment Services
Address and Telephone
9063 E. Gregory
Kansas City, MO 64133
816/743-6280
Current Responsibilities
Investment services for Mercantile's banks;
Kansas Geological Survey Advisory Council
Experience
Banking since 1982, USGS during college.
Education
Stanford - BS 1978 (Geology)

David Corbin
Title
Senator, 16th District
Affiliation
Kansas Senate; Corbin Investments, Inc.; Farming
Address and Telephone
645 State St.
Augusta, KS 67010
316/775-1888
Current Responsibilities
Chairman, Senate Agriculture Committee

Kent Crisler
Title
Director
Affiliation
Kansas Geological Society
Address and Telephone
Pickrell Drilling Co.
110 N. Market, Ste. 205
Wichita, KS 67202
316/262-8427
Current Responsibilities
Petroleum Geologist - originate and review drilling prospects.
Experience
Pickrell Drilling, 3 years; Gear Petroleum, 14 years; Beren Corp, 2 years.
Education
University of Kansas - BS 1977

Vaughn L. Flora
Title
Representative, 57th District
Affiliation
Kansas House of Representatives
Address and Telephone
431 Woodland Ave.
Topeka, KS 66607
913/232-5147
Current Responsibilities
House Energy and Natural Resources Committee
Experience
President, Non-profit Affordable Housing Corp., 2 years; Real Estate Broker; Home remodeling and construction; Kansas Rural Center.
Education
Kansas State University - BS, 1968

Franklin D. Gaines

Title

Former State Senator

Affiliation

Independent Producer

Address and Telephone

Rural Route 1
Hamilton, KS 66853
316/678-3493

Current Responsibilities

Operate the Burkett Unit, Greenwood County, Kansas; Ranching

Experience

Kansas Senate, 20 years; Kansas House 6 years; Independent Producer, Burkett Unit; Rancher; Attorney

Education

Washburn Law School - JD, 1960

David J. Heinemann

Title

General Counsel

Affiliation

Kansas Corporation Commission

Address and Telephone

1500 SW Arrowhead
Topeka, KS 66604-4027
913/271-3162

Current Responsibilities

Chief attorney to the Kansas Corporation Commission; Kansas Geological Survey Advisory Council

Experience

Former Member, House of Representatives, 123rd District, 27 years; Attorney in private practice, Garden City, Kansas.

Education

Augustana College - 1967
Washburn Law School - JD, 1973

Gerald Karr

Title

Senator, 17th District
Senate Minority Leader

Affiliation

Kansas Senate

Address and Telephone

1155 N. Highway 99
Emporia, KS 66801
913/296-3245

Current Responsibilities

Democratic Leader; Senate Agriculture Committee; Farmer/Stockman

Education

Kansas State University - BS, 1959
Southern Illinois University - MS, 1962
Southern Illinois University - PhD, 1966

Robert E. Krehbiel

Title

Representative, 101st District

Affiliation

Kansas House of Representatives

Address and Telephone

P.O. Box 7
Pretty Prairie, KS 67570
316/459-6464

Current Responsibilities

House Energy and Natural Resources Committee

Experience

Currently attorney in private practice; Attorney, Energy Reserves Gp.; Attorney, Imperial Oil Co.

Education

University of Kansas - BA, 1968
University of Kansas Law School - JD, 1973

Wayne Lebsack

Title

Chairman

Affiliation

The Nature Conservancy, Kansas Chapter

Address and Telephone

603 S. Douglas
Lyons, KS 67554
316/938-2396

Current Responsibilities

Chairman, Kansas Board of Trustees

Experience

Oil and gas exploration; Ground water exploration and pollution research.

Education

Colorado School of Mines - Geol. Eng., 1949
Colorado School of Mines - Geol. Eng., 1951
Colorado School of Mines - 2 years grad. studies

Al LeDoux

Title

Director

Affiliation

Kansas Water Office

Address and Telephone

109 SW 9th St., Ste. 300
Topeka, KS 66612-1249
913/296-3185

Current Responsibilities

Plan, market, develop, implement, and evaluate policies/programs for current and future water needs.

Experience

Sr. Govt. Affairs Liaison, Gov. Graves; Adm. Assist. to Maj. Leader, Ks. Sen., Lt. Gov. Frahm; Legis. Liaison and Ag. Advisor, Gov. Hayden; Admin. Assist. to the Maj. Leader, Ks. House;

Education

Baker University - BA, 1969

Janis K. Lee
Title
Senator, 36th District
Affiliation
Kansas Senate
Address and Telephone
Rural Route 1, Box 145
Kensington, KS 66951
913/476-2294
Current Responsibilities
Senate Energy and Natural Resources Committee
Experience
Ranching and farming.
Education
Kansas State University - BS, 1970

Laura McClure
Title
Representative, 119th District
Affiliation
Kansas House of Representatives
Address and Telephone
202 S. 4th
Osborne, KS 67473
913/346-2715
Current Responsibilities
House Energy and Natural Resources Committee; House Agriculture Comm.
Experience
Owned/operated flower and antiques shop; managed senior/low income housing; farmed; managed nutrition site; organized grass roots organization for a solution to nuclear waste.

David Nance
Title
City Commissioner
Affiliation
Pittsburg, Kansas
Address and Telephone
601 W. Quincy
Pittsburg, KS 66762
316/231-1365
Current Responsibilities
Pittsburg City Commission; Environmental consulting; Kansas Geological Survey Advisory Council
Experience
Engineer at Standard Oil, Monsanto, CPC Intl, Muskegon Chemical, Koch Ind., Allied Signal.
Education
University of Kansas - BS, 1959
Western Michigan University - MBA, 1975

John C. Prather
Title
Vice President Northern Region
Affiliation
Groendyke Transport, Inc.
Address and Telephone
2318 W. Central
El Dorado, KS 67042
316/321-6378
Current Responsibilities
Groendyke operations in Kansas; Kansas Geological Survey Advisory Council
Experience
Tank truck industry, 26 years.
Education
Emporia State University - BSB, 1969

Randy Rose
Title
President
Affiliation
Kansas Earth Science Teachers Association/ Blue Valley North High School, Overland Park
Address and Telephone
12200 Lamar
Overland Park, KS 66209
913/345-7300
Current Responsibilities
Kansas Earth Science Teachers Association; Teach Physical and Earth-Space science; Science club sponsor
Experience
High school science teacher, 11 years; Junior high science, 2 years.
Education
Emporia State University - BS, 1981
Emporia State University - BS, 1989

Tom Stiles
Title
Assistant Director
Affiliation
Kansas Water Office
Address and Telephone
109 SW 9th St., Ste. 300
Topeka, KS 66612-1249
913/296-4094
Current Responsibilities
Development and implementation of Ks. Water Plan, recommendations for Water Plan Fund.
Experience
Kansas Water Office, 13 years.
Education
Colorado State University - BS, 1978
University of Minnesota - MS, 1982

David B. Stutt

Title

District Environmental Administrator

Affiliation

Kansas Department of Health and Environment

Address and Telephone

Southeast District Office
1500 West 7th
Chanute, KS 66720
316/431-2390

Current Responsibilities

Administer environmental programs in the Southeast District Office (Chanute).

Experience

KDHE, 2 years; Ok. Army National Guard, 1 year; Ok. State Dept. of Health, 11 years.

Education

University of Oklahoma - BS, 1978
University of Oklahoma - MS, 1985

David P. Williams

Title

Supervisor of Production

Affiliation

Kansas Corporation Comm., Conservation Div.

Address and Telephone

130 S. Market, Ste. 2078
Wichita, KS 67202-3758
316/337-6200

Current Responsibilities

Technical review and guidance in petroleum geology, geohydrology, well evaluations, and proration matters; Staff advisor and expert witness on production matters before the KCC.

Experience

KCC, 6 years; exploration and production geology and petroleum consulting, 13 years.

Education

Fort Hays State University - BS, 1974

KANSAS GEOLOGICAL SURVEY STAFF

Lee C. Gerhard
Title
Director and State Geologist
Affiliation
Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
Campus West
Lawrence, KS 66049
913/864-3965
Current Responsibilities
Director of administration and geologic research at the Kansas Geological Survey.
Experience
Kansas Geological Survey, 9 years; Colorado School of Mines, 5 years; North Dakota Geological Survey, 6 years; W. Indies Lab., Fairleigh Dickinson Univ., 3 years; Univ. of Southern Colorado, 6 years; Sinclair, 2 years; Consultant and Independent Petroleum Geologist.
Education
Syracuse University - BS, 1958
University of Kansas - MS, 1961
University of Kansas - PhD, 1964

Lawrence L. Brady
Title
Deputy Director
Affiliation
Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
Campus West
Lawrence, KS 66049
913/864-3965
Current Responsibilities
Geologic research and administration.
Experience
Kansas Geological Survey, 24 years; Oklahoma State University, 1 year; U.S. Corps of Engineers, 5 years.
Education
Kansas State University - BS, 1958
University of Kansas - MS, 1967
University of Kansas - PhD, 1971

Rex C. Buchanan
Title
Assistant Director
Affiliation
Publications and Public Affairs Section, Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
Campus West
Lawrence, KS 66049
913/864-3965
Current Responsibilities
Supervise publication and public outreach activities, media relations, and non-technical communications.
Experience
Kansas Geological Survey, 17 years; University-Industry Research, University of Wisconsin, 3 years; Salina Journal, 4 years.
Education
Kansas Wesleyan University - BA, 1975
University of Wisconsin-Madison - MA, 1978
University of Wisconsin-Madison - MS, 1982

Pieter Berendsen
Title
Senior Scientist
Affiliation
Acting Chief, Geologic Investigations Section, Kansas Geological Survey
Address and Telephone
1930 Constant Ave.
Campus West
Lawrence, KS 66049
913/864-3965
Current Responsibilities
Acting Section Chief, Geologic Investigations Section; Research metallic minerals; Student advisor.
Experience
Kansas Geological Survey, 21 years; Taught at Stanford University; Manitoba Mines Branch; Mobil Oil in Canada.
Education
University of Manitoba - BS, 1964
University of California-Riverside - PhD, 1970

Timothy R. Carr

Title

Senior Scientist

Affiliation

Chief, Petroleum Research Section, Kansas Geological Survey

Address and Telephone

1930 Constant Ave.
Campus West
Lawrence, KS 66049
913/864-3965

Current Responsibilities

Chief, Petroleum Research Section; Co-Director, Energy Research Center; Adjunct Professor of Geology.

Experience

Kansas Geological Survey, 3 years; ARCO Oil and Gas Company, 12 years; Petroleum research, exploration, and operations.

Education

University of Wisconsin - BS, 1973
Texas Tech University - MS, 1977
University of Wisconsin - PhD, 1980

John R. Charlton

Title

Research Assistant

Affiliation

Publications and Public Affairs Section, Kansas Geological Survey

Address and Telephone

1930 Constant Ave.
Campus West
Lawrence, KS 66049
913/864-3965

Current Responsibilities

Staff photographer and in-house photographic services for publications, presentations, and exhibits.

Experience

Kansas Geological Survey, 14 years; Kress Foundation, Spencer Museum of Art, 5 years.

Education

University of Kansas - BA, 1976
University of Kansas - MA, 1982

James R. McCauley

Title

Assistant Scientist

Affiliation

Geologic Investigations Section, Kansas Geological Survey

Address and Telephone

1930 Constant Ave.
Campus West
Lawrence, KS 66049
913/864-3965

Current Responsibilities

Geologic mapping, remote sensing, and public inquires.

Experience

Kansas Geological Survey, 19 years; KU Remote Sensing Laboratory, 6 years.

Education

University of Kansas - BS, 1970
University of Kansas - MS, 1973
University of Kansas - PhD, 1977

Robert S. Sawin

Title

Research Assistant

Affiliation

Publications and Public Affairs Section, Kansas Geological Survey

Address and Telephone

1930 Constant Ave.
Campus West
Lawrence, KS 66049
913/864-3965

Current Responsibilities

Public outreach activities, Geology Extension program, Kansas Earth Resources Field Project, and public inquires.

Experience

Kansas Geological Survey, 3 years; Petroleum Geology, 15 years; Engineering Geology, 6 years.

Education

Kansas State University - BS, 1972
Kansas State University - MS, 1977

KANSAS EARTH RESOURCES FIELD PROJECT

"Understanding Energy and Energy Issues in Kansas"

1995 FIELD CONFERENCE

October 5-7, 1995

Welcome to the 1995 Field Conference. This year's conference is structured to follow our heavy reliance on energy from extraction of the natural resource through processing, transportation, and conversion to use by the consumer. How many of us think about coal mining when we turn on the light switch or an oil field while we fill our gas tanks? During this trip we'll be able to observe some of the processes and problems involved between extraction and consumption and perhaps appreciate how complicated and expensive the "unseen" intermediate steps are. We will also experience the connections between energy issues and environmental issues.

The theme for the 1995 Field Conference will be *Understanding Energy and Energy Issues in Kansas*. During the two and one-half day conference, participants will travel via chartered bus to selected sites. The sites will include a surface coal mine, nuclear- and coal-powered electrical generation plants, oil and gas fields and their related facilities, and associated waste-handling or reclamation operations. When applicable, participants will analyze the technology implemented at these sites to prevent or to remediate environmental degradation.

En route, at the sites, and at various other times, local and regional experts in resource development will brief participants about what they will see and what issues relate to the sites. In addition, a comprehensive Field Guide provides background on the sites and issues. When possible, participants will interact with county, state, and regional officials, environmental groups, and citizens' organizations. This information base provides participants with new and broader perspectives useful in formulating energy policies.

The 1995 Field Conference is more than merely a guided tour of the sites. Rather, the sites are selected to demonstrate particular perspectives on an issue, and the program is designed to be both experientially and educationally rewarding.

The Kansas Earth Resources Field Project does not seek to resolve policy or regulatory conflicts, but rather provides unique opportunities to acquaint decision-makers and policy-makers with the various perspectives on resource problems and issues. Furthermore, the Field Project goes beyond merely identifying the issues by bringing together experts who examine the issues in light of the unique technical, geographical, geological, environmental, social, and economic realities of the situation.

The Field Project provides an opportunity for participants to visit a variety of earth-resource production sites and discuss problems and issues with industry and government experts, residents, and community leaders. Participants will gain a better understanding and appreciation of the technology and issues surrounding such development.

About the Kansas Earth Resources Field Project

The Kansas Earth Resources Field Project is an educational outreach program of the Kansas Geological Survey administered through its Geology Extension program. The mission of the Field Project is to provide educational opportunities to individuals who make and influence policy about earth resources and related social, economic, and environmental issues in Kansas. Earth resources are defined as the mineral, energy, water, and soil resources of the earth. The industries that deal with earth resources include energy, mining, quarrying, and agriculture.

The Field Project consists of a series of onsite conferences at which the participants are introduced to the technical, economic, environmental, social, and policy-related aspects of earth-resource development. Using a field experience, the goal of the program is to provide participants with an educational opportunity that will assist them in making better informed, efficient, and effective decisions when dealing with earth-resource issues.

The Kansas Earth Resources Field Project strives to facilitate the exchange of information and ideas between working professionals who deal with earth-resource related issues. The programs are designed to open channels of communication among federal, state, and local governments as well as the private sector. The contacts established during the conference will provide a network for future information and idea exchange among the participants, and between participants and regional water, soil, energy, and mineral specialists.

The Kansas Earth Resources Field Project is modeled after a similar program of national scope, the Energy and Minerals Field Institute, operated by the Colorado School of Mines. The Kansas Geological Survey appreciates the support of Dr. Erling Brostuen, Director of the Energy and Minerals Field Institute, in helping develop the Kansas project.

Kansas Geological Survey

The Kansas Geological Survey is a research and service division administered by the University of Kansas. The Survey is responsible for studying and providing information about the state's geologic hazards and resources, particularly ground water, oil, natural gas, and other minerals. The Kansas Geological Survey's role is strictly one of service, research, and reporting of the various results, and it has no regulatory or operational responsibility within State government.

The Kansas Geological Survey is organized into four research sections and several support groups. Research sections are Geologic Investigations, Geohydrology, Petroleum Research, and Mathematical Geology. Support sections include Analytical Services, Computer Services, Editing, Publication Sales, Exploration Services, Library/Archives, Geology Extension, Technical Information Services, and Administration. The Survey also has a branch office in Wichita, whose primary function is to collect, store, and loan cutting samples from oil and gas wells drilled in the state. In addition, the Wichita office provides publications sales and conducts geologic studies. The Kansas Geological Survey consists of more than 50 scientists, assisted by about 80 full-time staff members and student employees, specializing in a variety of geologic disciplines.

The Geologic Investigations Section studies and maps the state's surficial geology, paleontology, and industrial and metallic minerals deposits. This section has been the focus for the Survey's geologic-mapping activities.

The Geohydrology Section studies the state's ground-water resources. The section conducts research and service projects directed toward accurately assessing the state's ground-water problems and finding effective ways of maintaining ground-water supplies to ensure availability for future generations. Research is designed to further the scientific understanding of the hydrology and water resources of Kansas and to disseminate research results and other hydrologic-related information to the people of the state.

The Petroleum Research Section conducts research to increase the scientific understanding of the geologic and economic factors controlling the occurrence and production of hydrocarbon resources in Kansas. The section also works on the efficient transfer of research results and information to the people of Kansas in order to advance the understanding and effective management of its hydrocarbon resources. The section participates with other University of Kansas units in projects funded by the U.S. Department of Energy on the transfer of technology to Kansas operators through workshops held throughout the state, demonstration projects done in cooperation with independent producers, and the publication of results.

The Mathematical Geology Section applies statistical and mathematical techniques to various aspects of geology, such as mapping, analysis of the records of wells drilled in search of oil and gas, the movement of fluids through underground rocks, and other areas. These techniques can be applied to questions about natural-resource availability or the analysis of water contamination.

The Survey has recently developed a new Geology Extension program that is designed to develop materials, projects, and services that communicate information about the geology of Kansas, the state's earth resources, and the products of the Kansas Geological Survey to the people of the state. The Kansas Earth Resources Field Project is managed and administered through this program.

KGS Staff Participating in the 1995 Field Conference

Lee C. Gerhard, Director and State Geologist
Lawrence L. Brady, Deputy Director
Rex C. Buchanan, Assistant Director, Publications and Public Affairs
Pieter Berendsen, Acting Chief, Geologic Investigations Section
Timothy R. Carr, Chief, Petroleum Research Section
John R. Charlton, Research Assistant, Publications and Public Affairs
James R. McCauley, Assistant Scientist, Geologic Investigations Section
Robert S. Sawin, Research Assistant, Geology Extension

SCHEDULE & ITINERARY

Thursday October 5, 1995

7:15 am	Coffee and Donuts - Kansas Geological Survey
7:30 am	Greetings and Conference Overview Lee Gerhard, Director, Kansas Geological Survey
7:45 am	Bus to La Cygne Generating Station Coal in Kansas Larry Brady, Deputy Director, Kansas Geological Survey
9:30 am	**SITE 1** - Tour La Cygne Generating Station Dana Crawford, La Cygne Generating Station
11:00 am	Bus to Ft. Scott
11:45 am	Lunch at Ft. Scott National Historic Site
1:00 pm	Bus to Clemens Coal Mine 22
1:30 pm	**SITE 2** - Tour Clemens Coal Mine 22 and Tipple Dennis Woolman, The Clemens Coal Company Mike Puffinbarger, The Clemens Coal Company
3:15 pm	**SITE 3** - Visit Coal Mine Reclamation Sites Murray Balk, Surface Mining Section, KDHE
4:15 pm	**SITE 4** - Visit Proposed Jayhawk Energy Project Site Dennis Woolman, The Clemens Coal Company
5:00 pm	Bus to Chanute
6:15 pm	Check-in at the Holiday Park Motel, Chanute
7:00 pm	Dinner at the Holiday Park Motel
8:00 pm	Evening Session - Oil and Gas in Kansas Tim Carr, Kansas Geological Survey

LA CYGNE GENERATING STATION

The La Cygne Generating Station is a coal-fired electrical generation facility owned by Kansas City Power & Light Company (KCPL), headquartered in Kansas City, Missouri, and Kansas Gas and Electric, a Western Resources company. KCPL operates the facility. The Station consists of two units that are differentiated by the type and quality of coal burned and the air-protection systems used to control emissions.

La Cygne Unit No. 1 was constructed (1969 to 1973) to burn local coal from southeast Kansas and southwest Missouri. Because of the high sulfur (average 5.25 %) and ash (average 24 %) content of local coal, the wet-scrubbing process was selected to control both sulfur dioxide and fly-ash emissions. In 1993, modifications to La Cygne Unit No. 1 were completed to allow burning of a blend of low-sulfur western coal and higher-sulfur and higher-BTU local coal. Blending the coals reduces fuel costs while helping the unit to meet environmental regulations.

Construction on La Cygne Unit No. 2 was completed in 1977. This unit was designed to burn the more environmentally acceptable low sulfur coals from the western United States. This coal is shipped by rail in 110-car trains from mining operations near Gillette, Wyoming. Air-quality protection at Unit No. 2 is achieved with an electrostatic precipitator.

Generating Electricity from Coal

Coal is burned to produce heat energy, that in turn heats water to form steam (Figure 1). Steam-electric turbogenerators, like those at La Cygne, convert heat energy to mechanical energy by burning coal in water tube-lined boilers. In this closed system, steam pressure forces the turbine to spin a shaft at 3,600 revolutions per minute. The generator on the end of the shaft spins a coil of wire through a magnetic field, causing electrons to move in the wire. The movement of electrons is electricity.

La Cygne Lake serves as a giant radiator for the power plant. Water from the lake is pumped through a huge condenser to change the spent steam back into water before it is returned to the boiler to complete the cycle. The cooling water is then returned to the lake.

The steam electric turbine of Unit No. 1 produces the equivalent of 1,200,000 horsepower.

Environmental Controls

The carbon in coal is burned to generate heat. In addition to carbon, coal contains various other elements: magnesium, silica, phosphate, alumina, iron, and sulfur, to name a few. These elements are usually not entirely consumed in the flame, and are emitted in the combustion process as visible particles, or smoke, which is always present when coal is burned. The sulfur combines with air to form an invisible gas called sulfur dioxide. Environmental regulations of the Clean Air Act require sulfur dioxide emissions to be reduced. A sizable effort is required to protect the environment from the emission of such pollutants.

Wet Scrubber. The wet scrubber for La Cygne Unit No. 1 cleans both smoke and sulfur dioxide from the emissions stream (Figure 2). The boiler gas is split into eight streams, each equipped with its own two-stage scrubber system. Particles are cleaned from the emission stream in the first stage by a water spray. The stream makes a "U" turn through the absorber stage where sulfur dioxide is forced to react with a limestone slurry to form calcium salts. The pollutants fall to a sump and are pumped at a rate of 3,500 tons a day to a settling pond for storage. The cleaned gas is demisted to reduce water content and then reheated to provide the buoyancy to rise up the 700-feet stack. Eighty percent of the sulfur dioxide and more than 99 percent of the smoke emissions are controlled with the wet-scrubber process.

Electrostatic Precipitator. La Cygne Unit No. 2 utilizes an electrostatic precipitator to control emissions (Figure 3). An electrostatic precipitator creates an electric atmosphere inside a series of huge chambers. Each chamber contains numerous steel plates separated from rows of heavy wires. The wires and plates carry opposite charges of electricity. As the boiler gas passes through the chambers on the way to the stack, the particles in the smoke become charged and cling to the plates. Vibration of the plates causes the particles to fall into hoppers for removal. The precipitator captures 99.4 percent of the particles in the emission stream.

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La Cygne Generating Station Pamphlet.

Kansas City Power and Light Company Annual Report, 1994.

Resource Contact

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816/556-2926

La Cygne Station Facts

	La Cygne Unit No. 1	La Cygne Unit No. 2
Cost	$200 million	$230 million
Capacity	686,000 kilowatts	670,000 kilowatts
Construction Start	April 1969	May 1973
Commercial Operation	June 1973	May 1977
Circulating Water	500,000 gal/min	332,000 gal/min
Maximum Coal Burn	380 tons/hr	400 tons/hr
Architect/Engineers	Ebasco Services	Black & Veatch
Constructor	Ebasco Services	Daniel International
Boiler:		
Manufacturer	Babcock & Wilcox	Babcock & Wilcox
Height	260 feet	240 feet
Steam Capacity	6.2 million lb/hr	4.8 million lb/hr
Pressure	3,500 lb/sq in	2,400 lb/sq in
Temperature	1,000 degrees F	1,000 degrees F
Cost	$31 million	$38 million
Turbine:		
Manufacturer	Westinghouse	General Electric
Speed	3,600 rpm	3,600 rpm
Generating Voltage	22,000 volts	24,000 volts
Air Quality System:		
Type	limestone slurry scrubber	electrostatic precipitator
Cost	$54 million	$31.5 million
Stack:		
Height	700 feet	700 feet

Common Facilities

La Cygne Lake:	
Full Reservoir	2,600 acres
Shoreline	42.5 miles
Watershed	57.5 square miles
Maximum Level	847 feet above sea level
Normal Operating Level	840 feet above sea level
Minimum Operating Level	831 feet above sea level
Average Depth	15.4 feet
Dam Length	7,000 feet
Earth Fill	1.6 million cubic yards
Concrete Spillway	20,000 cubic yards
Radial Gates	2 taintor gates, each 23 X 44 feet
Maximum Discharge	43,270 cubic feet per second
Marais des Cygnes Pumping Station:	
Pumps	2 pumps, each 15,000 gal/min
Delivery	48-inch pipe, nearly 5 miles long

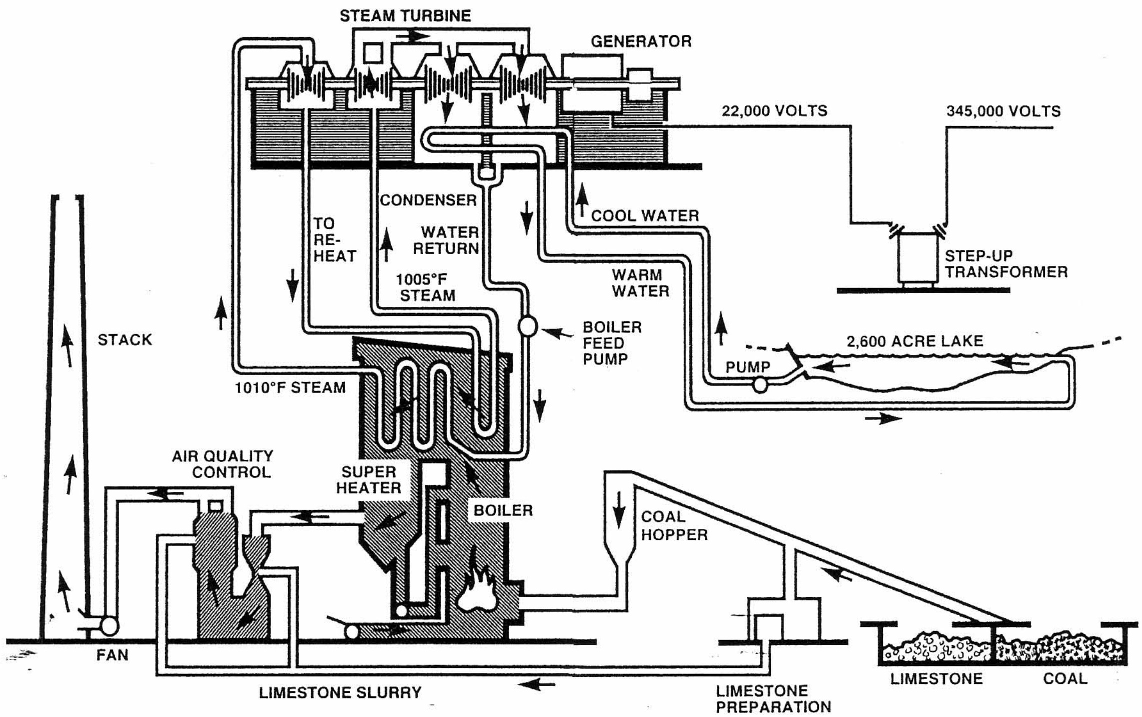

Figure 1. Schematic diagram of La Cygne Generating Station.

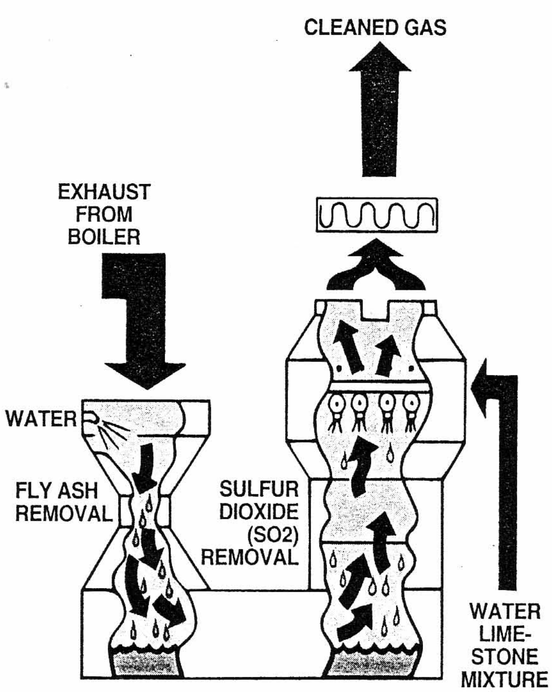

Figure 2. Wet Scrubber, La Cygne Unit No. 1.

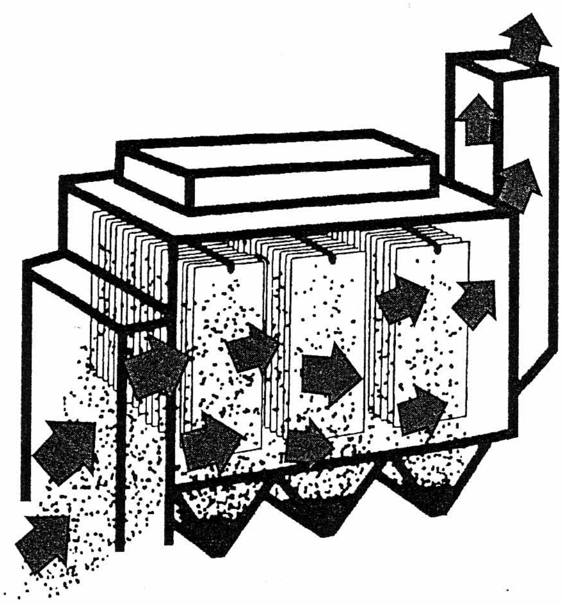

Figure 3. Electrostatic Precipitator, La Cygne Unit No. 2.

KANSAS COAL, ITS PRODUCTION AND USE

by

Lawrence L. Brady
Kansas Geological Survey

Introduction

Bituminous coal resources are widespread in eastern Kansas. These deposits have been commercially exploited for nearly 140 years, producing approximately 300 million tons of coal (Figure 1). Two major peaks of production during this period correspond to World War I and World War II. The availability and use of natural gas and petroleum in Kansas, and the extraction of most of the important Weir-Pittsburg coal reserves, were major factors in the decline of Kansas coal production. The peak production year was 1918 with over 7.3 million tons produced. Production of coal in 1994 was 0.28 million tons, while as recently as 1987, production was 2.0 million tons. During the past 25 years, production in Kansas has come from 25 different coal mines operated in Crawford (7), Bourbon (5), Cherokee (4), Linn (4), Labette (4), and Wilson (1) counties in southeast Kansas. In 1995, only one coal mine is operating in Kansas, the Clemens Mine #22 in northeastern Crawford County.

Coal Resources

Strippable coal resources in Kansas are represented by 17 coal beds (under less than 100 feet of overburden) and total nearly 2.8 billion tons of coal. The Demonstrated Coal Reserve Base for Kansas as listed by the U.S. Department of Energy was 973.4 million tons for 1992. This figure was derived from an earlier study by Brady and others (1976) and represents in-place strippable coal in Kansas that is in the Measured and Indicated categories with 0-100 feet of overburden, less the amount of coal mined from 1976 until 1992. Reliability categories for coal resources are shown in Figure 2 and the stratigraphic position of the economically strippable coals in the Cherokee and Marmaton Groups is shown in Figure 3. A general analysis of the strippable coals, having a stripping ratio (overburden/coal) of 30:1 or less, indicates a total of over 1.3 billion tons of coal are present. Minimum thickness of the coals evaluated was 12 inches. The areal distribution of the coal resources by stratigraphic group is shown in Figure 4.

The deep coal resource quantity for 32 different coals in eastern Kansas (over 100 feet of overburden) is about 53 billion tons of coal (Brady and Livingston, 1989; Brady 1990). These preliminary resource quantities are subject to additional data review. Emphasis of the deep coal resource study was on coal beds of the Cherokee Group because of the recognized importance of these coals in Kansas. However, six coal beds stratigraphically above the Cherokee coals are included in the deep resource total. A coal bed thickness of 14 inches or greater is considered for deep coal resource totals.

Coal beds having the largest deep resources in Kansas include the Bevier, Riverton, Mineral, and "Aw" (unnamed coal bed in the lower part of the Cherokee Group) coals. The distribution of these four coal beds in Kansas is shown in Figures 5A-D. Total quantities of deep coal resources having a thickness of 42 inches or more amounts to about 2 billion tons (Brady, 1990).

Coal Quality

Bituminous coal in Kansas is of high-volatile bituminous rank. Nearly 90 percent of the coal produced in the past was high-volatile A, mostly from southeast Kansas. Large amounts of high-volatile B and C rank bituminous coal were produced mainly from Leavenworth County (Bevier coal from deep mines), Osage County (Nodaway coal from strip and deep mines), and Linn County (Mulberry coal from a large strip mine).

A general summary of the chemical quality of strippable coals of the Cherokee Group in southeast Kansas and adjacent areas of southwest Missouri is shown in Table 1. The samples used in this summary were channel samples collected from fresh coal exposures in mines.

Production and Use of Kansas Coal

Coal beds in Kansas with resource potential are found almost entirely in rocks of Pennsylvanian age that were deposited in the bottom of a shallow swampy sea that covered southeast Kansas about 300 million years ago. Nearly 90 percent of all coal mined in Kansas is from the Cherokee Group, mostly from Crawford and Cherokee counties. Two important exceptions are the Nodaway coal of the Wabaunsee Group and the Mulberry coal of the Marmaton Group. The Mulberry coal was recently mined by the Pittsburg and Midway Coal Mining Company at their Midway mine (closed in 1990) in eastern Linn County. This was the main coal bed being mined in Kansas between 1982 and 1990. Prior to the extensive mining of the Mulberry coal, the Cherokee Group coals (especially the Weir-Pittsburg coal) were the main coal beds mined. Mining of the Weir-Pittsburg coal bed represents nearly half of the total historic coal production in Kansas. Most of the original shallow-depth coal resources (down to about 200 feet) of the Weir-Pittsburg coal bed were either stripped or mined by room-and-pillar methods. Cherokee coal beds presently mined at the Clemens Mine #22 include the Mineral, Croweburg, and Bevier coals (Figure 6). Other coal beds in the Cherokee Group mined within the past twenty years include the Mulky, Fleming, Dry Wood, Rowe, and two unnamed coal beds.

Coal mined in Kansas had many uses. In early times, coal was used for steam generation in railroad locomotives, heat for metal smelters and cement manufacture, and for home and industrial heating. Other uses included coke production and brick, tile, and other types of industrial manufacturing. Present use of Kansas coal is almost exclusively power generation and cement manufacture. However, small amounts of coal are still used for industrial purposes and home heating.

Power generation is the dominant end-use of coal in Kansas, with nearly 18 million tons per year used in the state (Table 2). Concern by state and federal regulatory authorities over the sulfur dioxide and nitrogen oxide in gases emitted from coal-fired power-generating plants has resulted in demand for low-sulfur coal. This demand has been met by using coal from Wyoming. Thick coal beds and large mines make Wyoming coal cost-competitive in Midwest markets. Kansas and nearby Missouri coals are higher sulfur, but also have a much higher heat (Btu) content. They are now commonly blended in small amounts with Wyoming coals to increase power output. The present Kansas coal market is shrinking because of the medium-to-high sulfur content of Kansas coal, and the thinness of the coal beds (12-36"), which results in higher mining costs.

What potential exists for use of Kansas coals in the near future? Perhaps the biggest hope lies in the use of fluidized bed combustion for power generation in smaller power-generation plants or industrial plants. This new technology should provide some direct benefits to the Kansas coal industry. Another recent but at present limited development is the production of methane gas from deep coal beds.

Fluidized Bed Combustion Technology

Interest has increased in recent years for use of fluidized bed combustion technology. Important advantages of these systems are high combustion efficiency, sulfur dioxide emission control, and the ability to use a wide range of fuels such as coal, coal refuse, and petroleum coke. The primary advantage of using fluidized bed boilers to burn Kansas coals is the reduction of sulfur dioxide and nitrogen oxide emissions during combustion.

A typical fluidized bed design has a bed of limestone and coal within the boiler that is supported by a bar grate through which air is blown. The coal and limestone are lifted and suspended by air which allows the bed to act as a fluid. The high velocity of the air results in bubbles passing through the bed. These air bubbles evenly mix the bed resulting in rapid heat distribution. At any given time, the bed contains less than 5 percent coal. The sulfur dioxide is captured by the limestone. Optimum sulfur dioxide absorption by the limestone occurs when temperatures are between 850-900 degrees Celsius (Valk, 1986).

The fluidized bed combustion boiler can use high-sulfur coal as well as other fuels. The sulfur dioxide is captured by the limestone and the combustion temperatures are maintained below the ash melting point, which minimizes solids accumulation and boiler tube erosion and corrosion. Flue gas clean-up requires only particulate removal (Office of Fossil Energy, 1987).

This type of power plant, although still in smaller size designs (up to approximately 260,000 kilowatts), will be important in the use of high-sulfur coals because of its pollution-abatement potential. Cost, however, rather than air-pollution concerns, will be the primary factor governing fuel use. Kansas coal should be able to compete with fuels from other states in eastern Kansas markets where it is anticipated the fluidized bed combustion boilers will be installed.

Methane from Coal

Methane is present in large amounts in certain ranks of coal. For years, methane has been considered a major problem in deep coal mines because of the potential for explosions. In recent years, utilization of the methane from coal has become an important commercial gas source. In areas of the San Juan Basin in New Mexico and Colorado, and parts of the Warrior Basin in

Alabama, large amounts of methane are presently being produced from deep coal beds.

Medium-volatile bituminous coal is the ideal rank for methane to be present in large quantities. High-volatile A bituminous coal that is present in southeast Kansas and adjacent areas is slightly lower in rank, but still has the potential to release large quantities of methane. If sufficient overburden is present over the coal and a seal (such as a thick shale) overlies the coal bed to prevent the gas from leaking to the surface, then methane of economic quantities could be present. In areas where the coal is deeper than 500 feet, the coals probably retain large amounts of methane. Drilling and artificial fracturing of the thicker coal beds or multiple coal beds could produce significant amounts of the gas.

Over 200 wells have been drilled and completed for coalbed methane in Kansas (Quarterly Review of Methane from Coal Seam Technology, 1993). Most of this activity has been in southeast Kansas, primarily in northern Montgomery, southern Wilson, and western Labette counties. Good potential for economic development is present in these areas, primarily due to thick coal beds. However, development of these wells takes several months because large quantities of water have to be pumped from the coal bed (to lower the hydrostatic head of the formation water) to allow the methane that is under reduced pressure to be desorbed from the coal.

With numerous widespread coal beds and a coal resource of 50 billion tons in eastern Kansas, wells less than 2,500 feet deep could encounter multiple coal beds (up to 12) and 10 to 25 feet of total coal thickness. Several gas pipeline networks are in place, and subsurface zones exist in eastern Kansas for the disposal of formation water that is produced along with the gas. Under more favorable economic conditions, increased production of methane from coal in Kansas is possible in the future.

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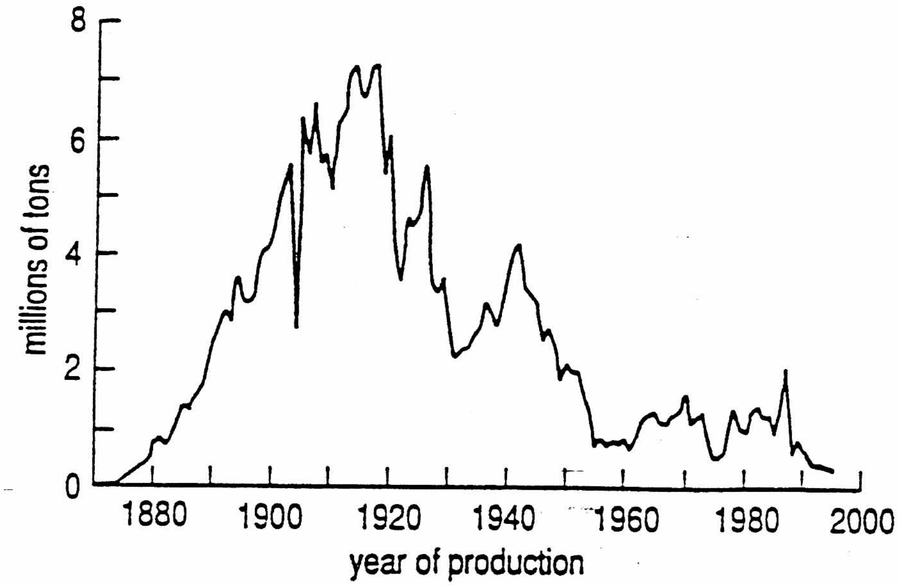


Figure 1. Historic production of coal in Kansas.

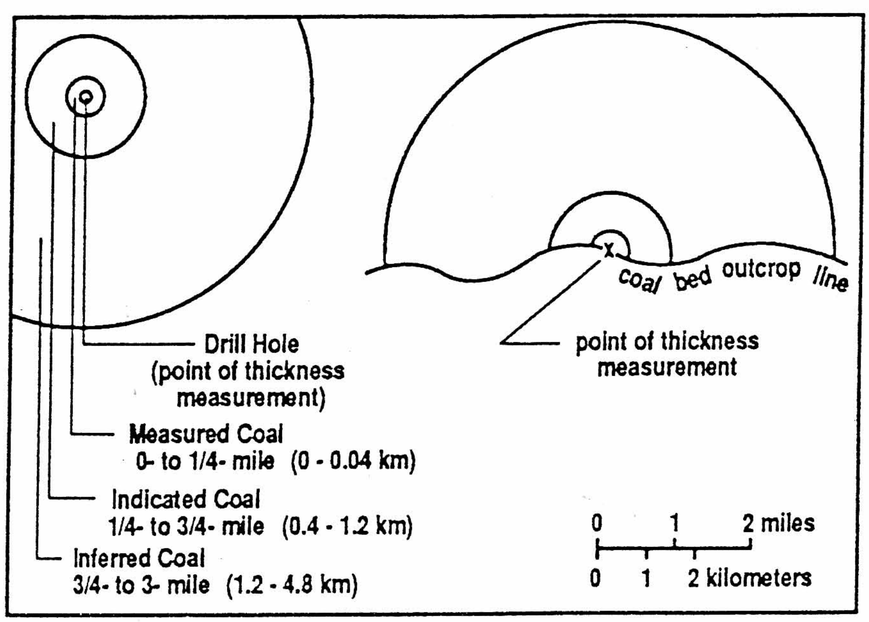
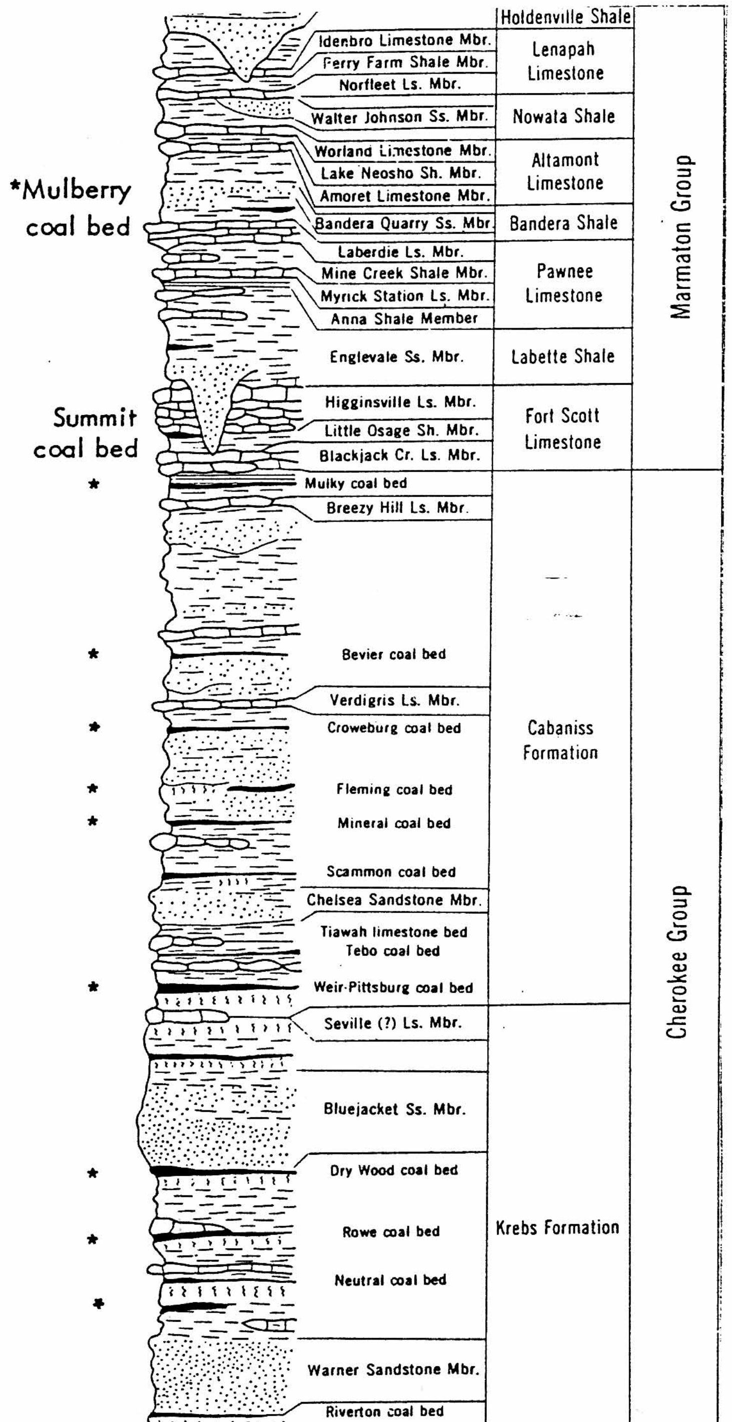


Figure 2. Radius of influence of reliability categories used in coal-resource studies. (Modified from Wood and others, 1983, p. 11.)



(*) Coals with recorded strip mining.

Figure 3. Stratigraphic occurrence of strippable coals mined in Kansas in the recent past from the Cherokee and Marmaton Groups (Middle Pennsylvanian). (Chart modified from Zeller, 1968.)

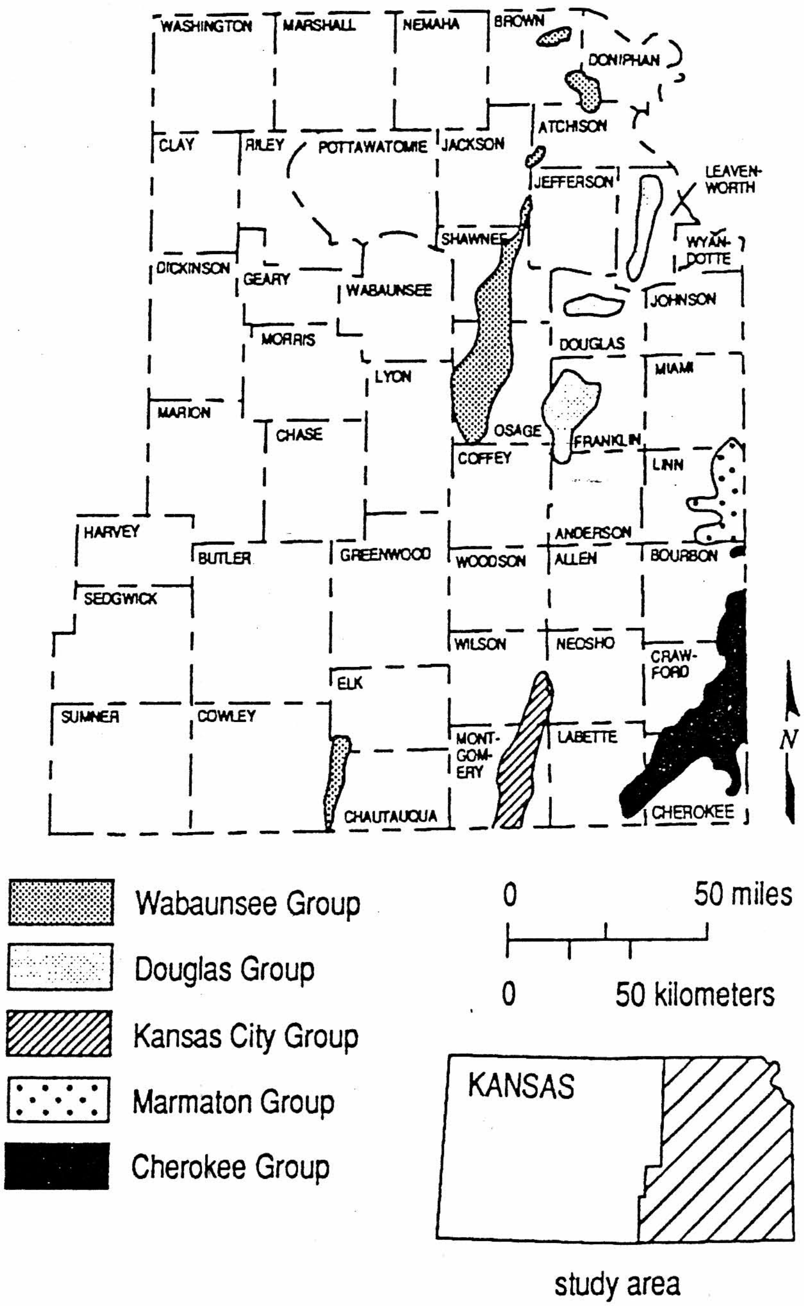


Figure 4. General distribution of strippable coal resources by geologic group.

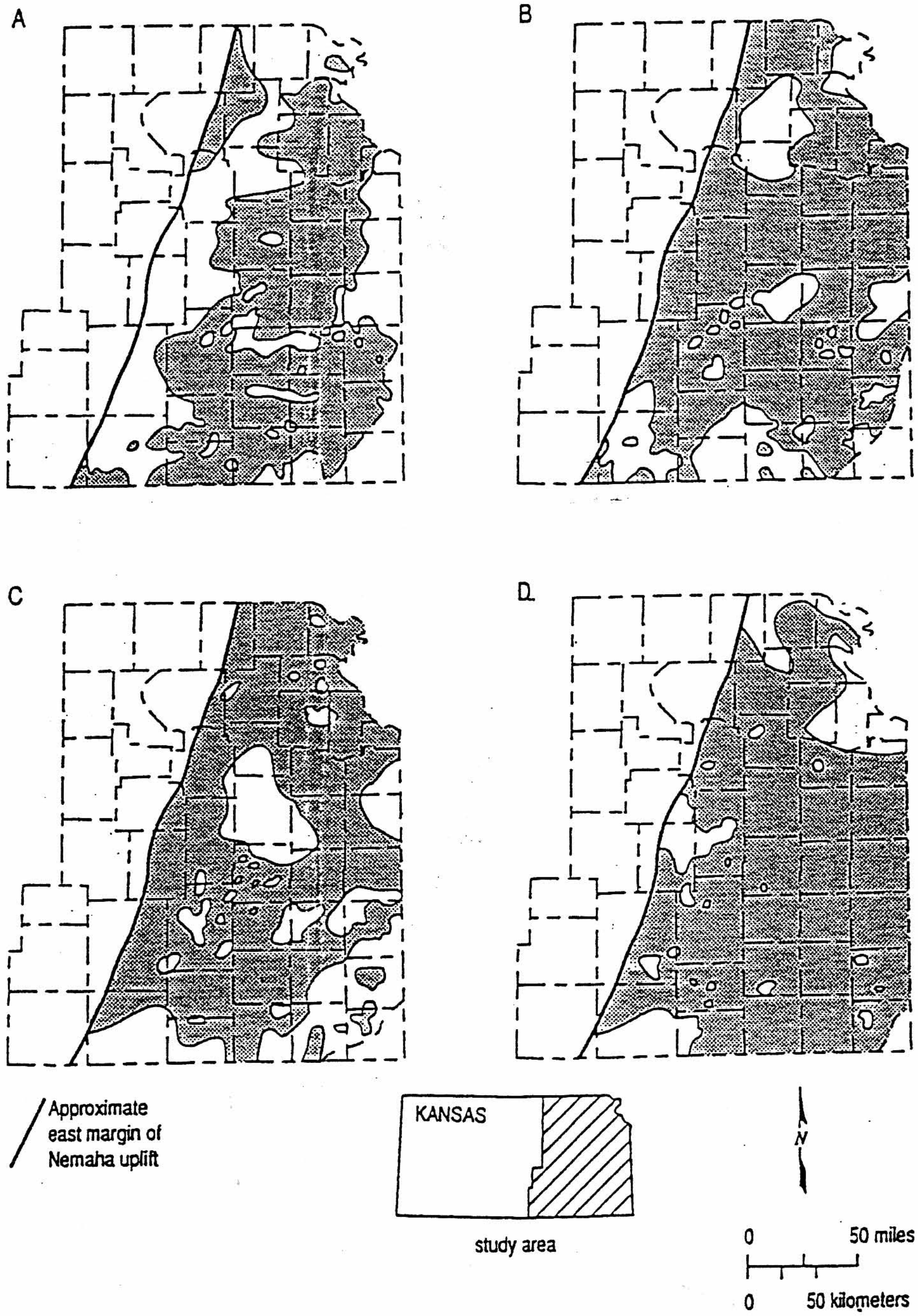


Figure 5. General distribution of four important deep coal beds-- (A) Bevier; (B) Mineral; (C) "Aw" (unnamed coal in the lower Cherokee Group); and (D) Riverton -- in eastern Kansas with thickness of 14 inches or more that are present under 100 feet or more of overburden (modified from Brady, 1990, p. 118).

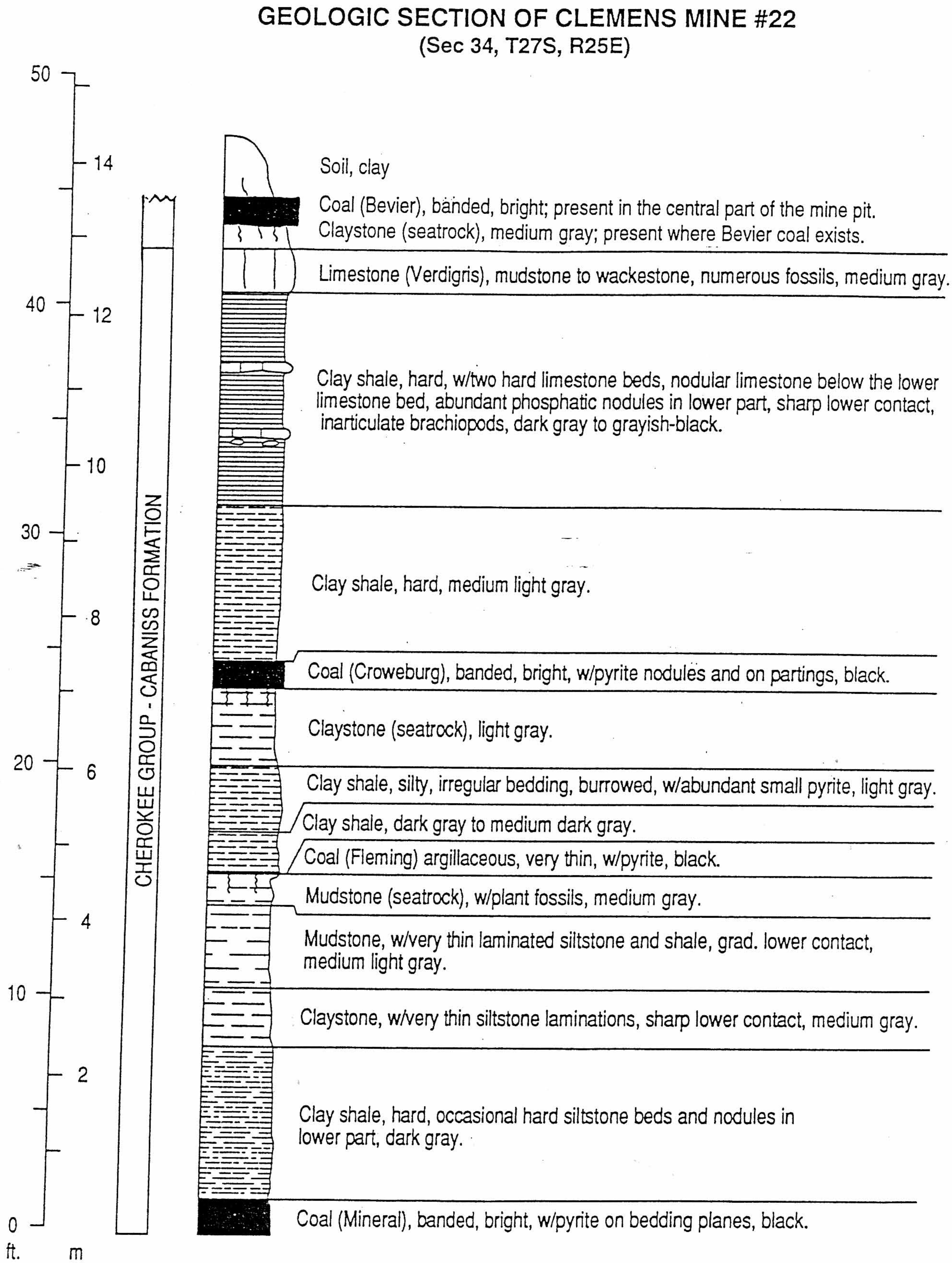


Figure 6. Geologic section of the Clemens Mine #22 showing the stratigraphic position of the Mineral, Croweburg, and Bevier coals.

Table 1. Mean values of proximate energy and sulfur values for individual coal beds in southeast Kansas and southwest Missouri.

Coal	n	Moisture %	Volatile Matter %	Fixed Carbon %	Ash %	BTU %	Sulfur: Sulfur %	Sulfur: Sulfate %	Sulfur: Pyritic %	Sulfur: Organic
Thayer	2	6.8	33.7	41.3	18.3	10,675	3.9	.53	2.29	1.08
Mulberry	3	6.8	32.3	39.4	21.4	10,310	4.5	.45	2.35	1.73
Mulky	5	3.0	38.3	47.4	11.4	12,695	4.6	.23	2.10	2.28
Bevier	2	3.9	36.1	48.6	11.5	12,250	2.7	.34	1.22	1.15
Croweburg	7	3.4	35.4	44.2	17.2	11,677	4.5	.35	3.21	0.91
Fleming	3	4.6	36.4	43.0	16.0	11,857	4.9	.60	2.97	1.29
Mineral	5	4.1	35.1	47.1	13.6	12,219	4.7	.42	2.92	1.22
Dry Wood	5	2.6	32.0	46.1	19.3	11,518	7.3	.45	5.59	1.27
Rowe	8	2.8	33.8	46.1	17.4	11,757	7.6	.41	5.99	1.20
"Aw"	1	3.3	31.2	50.4	15.1	12,060	4.1	.36	3.17	0.57

Data from Wedge and Hatch (1980), Swanson and others (1976, p. 279-287), and Brady and Hatch (1995).

Table 2. Use of coal in Kansas, and source of coal shipped to Kansas power plants.

COAL USE	1992 Amount*	1993 Amount*	1994 Amount*
Electric Utilities	14,227	17,386	17,966
Industrial	158	137	99
Residential & Commercial	<1	23	23

COAL SOURCE	1992 Amount*	1992 %	1993 Amount*	1993 %	1994 Amount*	1994 %
Kansas	90	0.7	86	0.5	81	0.5
Colorado	328	2.4	100	0.6	1,148	6.5
Illinois	767	5.6	302	1.8	305	1.7
Missouri	48	0.4	122	0.7	351	2.0
Wyoming	12,409	91.0	15,855	96.3	15,762	89.3
Total	**13,635**		**16,465**		**17,647**	

* Thousands of tons

Data modified from Quarterly Coal report, DOE/EIA-0121 (93/4Q), May 1994; and DOE/EIA-0121 (94/4Q), May 1995.

THE CLEMENS COAL COMPANY

The Clemens Coal Company has been mining bituminous coal beds in southeast Kansas and southwest Missouri since the inception of the corporation in 1906. During the early 1900's, the Weir-Pittsburg coal seam was mined underground utilizing the room and pillar method. This method of underground mining leaves a block or "pillar" of coal to support the roof of the mine for every "room" that is mined out, creating a checkerboard pattern of rooms-and-pillars. The Weir-Pittsburg coal bed was 3 to 4 feet thick in these mines, which allowed miners enough room to work underground. A shaft from the surface to the coal bed allowed removal of the coal to the surface, and access for the workers and their equipment.

During the 1920's and 1930's, strip mining (surface mining) became more popular and economical because of the development of the shovel and dragline.

The Clemens Coal Company presently surface mines three bituminous coal seams in southeast Kansas, the Bevier, Croweburg, and Mineral coal seams (see Figure 6, previous paper). After these coals are washed at the preparation plant, they will average 12,200 - 12,700 Btu's, 10 - 12 % ash, and 5.5 - 6.5 % moisture. The Bevier coal will average 2.3 - 2.6 % sulfur, the Croweburg coal 3.1 - 3.4 % sulfur, and the Mineral coal 3.1 - 3.6 % sulfur.

The present mining operation of the Clemens Coal Company is identified as Mine #22 which has been operating in southeast Kansas and southwest Missouri since 1938. The Clemens Coal Company presently employs more than 70 mine workers, excluding mine management and engineering personnel.

Reference

History of the Clemens Coal Company Informational Handout.

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SURFACE MINING SECTION
BUREAU OF ENVIRONMENTAL REMEDIATION
KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT

The Surface Mining Section is responsible for the regulation of coal mining and the reclamation of abandoned mine lands. Administered in Pittsburg, Kansas, the Administration and Enforcement Program is responsible for all laws and regulations applicable to active coal mining. The Abandoned Mine Land (AML) Program is responsible for reclamation of priority problems associated with historical coal mining.

Administration and Enforcement Program

The Administration and Enforcement Program was established by the Mined Land Conservation and Reclamation Act in 1969. The regulation of coal mining begins with the submission of a detailed permit application. Once the permit application has been approved and a performance bond posted, the operator can begin mining according to the permit document and performance standards. The mine is inspected by a staff member of the Surface Mining Section at least monthly during the life of the mine. The permit will remain bonded until the operator has met the revegetation standards of the regulations. At present there are 29 inspectable units in Kansas.

Abandoned Mine Land Program

The Kansas Abandoned Mine Land Program was established by Kansas statute in 1979 pursuant to the Surface Mining Control and Reclamation Act of 1977. The purpose of the Kansas Abandoned Mine Land Program is to reclaim and restore the land and water resources that have been adversely affected by past coal mining. The objective of the program is the protection of the public health, safety, general welfare, and property from the extreme danger and/or adverse effects of past coal mining practices. A secondary objective is the restoration of land and water resources and the environment previously degraded as a result of the adverse effects of past coal mining practices. Eligible lands under the program are those lands mined and left abandoned or inadequately reclaimed prior to the enactment of the Surface Mining Control and Reclamation Act on August 3, 1977.

Funding for the Abandoned Mine Land Program is through federal grants from the Office of Surface Mining Reclamation and Enforcement. During the early years of the program (1977-1990), Kansas received about $300,000-500,000 per year for administration of the program and construction projects. Through the efforts of the Mid-Continent Coal Coalition and the Association of Abandoned Mine Land Programs, Congress established a $2 million minimum program funding level for 1991 and beyond. Kansas also operates the Emergency Program, which responds to past coal mining problems that create such an extreme danger to life and/or property that abatement cannot be handled quickly through normal procedures. Coupled with about $475,000 of federal funding for the Emergency Program, about $2.5 million is available for reclamation purposes annually in Kansas.

Kansas currently has over 240 abandoned coal mine sites identified as health, safety, and general welfare problems. Current federal policy is to abate all of these problems (Priority 1 and 2 problems) before environmental restoration projects (Priority 3 problems) are started. The current projected cost to reclaim Priority 1 and 2 problems in Kansas is more than $70 million.

<u>Sheffield School Project.</u> The Sheffield School Project was the first major abandoned mine land project designed by the Surface Mining Section in Pittsburg. Plans and specifications were prepared to backfill highwalls more than 40 feet high and totaling more than 2,700 feet in length. The highwalls at the site were adjacent to a county road and within 60 feet of the community center that was formerly Sheffield School. Local residents were concerned with children playing near the highwall during community gatherings.

Construction on this Priority 1 project started in April 1991 and was completed by November of the same year at a cost of $457,156. Reclamation entailed moving 724,000 cubic yards of spoil material in order to fill the highwalls and construct a gently sloping terrain. Drainage improvements, including terraces, culverts, and rip rap, were made at the site to accommodate the additional flow created by the reclaimed surface.

The Sheffield School Project produced a dramatic change in the landscape around the former school. All hazards associated with the highwall have been eliminated and the regraded area has been seeded and mulched. Local residents are pleased with the results of the reclamation and will benefit from it through the continued use of Sheffield School as a community center.

Arcadia Project. Located 1 mile west and 1 mile east of Arcadia, Kansas, the Arcadia Reclamation Project was also designed by the Surface Mining Section in Pittsburg. This site had a 30-feet highwall along a body of water that was used for swimming and recreational purposes by local residents, especially children. Submerged rock ledges presented a threat to persons diving off the highwall and material at the top of the highwall was eroded and unstable. An unimproved road paralleled the highwall and provided easy access to the site.

Approximately 328,000 cubic yards of adjacent spoil material was used to fill the abandoned pit and eliminate the highwall. The area was brought to grade and runoff was controlled with terraces, rip rap structures, drainage channels, and culverts. Approximately 29 acres were seeded with a native grass and legume mix. Construction started in January of 1993 and was completed one year later. The Arcadia Project was also a Priority 1 project and had a total cost of $213,894.

Reference

Surface Mining Section Employee Manual.

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316/231-8540

PROPOSED JAYHAWK ENERGY PROJECT

The proposed Jayhawk Energy Project is currently planned as a 260,000 kilowatts electrical generation facility utilizing fluidized bed combustion technology, a so-called clean coal technology (refer to the discussion on Fluidized Bed Combustion Technology on page 3-6). Ahlstrom Development Corporation, which specializes in the development of clean energy projects, has proposed building the $320 million project. The facility would be fired with a combination of coal refuse, petroleum coke, and coal, and would utilize local limestone in the process.

The proposed facility is to be located near Clemens Coal Company's old Mine #21, approximately 3 miles south of current mining activity at Mine #22. Empire District Electric Company, an investor-owned utility based in Joplin, Missouri, would be the potential buyer of electricity generated at the Jayhawk Energy Project.

Jayhawk Energy Project Facts

Size	260,000 kilowatts
Cost	$320 million
Location	Crawford County, KS
Fuel	
Coal Refuse	685,000 tons/yr
Petroleum Coke	440,000 tons/yr
Local Coal	155,000 tons/yr
Limestone	250,000 tons/yr
Technology	Fluidized Bed Combustion
Customer (potential)	Empire District Electric Company
Operation Date	June 2000
Estimated Employment	
Construction	400 jobs
Plant Operations	60 jobs
Fuel Processing	30 jobs
Coal Mining	70 jobs

Indirect Economic Benefits
380 jobs
$16.8 million annual retail sales

Environmental Benefits
- Clean-up and utilization of coal refuse
- Ash by-product can be used for reclamation
- Abandoned mine lands reclaimed

References

Ahlstrom Development Corporation, Informational Memorandum on the Jayhawk Energy Project, August 20, 1993.

Ahlstrom Pyroflow Brochure.

Resource Contacts

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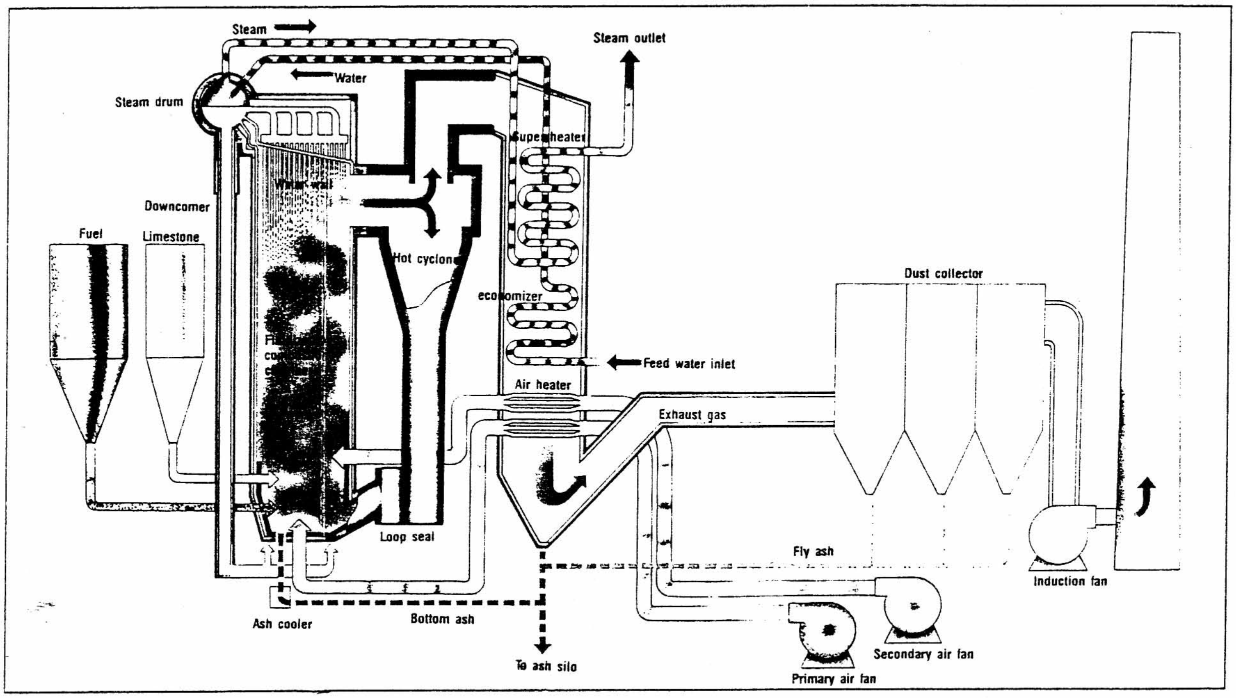

Figure 1. Schematic flow diagram of a fluidized bed combustion system (Ahlstrom Pyroflow®).

SCHEDULE & ITINERARY

Friday October 6, 1995

6:30 am	Bus to Burkett Field
7:45 am	Rest Stop - Eureka C-Mart
8:30 am	**SITE 5** - Tour Burkett Field Frank Gaines, Franklin D. Gaines Oil Trust, Burkett Unit Don Schnacke, Kansas Independent Oil and Gas Association
11:00 am	Bus to El Dorado Oil and Gas Regulatory Activities David Williams, Kansas Corporation Commission
12:00 am	Lunch and Oil Museum Marv McCown, El Dorado Chamber of Commerce Bob Burgess, Kansas Oil Museum
1:15 pm	Bus to El Dorado Field
1:30 pm	**SITE 6** - Tour El Dorado Field Steve Darwin, OXY USA Inc. Ken Peterson and Clark Duffy, Kansas Petroleum Council
2:45 pm	**SITE 7** - Tour Texaco Refinery Roy Sheffield, Texaco USA
4:45 pm	**SITE 8** - Transportation - Chase Pipeline and Groendyke Transport Chuck Johnson, Chase Pipeline Company John Prather, Groendyke Transport, Inc.
5:30 pm	Check-in at the Best Western Red Coach Inn, El Dorado
6:15 pm	Trolley leaves for Reception and Cookout Dinner
8:00 pm	Evening Session - Energy Alternatives and Renewable Energy Charles Gay, National Renewable Energy Laboratory, Golden, Colorado

Kansas Geological Survey
Open-file Report 95-42

KANSAS OIL AND GAS PRODUCTION TRENDS 1995

by

Timothy R. Carr and Doug Beene
Kansas Geological Survey

This report serves as a continuation of earlier reports on production trends in the Kansas oil and gas industry (Carr, 1994a and b). Data are derived from the files of the Kansas Geological Survey, which are maintained by Doug Beene, from the publications and on-line data of the Energy Information Agency, and from various published sources. This report updates and supplements information provided in previous reports.

What is the value of oil and gas production to Kansas?

Estimates from the U.S. Department of Energy (DOE) and the Kansas Geological Survey put Kansas production at 50 million barrels of oil and at 686 billion cubic feet (BCF) of gas in 1993. Estimates for 1994 are that oil production continued to decline, and annual production was just under 47 million barrels. This is a 6.0% decline from 1993, and is the lowest rate of oil production since 1934. Gas production in 1994 increased to an estimated annual production of approximately 713 BCF (+3.8%). Using estimated 1994 average prices for oil ($14.71 per barrel) and gas ($1.78 per MCF) in Kansas, the value of the oil and gas produced in the state is approximately 1.95 billion dollars. This is a decrease in estimated value of almost 200 million dollars from 1993. The decrease in total value is a result of decreased oil volumes, and what is more important, a decrease from the average 1993 prices for oil ($16.93 barrel) and gas ($2.00 MCF).

The significance of Kansas oil and gas production relative to other parts of the Kansas economy is illustrated by comparing the value of oil and gas production to a product (crops) that is perceived as central to the Kansas economy. Over the past forty years, the value of Kansas oil and gas production is comparable to the value of total statewide crop production as measured by the cash receipts for all the crops produced in the state (Figure 1).

How important is oil versus gas production in Kansas?

Both oil and gas are important to the health of the Kansas economy. However, 1992 was significant to the history of Kansas oil and gas production. In 1992, the value of the gas produced in the state exceeded the value of oil for the first time (Figure 2). In 1993 and 1994, Kansas oil production continued to decrease while gas continued to increase (Figure 3). Wellhead prices for both oil and gas decreased. This combination had an obvious effect of increasing the difference in value between oil and gas to over 500 million dollars. In 1994 the value of gas production in Kansas was approximately double the value of the oil produced.

An examination of the historical record shows the effects of changes in government policy and perturbations in global supply on oil and gas production in Kansas (Figures 2 and 3). Kansas oil production peaked in 1956 at over 124 million barrels per year, and has declined at an average annual rate of 2.5% to the present production of just under 47 million barrels per year. The oil boom of the early 1980's and a modest increase in 1991 appear as anomalies to this long-term trend. These anomalies are related to supply disruptions (e.g., the Arab oil embargo, the Iranian revolution, and the Iraq-Kuwait war), and are evident in both the value and quantity of oil production. The decline rate resumed in the 1990's and appears to be very similar to that of the 1960's.

As discussed in earlier reports, government policies have also affected Kansas oil and gas production (e.g., the Energy Petroleum Allocation Act of 1973, the Energy Policy and Conservation Act of 1975, the Power Plant and Industrial Fuel Use Act of 1978 and the Price and Allocation Decontrol in 1981). The dramatic decrease in gas production during the 1970's from 900 BCF per year to less than 450 BCF per year appears to be directly related to market distortions resulting from federal government policies. Subsequent decontrol in 1981 of prices, allocations, and uses of fuels permitted fuel switching based on economic criteria, and appears to have contributed to the recovery of Kansas gas production to its present rate of more than 700 BCF per year (Figure 3).

State policy also can have an effect on oil and gas production as illustrated by gas production from the Hugoton Field and oil production from the same area (Figures 4 and 5). In 1988, the Kansas Corporation Commission (KCC) modified spacing rules in the Hugoton field. The effect of the rule change allowing infill is evident in an increase in both the numbers of wells and gas production from the Hugoton Field (Figure 4). The decrease in severance tax on gas production enacted by the state began in 1994, and should have a positive impact on continued gas production. The drilling of infill gas wells opened up the possibility of relatively low-cost exploration tales to explore for oil production beneath the Hugoton Gas field. This coupled with the "Deep Horizons Bill" that opened the "deep Hugoton" to exploration has led to the doubling of oil production from southwest Kansas (Figure 5). The 13 southwest counties now produce over 10 million barrels of the state's 47 million barrels of oil. This increased oil production in the Hugoton area is in stark contrast to the overall statewide decrease in oil production and runs against the negative effect of the decrease of oil prices.

How important are oil and gas production to state and county tax revenues?

In fiscal year 1994, severance taxes received by the state amounted to over 94 million dollars (Kansas Statistical Abstract, 1993-94). Severance tax remains a very significant component of state tax revenue (fifth largest source of revenue). Oil and gas production also contribute to state revenues through income tax on the nearly 1,000 companies based in Kansas, the 7,000 Kansas citizens employed in the industry, and on the income of the numerous royalty owners. Estimated 1993 personal income resulting from oil and gas extraction was over 309 million dollars. The estimated state and local revenue derived from this personal income is $19 million and $14 million, respectively. The direct contribution of severance and income taxes on payroll and royalties amounts to approximately 4% of total state revenue in fiscal 1993. This percentage of total state revenue has remained fairly constant over the years except for the oil boom years of 1984 - 1986. While this amount of revenue is significant to the fiscal health of state government, it does not consider the probably even greater contribution of other taxes that result from the activity of the oil and gas industry in Kansas. These include indirect taxes on the goods and services purchased by the oil and gas industry, and the taxes generated by the downstream oil and gas industry (e.g., refining and distribution, and manufacture of hydrocarbon-based commodities such as plastics and fertilizer). At the county government level, the oil and gas industry is a major source of property taxes. The oil and gas industry remains one of the important "contributors" to the fiscal health of our state and local governments.

What are the important stratigraphic horizons that produce oil and gas in Kansas?

Of the approximately 5.9 billion barrels of cumulative oil production reported from Kansas, the Ordovician Arbuckle Group has accounted for approximately a third (Figure 6). The Arbuckle is followed in descending order by the various units assigned to the Missourian (Lansing-Kansas City) and the Mississippian. Together, these three intervals account for just shy of three-quarters of the state's cumulative oil production since the initial oil flowed in 1889. A look at the stratigraphic distribution of oil production in 1992 shows a decrease in the dominance of oil production from the Arbuckle interval. The percentage of both Mississippian and Morrow oil production has doubled, while the contribution of Arbuckle production has halved. Together, the Mississippian and the Morrow intervals accounted for approximately 50 percent of the oil produced in the state during 1992. This change in the stratigraphic distribution of oil production is the result of a number of new Morrow and Mississippian fields and extensions in the Hugoton embayment of southwestern Kansas. This trend has continued and oil production from the 13 counties of southwestern Kansas now accounts for over 20% of the state's production (Figure 5).

Gas production on both a cumulative and an annual basis is dominated by the Permian interval. Over 86% of the cumulative 30 TCF and 80% of the annual gas production comes from the Permian (primarily Chase and Council Grove Groups; Figure 7). Two fields located in southwestern Kansas, the Hugoton (Chase Group) and the Panoma (Council Grove Group), account for 60% and 16% of the state's 1993 annual production. However, gas production as a percentage of annual production from both the Morrow and Mississippian intervals has increased significantly as compared to the percentage of cumulative production. As with oil, this increase in the percentage of Mississippian and Morrow gas production reflects exploration beneath and around the margins of the Hugoton embayment.

What is the geographic distribution of oil and gas production in Kansas?

The stratigraphic distribution of oil and gas has a strong influence on the geographic distribution of production. Oil production is distributed throughout the geologic column and as a result is scattered through the state. Of the 105 counties in Kansas, 95 have reported oil production at some time in the past. In 1994, at least some oil production was reported from 89 counties The top ten counties ranked on 1994 production showed some changes from 1992 (Table 1). Two counties in southwest Kansas, Seward and Haskell, rose in the rankings and Graham County on the Central Kansas uplift dropped out of the top 10. However, the top 10 producing counties remain scattered throughout the state, occurring on the Central Kansas uplift (Ellis, Russell, Rooks, Barton, and Stafford), the Nemaha uplift (Butler), and the Hugoton embayment (Finney, Seward, Ness, and Haskell). However, counties showing 1993 to 1994 increases in production are concentrated in western Kansas, within and along the margins of the Hugoton embayment. The largest year-to-year increase was reported in Haskell County (367 MBO), followed in descending order by Stanton (320 MBO), Seward (271 MBO), Kearny (121 MBO) and Wallace (99 MBO) counties. Largely, the increases can be attributed to the recent discoveries in the "Deep Hugoton" coming into production (e.g., Big Bow West Field, a 1993 discovery that had a 1993-94 increase of 220 MBO). The largest year-to-year decreases in production by county were reported from western Kansas and along the Central Kansas uplift, with Grant County recording the biggest drop (218 MBO). Ellis County was followed in diminishing magnitude of production decrease by Morton, Stafford, Rooks, and Russell counties.

Table 1. Top 10 oil-producing counties in Kansas. Production in 1994 from the top 10 counties amounted to 21.7 million barrels, 46% of the state's total.

Rank 94	Rank 92	County	Barrels of Oil	% of total
1	1	Ellis	3,213,196	6.8
2	2	Finney	2,820,800	6.0
3	3	Russell	2,647,054	5.6
4	4	Rooks	2,176,130	4.6
5	5	Barton	2,012,060	4.3
6	9	Seward	1,939,186	4.1
7	6	Ness	1,889,109	4.0
8	7	Butler	1,847,366	3.9
9	8	Stafford	1,593,086	3.4
10	*	Haskell	1,525,240	3.2

* not in top 10 producing counties in 1992

The bulk of Kansas gas production is concentrated in the Permian interval of the Hugoton embayment (Chase and Council Grove Groups). The result is that the nine counties in the extreme southwestern corner of Kansas are the top nine producing counties and account for over 89% of 1993 annual production (Table 2). This is a continuation of the trend of increased concentration of Kansas gas production from the Hugoton and associated fields. In 1993, gas production from the Hugoton field increased to over 404 BCF/year from 385 BCF/year in 1992 (4.7% increase). This increase is a continuation of significant increases in Hugoton gas production since 1982 (Figure 4). On a county basis, the biggest year-to-year increase was reported from Stevens County (18 BCF). The largest year-to-year decrease in production was recorded from Hamilton County (1.3 BCF).

Table 2. Top ten gas producing counties in Kansas. Production in 1993 from the top ten counties amounted to 90.3% of the state's total.

Rank	County	Barrels of Oil	% of total
1	Stevens	148,847,312	21.9
2	Grant	111,905,007	16.5
3	Kearny	87,808,203	12.9
4	Morton	60,804,491	8.9
5	Finney	47,915,273	7.1
6	Haskell	46,244,859	6.9
7	Seward	42,955,225	6.3
8	Stanton	42,674,212	6.3
9	Hamilton	13,327,235	2.0
10	Barber	11,491,007	1.7

What is happening in Kansas oil and gas production?

The short answer is, that as usual a few things remain the same while numerous things are changing. Gas production continues its steady increase of the last decade. However, the stronger increase in production is counterbalanced by weaker gas and oil prices, and decreased oil production. As the relatively weak gas prices continue into 1995, the effect on the state's economic health and tax revenues could be significant. During the 1990's, total well completions in Kansas were at levels that were last seen in the 1930's and 40's (Figure 8). At these low rates of completion, the state can expect a continued or accelerated decrease in oil and gas reserves and future production. The increases in Kansas oil and especially gas production are associated with increased drilling and are concentrated in the Hugoton field and adjoining areas of southwestern Kansas. The oil production from the lower Paleozoic rocks of the Central Kansas uplift continues its decline.

Relatively recent discoveries such as Terry (Finney County, 1991 discovery), Big Bow (Grant and Stanton counties, 1989 discovery), Lahey (Stevens County, 1989 discovery), and Heinitz (Kearny County, 1988 discovery) are now among the top 20 fields in the state as ranked by annual production (Table 3b). Schuck Field (Seward and Stevens counties), a 1955 discovery, is ranked as the number one producing field in 1994 (Table 3b). Schuck Field was unitized in 1990 and placed on waterflood. The response was dramatic with production increasing from 213,644 barrels in 1992 to over a million barrels in 1994. A comparison of the 20 largest fields by cumulative and annual production in 1994 highlights the decreased dominance in terms of current production of the older lower Paleozoic (Arbuckle) fields of the Central Kansas uplift, and the increased importance of production from the younger Paleozoic (Lansing-Kansas City, Morrow, and Mississippian) intervals of the Hugoton embayment (Tables 3a and b). This trend is even more dramatically illustrated by the stratigraphic and geographic distribution of the 20 fields that showed the biggest year-to-year increase in production (Table 3c). With only a few notable exceptions, increased oil production is associated with the relatively new fields in the upper Paleozoic horizons of southwest Kansas. The dominance of recent discoveries from southwest Kansas indicates that that part of the state should continue as a significant exploration and development area and increase its percentage of the state's oil and gas production.

As stated in previous reports, what remains constant is that the oil and gas industry of Kansas continues to respond to the challenges of the international marketplace and government policy. The oil and gas industry remains, as it has from the late 1800's, an important component of the Kansas economy and way of life.

References

Carr, T. R., 1994a, Kansas Oil and Gas Production Trends: Kansas Geological Survey Open File Report 94-11, 9p.

Carr, T. R., 1994b, Kansas Oil and Gas Production Trends: Kansas Geological Society Bulletin, v. 69, no. 8, p.12-14, 29-30.

A copy of this manuscript along with associated figures is available from the Kansas Geological Survey's web server. The paper is located under the Petroleum Research Section. Additional oil and gas data and information are also available from this server. The server's universal resource locator (URL) is http://www.kgs.ukans.edu/.

Table 3a. The 20 largest Kansas oil fields by cumulative production through 1994. Together these 20 fields have produced over 2.2 billion barrels of oil from 8,003 wells, or approximately 37% of the state's total cumulative oil production. A total of 6,036 fields have been recognized in Kansas as of the end of 1994. Data from Doug Beene of the Kansas Geological Survey.

Rank 94	Field Name	Disc. Year	Cumulative Production	Producing Wells 1994	Counties	Producing Horizon(s)
1	Trapp	(29)	299,367,391	761	Barton, Russell	Arb. et al.
2	El Dorado	(15)	298,553,250	633	Butler	Arb. et al.
3	Chase-Silica	(30)	271,609,669	862	Barton, Rice, Stafford	Arb.-LKC
4	Bemis-Shutts	(28)	247,324,118	776	Rooks, Ellis	Arb.
5	Hall-Gurney	(31)	151,610,822	991	Barton, Russell	LKC et al.
6	Kraft-Pursa	(37)	132,228,920	442	Barton,Ellsworth,Russell	Arb. et al.
7	Gorham	(26)	94,457,593	373	Russell	Arb. et al.
8	Geneseo-Edwards	(34)	85,728,360	189	Ellsworth, Rice	Arb. et al.
9	Burrton	(31)	77,145,736	321	Harvey, Reno	Miss., Arb.
10	Ritz-Canton	(29)	73,103,209	352	McPherson	Simpson et al.
11	Spivey-Grabs	(49)	67,442,235	705	Harper, Kingman	Miss.
12	Fairport	(23)	58,260,781	395	Ellis, Russell	Arb. et al.
13	Bloomer	(37)	54,206,202	139	Barton, Ellsworth, Rice	Arb., LKC
14	Stoltenberg	(31)	53,352,306	198	Barton, Ellsworth	Arb. et al.
15	Ray	(40)	47,960,683	120	Rooks, Graham, Norton	Arb. et al.
16	Augusta	(14)	47,652,998	112	Butler	Arb. et al.
17	Morel	(38)	46,571,896	165	Graham	Arb. et al.
18	Zenith-Peace Ck.	(37)	45,060,266	66	Reno, Stafford	Miss., Arb
19	Welch-Bornholdt	(24)	42,390,786	182	McPherson, Rice	Miss, LKC et al.
20	Marcotte	(44)	41,436,980	221	Rooks	Arb. et al.

Table 3b. The 20 largest Kansas oil fields ranked by 1994 annual production. Together these 20 fields produced approximately 11.5 million barrels of oil in 1994. Approximately 25% of the state's total annual production. An additional 3,545 fields reported oil production during 1994. Rank in 1992 is from Carr (1994a,b). Data from Doug Beene of the Kansas Geological Survey.

Rank 94	Rank 92	Field Name	Disc. Year	Annual Production	Producing Wells 1992	Counties	Producing Horizon(s)
1	*	Shuck	(55)	1,162,894	29	Seward, Stevens	Miss.
2	1	Bemis-Shutts	(28)	1,055,253	776	Ellis, Rooks	Arb.
3	2	Hall-Gurney	(31)	874,906	991	Barton, Russell	LKC et al.
4	*	Terry	(91)	867,948	16	Finney	Morrow, Miss, LKC
5	6	El Dorado	(15)	808,534	633	Butler	Arb. et al.
6	4	Chase-Silica	(30)	886,623	862	Barton, Rice, Stafford	Arb.-LKC
7	3	Trapp	(29)	746,258	761	Barton, Russell	Arb. et al.
8	7	Spivey-Grabs	(49)	595,842	705	Harper, Kingman	Miss.
9	9	Fairport	(23)	524,228	395	Ellis, Russell	Arb. et al.
10	16	Lemon NE	(65)	498,750	30	Haskell	LKC et al.
11	5	Big Bow	(89)	457,388	11	Grant, Stanton	Miss.
12	11	Burrton	(31)	413,841	321	Harvey, Reno	Miss., Arb.
13	14	Damme	(51)	360,110	153	Finney	Miss.
14	10	Kraft-Pursa	(37)	345,990	442	Barton,Ellsworth,Russell	Arb. et al.
15	13	Paola-Rantoul	(18)	340,128	926	Franklin,Johnson,Miami	Cher. et al.
16	12	Lahey	(89)	325,180	11	Stevens	Morrow, Miss.
17	17	Eubank	(58)	321,888	67	Haskell	Miss. et al.
18	*	Heinitz	(88)	318,196	15	Kearny	Morrow
19	15	Gorham	(26)	305,527	373	Russell	Arb. et al.
20	18	Pleasant Prairie	(54)	300,494	94	Finney, Haskell, Kearny	Miss. et al.

* not in top 20 fields in 1992

Table 3c. The 20 Kansas oil fields ranked by increase in annual production (1993-94). Data from Doug Beene of the Kansas Geological Survey. Rank in 1992 is from Carr (1994a,b).

Rank 94	Rank 92	Field Name	Disc. Year	Annual Production	Producing Wells 1992	Counties	Producing Horizon(s)
1	*	Shuck	(55)	308,764	29	Seward, Stevens	Miss., Morrow
2	5	Lemon NE	(65)	204,140	30	Haskell	LKC et al.
3	*	Big Bow West	(93)	139,266	6	Stanton	Miss.
4	*	Heinitz	(88)	120,038	15	Kearny	Morrow
5	*	Mt. SunflowerSE	(94)	117,826	4	Wallace	Morrow
6	*	Arroyo NE	(93)	107,960	3	Stanton	Morrow
7	1	Lahey	(89)	85,309	9	Stevens	Morrow, Miss.
8	*	Victory	(60)	77,671	69	Haskell, Seward	Marmaton, LKC, et al.
9	*	Angman South	(92)	70,227	6	Seward	Morrow, Miss.
10	*	Amazon Ditch	(61)	66,952	16	Finney	Miss, Marm, LKC
11	*	Broughton NW	(94)	59,377	3	Lane	LKC, Marmaton
12	*	Beauchamp NE	(85)	57,065	4	Stanton	Morrow
13	*	Sequoyah East	(81)	56,834	6	Finney	Morrow
14	*	Millrich SE	(86)	50,202	3	Scott	LKC,Marm,Morr,Miss
15	*	Lexington	(77)	47,466	20	Clark	Morrow, Miss.
16	*	Koenig	(58)	45,900	21	Haskell	Morrow, Marm.,LKC
17	*	Morel	(38)	45,493	165	Graham	Arb, Cong,Marm,LKC
18	*	Alford	(88)	41,966	15	Kearny	Morrow
19	*	Stockholm SW	(79)	38,546	36	Greeley, Wallace	Morrow
20	*	Logansport NW	(94)	36,316	3	Logan	Cherokee

* not in top 20 fields in 1992

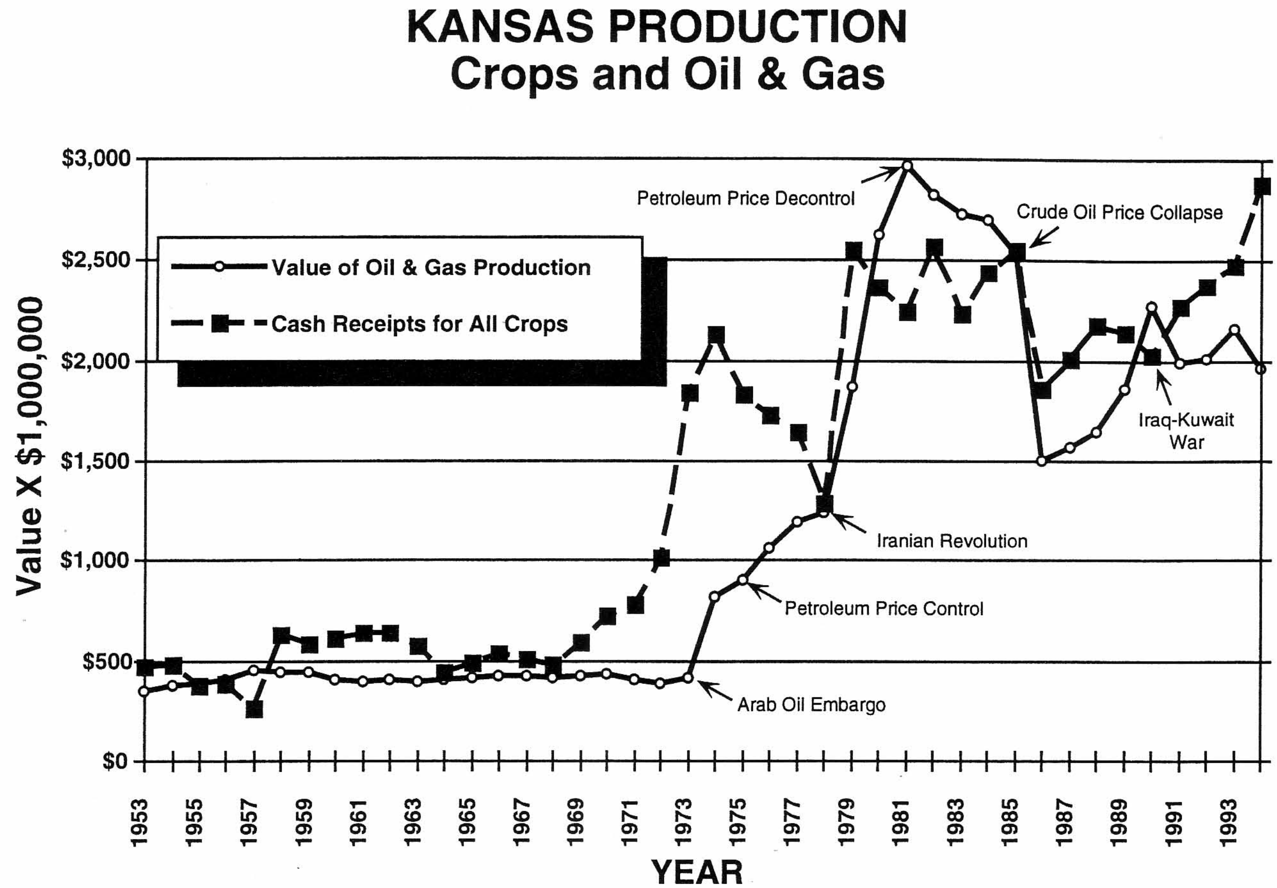

Figure 1. Value of oil and gas production compared to total crop production in Kansas.

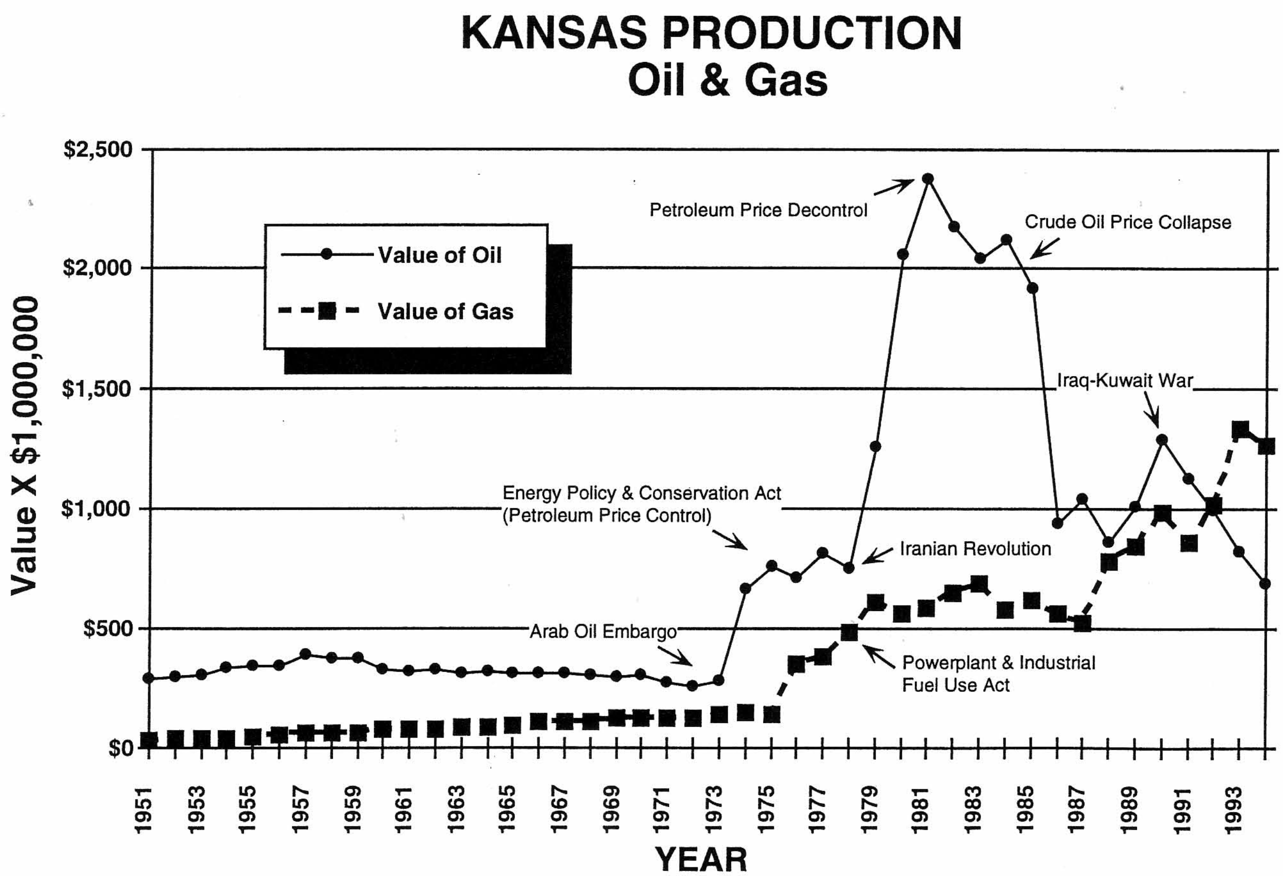

Figure 2. Value of gas production compared to oil production in Kansas.

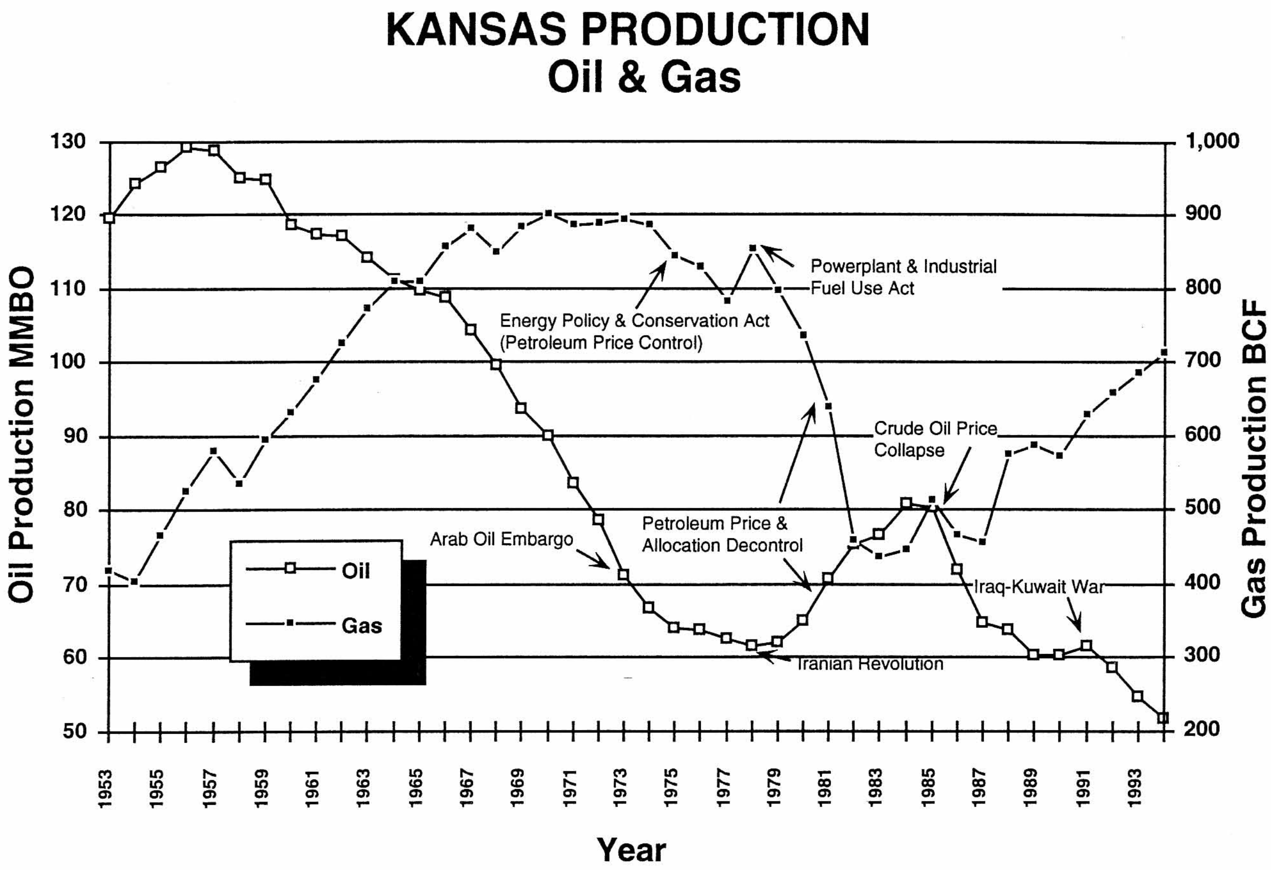

Figure 3. Gas production compared to oil production in Kansas.

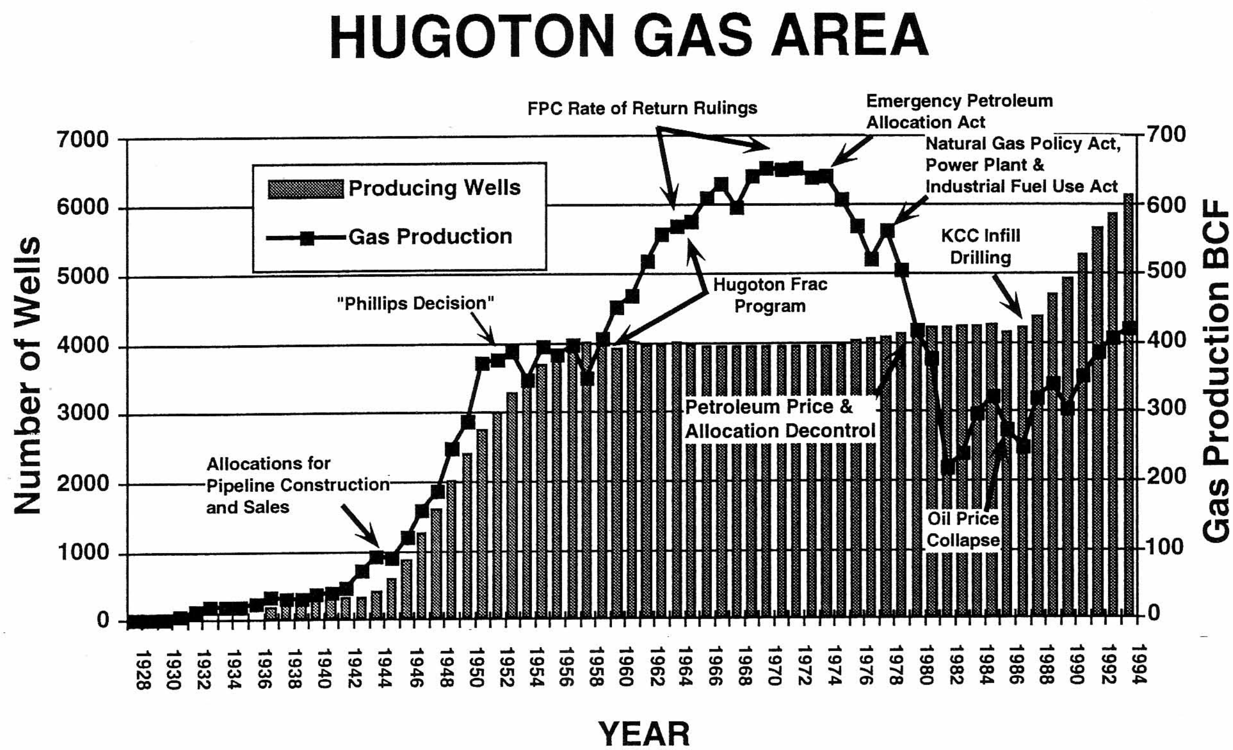

Figure 4. Number of gas wells compared to gas production from the Hugoton Field.

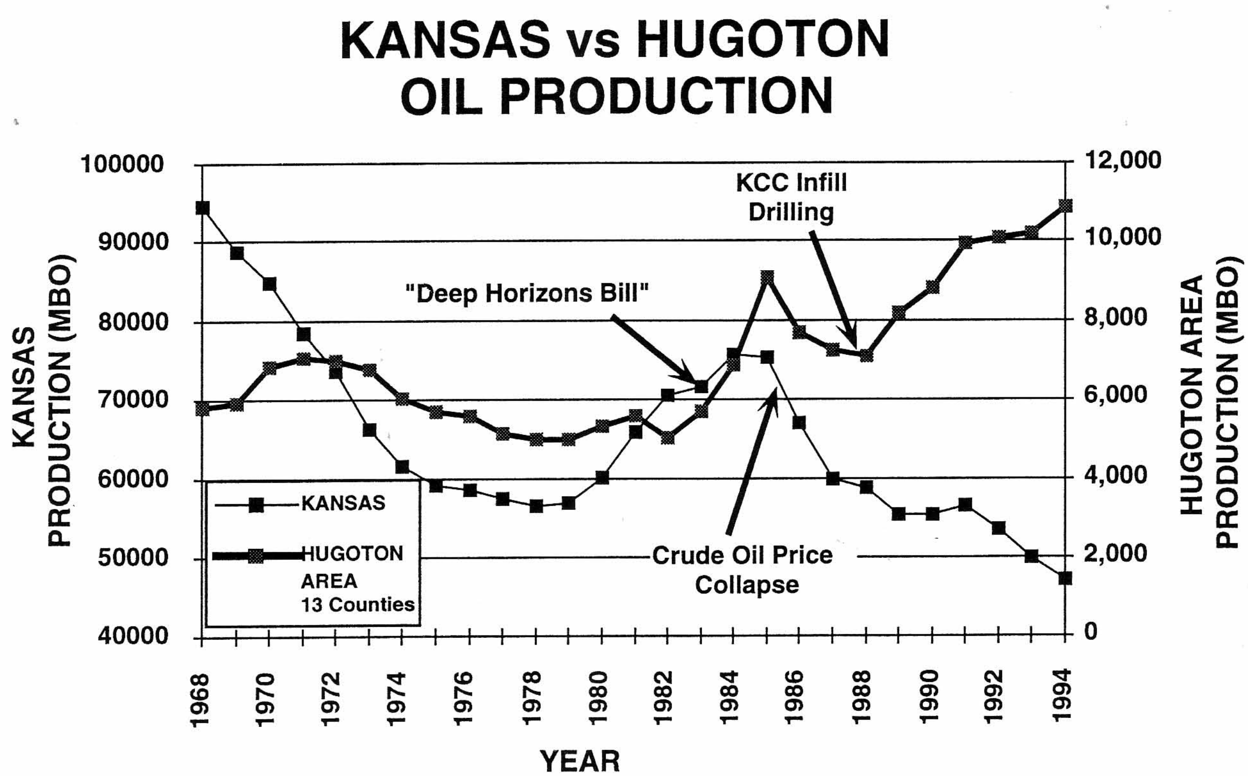

Figure 5. Statewide oil production compared to oil production from the Hugoton embayment.

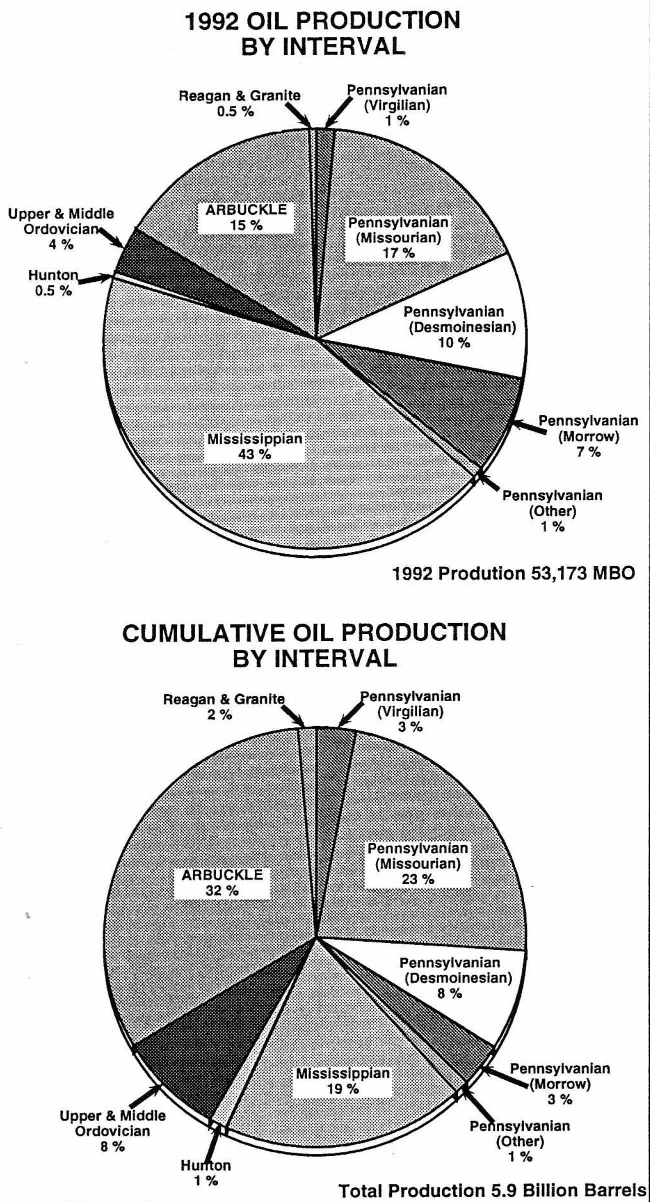

Figure 6

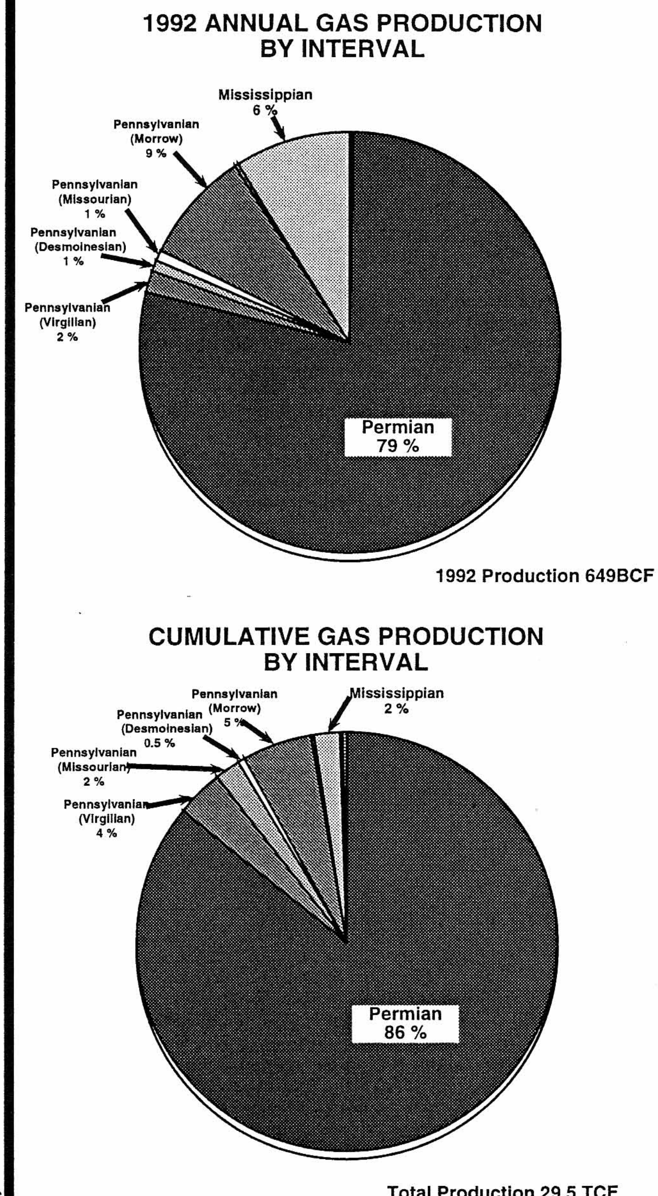

Figure 7

Figures 6 and 7. Oil production (Figure 6) and gas production (Figure 7) in Kansas by stratigraphic interval.

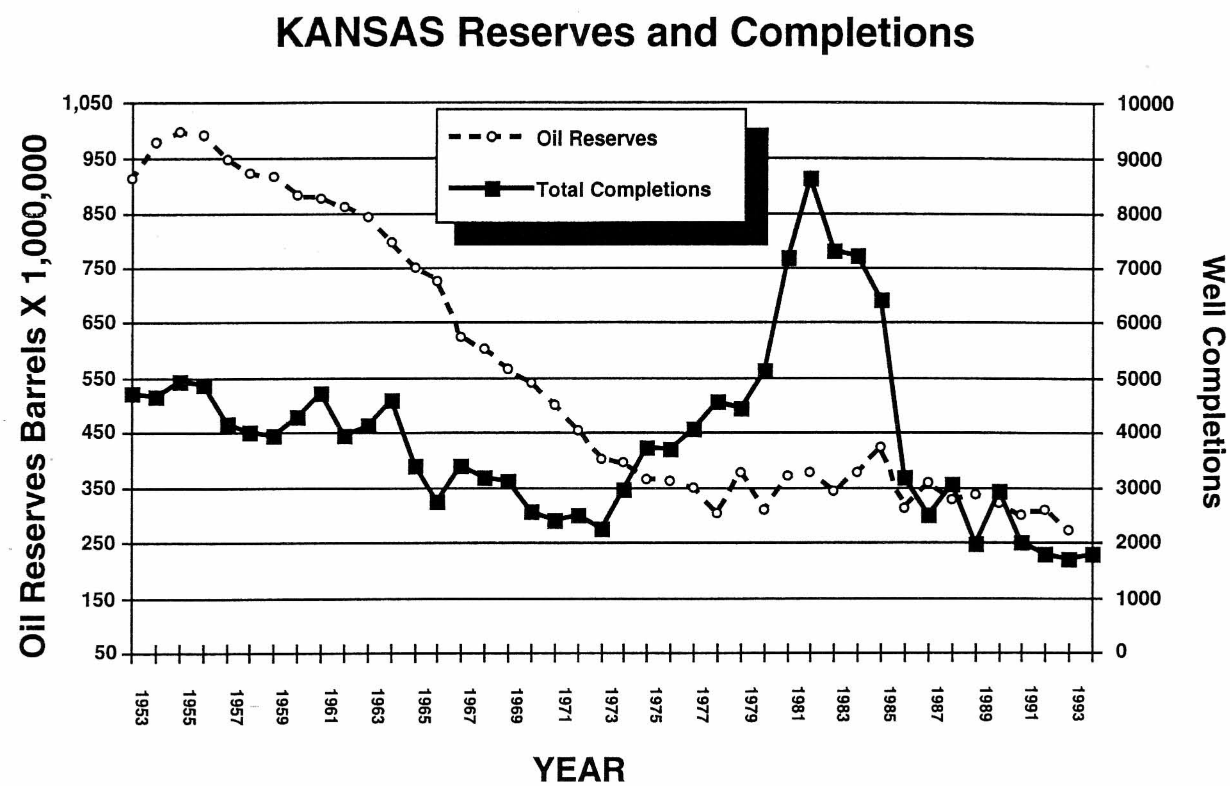

Figure 8. Number of well completions compared to oil reserves in Kansas.

BURKETT OIL FIELD

The Burkett Field is typical of many mature producing oil fields in Kansas. Discovered in 1922, Burkett Field is located in north-central Greenwood County (Figure 1) and underlies more than 1,100 acres. Oil production is from the Bartlesville sandstone, found at an average depth of 2,080 feet. The average thickness of the productive sandstone interval is 38 feet.

There are 160 wells in the field: 53 active producing wells, 28 active injection wells, and two water supply wells. The remaining wells are temporarily abandoned. The field has been under waterflood operations during the past 50 years. Most producing wells within the field currently exhibit high water-to-oil ratios.

In the past, five major companies and three individuals have owned working interests within the field. The current operator, the Franklin D. Gaines Oil Trust, purchased the property in 1970 from Phillips Petroleum Company when oil production from the field was 86 barrels per day. Since then, a program of well maintenance, reactivation of temporarily abandoned wells, and development drilling on the flanks of the field has been employed to maintain production at a level of nearly 180 barrels per day.

Geology

The Burkett Field produces primarily from the Bartlesville sandstone, an informal unit in the subsurface of Kansas and Oklahoma. The Bartlesville sandstone is thought to be equivalent to the Krebs Formation (Cherokee Group) in the outcrop region of extreme southeastern Kansas and Oklahoma. The Cherokee Group is the oldest Pennsylvanian unit in eastern Kansas.

The Bartlesville sandstone is often referred to as a "shoestring" sandstone because of the geometric shape of the sandstone bodies in the subsurface. These sandstones were probably deposited in channels associated with ancient deltas. As these channels meandered and cut across each other laterally, and built up vertically, they resembled a mass of intertwined "shoestrings." Burkett Field is part of the Sallyards trend in Greenwood County, a northeast-southwest string of oil fields that produce from the Bartlesville sandstone.

Production History

Wells at Burkett Field were drilled on 10-acre spacing. Individual wells initially produced at rates as high as 450 barrels per day. The peak annual rate of production by primary methods, nearly 800,000 barrels of oil, occurred in 1924. Oil production steadily declined until 1939, when the field was unitized and Phillips Petroleum Company was designated as the operator. Development of the entire field for water flooding began in 1943. Peak oil production from the water flood occurred in 1945, when 785,000 barrels of oil were produced.

Cumulative production from 1922 through 1942 was approximately 4,787,000 barrels of oil. Secondary oil recovery methods (primarily water flooding) have accounted for an additional 7,404,700 barrels of oil through 1991. Approximately 65,000,000 barrels of water have been injected into this field since 1943. Total oil recovery from Burkett Field through 1994 has been over 12,000,000 barrels of oil.

References

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Rodney Reynolds and Lynn Watney, 1991, Draft Proposal Submitted to the U.S. Department of Energy.

Resource Contact

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316/678-3493

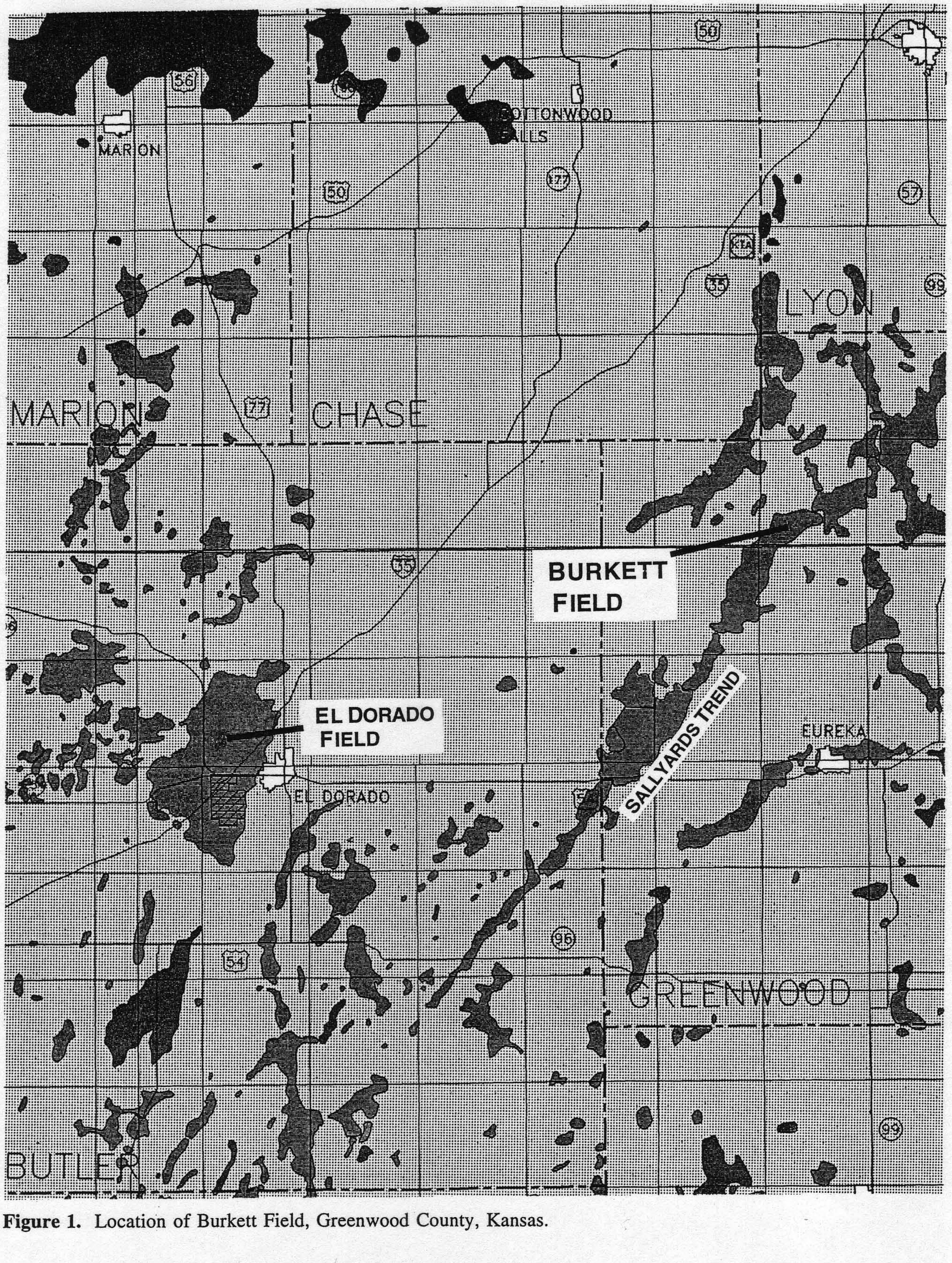

Figure 1. Location of Burkett Field, Greenwood County, Kansas.

CONSERVATION DIVISION
KANSAS CORPORATION COMMISSION

The Kansas Corporation Commission (KCC) regulates the state's telecommunications, electric and gas utilities, transportation, and oil and gas production. The KCC's responsibility is to ensure that the public interest is served by customers receiving adequate, reliable service at fair and reasonable rates which will allow the utilities' investors the opportunity to earn an adequate return to ensure the viability and health of the company. This same standard applies to the regulation of common carriers and motor carriers and falls under the KCC Transportation Division.

The KCC consists of three Commissioners appointed by the Governor with the consent of the Senate. By law, no more than two commissioners may be of the same political party. The Chairman of the Commission is elected by the Commission.

The Conservation Division is one of the major divisions of the Kansas Corporation Commission. The oil and gas regulatory activities of the Conservation Division were first enacted by the Kansas Legislature in 1931. In 1935, the Commission was given responsibility for the saltwater injection program. The KCC Conservation Division was given sole authority for the regulation of oil and gas activities in 1986, including responsibility for the water and environmental protection aspects.

Purpose

The KCC's rules and regulations are basically tailored toward:

- Protection of fresh and usable water and soil
- Prevention of waste of oil and gas resources
- Protection of correlative rights

The goal of the KCC Conservation Division is to set practical and effective standards that protect the environment without unduly restricting drilling and production of oil and gas.

Organization

To enforce Rules and Regulations, the Conservation Division consists of six operating divisions that are administered from the Conservation Division Office in Wichita, Kansas:

- Department of Production
- Department of Underground Injection Control
- Department of Environmental Protection and Remediation
- Legal Department
- Field Services Department
- Administrative Services Department

The Conservation Division also has district offices in Dodge City, Wichita, Chanute, and Hays.

Reference

Conservation Division, Kansas Corporation Commission Pamphlet.

Resource Contact

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EL DORADO OIL FIELD

by

Timothy R. Carr
Kansas Geological Survey

El Dorado ("the gilded one" in Spanish) may be the most important oil field in Kansas because of its size, its long history of sustained production, and its place in history as one of the first applications of science to the search for oil and gas. Currently, the field produces over 2,200 barrels of oil per day from 633 wells, and cumulative production since its discovery in 1915 is approaching 300 million barrels of oil.

Geology

El Dorado Field is a large, complex field with production from multiple horizons. Distributed over 30 square miles, the field is located on a series of faulted northeast-trending structures that are part of the Nemaha Ridge running through central Butler County (Figure 1). Up to 15 horizons have been reported to contain hydrocarbons, but only 8 (Admire, Wabaunsee, Lansing, Kansas City, Mississippian, Viola, Simpson, and Arbuckle) are listed as productive. Production is primarily oil, but for a short period in its early history, significant quantities of gas were also produced.

Structural movements during the Late Devonian and Late Mississippian periods exposed pre-Pennsylvanian strata to weathering and erosion. Erosion across the uplifted structure created truncations of porous weathered horizons. Subsequent Pennsylvanian and Permian deposition covered and sealed the pre-Pennsylvanian rocks. A final period of structural movement occurred in the Permian. The result is a complex arrangement of stratigraphic layers and elevated structural blocks that were ideal for the accumulation of large quantities of oil and gas in multiple reservoirs.

Production History

The discovery well at El Dorado Field was the Wichita Natural Gas Company Stapleton No. 1. The well was drilled through the fall and winter of 1915 and completed on February 5, 1916, at a depth of 2,511 feet (Miner, 1987). The Wichita Natural Gas Company was soon to become Empire Gas and Fuel Company, which in turn begot Cities Service Oil Company. Today, because of the purchase of Cities Service, El Dorado Field is operated by OXY USA Inc.

The discovery of El Dorado Field with the Stapleton No. 1 was one of the first oil and gas discoveries that can be attributed to the science of geology. Leasing, specific location of the discovery well, and drilling to a specific target horizon were all based on geologic mapping of surface structures, and a scientific understanding of oil and gas accumulations (Dr. Erasmus Haworth, then Director of the Kansas Geological Survey, was one of the first people to identify in print [1908] the El Dorado structure and to understand the importance of structure and stratigraphy in hydrocarbon accumulations). Prior to drilling, the work of geologists had identified almost 90% of the acreage that was to be proven productive, and enabled Empire Gas and Fuel Company to acquire nearly two-thirds of the field (Fath, 1921).

The success of the discovery well initiated a frenzy of development. Empire Gas and Fuel Company alone drilled over 1,000 wells in 1917. The development of El Dorado was highlighted by the discovery of a number of spectacular "Kansas gushers." Wells such as the Shumway No. 5 did not gush in the popular sense, but had steady flow rates that could approach 19,000 barrels per day, and produced millions of barrels of oil in only a few months. With the success of the development program at El Dorado, annual field production quickly climbed to almost 29 million barrels in 1918. In that year, El Dorado was the leading field in the U.S. and accounted for 8.9% of all the oil produced in the country (Fath, 1921). El Dorado also marked the beginning of a rapid increase in Kansas production. Prior to the discovery of El Dorado, annual oil production in Kansas had fluctuated for over a decade between 1 and 5 million barrels. From less than 3 million barrels in 1915, the state's production rose to over 45 million barrels of oil in 1918.

The majority of the development in the El Dorado Field took place prior to 1920. Development drilling was controlled by lease considerations and spacing practices without regard to reservoir geology. Completions were for the most part open hole with uncemented casing. The long intervals of open hole, high rates of production, and lack of cemented casing invited massive invasions and mixing of "top and bottom water." This resulted in build-up of scale and coning of water. By the early 1920's, oil production plunged and water production soared. Many of the wells in the field were abandoned by the 1930's (Ramondetta, 1990). However, oil production at El Dorado has continued with renewed vigor to the present day. The development of new technologies for reservoir evaluation and management has continued to maintain field production. Today, nearly 80 years after its discovery, El Dorado continues to produce over 800,000 barrels of oil per year, and remains one of the top 10 producing fields in Kansas (Carr, 1994).

References

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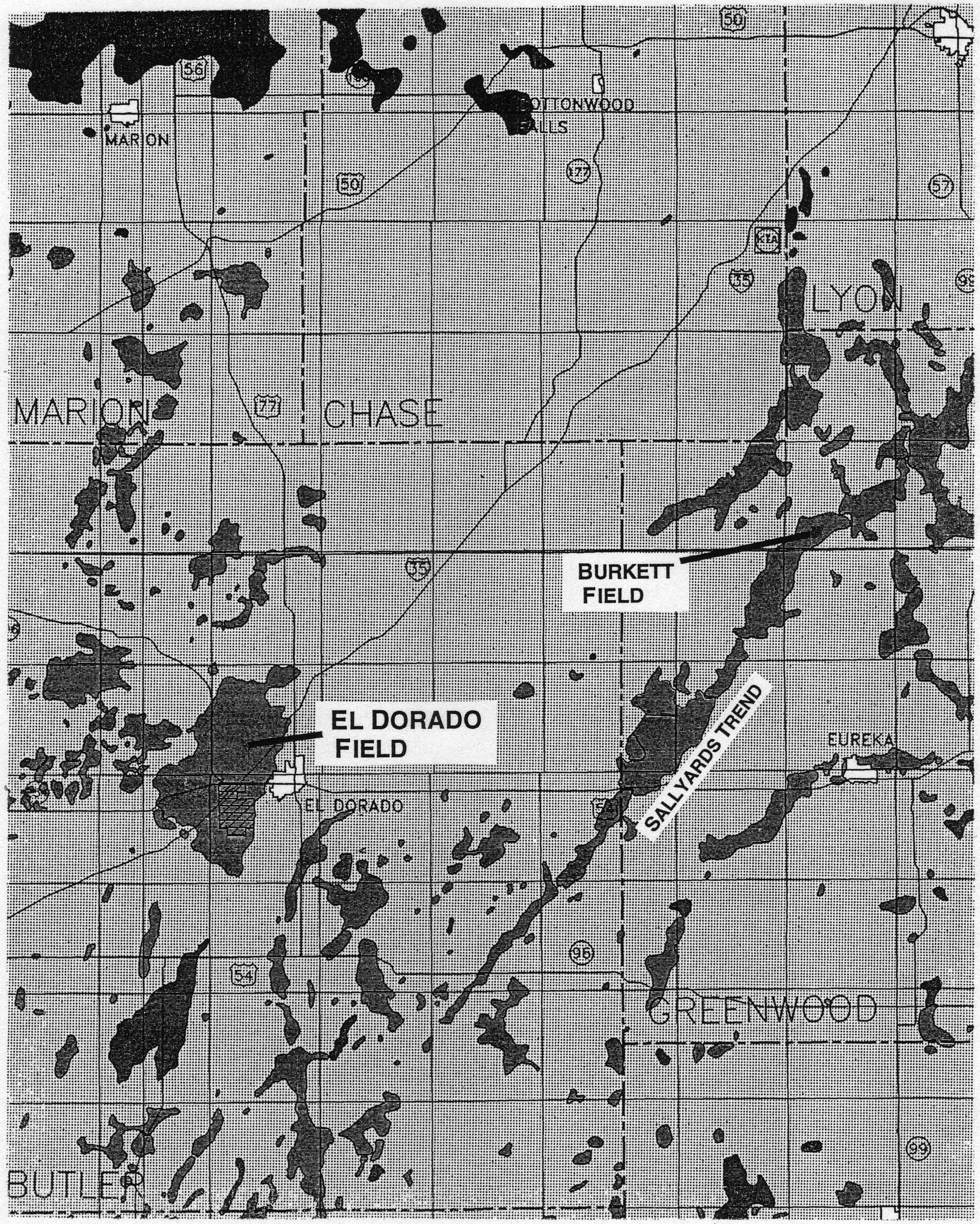

Figure 1. Location of El Dorado Field, Butler County, Kansas.

TEXACO REFINERY

Texaco's El Dorado Plant is the state's largest refinery and its only petrochemical complex. This facility is situated on nearly 1,100 acres of land and employs approximately 500 people.

Refining began on the site in 1917 during the "oil boom" days associated with the discovery of huge oil reserves in the El Dorado area. The operation then consisted of a primitive skimming plant with a daily capacity of 2,000 barrels of crude oil. It was known as the Midland Refining Company, a forerunner of Skelly Oil Company, founded in 1919. Skelly was merged into Getty Oil Company in 1977, and Getty was acquired by Texaco in 1984. Today, the refinery can process 105,000 barrels of crude oil and 15,000 barrels of natural gas liquids daily.

Fuels Refinery

The El Dorado Plant manufactures a full range of fuel products including several grades of gasoline, aviation jet fuel, diesel fuels, home heating oils, and fuel oils for industrial facilities. By-products include ashpalt blending material, petroleum coke, and commercial grade sulfur.

To obtain the many products available from crude oil, it first must be refined. Crude oil is a complex mixture of hydrocarbon compounds made up of carbon atoms linked with hydrogen atoms. Refining processes separate these hydrocarbon compounds into groups, or "fractions," the molecular structure of which may be changed or rearranged to form new hydrocarbon compounds with different characteristics.

The El Dorado Plant has processing capabilities that include Gas Oil Desulfurization, Fluid Catalytic Cracking, Delayed Coking, two Alkylation Units, two Catalytic Reforming Units, Isomerization of Light Naphtha Streams, and two Sulfur Recovery Units. These facilities contribute to a daily production of 53,000 barrels of gasoline, 24,000 barrels of intermediate fuels, 600 tons of coke, and 80 tons of elemental sulfur. Most of the gasoline produced by the refinery is transported by three major pipeline systems that serve a 10-state area.

In 1993, the plant added a Diesel Hydrotreater Complex. The complex consists of a Diesel Hydrotreating Unit, a Hydrogen Generation Unit, a Sulfur Recovery Unit, and a Sulfur Plant Tail Gas Treating Unit.

Petrochemicals

Highly integrated with fuels refining is the production of petrochemicals. A number of specialized processing units make such diverse products as toluene, cunene, phenol, acetone, and several grades of industrial solvents. Petrochemical products are used as raw materials in the manufacture of such products as resins, plastics, pharmaceuticals, paint thinners, lacquers, adhesives, rubber products, dry cleaning agents, charcoal lighter fluid, stove and lamp fuel, and many other products.

Waste Water Treatment

Water from the City of El Dorado provides cooling for the various processes in the plant and supplies water to boilers and heat exchange equipment for the generation of steam. A 2.5-million gallons-per-day waste-water treatment facility treats the plant's waste water by recovering floating oils and removing solids prior to secondary treatment. Secondary treatment includes an activated sludge treatment section in which bacteria remove dissolved organic materials. Treated waste water is discharged into holding ponds where it flows into a new wetlands area, now under construction, before finally re-entering the nearby Walnut River drainage system.

References

Texaco's El Dorado Plant Brochure.

El Dorado Plant Diamond Jubilee Information Sheet.

Resource Contact

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CHASE PIPELINE COMPANY

Chase Transportation Company and Chase Terminaling Company were established in 1972, and are a partnership between Texaco and Koch Industries Inc. Chase Pipeline Company is the operating company and is owned by Koch Industries. Chase employs approximately 20 people.

Chase Transportation Company is a common carrier pipeline consisting of a 10-inch pipeline running from El Dorado, Kansas, to Aurora, Colorado, and a 10-inch pipeline running from El Dorado to Great Bend and Scott City, Kansas. Chase operates approximately 733 miles of pipeline. Chase Terminaling Company has truck loading and distribution terminals at Great Bend and Scott City, and Aurora, Colorado. Chase Transportation Company is the sole transporter of jet fuel via pipeline to the new Denver International Airport.

Chase was established to move refined products from southeast Kansas to western Kansas and into the Rocky Mountain areas to help increase markets for Kansas and Oklahoma refiners, and to provide transportation and distribution facilities for oil companies with midwestern marketing areas. Chase receives product from the Texaco Refinery at El Dorado, and is also able to receive product from William's Pipeline Company and KANEB Pipeline Company.

Chase ships about 50,000 barrels of refined products daily and has approximately 1,168,000 barrels of storage capacity.

Reference

Chase Pipeline Company Information Sheet.

Resource Contact

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GROENDYKE TRANSPORT, INC.

Groendyke Transport was founded in 1932 by Harold Groendyke who began by hauling gasoline from Borger, Texas, to his hometown of Beaver, Oklahoma. Today, Groendyke Transport is one of the largest motor carriers of bulk commodities with more than 1,100 employees at 43 terminals serving the continental U.S., Canada, and Mexico. The company's fleet consists of 750 tractors and 1,400 trailers for transporting and protecting various products.

Groendyke Transport's Northern Region office is located in El Dorado, Kansas. This region is involved primarily in transporting refined products. Gasoline from the refinery is trucked to gas stations, thus completing the last link in the chain from earth resource to the consumer.

Reference

Groendyke Transport, Inc. Brochure.

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NATIONAL RENEWABLE ENERGY LABORATORY

The National Renewable Energy Laboratory (NREL), based in Golden, Colorado, was established in 1977 by the Solar Energy Research, Development, and Demonstration Act of 1974 as a national center for federally sponsored solar energy research and development. Originally called the Solar Energy Research Institute, the name was changed in 1991 when it became a contractor-operated national laboratory owned by the U.S. Department of Energy. In addition to research in solar energy, NREL has expanded it's role to include other areas of renewable and alternate energy. The National Renewable Energy Laboratory is managed by Midwest Research Institute of Kansas City Missouri, a not-for-profit laboratory that specializes in performing and managing research for public and private clients. NREL has about 1,100 employees including research professionals, visiting researchers, and students.

Mission

NREL's stated mission is to "lead the nation toward a sustainable energy future by developing renewable energy technologies, improving energy efficiency, advancing related science and engineering, and facilitating commercialization." Much of the work done at NREL involves research and technology that can not be done in the private sector. Key to NREL's mission is the transfer of renewable energy and energy efficiency technologies to private industry for commercialization.

Programs

Although originally established to support the development of solar energy technology, NREL has expanded into other areas of renewable energy research. Research activities are conducted in seven major research divisions:

Basic Sciences
Industrial Technologies
Building and Energy Systems
Alternative Fuels
Wind Technologies
Photovoltaics
Analytic Studies

Activities within these divisions support the DOE Office of Energy Efficiency and Renewable Energy in programs such as photovoltaics, wind energy, biofuels, biomass electric, fuels utilization, solar industrial technologies, building technologies, solar thermal electric, municipal solid waste, hydrogen, geothermal power, and superconductivity.

Funding

NREL's total funding for fiscal year 1995 is approximately $237 million. Nearly 95% of this funding comes from the DOE Office of Energy Efficiency and Renewable Energy. Private firms and other DOE offices provide the balance of the NREL's funding. About 56% of funding is used in-house and 44% is subcontracted to industry and universities. In 1994, NREL awarded $155 million in subcontracts.

References

National Renewable Energy Laboratory Pamphlet.

Energy and Minerals Field Institute Field Guide, July 1995.

Resource Contacts

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Technical Information Service
National Renewable Energy Laboratory
303/275-4099

Energy Efficiency and Renewable Energy Clearinghouse
1-800/363-3732

SCHEDULE & ITINERARY

Saturday October 7, 1995

7:00 am	Bus to Wolf Creek Generating Station Uranium Pieter Berendsen, Kansas Geological Survey
8:30 am	**SITE 9** - Tour Wolf Creek Generating Station Mona Grimsley, Wolf Creek Nuclear Operating Corporation
12:30 pm	Lunch - Wolf Creek Environmental Education Area
1:15 pm	Bus to Lawrence
2:30 pm	Arrive Kansas Geological Survey

URANIUM

by

Pieter Berendsen
Kansas Geological Survey

Introduction

Uranium is used to power nuclear reactors, ship engines, and military hardware. The most common uranium minerals being mined are pitchblende, a common black, sooty, uranium oxide; uraninite, the crystalline form of pitchblende; and carnotite, a yellow hydrated oxide that commonly occurs as encrustations. Because oxidized uranium is highly soluble, it is easily transported by ground water.

Most of the easily recoverable uranium deposits in the United states are found in sandstones in New Mexico and Wyoming. Because organic matter causes uranium to precipitate out of solution, most of the uranium is found in ancient sandstone channels that contain plant fragments.

Chemistry

Uranium is the most abundant metallic element in the uranium decay series shown in Figure 1. Most of the decay products are metallic, except radon, which is an inert gas. During the decay process, when one element transforms into the next element in line, several kinds of energy, or radiation, are released. The time it takes for one element to decay to the next element down the line varies from less than a second to 4.5 billion years. The final product into which uranium changes is non-radioactive lead, a common element. The amounts of radiation released during these transformations are small. Radiation dangers can arise when these products occur naturally (such as in ore deposits) or in artificially concentrated form.

Radon is a radioactive gas that is produced naturally from the radioactive decay of uranium and thorium in rocks and soils. Radon gas constitutes a potential health problem because it can be inhaled. It takes only 3.8 days for half of the radon to change to metallic polonium, which cannot be exhaled. It precipitates on the lungs and in less than an hour changes successively into lead, bismuth, polonium, and again lead. During each of these transformations radiation is emitted, which damages the lungs, and is thought to cause lung cancer.

Occurrence

Uranium in the earth's crust is concentrated as either an oxide or silicate. More than 180 naturally occurring uranium-bearing minerals have been identified, but less than 10 occur in sufficient concentrations to become economically significant. There are two abundant isotopes of uranium: U-238, which makes up about 99.3% of natural uranium, and U-235, which makes up about 0.7%. Unfortunately, the more abundant U-238 is practically non-fissionable and is not useful in a nuclear reactor. The third isotope, U-234, derives from the decay of U-238 and its abundance is on the order of 0.0054%.

Uranium occurs in all geologic environments, and in rocks of all ages. Known ore deposits can be broadly classified as follows:

- Vein-type deposit
- Sedimentary deposits
  - Sandstone deposits
  - Uraniferous shale deposits
  - Carbonate rock hosted deposits
- Volcanic related or volcanogenic deposits
- Sedimentary-metamorphic deposits
- Magmatic deposits

Major ore deposits occur on several continents. In the United States, major ore deposits are located in northern New Mexico, southern Texas, Wyoming, Florida, and western Nebraska. Most of these deposits occur in sedimentary rocks. In Canada, large sedimentary deposits occur in the northern Saskatchewan province. Large deposits also occur in Australia, Africa, France, Germany, Russia, and Siberia.

Exploration

A number of methods are used to explore for uranium deposits. Geologists have developed models that explain the formation and localization of uranium deposits. The exploration technique depends on the type of uranium deposit being evaluated. For example, ground water samples can be analyzed for specific elements common in uranium deposits that were formed by moving ground water. Geophysical methods (gravity, magnetics) are sometimes used to locate igneous rocks that might host uranium deposits. Since most ore deposits do not occur at the earth's surface, exploration geologists often use a combination of these exploration methods. Some common exploration methods are:

- Geophysical methods (gravity, magnetics, electrical)
- Chemical analysis of rock samples
- Chemical analysis of stream sediments
- Chemical analysis of ground water (domestic and irrigation wells), and rivers and streams
- Chemical analysis of vegetation (leafs, twigs)
- Chemical analysis of natural occurring gases in rocks and soils

Mining and Production

Exploration leads to the development of areas with higher potential, called prospects. Prospects are then test drilled to evaluate their economic potential. This may lead to a feasibility study, and if deemed economic, eventual mining of the resource.

Primary uranium is extracted by underground and open-pit mining methods, and also by in-place solution mining. Open-pit mining and solution mining are usually the most economical methods of mining uranium, especially when mining lower grades of ore. Uranium is also recovered as a by-product of phosphate, copper, and nickel mining.

Grade (concentration) of the uranium, mining practices, infrastructure, location, and many other factors dictate whether a prospect will be economically feasible. Mines in igneous rocks have recovered uranium that ranged in concentrations from 0.05% to over 3.0%. In the Athabasca area of northern Saskatchewan, grades commonly run up to 2%. In the United States, similar concentrations of uranium are being solution mined in western Nebraska, southern Texas, and Wyoming (a new underground mine is under construction in Wyoming). Some by-product uranium is also available in the U.S.

During the energy crisis in the middle 1970's, many contracts were signed by operators of nuclear power plants, resulting in dramatic price increases. Consequently, many new uranium mines were started. The trend has since reversed because of a more plentiful supply of coal and petroleum fuel sources and because of environmental concerns regarding the operation of nuclear facilities.

Uranium Potential in Kansas

During the1970's, the Department of Energy supported several programs to evaluate the uranium potential in Kansas. Exploration drilling was conducted by a few mining companies, but economic uranium deposits were not located.

The thin black shale units that are common at the surface in eastern Kansas contain anomalous concentrations of uranium (up to about 0.02%). The thickness of these units (2-3 feet), combined with the low concentrations of uranium, makes this source uneconomical. In central and western Kansas, Cretaceous (65-140 million years old) and Pliocene-Pleistocene (up to about 1 million years old) sedimentary rocks could potentially host uranium deposits. The source of the uranium in these rocks may be the abundant volcanic ash present in the western part of Kansas or igneous rocks in the neighboring states to the west and north. Ground water leaches small amounts of uranium from these rocks and moves it downgradient until it is concentrated as an ore deposit.

The uranium potential of deeply buried sedimentary or igneous rocks in Kansas has not been properly evaluated.

Summary

At the end of 1994 a total of 430 commercial nuclear plants were operating in 30 countries around the world, with 109 nuclear power plants operating in the United States. These plants provided 21.9% of the nation's energy in 1994. The location, number of plants, and their capacity is shown in Table 1. Some people speculate we will eventually run out of fossil fuels, and uranium will be our major source of energy. The price of uranium has stabilized and increased slightly during the past year, opening the way for modest expansion of uranium mining activities.

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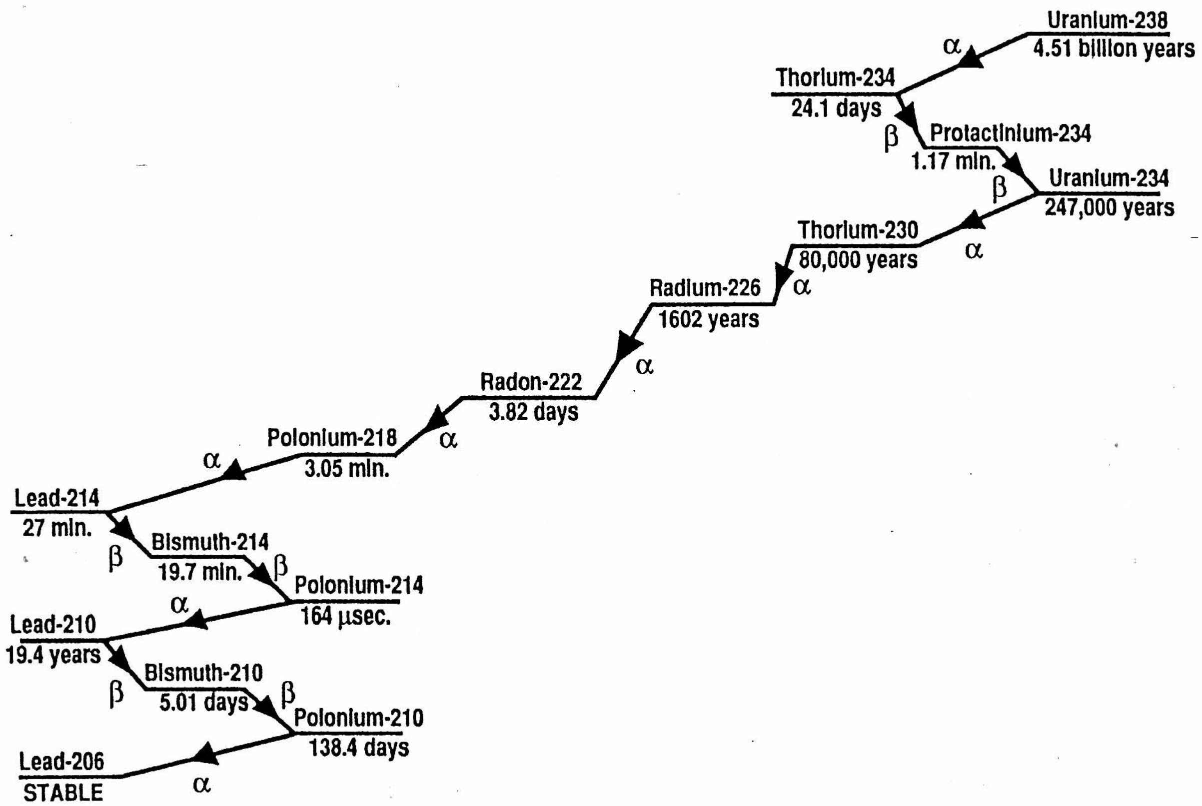

Figure 1. The uranium-238 decay series, showing the half-lives of elements and their modes of decay (after Wanty and Schoen, 1991).

Table 1. Operable Nuclear Power Plant Statistics, 1992 and 1993 (from World Nuclear Outlook, 1994)

Country	Number of Operable Units[a]		Net Capacity (MWe)[b]		Amount of Electricity from Nuclear Units			1993
					Net TWh[b]		Percent Change	Share[c] (percent)
	1992	1993	1992	1993	1992	1993		
United States	**109**	**109**	**98,985**	**99,041**	**618.8**	**610.3**	**-1.4**	**19.1[d]**
Canada	**21**	**22**	**R14,874**	**15,755**	**R76.0**	**88.6**	**16.6**	**17.3**
Western Europe								
Belgium	7	7	5,484	5,527	R40.9	39.5	-3.4	58.9
Finland	4	4	2,310	2,310	18.2	18.8	3.3	32.4
France	56	57	57,688	59,033	321.7	350.2	8.9	77.7
Germany	21	21	R22,559	22,657	150.0	145.0	-3.3	29.7
Netherlands	2	2	R504	504	R3.6	3.7	2.8	5.1
Slovenia	1	1	R632	632	3.8	3.8	0.0	43.3
Spain	9	9	R7,101	7,105	R53.4	53.6	0.4	36.0
Sweden	12	12	10,002	10,002	60.8	58.9	-3.1	42.0
Switzerland	5	5	R2,952	2,985	22.1	22.0	-0.5	37.9
United Kingdom	37	35	R12,066	11,909	R69.1	79.8	15.5	26.3
Subtotal:	**154**	**153**	**R121,298**	**122,664**	**R743.6**	**775.3**	**4.3**	**43.0**
Eastern Europe								
Bulgaria	6	6	R3,538	3,538	11.6	14.0	20.7	36.9
CIS/Kazakhstan	1	1	135	70	0.5	0.4	-20.0	0.5
CIS/Russia	R28	29	R18,893	19,843	119.6	119.2	-0.3	12.5
CIS/Ukraine	15	15	13,020	12,679	71.0	75.2	5.9	32.9
Czech Republic	4	4	1,632	1,648	12.3	12.6	2.4	29.2
Hungary	4	4	1,729	1,729	13.1	13.0	-0.8	43.3
Lithuania	2	2	R2,760	2,370	15.6	12.3	-21.2	87.2
Slovak Republic	4	4	1,632	1,632	11.1	11.0	-0.9	53.6
Subtotal:	**R64**	**65**	**R43,339**	**43,509**	**254.8**	**257.7**	**1.1**	**18.1**
Far East								
China	1	2	R288	1,194	0.5	2.5	400.0	0.3
Japan	44	48	R34,238	38,029	217.0	246.3	13.5	30.9
Korea, South	9	9	7,220	7,220	56.5	55.4	-2.0	40.3
Taiwan	6	6	R4,890	4,890	32.5	33.0	1.5	33.5
Subtotal:	**60**	**65**	**R46,636**	**51,333**	**306.5**	**337.2**	**10.0**	**32.9**
Other								
Argentina	2	2	935	935	6.6	7.2	9.1	14.2
Brazil	1	1	626	626	1.8	0.4	-77.8	0.2
India	9	9	R1,593	1,593	5.6	5.4	-3.6	1.9
Mexico	1	1	654	654	3.9	3.7	-5.1	3.0
Pakistan	1	1	125	125	0.5	0.4	-20.0	0.9
South Africa	2	2	R1,842	1,842	9.3	7.2	-22.6	4.5
Subtotal:	**16**	**16**	**R5,775**	**5,775**	**27.7**	**24.3**	**-12.3**	**3.8**
Total World	**R424**	**430**	**R330,907**	**338,077**	**R2,027.4**	**2,093.4**	**3.3**	**25.5**

[a]For all non-U.S. units, operable units are those that have generated electricity to the grid. An operable unit in the United States is one that has been issued a full-power license from the U.S. Nuclear Regulatory Commission. For all non-U.S. units, capacity is the net design electrical rating. For U.S. units, capacity is net summer capability. Capacities of individual units are subject to reratings from year to year. See definitions of capacities in glossary.

[b]MWe = megawatt-electric; TWh = terawatthours.

[c]Each country's net electricity generated from nuclear power generating units as a percentage of net electricity generated from utilities and nonutilities. The source for nuclear generation data is the International Atomic Energy Agency (IAEA). The nuclear share of utility-generated electricity for the United States was 21.2 percent.

[d]1993 utility generation was obtained from the Energy Information Administration, *Monthly Energy Review, May 1994*, DOE/EIA-0035(94/05) (Washington, DC, May 1994). Forecasted 1993 gross nonutility generation data was obtained from the Energy Information Administration, Projection for the Short-Term Energy Outlook Memorandum, June 9, 1994.

R = Revised.

Sources: **1992**–International Atomic Energy Agency, *Nuclear Power Reactors in the World* (Vienna, Austria, April 1993). **1993**–International Atomic Energy Agency, *Nuclear Power Reactors in the World* (Vienna, Austria, April 1994).

WOLF CREEK GENERATING STATION

Wolf Creek Generating Station provides electrical power for about 780,000 customers in Kansas and Missouri. Wolf Creek Generating Station is owned by Kansas Gas & Electric, a Western Resources Company, Kansas City Power & Light, and Kansas Electric Power Cooperative, Inc. Wolf Creek Nuclear Operating Corporation, a wholly-owned subsidiary of the three utilities, operates the plant and employs approximately 1,300 people.

Uranium used in nuclear fuel is plentiful in the United States and the world. Cost of uranium fuel is about half the cost of coal, and about a fourth as expensive as oil and gas. Use of nuclear fuel does not contribute to "acid rain" or the "greenhouse" effect. By choosing to build a uranium-fueled plant, as well as coal-fired plants, Wolf Creek's owners have a diversity of fuel sources to help assure an adequate, reliable supply of electricity.

Generating Electricity from Uranium

Wolf Creek generates electricity by heating water to produce steam. Steam turns turbines, which spin a magnet inside an electrical generator, thus producing electricity. Wolf Creek Generating Station has the largest electrical generator in Kansas.

Instead of burning gas, oil, or coal as a heat source, Wolf Creek produces heat by splitting, or "fissioning" atoms of uranium fuel. Fission begins when a neutron strikes a uranium atom, causing the atom to split. Heat is released and still more neutrons are produced, which strike more atoms, producing more heat. This process is called a controlled nuclear reaction, and takes place inside a reactor.

Nuclear fuel in the reactor is in the form of half-inch ceramic pellets that are stacked into metal alloy fuel rods that are 12 feet long. A fuel bundle contains 264 rods, and there are 193 fuel bundles in the Wolf Creek reactor. The fuel core weighs about 110 tons and can produce the energy equivalency of approximately 19 million tons of coal. About one-third of the fuel is replaced every 18 months.

Water surrounding these fuel bundles in the reactor is heated to more than 600 degrees Fahrenheit by the fissioning of uranium. This water system is kept under high pressure to prevent boiling. As this "super-heated" water circulates in pipes through four steam generators, heat is transferred to a second water system, which is completely separate from the first. Water in this second system boils, creating steam that is used to spin the turbine and produce electricity (see Figure 2).

The steam then enters a condenser, where water from a third system, Wolf Creek's 5,090-acre cooling lake, circulates through tubes. Steam passing over the tubes is condensed back into water, and then returned to the generators to repeat the cycle. Lake water does not physically mix with the second water system, but does absorb about 40 degrees of heat from the steam. The lake water is discharged back into the lake where it eventually cools to ambient temperatures.

Safety

Because the concentration of fissionable uranium in a nuclear power plant's fuel core is only a fraction of that necessary for an explosion, nuclear power plants cannot explode like an atom bomb.

A nuclear plant does contain radioactive material, which must remain isolated from the environment. Because of this, nuclear plant design includes numerous safety systems and physical barriers to prevent the release of radioactive materials (Figure 2).

The ceramic oxide pellets that contain the enriched uranium are designed to confine radioactive material at greater than normal operating temperatures. Fuel rods that contain the uranium fuel pellets are sealed at the fuel processing facility and are not opened at the plant. A second barrier, the "reactor pressure boundary," involves the reactor vessel, piping, and the water used to cool the fuel and transfer heat. This system is a closed loop that can stand strains much higher than experienced during normal operation. A third measure of protection is the domed containment building inside which the reactor and steam generators are housed. Constructed of reinforced concrete 3 to 4 feet thick, with a leak-tight steel inner wall, this structure is designed to contain radioactive materials even if all other barriers fail.

In addition to safety measures that are designed into the plant, an elaborate emergency action plan is in place, as required by federal regulatory agencies. This plan is designed to protect public health and safety. It involves about 1,400 people from Wolf Creek Nuclear Operating Corporation, the State of Kansas, and Coffey County who are trained to respond in the event of a plant emergency.

Environmental Work

Environmental studies began in the area before plant construction started in 1977. Weather conditions, wildlife, and archeological studies were conducted. The cooling lake, which was formed by damming Wolf Creek and is supplemented when necessary with water from John Redmond Reservoir, has become home to many species of fish, birds, and wildlife.

Wolf Creek cooling lake's fish population is a functional part of the powerplant. Predator fish (bass, crappie, walleye, catfish) were stocked in the lake to control gizzard shad who, if present in large numbers, can clog intakes where water is pumped from the lake to the plant's cooling system. If this occurs, the plant must shut down and may require expensive repairs. Work is currently underway to open up portions of the lake to public fishing.

The Wolf Creek Environmental Education Area, located on the upper reaches of Wolf Creek Lake, has been established with the support of several public and private organizations. This 160-acre area, which opened in 1994, contains three self-guided trails, a bird viewing blind, restrooms, and a picnic area. Two of the trails are accessible to all visitors, including those in wheelchairs or with limited mobility. The Wolf Creek Environmental Education Area is an official Outdoor Wildlife Learning Site (OWLS) partially funded by a grant from the Kansas Department of Wildlife and Parks through the Chickadee Checkoff program.

Wolf Creek Generating Station Facts

Cost	$3 billion
Capacity	1,150,000 kilowatts
Construction Start	May 1977
Commercial Operation	September 1985
Fuel	Ceramic pellets with 4.5% uranium-235
Reactor:	
Manufacturer	Westinghouse
Type	Four-loop Pressurized Water Reactor
Dimension	44 feet high, 14 feet wide
Containment Building:	
Dimension	208 feet high, 140 feet wide
Materials	Concrete (3-4' thick) lined w/ a leak-tight steel barrier
Wolf Creek Lake	5,090 acres

References

Wolf Creek Generating Station Pamphlet.

Wolf Creek Environmental Education Area Brochure.

Resource Contacts

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316/364-4143

Environmental education presentations at the Wolf Creek Environmental Education Area are available by calling Wolf Creek's Corporate Communications Department at 316/364-4141.

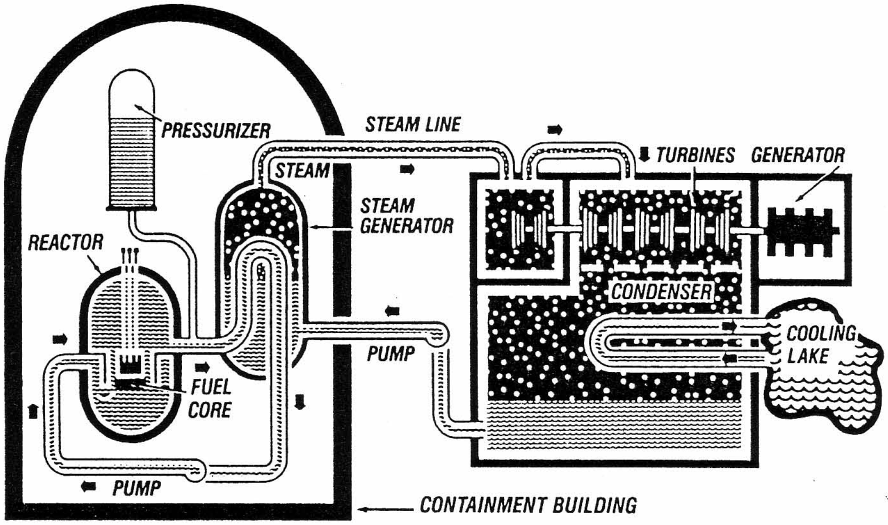

Figure 1. Schematic diagram of how electricity is generated at Wolf Creek Station.

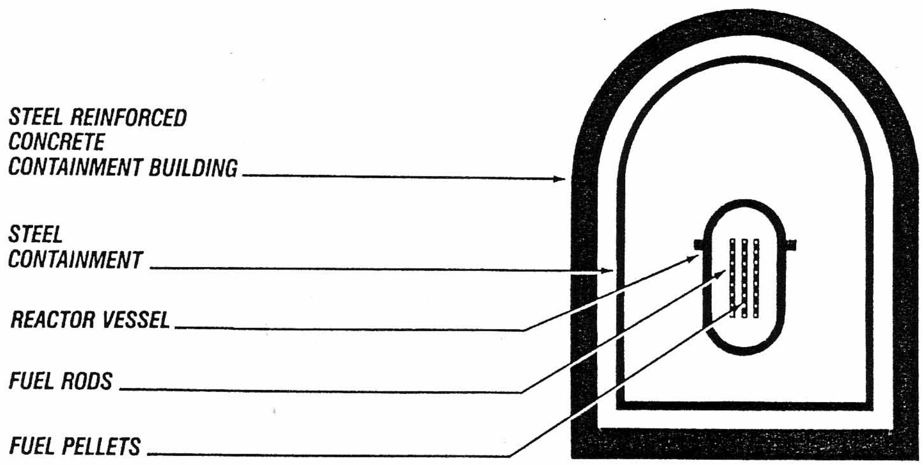

Figure 2. Schematic diagram of nuclear reactor and containment building at Wolf Creek Station.