Approved: Carl Dean Holmes

Date 3-22-93

MINUTES OF THE HOUSE COMMITTEE ON ENERGY AND NATURAL RESOURCES.

The meeting was called to order by Chairperson Carl Holmes at 3:30 p.m. on March 18, 1993 in Room 526-S of the Capitol.

All members were present except: Representative Ruff, excused
Representative Webb, excused

Committee staff present: Raney Gilliland, Legislative Research Department
Dennis Hodgins, Legislative Research Department
April Howell, Committee Secretary

Conferees appearing before the committee: Lee Gerhard, Director, Kansas Geological Survey
Philip Madell, Subcommittee Chairman, Non-Fossil Energy
Donald P. Schnacke, Fossil Energy Subcommittee
William R. Bryson, Chairman, Natural Gas Policy Comm.

Others attending: See attached list

The Chair called the meeting to order and opened the Review Briefing on the Kansas Energy Policy. Lee Gerhard, State Geologist and Director of the Kansas Geological Survey, Energy Policy Committee and Energy Subcommittee Chair, opened the briefing on the Energy Policy Committee Report previously sent to the Governor. The mission of the committee: *"We recognize in Kansas that the economy, energy and our environment are inextricably intertwined, and that one of these factors can be considered separately from the others. We want to ensure that any recommended public policy is, first of all, beneficial to all of our citizens, and provides for a stable and reliable supply of energy, with special acknowledgement of our responsibility to future generations of Kansans."*

"To meet this goal, we shall welcome and explore ideas, from whatever source, that address energy policy on a practical basis. We will pursue those suggestions that will work, the ones that keep our role as stewards of our natural resources in focus. To this end, we shall organize along functional lines that will encourage development of an honest strategy to use our natural resources wisely, including specific alternative fuels and energy conservation programs."

The fossil energy recommendations, which are fully outlines in the Executive Summary of their report (Attachment 1) ; first, the report suggests three means for increasing business activity in Kansas:

1) Capital gains tax reduction in Kansas income tax;'
2) Investment tax credits;
3) Cost/benefit review of all new regulations.

These three policy changes could stimulate all industry and assist to recruit new industry to the state. The federal government is loathe to replace these former business stimuli, and consequently the national economy stagnates. These is no incentive to take financial risk in today's tax environment.

Second, Kansas has an abundance of natural gas. The Hugoton gas area is one of the largest in the world.

Third, marketing of Kansas energy resources is not now a state priority, but the Department of Commerce and the Corporation Commission could materially assist in that endeavor. Kansas could be marketed as the location of a second strategic petroleum reserve as well.

Fourth, Kansas can take a lead in development of federal policy by aggressively advocating changes in federal policy that hinder development of the state's energy resources, and push for federal changes that favor Kansas rather than permit other states and other resources to dominate federal policy. Greater Washington representation of Kansas interests is required.

Finally, education and research can go a long ways to enhancing the state's economy. Education is needed about the resources, their impacts and benefits.

Unless specifically noted, the individual remarks recorded herein have not been transcribed verbatim. Individual remarks as reported herein have not been submitted to the individuals appearing before the committee for editing or corrections.

Philip Madell, Subcommittee Chairman, Non-fossil Energy addressed the Committee on the above information as well as addition recommended actions including promoting an open discussion among all the affected interests in additional measures involving conservation, research and alternative power sources through hearings and legislative recommendations. Energy saving policies in state transportation should be considered a priority. Data must be collected regarding energy use by state government for the executive and legislative arms to make continued decisions in the public's best interest. Purchasing policies should be flexible enough to permit common sense contracting for energy purchases as well as endorse energy conserving products. Integrated Resource Planning (IRP) by regulated utilities must be given the emphasis as an important step in the development of a prudent plan for benefit in the near-term and for future generations. (Attachment 1)

Questions were then directed at Lee Gerhard, Philip Madell and Donald P. Schnacke.

William R. Bryson, Chairman, Commission on Natural Gas Policy addressed the Committee on the Kansas Natural Gas Policy. It is the goal of the Commission to provide the Legislature and the Governor with a strategy which will assist the state and its citizens to obtain the full economic potential of its substantial natural gas reserves. The state must take steps supporting the development and production of this resource and create incentives to encourage the timely consumption of natural gas. The natural gas industry is also a substantial contributor to the state's treasury through severance taxes and taxes on the incomes of people associated with the industry.

In the Commission's opinion, both in-state and out-of-state markets can be further expanded if the state becomes an active advocate of Kansas natural gas and Kansas based natural gas consuming industries. It is also the Commission's belief that there are significant opportunities for an expanded natural gas market. With the enactment of the Clean Air Act Amendments of 1990 and the National Energy Policy Act of 1992, the demand for natural gas, an environmentally friendly fuel, will increase.

He also outlined economic development recommendations, for compressed natural gas, recommendations for utilization of natural gas at electric generating facilities, recommendations for Integrated Resource Planning, recommendations on fuel-switching and recommendations for helium. (Attachment 2)

Questions were directed at all Conferees.

The meeting adjourned at 4:50 p.m.

The next meeting is scheduled for March 22, 1993.

Date: March 18 '93

GUEST REGISTER

HOUSE

COMMITTEE ON ENERGY AND NATURAL RESOURCES

NAME	ORGANIZATION	ADDRESS	PHONE
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DAVID MADELL	KS CORP COMM	"	271-3249
W. Lynn Watney	Energy Research Center	Lawrence	864-3965
Lawrence Brady	Ks Geological Survey	Lawrence	864-3965
David R. Collins	Ks Geological Survey	"	864-3965
Paul Johnson	PACK	Topeka	2837
Kathy Sexton	DOB	"	
Bill Bryson	KCC	Topeka	271-3233
Jim Robinson	KCC	Topeka	271 3166
Lee Gerhard	Ks Geol Survey	Lawrence	864 3965
Don Schnacke	ICIOGR	Topeka	232-7772
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Carl Daugherty	EMPIRE DISTRICT ELE	Columbus	316 429 2337

Governor Joan Finney signed the Kansas Energy Policy Proclamation and established the Kansas Energy Policy Committee on September 17, 1991. This marked the beginning of the development of the state's first energy policy. The proclamation noted that the federal government's proposed national energy strategy had failed to meet the needs of Kansas energy producers and consumers. Those needs included policies on conservation, efficiency, protection of the environment; the effective search for and production of natural gas and crude oil; the generation of electricity; and dependable delivery of energy in all forms to Kansans.

J. Paul Jennings was appointed by Governor Finney to chair this blue-ribbon committee, which consisted of eighty volunteer members from throughout Kansas, representing every conceivable discipline, who devoted countless hours to the effort. Jennings divided the Kansas Energy Policy Committee into two subcommittees: fossil and non-fossil energy. The Fossil Energy Subcommittee, chaired by Dr. Lee Gerhard had five task forces of oil, gas, economics, environment, and coal. The Non-Fossil Energy Subcommittee, chaired by Philip Madell was divided into six task forces of efficiency/conservation/environment, transportation, renewables, utilities, state government, and agriculture.

This report is the culmination of the committee's work. The front section is the report written by the Fossil Energy Subcommittee and the following section is the report generated by the Non-Fossil Energy Subcommittee. The information contained in both sections was current as of September 1992.

Kansas Corporation Commission Chairman Jim Robinson has been a source of inspiration, guidance, and support throughout the project. This document was produced by Kansas Corporation Commission staff with special recognition to Graphic Designer Paula Schumacher, Information Resource Manager Jon McKenzie, and Director of Public Affairs Ramona Becker.

E & N R
March 18, 1993
Attachment 1

Mission Statement

State Energy Policy Committee

"We recognize in Kansas that the economy, energy, and our environment are inextricably intertwined, and that none of these factors can be considered separately from the others. We want to ensure that any recommended public policy is, first of all, beneficial to all of our citizens, and provides for a stable and reliable supply of energy, with special acknowledgment of our responsibility to future generations of Kansans."

"To meet this goal, we shall welcome and explore ideas, from whatever source, that address energy policy on a practical basis. We will pursue those suggestions that will work, the ones that keep our role as stewards of our natural resources in focus. To this end, we shall organize along functional lines that will encourage development of an honest strategy to use our natural resources wisely, including specific alternative fuels and energy conservation programs."

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FOSSIL ENERGY STRATEGY FOR KANSAS

NON-FOSSIL ENERGY REPORT (ENERGY FOR KANSAS)

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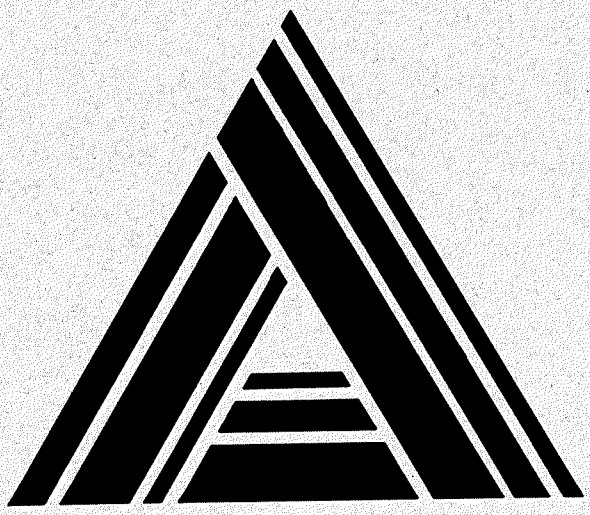
Fossil Energy Strategy For Kansas

Subcommittee on Fossil Energy
Lee C. Gerhard, Chairman



Compiled by

Energy Research Center
The University of Kansas
1930 Constant Avenue
Lawrence, Kansas 66047
(913) 864-3965 • FAX (913) 864-5053
October 1992

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Executive Summary

Energy issues in Kansas focus largely upon the need to more effectively produce and market its abundant energy resources, while conserving the physical environment of its citizens. Kansas has large resources of coal and oil, and very large reserves of natural gas. Although price is set in a global and national market place, Kansas can encourage the development of its resources and gain additional gross state product through implementation of state policies to enhance the use of state energy resources.

Kansas needs additional economic development and can use its governmental authority to encourage and reward significant advances in business growth. The Subcommittee for Fossil Energy recommends consideration of the following ideas for inclusion in the Kansas Energy Strategy:

General

1. Institute a capital gains tax reduction in the Kansas income tax.

2. Encourage risk capital formation in Kansas by instituting investment tax credits for new ventures and high risk investment.

3. Require a cost/benefit review of all new regulations.

Alternative Fuels

4. The State of Kansas should continue to exercise leadership in promoting CNG as an Alternative Fuel.

5. Greater encouragement should be provided for the use of alternative clean-burning fuels such as CNG, LPG, LNG, propane, etc. by public and private transportation fleets.

6. The governor should sponsor legislation to establish low-interest loans for the conversion of local government and school district fleets to CNG and to establish the infrastructure necessary to maintain and refuel such fleets.

7. A feasibility study should be conducted to explore the location of additional public CNG fill-stations in Kansas, with particular emphasis on locations on the Kansas Turnpike, Interstate 70, and in Johnson County and Wichita.

8. The State of Kansas should adopt policies that can lead to the expanded use of natural gas by Kansas utility plants.

9. The State should inventory idled natural gas generating capacity, and develop strategies to bring these facilities on-line once again.

10. The state should consider a "gas standard" policy, that electricity generated for Kansas consumption should be generated using natural gas unless utilities can demonstrate that use of an alternate fuel is cleaner, cheaper, and more reliable.

11. The state should work with local distribution companies and pipelines to improve rate and operating flexibility necessary to support the unique needs of the electric generating industry.

Taxes

12. The governor and the legislature should take steps to provide greater fairness and equity in taxation for the natural gas industry of Kansas. The Kansas legislature should lower the rate of the state severance tax on natural gas to 4.33%.

13. Tax credits to business could also be provided for the costs of conversion of fleet vehicles to CNG.

14. The impact of the sales tax on utilities used in production should be re-examined by the 1993 Legislature to determine the extent of the economic burden it places on industries in the state and whether it has reduced the attractiveness of Kansas for industrial location.

15. Provide tax credits for construction of fluidized-bed combustion units.

Marketing

16. The State of Kansas should create a marketing and promotional program for Kansas natural gas.

17. The State of Kansas, through the Kansas Corporation Commission (KCC), should work to encourage increased competitive access to gas supply by industrial consumers within the state.

18. The State of Kansas should promote the marketing and development of unique energy resources such as helium or other natural gas derivatives.

19. The Kansas Department of Commerce should explore the feasibility of establishing a department of gas marketing.

20. The State of Kansas should develop a market information clearinghouse for the natural gas industry.

21. Encourage the blending of Kansas coal with western coal.

Policy

22. The State of Kansas must take a more aggressive and visible position in influencing national energy policy, including advocacy at the Federal Energy Regulatory Commission (FERC).

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23. The State of Kansas should support the expedited treatment of incremental or expansion pipeline projects at the FERC, and before state and local governments.

24. The State of Kansas should not impose restraints on the production and marketing of Kansas natural gas except for conservation purposes.

25. The State, if possible under the decontrolled railroad rates, should seek more equable railroad rates for transport of Kansas coals to markets, when comparing transport of similar quantities of coal from producers outside of Kansas.

Environmental

26. Continue to implement effective and responsible state environmental regulations that are consistent with federal law, maintaining continued emphasis on the necessity of state-managed programs, but require more federal funding to support federal-mandated programs.

27. Create a forum to discuss the resolution of conflicting resource issues such as ground water protection concerns versus produced fluid disposal needs.

28. Provide an environmental base line and state standards, thus taking leadership from the federal establishment.

29. Provide legislation that will alleviate the extreme financial liabilities upon industry for actions taken under regulatory control. At present, even if operators follow regulations to the letter, they remain liable for damages resulting from their regulated activities. Prescribed actions by regulatory standard practice should not be liable for punitive damages. Other mitigation costs should be shared or paid by the regulatory agency.

30. Develop improved means to clean Kansas coal and encourage the market to purchase currently minable coal.

Education and Research

31. The State of Kansas should support an education program for consumers and students that informs them of the uses and benefits of natural gas.

32. Support research towards development of new environmental damage prevention and remedial techniques. Funding should be developed to allow the Energy Research Center and other entities to develop technology, which, when combined with state oversight, will help prevent adverse environmental effect from oil and gas activities.

33. Develop educational programs for the public about environmental issues facing the industry and the industry's initiatives to addressing those concerns.

34. Assist existing efforts to develop and apply technology which will improve recovery of existing Kansas energy resources in an environmentally benign manner.

35. Educate the public about real and perceived environmental issues which can be difficult, since the public sees as "real" some problems that the industry doesn't perceive as "problems".

36. Provide for technical assistance to independent operators, similar to the technical support given to agriculture. Help develop a Kansas Energy Research and Technology Transfer Center.

37. Develop information on the economic potential of coalbed methane in Kansas.

38. Make a study of the value of the petroleum industry to Kansas as a base for policy decisions.

Not all of these recommendations may be implemented, but they should serve as a base of discussion of the issues and opportunities Kansas faces now. Above all, the opportunity for Kansas to take national leadership in encouraging development of its resources is in front of us, and Kansas must determine whether to seize that opportunity.

Subcommittee on Fossil Energy

Lee Gerhard, Chair
Lawrence Brady, Technical Advisor
David Collins, Technical Advisor
Lynn Watney, Technical Advisor
David Pope, Task Force Chair
Larry Richardson, Task Force Chair
Donald Schnacke, Task Force Chair
Charles Warren, Task Force Chair
Dennis Woolman, Task Force Chair

Subcommittee members:

Thornton Anderson
Lee Banks
Rep. Marvin Barkis
Danny Biggs
Grady Bolding
Ralph Brock
William Brown
Sen. Paul Burke
William Bryson
Richard "Jack" Byrd
Spencer Depew
James Devlin
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R. O. "Dick" Pearce
R. D. "Dick" Randall
Gary Reed
Larry Richardson
A. Scott Ritchie
Jim Robinson
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Bill Wohlford
Lloyd Zelewski

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Energy Policy Committee-Fossil Energy Task Forces

Oil (Watney, Advisor)
Larry Richardson, Chair
Orvie Howell
Andrew McCalmont
Danny Biggs
Dick Pearce
Jim Rockhold
Jerry Langrehr
Thornton Anderson
Grady Bolding
Raymond Friend
Jack Goodman
Frank Novy
Gary Reed
M. D. Harrison
Bernard Nordling

Environmental (Gerhard, Advisor)
David Pope, Chair
Marsha Marshall
A. Scott Ritchie
Charles Warren
Jeff Kennedy

Economics (Collins, Advisor)
Charles Warren, co-Chair
Don Schnacke, co-Chair
Terry Leatherman
James Devlin
David Murfin

Gas (Warren, Advisor)
Charles Warren, Chair
Lee Banks
Spencer Depew
Dick Randall
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Dennis Langley
Ralph Brock
Bill Bryson
Jack Byrd
Jack Glaves
Mike McGraw
Lloyd Zelewski
Don Oden
William Brown

Coal (Brady, Advisor)
Dennis Woolman, Chair

(division of specific work areas for task force members)

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Introduction

October 15, 1992

Energy. Civilization is built on natural resources and energy. Society demands an ever-increasing abundance of energy to sustain its ever-increasing population. Third-world countries demand their share of the Earth's resources and energy, and look to consuming industrialized nations for supplies, or assistance in developing natural resources that may be indigenous to them. From the domestication of simple fire to the technological marvels of computers, human civilization has depended upon easily obtained energy resources for basic control of the human life environment. Settlement of mid-and-high latitude regions including Kansas require energy for maintaining shelter temperature. Energy is used to cool, heat, manufacture, grow, and process items necessary to modern survival. Fossil energy resources are the source of medicines and chemicals on which our daily lives depend, as well as fertilizers, clothing, housing materials, and transportation. In 1973, we were forced by the oil embargo to recognize that we live in an energy-based economy. The price of oil is by now more important than the price of gold to the United States economy.

Fossil energy resources are a primary source of national wealth. Like water, mineral, and soil resources, they support the basic social needs of our society. Wealth is created by the production and use of these resources. Wealth moves by wages and taxes through the entire economy. Additional wealth is created by further processing of natural resources to make value-added products. For years, the abundance of these natural resources in America provided the driving force for our economy. Without access to them, our economy would cease to function.

A few nations with limited endowments of natural resources (most notably, Japan) have found ways to prosper almost exclusively on the wealth created from value-adding activity. In such cases, the country is absolutely dependent upon the suppliers of raw materials for their survival. World War II was fought in the Pacific, in large part, over Japan's efforts to control access to the fossil energy resources and other natural resources which supported its economy.

Development of the vast fossil energy resources of the Middle East since World War II has resulted in a petroleum-based world economy. Like Japan, most nations in this world economy (including the United States) now depend upon imported fossil energy resources as a critical fuel for their economic engines. If not for this petroleum-based world economy, we would not have fought the Arabian Gulf War in February 1991.

The United States is now the world's leading debtor nation. When a country does not produce its own resources, but purchases them abroad, it sends some of its national wealth to other countries. Wealth may also return in trade, but the United States is experiencing a large net capital export. Careful development and implementation of public policy for natural resource management could decrease the rate at which we move our wealth to the rest of the world. Because the primary contributor to our trade imbalance is the cost of imported energy resources, a well-considered energy policy should form the foundation of such public policy.

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Global and National Fossil Energy Picture

The United States is the largest consumer and importer of oil in the world, using about 17 million barrels of oil a day. (Figure 1) Before the Kuwait invasion, we were importing over 50% of our oil (Figures 2 and 3). This means that about 8.5 million barrels a day came from non-U.S. sources, much of it (26%) from the Arabian Gulf region (Figure 4).

Global production is about 64 million barrels per day. Of that amount about 16.5 million barrels comes from the Middle East. Probably more than 50% of the world's reserves of oil are in the Middle East. Global oil production, excluding the Arabian Peninsula, has peaked and is falling off at a 0.9% annual rate. The United States leads the global decline, having lost nearly 2 million barrels per day of domestic production between 1985 and 1990. This loss of about 22% from the 1985 production resulted from reduced exploration, economic shutdown of leases, and normal production decline.

On the demand side, Dr. Lee Gerhard forecasts a continuing 1.5% global annual increase in demand, which has been exceeded in each of the last two years (Gerhard, 1989, 1991). This trend will continue unless external forces (supply interruptions, great price increases, or extended worldwide recession) mitigate demand.

The Middle East is the only region with substantial potential to increase oil production rates. Global production capacity in 1990 was estimated at 68 million barrels per day, with the 4 million barrels per day in excess production capacity located almost totally in the Middle East.

Figure 1 - U.S. Domestic Oil Production and Crude Prices, 1970-1991.

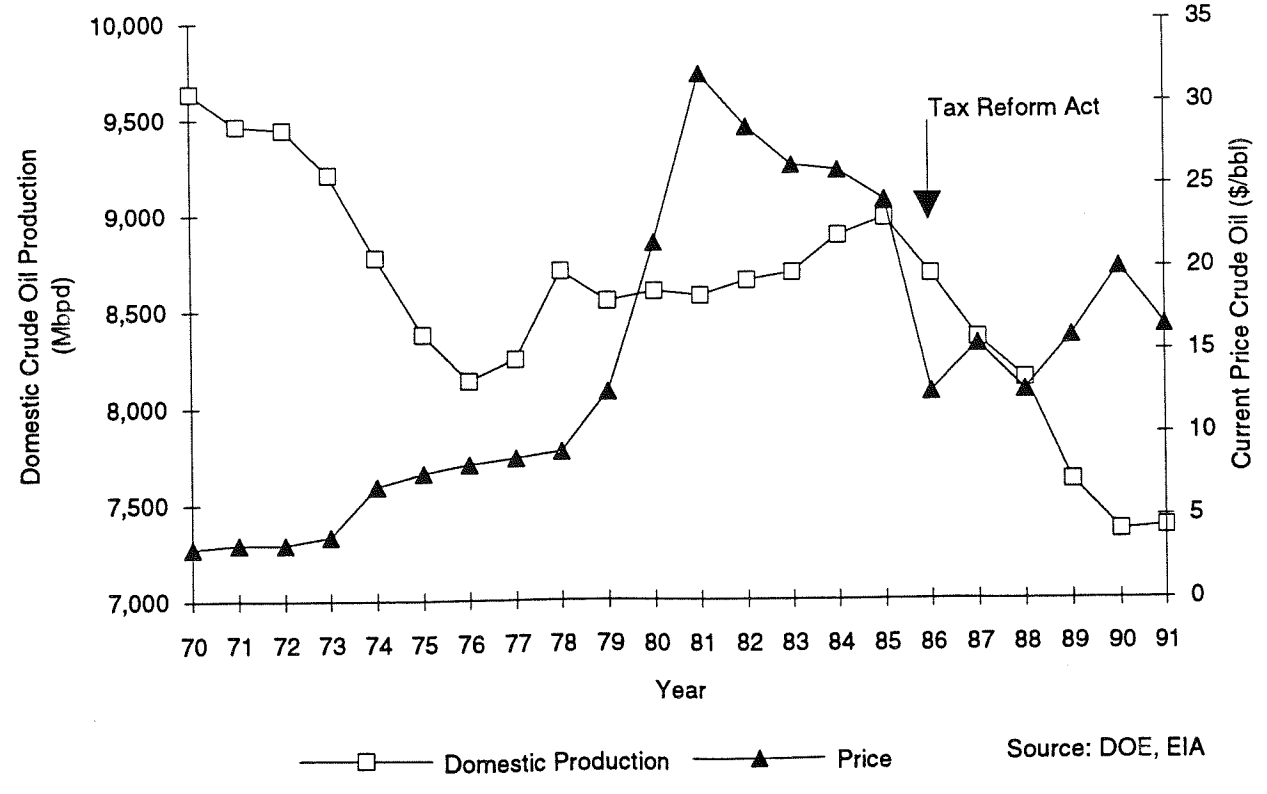

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Figure 2 - U.S. Domestic Oil Production and Annual Import Rates, 1970-1991.

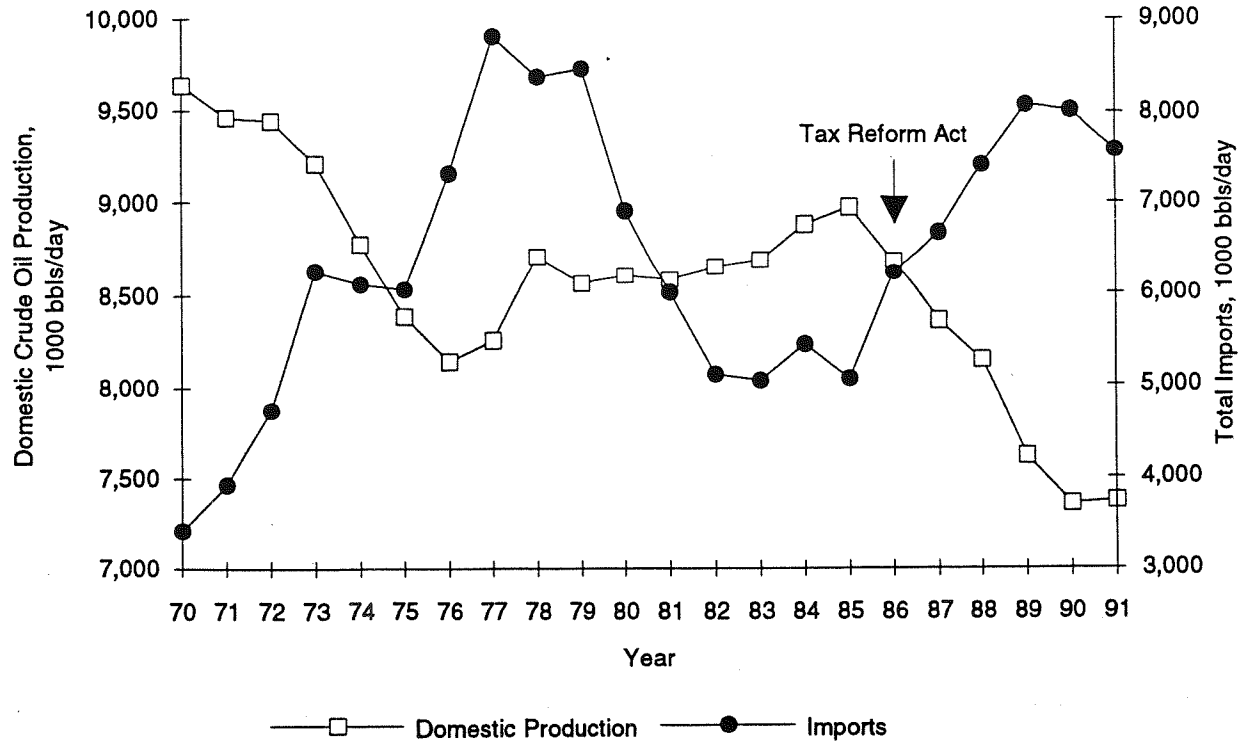

Figure 3 - U.S. Oil Imported vs. Crude Oil Price, 1970-1991.
Note timing of the 1986 Tax Reform Act with increased imports and lowered domestic rates.

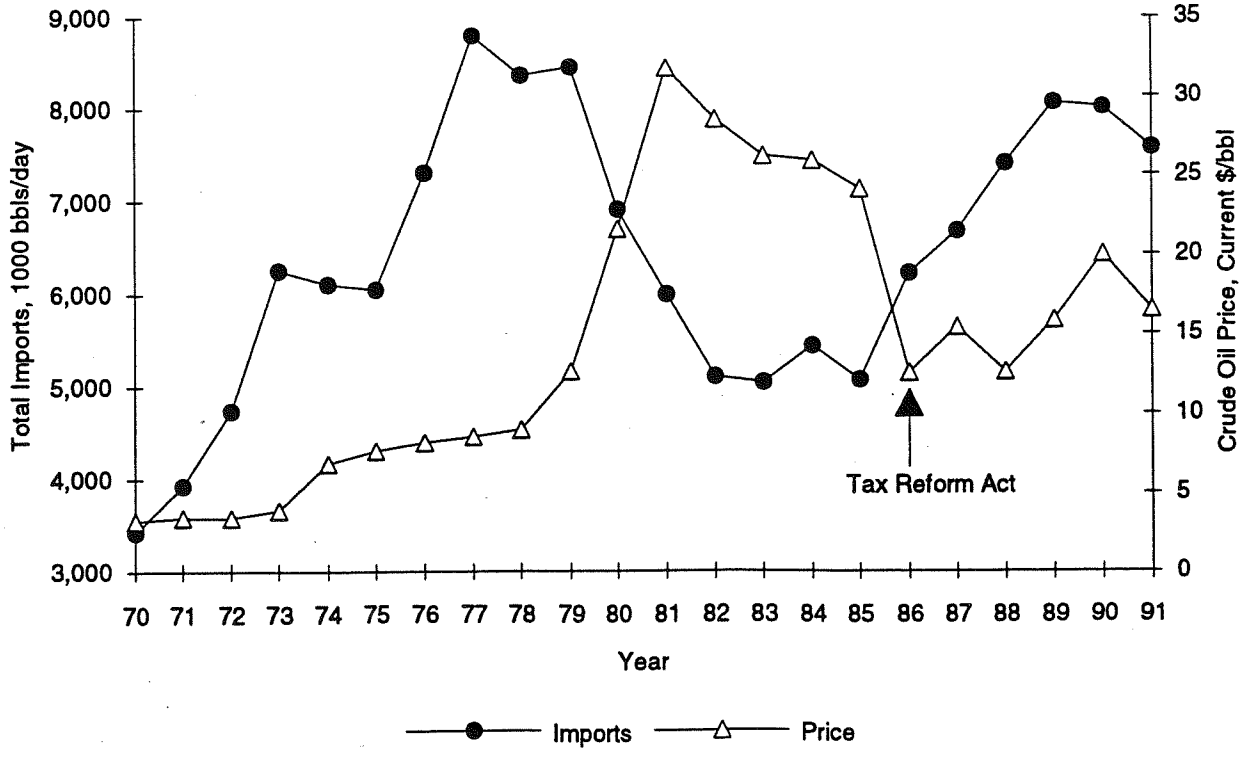

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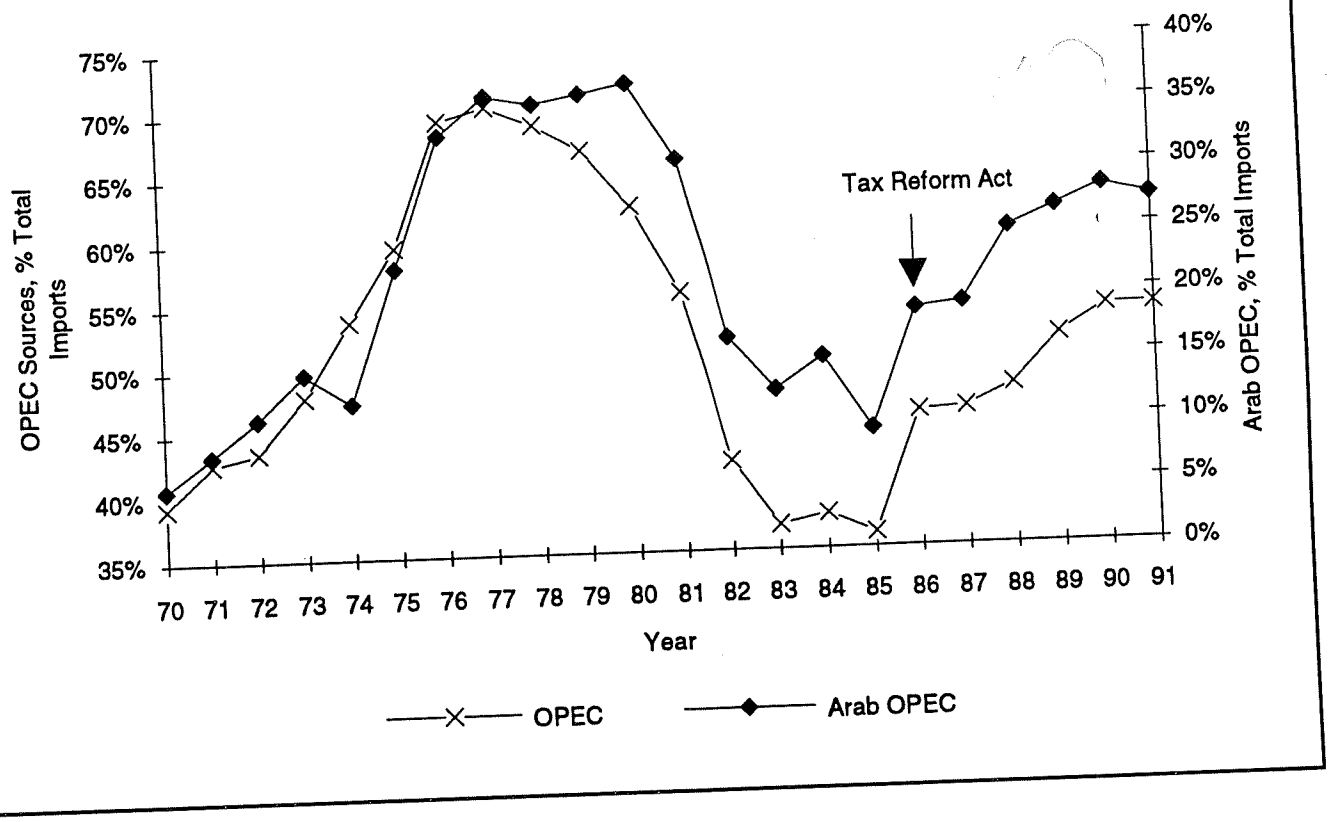
Figure 4 - Total Oil imported from OPEC Plotted against Amount from the Arab Portion of OPEC. Note increased reliance on Arab OPEC Oil from 1977-1989.



Through 1991, excluding brief shocks related to Operation Desert Storm, the price of crude oil was fairly stable in the range of $20/barrel. If the forecasted decline in non-Arabian production and increase in world demand are summed and compared with the excess capacity of 4 million barrels per day available in 1990, it is clear that at these prices ($20/barrel) global supply and demand may be equal (at about 66 million barrels per day) by late 1992. This would lead, not to shortages but to subsequent price increases at moderate rates (barring artificial price manipulation). If the non-Arabian production decline does not occur but demand increases as forecast, then global production should balance demand at the 68 million barrel per day capacity level in 1995. Other forecasts of stability or shortage are now appearing in relation to observed declines in Russian oil field production (N.Y. Times News Service, 1991).

Oil, after natural gas, is the most environmentally benign of the significant energy sources. Oil happens to be the easiest energy source to transport and use. Consequently, we use 8.5 million barrels per day in the United States simply for transportation fuel: gasoline, diesel, and jet fuel. That is over half of our current daily use of oil and that is why we have an energy problem. While the U. S. resource declines, the domestic petroleum industry is unable to respond as it did in the 1970s, mostly because of federal policies.

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Kansas Fossil Energy Production and Consumption

Let's continue to explore why we are in this position, and what the declining domestic industry means to Kansas in particular. Of the 33 oil and gas producing states, Kansas ranks 8th in oil output. Kansas oil production peaked in 1984-85 at a little over 75 million barrels for the year, from 51,888 oil wells. (Figure 5) During that same year, Kansans consumed 141 million barrels. Kansas is a net importer of petroleum. During that peak year, there were over 15,460 Kansans employed in the petroleum extraction industry; severance and production taxes paid in the state were over $243 million.

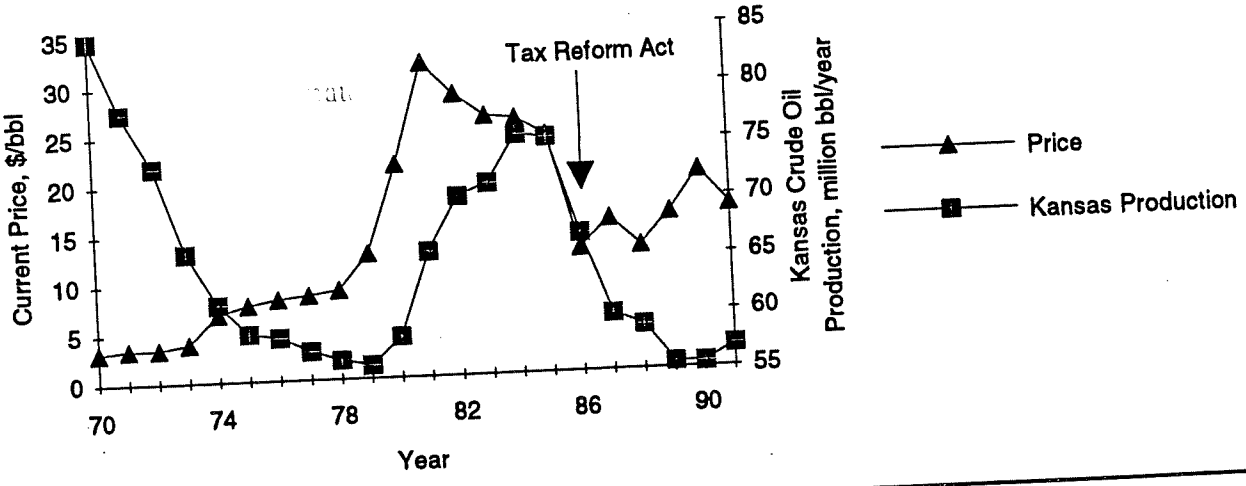
By 1990, Kansas production was down to 55.4 million barrels annually from 45,470 wells, consumption was down to 81.6 million barrels annually, and employment in the industry was down to 8,447. Severance and production taxes were about $206 million, up from $168.5 million in 1989 as a result of price increases resulting from tensions in the Middle East. There is a lesson in political economics here. During a time of increasing national needs, federal energy policy has caused the loss of over 7,000 Kansas jobs (over 430,000 jobs nationally) and millions of dollars in direct Kansas tax revenues (not counting the "ripple effect" coming from unemployed workers, royalty owners, and producers). The ripple effect is generally thought to be $3-4 for each dollar of new income created from oil production, so for every dollar lost, the state's economy loses $3-4 dollars in possible revenue.

Coal production and consumption have also changed dramatically over the last decade. In 1981, 1.35 million tons of Kansas coal was mined. That amount rose in 1987 to over 2.0 million tons, but dropped to 0.414 million tons in 1991. In contrast, over 15 million tons of coal were burned in Kansas in 1991, most of which originated in Wyoming and Illinois.

Natural gas is an important resource and export for Kansas. In 1985, Kansas produced 513 billion cubic feet (BCF), while consuming 355 BCF. In 1990, production was 558 BCF. Consumption data are not available for 1990, but should approximate the 1989 value of 341 BCF. At present usage, national reserves and potential resources of natural gas amount to about a 56-year supply.

Kansas produces no radioactive fuels. Uranium used in the Wolf Creek Plant is imported. Wolf Creek does produce radioactive waste.

Figure 5 - Kansas Oil Production vs. Price, 1970-1991.



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Kansas fossil energy production is constrained by federal policies. For instance, reductions in federal income tax rates for high incomes were introduced in 1981 and again in 1986, but with the consequent loss of tax deductions for exploration investments. Installation of an alternative minimum tax has greatly reduced the availability of venture (risk) capital. Without venture capital, risky wildcat and field extension drilling does not take place. There will be additional citations and discussions in this report which detail other constraints, but in general, federal policy changes in the last decade have worked to decrease investment capital in the energy production industries and have accelerated both the decrease in United States oil production and the flight of companies with working capital to overseas operations. The dilemma of the oil and natural gas industry is best shown by the number of drilling rigs operating in the United States. In 1981, there were 3,970 rigs operating. This number eventually peaked at 4,250 rigs. In April 1992, there were about 600 active rigs, the lowest rig count since record keeping began in 1942. Kansas rig count has similarly declined to record low levels since 1986 (Figure 6). Not only are many rigs stored in tool yards, but many have been dismantled and sold piecemeal, or exported overseas and their crews have been forced to seek employment elsewhere. The U. S. rig fleet has shrunk from 5,600 in 1982 to 2,300 in 1990. Additionally, 317,000 trained personnel have disappeared from the industry because of a lack of drilling activity in both major and smaller companies (Figure 7).

Success in stabilizing an ever decreasing oil and gas production in the United States will take a coordinated effort between independent operators and the government along with a new level of understanding by the American people. Reduced dependency on foreign oil requires sustained domestic energy production and increased energy efficiency. The American public must understand that the costs borne now will be paid back in an economically stronger and more strategically sound America.

Figure 6 - Oil Price and Number of Drilling Rigs Active in Kansas, 1970-1991.

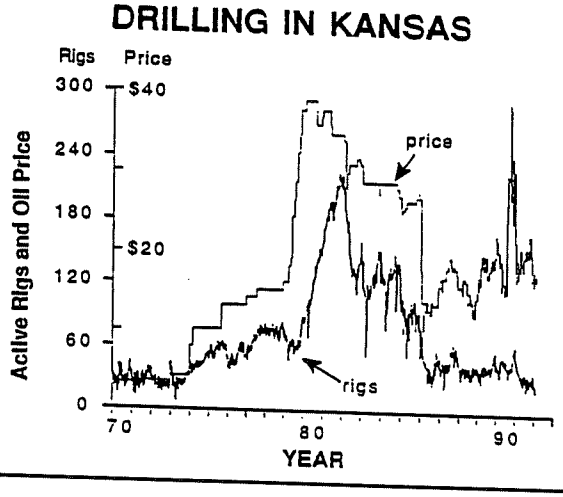
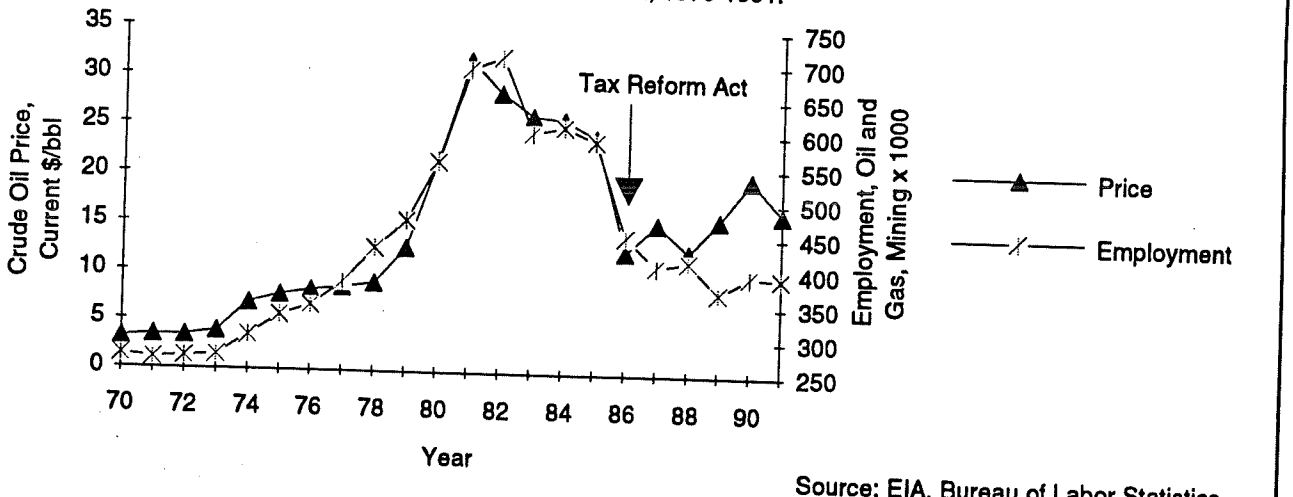


Figure 7 - Employment in Extractive Industries and Price of Oil, 1970-1991.



Source: EIA, Bureau of Labor Statistics

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National Versus State Activity In Fossil Energy

Several areas of national policy or attitudes affect the conduct of state energy development plans. For Kansas, discouragement toward access to federal lands is not a serious issue, for few federal lands or minerals are present. In most western states, however, federal control over access to minerals is a major impediment to development of resources of all kinds. Tax policy is certainly discouraging, as the prudent investor can make a better return on investment in an insured certificate of deposit than in a high risk oil or gas drilling venture. The federal energy policy now under discussion is slanted heavily towards coal, and the United States Department of Energy (USDOE) funding of coal programs, including research, is very high. Review of the National Energy Strategy (NES) shows little to assist the independent petroleum industry, although with careful nurturing, some support for reservoir research will be available. In the main, the federal policy recognizes that although the independent industry is now the mainstay of American oil production, the primary large deposits upon which a national strategy of cheap energy can be based are in the Arctic, offshore, and in other countries.

Environmental regulation and court decisions establishing unlimited financial liability Comprehensive Environmental Recovery and Clean-up Liability Act [CERCLA (Super Fund Act)] have placed another damper upon natural resource development. Few investors are willing to risk capital in risky ventures which could be wiped out by small changes in regulations or nuisance lawsuits. The reauthorization of the Resource Conservation and Recovery Act (a real misnomer) in the next congressional session would have a major negative effect upon the Kansas industry. One example of the impact of environmental regulation, both national and local, is that no new oil refineries have been constructed in several years, although some 200 have closed down. Efficiencies created in remodeling existing large refineries keep fuels flowing; however, a major shutdown of any large refinery can bring shortages within a few days.

Also, OPEC countries are focusing their investments into downstream operations following production such as refining and marketing operations. We are importing increasing amounts of products, where the labor costs are paid overseas and we purchase value-added goods.

Finally, there is little interest in Washington in conservation. The focus is on cheap energy. Kansas must recognize the political power of eastern and western seaboard states that have few or no energy resources and have major energy-consuming industries and populations. These states will not permit the real cost of energy to rise more than dictated by OPEC. However, consideration should still be given to fossil energy conservation policies, such as selective energy consumption taxes and mass transit.

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OIL

The Kansas oil industry is characterized by small operators (over 3,000 registered operators), small lease ownership concentrated in tightly held areas, and small capitalization. Many operators are sole proprietorships, so that decisions can be made rapidly. However, long-term planning and coordination of resource extraction at the regional level suffers. Individual companies may operate only within a single play (similar reservoirs), further dividing an industry whose smaller operators are fiercely competitive and secretive.

Sources of investment capital range from internal company funds for the smallest operators drilling and producing solely for their own accounts, to drilling funds, such as limited partnerships, that bring external capital to the ventures.

For the most part, Kansas is regarded as a mature part of the Midcontinent oil province, with limited opportunities for major new discoveries or very large returns on investment. Generally speaking, a return of 30% before taxes or 5-7% after taxes is normal. Large fields are now found much less frequently than in the past. However, ample opportunity exists for discovery of new fields, especially in the western two-thirds of the state, and for implementation of improved recovery in existing fields. Some 11 billion barrels of oil are believed to remain unproduced and in existing fields. Table 1 compares estimated proven oil reserves in the U.S. and Kansas for the period of 1981-1989. Table 2 compares crude oil production in Kansas, the U.S., and the world with crude oil price.

Subtle traps and bypassed oil are the future of new exploration and development in Kansas, relying on an increasingly sophisticated geological interpretation of reservoir rock formation and location. Engineering of wells from beginning to final production coupled to geological characterization of reservoirs may recover many more barrels of oil than was hitherto possible.

Table 1
Estimated Proved Reserves of Crude Oil for Kansas and the U.S. [1] (Millions of Barrels).

	Kansas	U.S.
1981	371 [2]	29,426 [3]
1982	378	27,858
1983	344	27,735
1984	377	28,446
1985	423	28,416
1986	312	26,889
1987	357	27,256
1988	327	26,828
1989	338	26,501
1990	321	26,254 [4]

(1) Amounts are for Dec. 31 of years shown.

(2) Energy Information Administration (EIA), 1983, U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1982 Annual Report: U.S. Department of Energy, DOE/EIA-0216 (82), p. 99.

(3) U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1988 Annual Report, DOE/EIA-0216 (88), Table 1, p. 6.

(4) DeGolyer and MacNaughton, Twentieth Century Petroleum Statistics, 1991, 46th Edition, Table 18, U.S. Crude Oil Reserves and Production (data from EIA).

(5) U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1990 Annual Report, DOE/EIA-0216 (90), Table 1, p. 8.

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Table 2
Crude Oil Production (Kansas, U. S./World)
in thousands of barrels and price of oil.

	Kansas	U.S.	World	U.S. avg. Nomial crude oil price
1981	65,810 (1)	3,128,624 (2)	20,362,810 (3)	$31.07 (4)
1982	70,525	3,156,715	19,419,066	28.52
1983	71,594	3,170,999	19,331,073	26.19
1984	75,729	3,249,696	19,842,847	25.88
1985	75,407	3,274,553	19,586,219	24.09
1986	67,034	3,168,252	20,402,858	12.51
1987	60,544	3,053,488	20,588,486	15.40
1988	58,824	2,983,172	21,417,112	12.58
1989	55,484	2,783,588	21,752,549	15.85
1990	55,427	2,684,687	22,438,966	20.03*

(1) DeGolyer and MacNaughton, Twentieth Century Petroleum Statistics, 1990, 46th Edition, Table 23, Crude Oil Production, P.A.D. District No. II, (data from DOE).

(2) DeGolyer and MacNaughton, Twentieth Century Petroleum Statistics, 1991, 46th Edition, Table 18, U.S. Crude Oil Reserves and Production (data from EIA).

(3) DeGolyer and MacNaughton, Twentieth Century Petroleum Statistics, 1990, 46th Edition, Table 4, World Crude Production (data from DOE, World Oil).

(4) EIA, Annual Energy Review 1990, DOE/EIA - 0216 (90).

Oil that has lost major portions of light or volatile components is commonly viscous or tar-like, frequently referred to as "heavy oil". Heavy oils are defined as being below 25 degree American Petroleum Institute (API) gravity (as compared with a more normal average of 35 degree oils elsewhere in Kansas). These oils are difficult to extract from reservoirs because of their very viscous to nearly solid or tarry nature. (Wells, et al., 1982) These kinds of oils occur in scattered fields across Kansas, but are primarily concentrated in extreme Southeastern Kansas. A resource of 200-225 million barrels of heavy oil in-place is estimated to be present in Bourbon, Crawford, and Cherokee Counties. (Ebanks, et al., 1977) This is also an important resource for Kansas. In Southeastern Kansas, the heavy oil reservoirs are irregularly distributed, discontinuous sandstones buried at less than 1,000 feet. Sandstones of over 20 feet in thickness and with greater than 400 barrels per acre-foot saturation may be suited to recovery by special techniques. The quality of oil appears to be good with an average hydrocarbon content of 70%. (Ebanks, et al., 1977)

Some of the strengths of the Kansas oil industry are lower cost leases (averaging about $10 per acre with an 87.5% net revenue interest to the lessor), limited environmental regulation of land use, and limited

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population growth interfering with non-urban land use. Air quality and water quality are very good compared to the rest of the country. Climate plays little role in the cost of operations, neither being too hot nor too cold. Roads and land are not affected by deep frost and year-round operations are the norm.

As the international oil industry changes, the Kansas industry is impacted. Competition is global, with Kansas oil competing for market share with other states and with OPEC, Mexico, and other international producers. Costs of operating in Kansas thus become crucial to the industry's health. Finding costs, lifting costs, and taxes in Kansas are high compared to other areas due to the low productivity of Kansas wells. Consequently, every increment of costs either saved or expended determines the fate of many of the small stripper wells that produce much of the Kansas oil.

A disturbing trend in the international arena is the concentration of downstream operations such as refineries and marketing into the hands of a few companies. Many of them are national oil companies of OPEC. Some U.S.-based multi-national companies have formed partnerships or outright sold interests in their domestic downstream operations (such as Texaco's refinery deal with Saudi Arabia). Foreign companies are increasing investments into refineries. All this indicates that further multi-national control of U.S. oil supplies is unavoidable.

Oil must also compete for market share with other fuels. At the present time, natural gas is an attractive alternative to oil because of low price and environmentally benign side effects of both development and consumption. Coal, particularly clean western coal, is also competitive as a boiler fuel. As yet, no other energy source threatens gasoline as an automotive fuel. However, natural gas may offer a viable alternative to gasoline as refueling stations become more numerous.

Although oil has been a relatively clean fuel source, much environmental criticism has been extended to the industry because so much oil is found on federal lands and in federal waters. As long as there are vocal groups focusing on denying access to federal lands and resources, the oil industry will be targeted for great attention. While this is becoming more evident in the Kansas oil industry, private ownership of land and minerals has aided Kansas exploration.

By and large, the regulatory load in Kansas is being increasingly enforced and tightened. Environmental regulation is mostly imposed from federal agencies, but administered by state agencies. The cost of environmental cleanup and litigation is rapidly increasing, requiring that appropriate technically-based regulation coupled with protection from non-negligent liability be implemented to encourage full voluntary regulatory compliance.

New technology brought to the industry may or may not be effectively used in Kansas. Most of the multinational companies have left Kansas or have only minimal presence, thus demonstrations of new technology developed by industry research laboratories are few. Many operators do not belong to or participate in industry trade groups with technology transfer programs, leaving few options to move new techniques of oil recovery to individual operators. State-supported research groups, such as the Kansas Geological Survey and Tertiary Oil Recovery Project (TORP), and academic groups such as the Kansas University (KU) Energy Research Center can be effective, but their programs are insufficiently funded at this time to fully address this large issue of technology transfer to the independent oil operator. Federal efforts to develop and transfer technology to independent operators are increasing and may be the most effective way of increasing the efficiency of small operators. These federal programs fund local organizations to develop and demonstrate technology and technology transfer and educational programs. The Energy Research Center at the University of Kansas is currently developing a major technology transfer program. This, along with technology transfer programs available through the Interstate Oil and Gas Compact Commission (IOGCC), should aid Kansas producers in maximizing their enhanced recovery programs.

Several methods of potentially increasing production from marginal wells and marginal properties are being examined in Kansas. Among these, horizontal drilling, carbon dioxide floods, and better reservoir management appear to have good potential.

At present Kansas produces 155,000 barrels of oil per day and has proved reserves of 338,000,000 barrels. Over 93% of all producing wells are strippers. Kansas lost 1,470 wells in 1989 while drilling and completing 917 oil wells, 552 gas wells, and 1,071 dry holes.

NATURAL GAS

Natural gas in Kansas is an important resource and a potential major income producer. However, current prices, the need to increase pipeline access to existing markets, the need to enhance existing markets for natural gas, and the need to develop significant new uses of natural gas has limited its potential contribution to the Kansas economy.

The Potential and Problems of Natural Gas

Natural gas is widely considered to be the most environmentally benign fossil fuel; it is abundant, and can be easily transported and used. Barriers to widespread further development of natural gas as a fuel are adequate storage and transmission, a perceived uncertainty of reliable supply, and competition from existing fuels for maintaining their current market shares.

A June 1992 study commissioned by the Interstate Oil and Gas Compact Commission (IOGCC), Barriers to the Development and Expanded Use of Natural Gas Resources, identified the major impediments. The authors classified three types of barriers: physical, regulatory, and market. They are summarized as follows:

Physical Barriers

- Inadequacy of existing pipelines: "...demand may be located in a part of the country that is not adequately connected to natural gas pipelines," as in Florida for example. (p. 11)
- Lack of natural gas infrastructure: Lack of compressed natural gas (CNG) stations for natural gas vehicles (NGVs).
- Low Capacity Electric Generation Economics: Low capacity generation facilities cannot justify the capital expenditures to convert to natural gas use.
- Lack of necessary gas flow information: "As the pipeline transportation market becomes more competitive, the lack of instantaneous information about the precise flow of natural gas at every location on a pipeline becomes, in practical effect, a physical barrier." (p. 12)
- Lack of storage facilities to meet peak demands: Especially near major cities to increase the attractiveness of natural gas as a year-round fuel and to ensure supplies in cold winters.
- Lack of adequate supply and market pooling points: Supply pooling points or hubs closer to the market would increase reliability and improve pricing signals.

Existing Regulatory Barriers

- "Producers are concerned about their ability to compete with pipelines and local distributing companies (LDCs) for bundled sales service; they also are uncertain whether potentially adverse actions may be taken by state regulatory agencies." (p. 13)
- "The 'sanctity of contracts' has been shaken by recent history and has resulted in uncertainty in the industry, due to curtailment and take-or-pay problems."
- "Interstate pipelines are concerned about their ability to compete and earn adequate rates of return," given recent FERC rulings.
- "LDCs are concerned about being bypassed by other pipelines which can offer service to their high-volume customers ..."
- Consumers are concerned about proration efforts of gas producing states and regulations that will unreasonably increase the delivered cost of the product.
- "Many segments of the gas industry are concerned about regulatory actions which may increase their costs of doing business (such as environmental compliance costs)."

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Existing Market Barriers

- "Some view natural gas as unreliable, as a result of the spot shortages of natural gas during the late 1970s and early 1980s."
- "Some may view natural gas as being dangerous, subject to leaks and to potential explosions."
- "Some may view natural gas as an exotic 'alternate' fuel in comparison to heating oil or coal which may appear to be more traditional energy sources."
- "Some customers are concerned that the supplies of natural gas may be inadequate to meet future demands." (p. 15)

The IOGCC report provides great detail about these barriers and offers a number of specific recommendations to overcome them.

At the national level, curtailments in the mid-1970s and price increases created public mistrust of natural gas. Although reserves are high, they have declined in the past ten years, primarily as a result of low market prices and a consequent decline in exploration and production. Nationally, natural gas reserves in 1990 had declined 19 percent since 1981. But, Kansas reserves have remained relatively stable at 9.6 trillion cubic feet (TCF) declining only 8 percent since 1981. (Table 3) However, reserves are not a primary issue. Future supplies of natural gas and its availability to consumers are the major issues hampering increased use of natural gas by both major industry users and those who generate electricity.

In 1986, the Potential Gas Committee (out of the Colorado School of Mines, Golden, Colorado), an independent "think group" of volunteer experts, estimated that there was about 461 TCF of probable and possible gas to be discovered, with an additional 278 TCF in a "speculative" category. In 1988, the numbers were 440 TCF and 265 TCF, also 90 TCF was added to national total potential gas from coalbed methane. Changes in values reflect the booking of reserves from probable potential gas, technology changes, and new information about gas reservoirs.

Table 3
Estimated Proved Reserves of Dry Natural Gas for Kansas and the U.S. [1] (billion cubic feet).

	Kansas	U.S.
1981 [2]	10,443	209,434
1982 [3]	9,724	201,512
1983 [3]	9,553	200,207
1984 [3]	9,387	197,463
1985 [4]	9,337	193,369
1986 [4]	10,509	191,586
1987 [4]	10,494	187,211
1988 [4]	10,104	168.024
1989 [4]	10,091	167,116
1990 [5]	9,614	169,346

1) Amounts are for Dec. 31 of years shown.

2) U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1982 Annual Report, DOE/EIA-0216 (82), Table 8.

3) Natural Gas Annual 1986, vol. 1, DOE/EIA-031 (86), Kansas Table 6, U.S. Table 1.

4) Natural Gas Annual 1989, DOE/EIA-0131 (89), Kansas Table 6, U.S. Table 1.

5) U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves, 1990 Annual Report, DOE/EIA-0216 (90), Table 11.

The estimates of proven and potential supplies of natural gas range between an optimistic 56-year supply and a pessimistic 20-year supply. The most optimistic projection was made in 1990 (Rochester, 1991) at 519 TCF in probable and possible reservoirs, including a major increase in assigned probable gas to Alaska, and 866 TCF total (compared to 796 TCF, 1988; and 739 TCF, 1986), including 145 TCF of coalbed methane. Adding in estimated reserves of 169 TCF, and dividing by annual present rates of consumption of 18.5 TCF, a 56-year supply of gas to the nation is forecast. This estimate would depend on the discovery of all of the highest risk speculative gas thought to exist.

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The future scenarios for the supply of natural gas depend on estimates of market prices and, thus, the extent of exploration and drilling. If price does not change appreciably, (although volatile at the time of this writing) and the possible and speculative gas is not exploited, the nation could have 369 TCF, which is only a 20-year supply at current consumption levels.

Several other issues hamper fuller development of natural gas. Transportation of natural gas is primarily by pipeline, and the capacity of pipelines are restricted at times. Some major geographical markets lack nearby storage causing transmission facilities to fail to meet demand during peak usage, such as major, prolonged cold waves. The failure of the gas industry to adequately supply domestic needs during the 1970s was widely perceived as a lack of gas supply, when it was actually a lack of transportation. Major markets in the Northeast and California will be served by Canadian natural gas, as North Central United States has been served for some years.

Environmental constraints on pipeline siting and construction, largely due to local resistance, rather than actual environmental damage, will continue to hinder the development of a more comprehensive transportation and storage system. Safety concerns are exacerbated by residential explosions and fires, and petroleum-related storage tank explosions and spills.

It is in the context of this history and background that the Kansas natural gas industry seeks new markets and expanded production at higher price levels.

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Kansas Natural Gas Production

Kansas natural gas production was first recorded in the 1860s and over 28 TCF has been produced in the state. (Beene, 1991) In 1990, nearly 560 BCF was produced from over 14,000 wells in 61 counties. Natural gas is a broad-based Kansas resource; over half of the counties in Kansas participate in revenues derived from the industry and payrolls associated with the resource development. Yet, 70 percent of the natural gas produced is derived from six counties in Southwest Kansas.

Each of 679 gas fields in Kansas has produced more than 200 million cubic feet of natural gas. The largest producing areas in 1990 were: 1) Hugoton, 19.5 TCF, 2) Panama, 1.6 TCF, 3) Greenwood, .98 TCF, and, 4) Spivey-Grabs-Basil, .7 TCF. The single most important reservoir rocks are the Chase Group of the Hugoton area, but nine distinct geologic units produce significant natural gas. (Newell, et al., 1987)

Production of natural gas in Kansas does not follow national trends. (Table 4) For instance, production fell 33 percent between 1981 and 1982 in Kansas, whereas national production was up approximately 5 percent. Conversely, national production went up 3 percent from 1987 to 1988, while Kansas production was up 25 percent. From 1989 to 1990, Kansas production declined 5 percent, while national production was up 2.6 percent.

Price for Kansas gas has lagged national norms because of price constraints under existing, interstate contracts on Hugoton production and other "old" gas. In 1981, Kansas gas sold for 46 percent of the national average. (Table 4) With deregulation, the gap between Kansas and national prices has narrowed. In 1981, Kansas gas sold for 46 percent of the national average; in 1987, 69 percent; in 1988, 80 percent; and, in 1990, latest figures available, 91 percent. Although an extensive amount of Kansas gas is sold to local markets, many have suspected that the Hugoton area was being held as a "swing field" and storage reservoir rather than being exploited to its maximum, efficient rate of production. However, since gas deregulation in 1987, the responsibility to move gas has fallen to the producer. In order to protect the correlative rights of royalty owners in the competitive Hugoton field, operating companies have faced increased pressure to produce gas to protect reserves. Field competition has caused operators to move as much gas as possible.

Kansas natural gas consumption is high compared to production, and unlike oil, Kansas is a net exporter of natural gas. In 1981, Kansas consumed 67 percent of its marketed production, and, in 1990, 62 percent. (Figure 5)

Conclusion

There is a very large natural gas resource available in Kansas. It has not produced as much of its capacity or at as high a price as other natural gas resources in the United States. In order to develop the Kansas natural gas resource further, initiatives to ensure fair treatment are needed. Development of additional local and national markets are also necessary.

Table 4
Marketed Production of Natural Gas (Kansas, U.S.) (Million cubic feet).

	Kansas	Kansas Average Wellhead Price $	U.S.	U.S. Average Wellhead Price $
1981	640,114	$ .92	19,955,823	$ 1.98
1982	440,951	1.51	18,582,005	2.46
1983	447,207	1.57	16,884,093	2.59
1984	480,211	1.49	18,304,339	2.66
1985	528,032	1.27	17,270,227	2.51
1986	478,963	1.21	16,858,675	1.94
1987	472,752	1.15	17,432,901	1.67
1988	592,845	1.36	17,918,465	1.69
1989	601,196	1.44	18,095,147	1.69
1990	573,603	1.56	18,561,596	1.71

Source: Natural Gas Annual 1990, Vol. 1, Table 7. p. 38-44, DOE/EIA-D130 (90) 1.

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Table 5
Consumption of Natural Gas in Kansas
(million cubic feet).

Delivered to Consumers

	Residential	Commercial	Industrial	Electric Utilities	Other [1]	Total
1981	74,701	52,036	154,979	79,117	67,297	428,130
1982	81,804	55,470	118,922	61,063	83,661	400,920
1983	80,538	52,535	95,963	47,226	68,942	346,204
1984	79,340	57,516	118,238	32,234	76,343	363,671
1985	78,350	56,522	118,847	21,181	80,567	355,467
1986	70,582	55,730	100,005	15,029	71,334	312,680
1987	69,653	53,609	113,390	16,074	75,338	328,064
1988	76,420	61,120	108,108	18,890	88,385	352,924
1989	76,033	58,554	100,623	19,152	86,928	341,289
1990	71,327	56,045	116,915	26,978	81,514	352,780

1) Other includes lease and plant fuel, and pipeline fuel (fuel used to produce fuel).
Source: Natural Gas Annual 1990, Vol. 2, DOE/EIA 2 tables 14-15, p. 132-141, 170-189.

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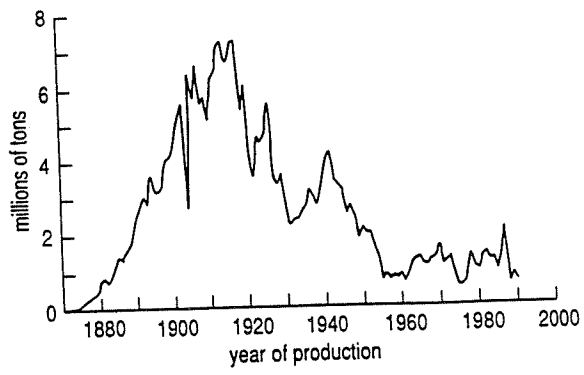
Coal deposits in Kansas have been exploited for nearly 140 years with a total production of approximately 300 million tons. There were two major peaks of production during this period corresponding to World War I and World War II. (Figure 8) The availability and use of natural gas and petroleum in Kansas and the extraction of most of the important Weir-Pittsburg coal reserves were the major factors in the decline of Kansas coal production. The peak production year was 1918 with over 7.3 million short tons produced. Production of coal in 1991 was 0.41 million tons and as recent as 1987 production was 2.0 million tons (1.8 million mt). In the past 20 years, 19 different coal mines operated in Kansas. All but one of the mines operated in either Crawford, Cherokee, Bourbon, Linn, or Labette Counties in Southeast Kansas. In 1992, only two coal mines are in operation in Kansas, both in eastern Crawford County.

Bituminous coal resources of Pennsylvanian age are widespread in Eastern Kansas and represent nearly all the coal resources in the state. There is a small amount of coal in Lower Permian rocks and a limited amount of lignite in Lower Cretaceous rocks in Central Kansas. Deep coal resources are known in 32 coal beds, and strippable coal resources in 17 coal beds. Most of the deep coal resources are coals of the Cherokee Group. At the present time, six coal beds stratigraphically higher than the Cherokee Group are also included in the deep coal resource total.

Figure 8 - Historic production of coal by year in Kansas.



Stratigraphic Position of Coal

Coal beds having present resource potential are almost entirely in rocks of Pennsylvanian age. Past production included coals from Permian and Cretaceous age rocks in Kansas; but coal from Pennsylvanian age rocks represents 99.9 percent of the total recorded coal production in Kansas. The remaining 0.1 percent represents a small production of 300,000 tons of lignite from the Dakota Formation of Lower Cretaceous age (Schoewe, 1952, p. 99) and about 10,000 tons of lignite from Permian rocks (Schoewe, 1951, p. 57). Shown in Table 6 (Brady, 1990, p. 109) are the stratigraphic positions of the coal beds with past commercial mining history in the state. Nearly 90 percent of all coal mined in Kansas is from the Cherokee Group and these coals also dominate the resources in the state. 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 in eastern Linn County. This coal bed was the leading coal bed produced in Kansas during the late 1980s. Prior to the recent extensive mining of the Mulberry coal in those years, the Cherokee Group coals were the main coal beds mined, especially the Weir-Pittsburg coal. Mining of this one coal bed (Weir-Pittsburg) represents nearly half of the total historic coal production in Kansas. Most of the original shallow-depth coal resources of this important coal bed were either stripped or mined by room and pillar methods. Cherokee coal beds presently mined include the Mineral, Bevier, and Croweburg coals. Other coal beds mined within the past 20 years include the Mulky, Fleming, Dry Wood, Rowe, and two unnamed coal beds. One of the two unnamed coal beds is present above the Bevier coal and the second bed is present below the Neutral coal bed.

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Table 6
Stratigraphic distribution of commercial coal beds mined in Kansas.

Period	Group	Formation[1]	Coal Bed[2]
Cretaceous		Dakota Fm.	Lignite in Janssen Member (several beds)
Permian	Council Grove	Blue Rapids Sh.	Unnamed Coal
Pennsylvanian	Wabaunsee	Root Sh.	Unnamed "Lorton"
"		Pillsbury Sh.	Unnamed "Nyman"
"		Cedar Vale Sh	Elmo
"		Aarde Sh	Nodaway (*) (u)
"	Douglas	Lawrence Fm.	Williamsburg
"	"	Stranger Fm.	Upper Sibley
"	"	"	Unnamed "Ottawa"
"	"	"	Unnamed "Blue Mound"
"	Kansas City	Chanute Sh.	Thayer
"	Marmaton	Bandara Sh.	Mulberry (*) (c)
"	Cherokee	Cabaniss	Mulky (*)
	"	"	Unnamed "Stice"
	"	"	Bevier (*) (u) (c)
	"	"	Croweburg (*) (c)
	"	"	Fleming (*)
	"	"	Mineral (*) (c)
	"	"	Weir-Pittsburg (*) (u) (c)
	"	Krebs	Dry Wood (*)
	"	"	Rowe (*)
	"	"	Unnamed
	"	"	Riverton

(*) Important Production.
[1]Formation and informal coal bed names based on Zeller (1968).
[2]If the unnamed coal has a local name, it is shown in quotes.
(c) Coal beds mined commercially in 1989.
(u) >500,000 tons underground production.

Strippable Resources

Strippable coal resources in Kansas that are present under less than 100 ft. of overburden total nearly 2.8 billion tons as summarized in Table 7. The Demonstrated Coal Reserve Base for Kansas as listed by the U.S. Department of Energy (USDOE) is 978.3 million tons for 1990. This figure represents strippable coal in Kansas in place that is, in the Measured and Indicated categories of the 0-100 ft overburden less the amount of coal mined from 1976 until 1990.

Details of individual coal-bed resources and their reliability category (Figure 9) amounts are also listed in Table 7. 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. Minimum thickness of the coals evaluated by Brady and others (1976) was 12 inches. General area distribution of the coal resources by stratigraphic group is shown in Figure 10.

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Deep Coal Resources

The coal resource quantity for deep coals in Eastern Kansas is determined to be about 53 billion tons of coal (Table 8) measured from 32 different coal beds. These preliminary resource quantities are subject to additional review of data. Emphasis in the evaluation of the deep coal resources was on coal beds of the Cherokee Group because of the recognized importance of coal in this geologic group in Kansas. However, six coal beds stratigraphically higher than the Cherokee coals are included in the deep resource total. For deep coals, a thickness of 14 inches or greater is considered in the resource amounts.

Table 7
Summary of strippable coal resources by bed and reliability category.[1]

Tonnages (Million short tons) by Reliability

Category Geologic Group	Coal Bed	0-100 ft Overburden			30:1 Stripping Ratio		
		Measured	Indicated	Inferred	Measured	Indicated	Inferred
Wabaunsee	Lorton	0.1	1.3	6.1	0.1	1.3	2.8
	Elmo	5.9	22.4	222.5	3.6	14.0	44.7
	Nodaway	20.3	87.3	389.6	15.0	58.8	87.9
Douglas	U. Williamsburg	14.7	26.6	40.4	7.7	19.4	8.8
	L. Williamsburg	0.8	3.6	49.2	0.6	2.1	16.2
	Sibley	4.7	12.5	63.6	3.4	8.8	2.3
	Blue Mound	0.9	2.7	3.9	0.5	0.8	1.8
Kansas City	Thayer	1.8	9.1	53.6	1.5	6.1	16.0
Marmaton	Mulberry	59.4	137.4	217.8	30.6	67.1	162.0
Cherokee	Mulky	4.9	12.5	86.6	4.2	10.2	38.4
	Bevier	48.7	118.7	113.6	31.6	54.4	59.6
	Croweburg	9.4	35.6	70.7	6.6	19.2	54.2
	Fleming	14.9	26.8	19.6	3.0	2.7	18.9
	Mineral	120.6	88.5	307.2	53.5	25.7	131.7
	Weir-Pittsburg	29.5	47.6	62.9	10.9	36.0	43.4
	Dry Wood	1.3	6.9	25.0	1.4	6.3	19.9
	Rowe	3.8	16.2	82.9	3.8	15.5	67.7
Totals		**341.7**	**655.7**	**1,815.2**	**178.0**	**348.4**	**794.7**

[1] Data modified from Brady and others (1976).

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Table 8
Preliminary summary of deep coal resources and reliability category in Kansas.

Geologic Group	Coal Bed	Tonnages (million short tons) by Reliability Category Measured	Indicated	Inferred	Total
Douglas	Williamsburg	1	6	109	116
Kansas City	Thayer	3	20	282	305
Pleasanton	"Dawson"	4	33	473	510
Marmaton	Mulberry	11	83	1,158	1,252
"	"Labette B"	19	120	1,381	1,520
"	"Labette C"	2	17	249	268
Cherokee	Mulky	5	31	413	449
"	"Iron Post"	13	82	771	866
"	Unnamed	6	42	433	481
"	Bevier	90	561	5,477	6,128
"	Croweberg	20	141	1,613	1,774
"	Fleming	13	74	615	702
"	Mineral	87	540	4,975	5,602
"	Scammon	20	148	1,752	1,920
"	Scammon B"	2	18	158	178
"	Tebo	16	117	1,576	1,709
"	"Tebo B"	1	6	99	106
"	Weir-Pittsburg	73	364	2,616	3,053
"	Weir-Pittsburg	5	44	719	768
"	"Abj"	13	91	1,170	1,274
"	"Bbj"	3	23	298	324
"	Dry Wood	4	31	413	448
"	Rowe	35	258	3,135	3,428
"	Neutral	3	26	420	449
"	"Neutral B"	0	2	23	25
"	"Aw"	49	381	4,579	5,009
"	"Bw"	15	109	1,330	1,454
"	"Cw"	29	228	2,862	3,119
"	"Dw"	15	114	1,446	1,575
"	Unnamed	2	17	175	194
"	Riverton	88	654	7,225	7,967
"	Unnamed	5	40	516	561
	Totals	**652**	**4,421**	**48,461**	**53,534**

From Brady, 1990, p. 117.

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Deep coal resources were determined from old underground coal mine maps, from deep coal tests by mining companies, and especially from wireline geophysical logs run for oil and gas tests. Gamma ray-density and gamma ray-neutron logs were the logs used for most of the resource estimates.

Coal beds having the largest deep resources in Kansas include the Bevier, Riverton, Mineral, and "Aw" (unnamed coal bed) coals. The distribution of these four coal beds in Kansas are shown in Figures 11A-D (Brady, 1990, p. 118). Total coal distribution of those deep coal resources that are 42 inches or thicker is summarized in Table 9 and their general distribution is shown in Figure 12. Total resource amounts of these thick coal areas are two billion tons.

Coal Quality

Kansas coal of Pennsylvanian age is all high-volatile bituminous rank. Nearly 90 percent of the coal produced in the past was high-volatile A, with most of this coal produced in the Southeast Kansas area. Large amounts of high-volatile B and C rank bituminous coal were produced mainly from Leavenworth County (Bevier coal produced from deep mines), and Osage County (Nodaway coal produced from strip and deep mines).

A general summary of the chemical quality of strippable coals of Southeast Kansas and adjacent areas of Southwest Missouri is shown in Table 10. The samples used in this summary were channel samples collected from fresh exposures in coal mines.

Figure 9 - Radius of influence of reliability categories used in coal-resources studies. (Modified from Wood and others, 1983, p.11)

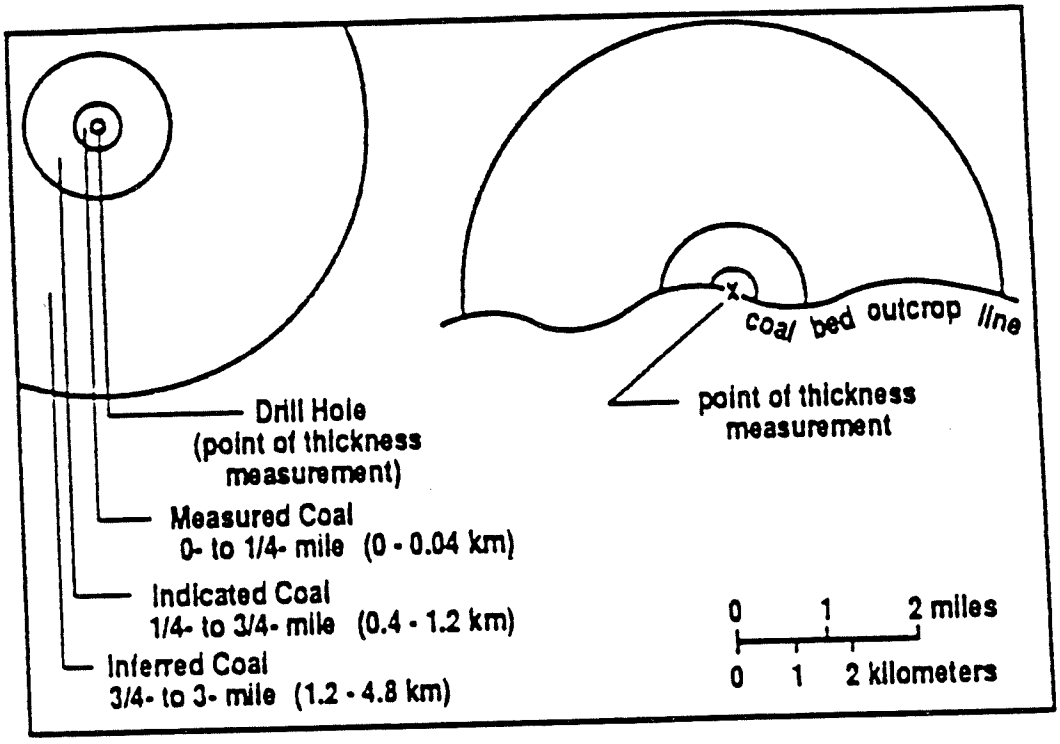

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Figure 10 - General distribution of strippable coal resources by geologic group. (Modified from Brady and others, 1976, p. 18).

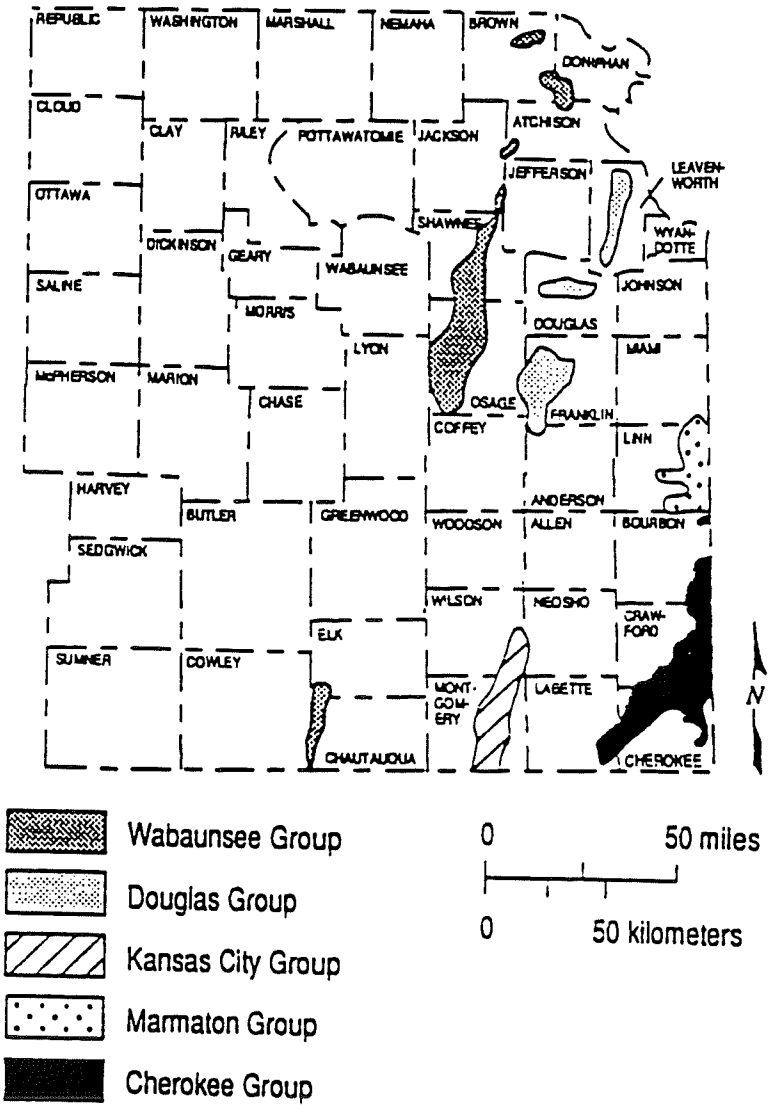

Figure 11 - General distribution of four important deep coals beds - Bevier (A), Mineral (B), "Aw" (unnamed coal) (C), and (D) in eastern Kansas with thickness of 14 inches (35 cm) or greater that are under 100 feet (30 cm) or more overburden.

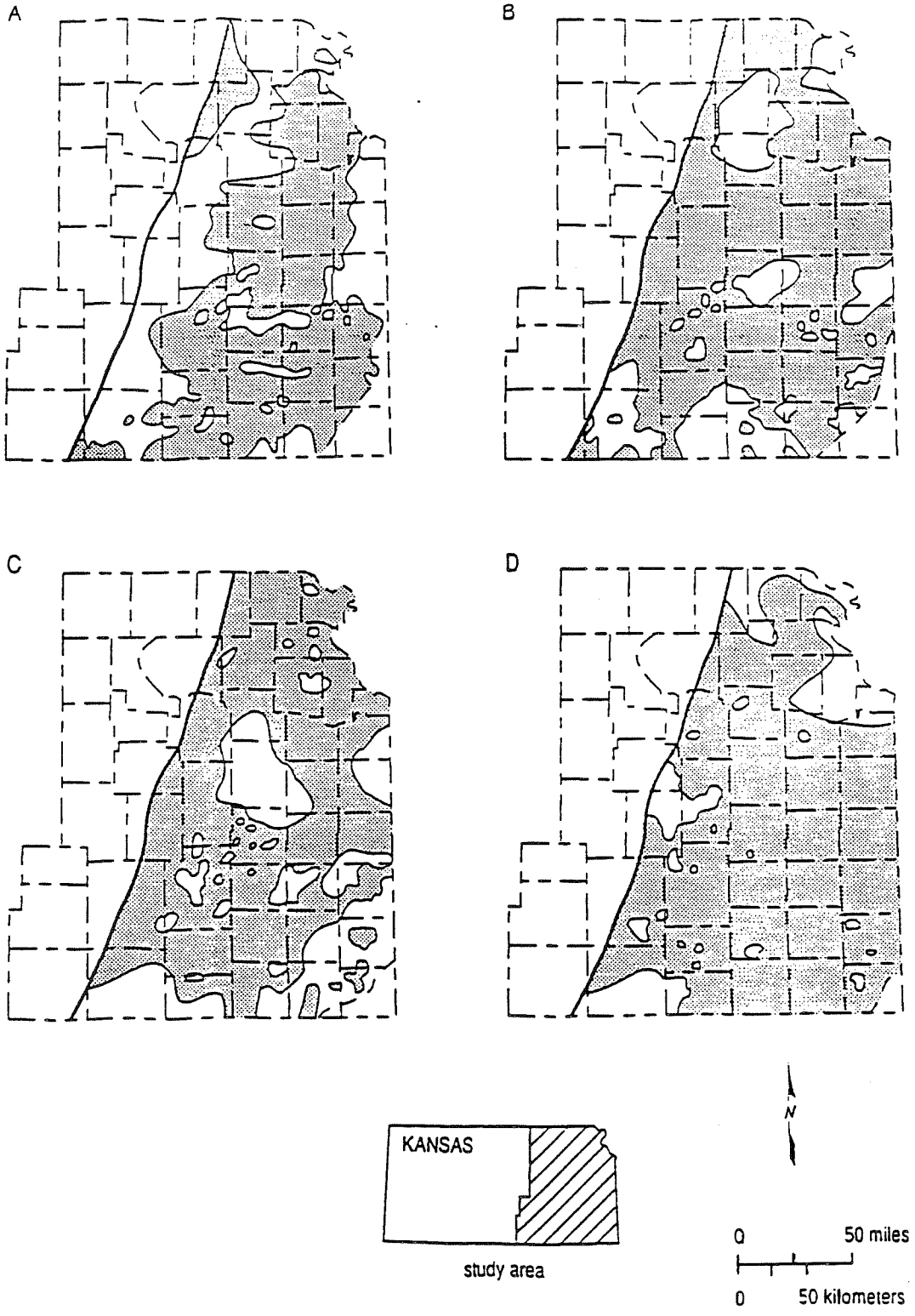

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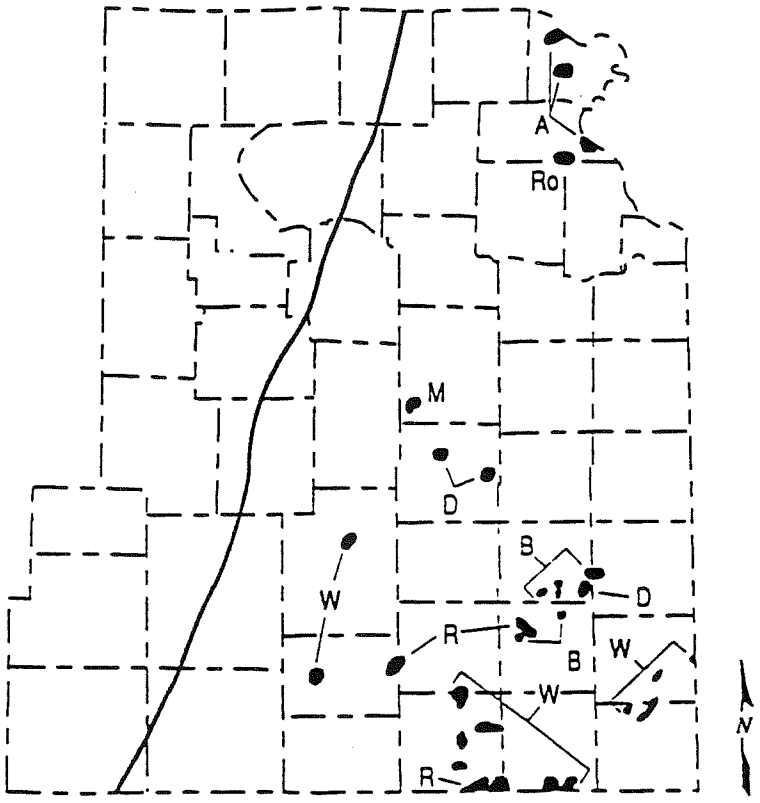
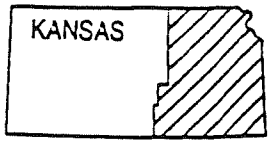
Figure 12 - Distribution of deep coal beds 42 inches or greater in Eastern Kansas. Resource amounts are listed in Table 4 (from Brady, 1990, p.121).



(D) Dawson
(M) Mulberry
(B) Bevier
(W) Weir-Pittburg
(Ro) Rowe
(A) "Aw"
(R) Riverton

0 50 miles

0 50 kilometers



study area

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Table 9
Preliminary estimate of deep coal resources (≥100 ft) in Eastern Kansas of bed ≥42 inches by county and reliability category.

Coal	County	Resource total (million short tons) Measured	Indicated	Inferred	Total
Dawson	Allen	2	12	88	102
	Coffey	2	17	285	304
Mulberry	Osage	1	7	86	94
Bevier	Allen	2	11	16	29
	Bourbon	-	1	34	35
	Neosho	2	13	11	26
Weir-Pittsburg	Cherokee	1	9	61	71
	Crawford	1	8	36	45
	Elk	1	9	139	149
	Greenwood	1	7	102	110
	Labette	12	40	84	136
	Montgomery	6	39	259	304
	Wilson	-	-	59	59
Rowe	Atchison	1	5	39	45
"Aw"	Atchison	1	5	59	65
	Doniphan	2	13	38	53
Riverton	Elk	2	15	149	166
	Montgomery	-	1	26	27
	Neosho	2	16	161	179
	Wilson	-	-	1	1
TOTALS		**39**	**228**	**1733**	**2000**

From Brady, 1990, p. 120.

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Table 10 - Mean values of proximate energy and sulfur values for individual coal beds in Southeast Kansas and Southwest Missouri.

Coal	n	Moisture %	Matter %	Carbon %	Ash %	BTU	kcal/kg	Sulfur %	Sulfate %	Pyritic %	Organic %
Thayer	2	6.8	33.7	41.3	18.3	10,675	5,930	3.9	0.53	2.29	1.08
Mulberry	3	6.8	32.3	39.4	21.4	10,310	5,730	4.5	0.45	2.35	1.73
Mulky	5	3.0	38.3	47.4	11.4	12,695	7,050	4.6	0.23	2.10	2.28
Bevier	2	3.9	36.1	48.6	11.5	12,250	6,810	2.7	0.34	1.22	1.15
Croweburg	7	3.4	35.4	44.2	17.2	11,667	6,490	4.5	0.35	3.21	0.91
Fleming	3	4.6	36.4	43.0	16.0	11,857	6,590	4.9	0.60	2.97	1.29
Mineral	5	4.1	35.1	47.1	13.6	12,219	6,790	4.7	0.42	2.92	1.22
Dry Wood	5	2.6	32.0	46.1	19.3	11,518	6,400	7.3	0.45	5.59	1.27
Rowe	8	2.8	33.8	46.1	17.4	11,757	6,530	7.6	0.41	5.99	1.20
"Aw"	1	3.3	31.2	50.4	15.1	12,060	6,700	4.1	0.36	3.17	0.57

Data from Wedge and Hatch (1980), Swanson and others (1976, p. 279-287), and Brady and Hatch (1991).

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Production and Use of Kansas Coal

Coals mined in Kansas have had many uses in the past. Early coal was used for steam generation in railroad locomotives, heat for smelters, cement manufacture, home and industrial heating. Other uses included coke production, brick and tile, and other types of industrial manufacturing. A summary of Kansas coal production and mine price is shown in Table 11, with comparison of the total U.S. coal production and average price for bituminous coal and lignite. Reduced U.S. mine price through the years is influenced by the increased mining of the thick seam western coals of Wyoming and Montana.

Present use of Kansas coal is almost exclusively for power generation and cement manufacture. (Table 12) However, small amounts of coal are still used for other industrial purposes such as lightweight aggregate manufacture and home heating. Power generation is the dominant end-use of coal in Kansas, with nearly 15.5 million tons used for that purpose (Table 13). Concern by state and federal regulatory authorities over the sulfur dioxide(SO_2) and nitrous oxides (NO_x) content of gases emitted from the power plants has resulted in a demand for low-sulfur coals for use in new power-generating plants. This low-sulfur demand has been met by use of Wyoming coal. Some power plants equipped with scrubber systems are using local Kansas or Missouri coals. However, tighter controls on the SO_2 emissions are now forcing some of these plants to blend with lower sulfur coals to meet these new standards. With the Kansas coals having a medium-to-high sulfur content and the thin-coal beds (12-36") of Kansas resulting in a high mining cost, the present Kansas coal market is shrinking rapidly. The origin and amounts of coal shipped to Kansas in 1991 is shown in Table 13. Use of coal in Kansas is listed in Table 15 for the years 1981-1990.

Table 11
Kansas coal production and average mine price as compared with U.S. production and coal price.

	Kansas		U.S.	
Year	Millions/tons (1)	Avg. price (2)	Millions/tons (3)	Avg. price (3)
1981	1.354	27.10	823.8	26.29
1982	1.396	26.61	838.1	27.14
1983	1.305	26.89	782.1	25.85
1984	1.306	26.91	895.9	25.51
1985	.989	26.00	883.6	25.10
1986	1.481	25.65	890.3	23.70
1987	2.021	24.54	918.8	23.00
1988	.734	30.59	950.3	22.00
1989	.856	27.00	980.7	21.76
1990	.721	26.50e	1035.9	22.00
1991	.414			

Information Source

(1) Kansas production summaries, Kansas Mined Land Board (81-87), Surface Mining Section (KDHE) (88-91).
(2) Coal Production-1991, DOE/EIA-0118 (Annual reports 1981-89).
(3) Annual Energy Review 1990, DOE/EIA-0384 (90).
e Estimate.

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Table 12
Use and distribution of Kansas coal shipped during 1991 (thousands of tons).

Destination Use	Kansas	Missouri	Total
Electric Utilities	101	215	316*
Industrial Plants	35	70*	105
Residential & Commercial	--	3	3
	136	288	424

Source: Coal Distribution—January-December 1991, DOE/EIA-0125 (90/4Q) p. 47
*Numbers modified from source to match totals for states.

Table 13
Coal shipped to Kansas in 1991 showing use and source of coal (thousands of tons).

State	Electric Utilities	Industrial	% of total
Kansas*	101	35	1
Wyoming	14,016	-	90
Illinois	1,320	-	8
West Virginia	--	60	--
Oklahoma	5	18	-
Missouri	10	9	--
Kentucky	15	3	-
Indiana	-	6	-
	15,467	**132**	

West Virginia, Oklahoma, Missouri, Kentucky, and Indiana combined make up less than 1%.
Source: Coal Distribution - January-December 1991, DOE/EIA-0125 (90/4Q), p. 83-84.

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Table 14
Use of coal shipped to Kansas (thousands of tons).

	Electric Utilities	Industrial Plants	Residential & Commercial	Total
1981[1]	11,165	303	3	14,088
1982[2]	11,092	342	12	11,445
1983[2]	13,069	220	3	13,292
1984[2]	13,924	267	3	14,193
1985[2]	14,088	374	1	14,464
1986[2]	13,952	251	1	14,204
1987[3]	15,108	243	1	15,352
1988[3]	14,204	138	1	14,343
1989[2]	15,343	164	6	15,512
1990[4]	17,353	93	-	17,447
1991[5]	15,467	132	--	15,599

1) Coal Distribution Jan .-Dec. 1985, DOE/EIA-0125 (85/4Q) P. 26, 33, 37, 39.
2) " " " " 1987, DOE/EIA-0125 (86/4Q) p.27, 33, 37, 39.
3) " " " 1989, DOE/EIA-0125 (89/4Q) p. 56, 15,19, 21.
4) " " " " 1990, DOE/EIA-0125 (90/4Q) p. 81.
5) ...."....."...."....."....1991, DOE/EIA-0125(91/4Q) p. 83-84.

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. A second possibility, and perhaps of a more immediate use, is the production of methane gas from deep coal beds.

Fluidized Bed Combustion

Interest has greatly increased in recent years in the use of fluidized bed combustion technology. The important factors of these systems are high combustion efficiency, sulfur dioxide emission control, and the flexibility to use a wide range of fuels. The primary advantage of using fluidized bed boilers for Kansas coals would be the large reduction of sulfur oxides and nitrogen oxide emissions during combustion as compared with conventional coal-fired boilers in power plants.

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 the air allowing the bed to act like 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 oxides are captured by the limestone in the bed with the optimum sulfur oxide absorption by the limestone between 850°-900°C (Valk, 1986, p. 7).

The fluidized bed combustion boiler can use high-sulfur coal as well as other fuels. The sulfur dioxide

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is captured by the limestone bed and the combustion temperatures are below the ash melting point so that solid accumulation and boiler tube erosion and corrosion are minimized. Flue gas clean-up requires only particulate removal. (Office of Fossil Energy, 1987, Appendix A, p. A-18-21)

This type of power plant, although still in smaller size designs (up to approx. 150 MW), will be important in the use of high-sulfur coals because of its pollution-abatement potential. Cost, rather than air-pollution concern, would be the primary factor governing fuel use. Kansas coal should then be able to compete favorably with fuels from other states for the Eastern Kansas markets where the fluidized bed combustion boilers are anticipated to be installed.

Methane from Coal

Methane is present in large amounts in certain ranks of coal. For years, this fact 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 important as a 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 developed 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 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 loss of the methane, then methane of possible economic quantities could be present and possibly developed.

In areas where the coal is deeper than 500 feet, the coals probably retain a large amount of methane. Drilling and artificial fracturing of the thicker coal beds or multiple coal beds could produce significant amounts of the gas. Stoeckinger (1989) has measured and reported a gas content of 220 cubic feet per ton from a core sample of the Weir-Pittsburg coal bed in Montgomery County. Other coal beds reported by Stoeckinger (1989) have also given good indication of large methane content. Recent developments in Kansas at recovering coal bed methane, as reported by the Oil and Gas Journal (1990, p. 70), shows good promise for this new gas source.

By September 1991, there were nearly 75 wells completed for coal bed methane in Kansas. Most of the activity has been in Southeast Kansas, primarily Northern Montgomery County, Western Labette County and Southern Wilson County. Good potential for economic development exists in these areas. However, development of these wells to their full potential takes several months because of the need to pump large quantities of water from the coal bed in order to lower the hydrostatic head of the formation water to allow the methane to be desorbed from the coal. Important to the coalbed methane development is the present federal tax credit of 91 cents per million BTU for development of this unconventional gas source. Under present law, the tax credit will be available for coal bed methane wells drilled through 1992, and production from those wells and earlier wells until the year 2001. The tax credit will rise to $1.34 per million BTU by the year 2000.

With numerous widespread coal beds and a coal resource of 50 billion tons in Eastern Kansas, wells drilled in a large part of the area could encounter multiple coals (up to 12 beds) and 10 to 25 feet of total coal thickness in wells drilled less than 2,500 feet deep. Many gas pipeline networks are in place, and recognized disposal zones for the formation waters exist in Eastern Kansas.

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A primary premise in this report is that Kansas wishes to continue to produce fossil energy, to make that process effectively produce the maximum amount of resource possible, and to gain revenues through taxes and economic development from production that accrue to all citizens of the state. Extraction and use should be environmentally benign where possible, and when choices have to be made between pristine environments and societal energy needs, the environmental costs should be explicitly taken into account.

Fossil energy development in Kansas is constrained by variables which are independent of technology and others dependent upon technology. For example, taxes, environmental rules and costs, and regulation of the industry itself are variables which respond to external political and economic forces totally independent of their effects upon production of fossil energy. In Kansas, the ad valorem tax levels are set by county economic needs and bear little relationship to state-wide production value (Little, 1990). Another example of an independent variable is the effect of Environmental Protection Agency (EPA) rules and regulations. While recognizing that the intent of environmental regulations is to internalize costs (e.g. cost of pollution), the additional costs to develop and produce energy, resulting from policies such as the Clean Air Act have devastated the Kansas coal industry. In some states, the regulatory cost burden discourages investment and activity, in others, such activity is encouraged. These independent variables are voluntary legislative constraints on fossil energy development and production, and greatly affect the rate at which Kansas is abandoning its coal and oil resources.

Similarly, there are dependent variables which constrain fossil energy production. Some of these are recovery ratios, that is, the rate of recovery of resource as a function of original resource in place. In many cases in Kansas, the primary recovery of oil is only 20-25% of the original oil in place. Technology to increase this ratio can dramatically affect the resource base, taxes collected, and economic impact of the resource. Drilling costs, costs of equipment, availability of skilled labor, and processing costs are constraints which are dependent on technology or which are controllable by the industries affected.

With this background, there are several issues of fossil energy development in Kansas which could be addressed by state energy strategy and plan for legislative action. Some of these issues were identified in 1989 in the Kansas, Inc., study of taxation, but will also be cited here (Little, 1990). Others are newly identified, in part through a series of public meetings held in Great Bend, Chanute, and Wichita by the University of Kansas Energy Research Center during the summer of 1991, some through solicitation by this committee during the fall of 1991, and others generated by the writers of this report from discussions with USDOE Office of Fossil Energy staff and leadership, operators, and policy makers across the country. Generally these issues can be categorized in six related groups:

1. Taxation, including income, ad valorem, severance, and alternative minimum taxes.
2. Environmental liability and regulation.
3. Price, including unequal pricing of gas vis a vis other energy supplies.
4. Development of clean coal technology.
5. Recovery of additional oil from existing pools.
6. Research needs and data base development.

Taxation

Taxation of the Kansas industry differs from some other states by having a combination of income taxes, ad valorem taxes, severance taxes, and sales taxes applicable to various aspects of production. A previous study has already recommended changes in the Kansas tax structure (Little, 1990). Inequities of taxation levels among the counties levying ad valo-

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rem taxes has been the largest area of concern and may result in litigation unless addressed soon. (Table 15) Discrimination between the oil industry and other industries, especially agriculture, in what property is actually taxable will no doubt result in litigation unless legislative relief is forthcoming. For instance, farm equipment has been removed from the property tax rolls, but well-head and operation equipment for the energy industry has not. This inequity may well be in violation of federal constitutional provisions. An example of the changes which took place with the new property appraisals and consequent redistribution of property taxes is taken from the Energy Research Center (ERC) files from which this report is prepared. (Table 16)

Table 15
Kansas Ad Valorem Tax Analysis for Selected Oil and Gas Leases June 1, 1990.

COUNTY Lease	Oil or Gas	1989 Valuation ($)	Tax ($)	1988 W.I. Revenue ($)	% Tax/ W.I. Rev.	1988 Lifting Cost ($)	1988 Operating Income ($)	% Tax/ Oper. Inc.
COMMANCHE								
Fischer #1	Gas	34,791	3,497	60,566	0.0558	17,905	42,661	0.082
FINNEY								
Aeilts #5	Gas	43,630	4,601	28,047	0.1640	5,901	22,146	0.208
Maune #4	Gas	88,760	9,361	42,178	0.2220	5,931	36,247	0.258
R. Christ	Oil	115,410	12,171	268,281	0.0450	97,427	170,854	0.071
KEARNEY								
Beyer	Oil	11,095	557	56,371	0.0100	36,611	19,760	0.028
Thornbrough	Oil	24,820	1,246	12,475	0.1000	7,162	5,313	0.235

Table 16
1989 Values for Leases 1/2 Mile Apart.

	Lease A	Lease B	difference	% difference
OIL PRODUCTION	1206	1195	-11	-0.92%
ASSESSED VALUE	$13,874.00	$4,458.00	-$9,416.00	-211.22%
COMPANY TAXES	$1,235.00	$335.00	-$900.00	-268.66%
PROPERTY TAXES (Min. Owner)	$352.00	$26.74	-$325.26	-1216.38%
TOTAL LEASE TAXES	$1,587.00	$361.74	-$1,225.26	-338.71%

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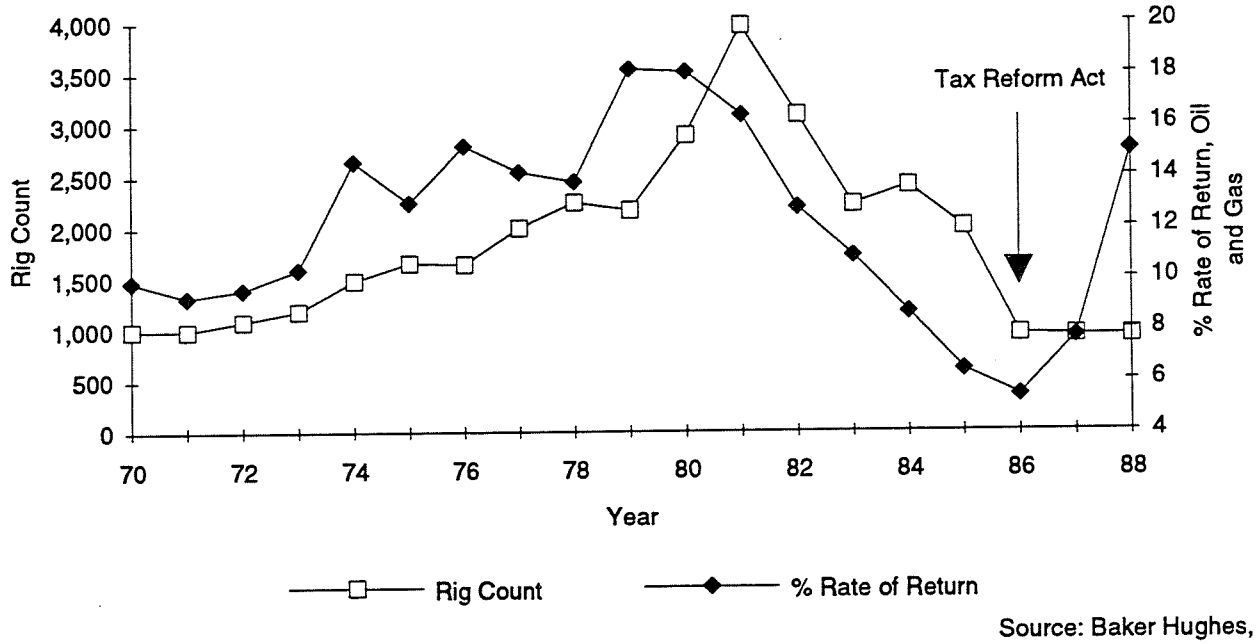
Two federal tax policy changes are responsible for the loss of high risk investment capital: the income tax revisions of 1981 and 1986, and the alternative minimum tax (AMT). The effects of these tax provisions have been to drive the level of new exploration downward counter to price driven levels of activity. To fully understand how changes in federal tax codes affect the levels of drilling activity in the domestic oil and gas industry, it must first be understood that the majority of the financial capital employed by independent operators are derived from individuals and companies who earn excess income that allows them to invest in ventures outside their normal business operations. Money that would ordinarily be paid in taxes to the federal government by persons in the highest tax brackets can be invested in high risk oil and gas drilling ventures. Drilling failures and capital expenses incurred in successful wells result in normal business deductions. Figure 13 shows the dramatic effect that these onerous tax changes have had on rig activity in the U.S. Prior to 1981, drilling activity in the lower 48 states kept pace with fluctuations in price. When prices leveled off during the period from 1982 to 1986, after their all-time peak in 1980, the rig count steadily declined relative to current oil prices at the time. This is a direct result of lowering the highest marginal income tax rates provided for in the 1981 tax code revisions. As a result of the dramatic price collapse due to the flooding of the world oil markets by OPEC in 1986, the rig count also declined dramatically in response to investor uncertainty. As an unfortunate coincidence, the Tax Reform Act of 1986 was also implemented that same year. At that time, the highest marginal tax rates were lowered to 28%, along with the repeal of many traditional tax deductions associated with high risk investments. Additionally, Alternative Minimum Tax (AMT) provisions changed the deductibility of certain tax preference items thereby dramatically increasing tax liabilities (Table 17). Since 1986, oil prices have fluctuated considerably but have trended generally upward to the present time. The rig count, on the other hand, has continued to decline to historically low levels.

Figure 13 - National Rig Count and Rate of Return on Oil and Gas Ventures, 1970-1988.



Source: Baker Hughes, FTC

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Table 17
Simplified Alternative Minimum Tax (AMT) Calculation
(Smaller Taxpayer at 15% regular corporate rate).

This simplified example illustrates the inequity created when ordinary and necessary business expenses are subjected to Intangible Drilling Costs (IDC) and percentage depletion preference treatment under the AMT.

REGULAR TAX CALCULATION	NON-AMT TAXPAYER	OIL & GAS TAXPAYER
Gross Income	700,000	700,000
Ordinary & Necessary Business Expenses	(650,000)	
Intangible Drilling Costs		(450,000)
Other Oil & Gas Expenses	(150,000)	
Percentage Depletion		(50,000)
Regular Taxable Income	50,000	50,000
(1) Regular Income Tax (@ 15% corporate rate)	7,500	7,500
ALTERNATIVE MINIMUM TAX CALCULATION		
Regular Taxable Income	50,000	50,000
IDC Preference		76,750
Percentage Depletion Preference		50,000
Alternative Minimum Taxable Income	50,000	176,500
(2) Alternative Minimum Tax (@ 20% corporate rate)	10,000	35,350
TOTAL TAX LIABILITY (Higher of 1 or 2)	10,000	35,350

TAX LIABILITY HAS MORE THAN TRIPLED!

Note: This example has been simplified for illustrative purposes and ignores, among other things, the ACE adjustment, the special energy deduction, and the $40,000 exemption amount. *Also, changes have occurred in the federal AMT since this report was written and this data is current only as of Sept. 1992.*

This continued decline in exploration activity can be traced directly to the flight of investment capital from the oil and gas industry as a result of the 1986 Tax Reform Act.

Furthermore, federal income tax marginal rates have declined to 31% from 70%; and as a result the amount of risk capital available to the petroleum industry and other high risk ventures is less. Under the highest rate, the individual investor underwrote 30% of unsuccessful ventures, the remainder being a tax credit and therefore a tax incentive to invest. Coupled with a fair industry average rate of return, this stimulated investment toward the occasional large discovery that would result in a very large return on the risked dollars. Since most exploratory wells are dry holes, the investor gained as well as the economy in general. Taxes now collected go to fund the cost of government programs, defense, and trade deficits rather than to stimulate the economy as before. Sufficient risk

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capital is not available to the Kansas oil industry to sustain any significant expansion in drilling activity.

Fundamental to all of these arguments is that federal and state tax policies do not recognize the tremendous risk inherent in the petroleum business. The federal income tax, prior to 1981, provided for a maximum marginal tax rate of 70%, favorable treatment of capital gains, and a 27.5% depletion allowance for petroleum. Today there is an Alternative Minimum Tax, a marginal tax rate of 31%, no favorable treatment of capital gains, and a 15% depletion allowance. Education is needed for those who believe that these new provisions are closed "loopholes", for the entire economy reflects the loss of investment capital resulting from these tax changes. Treating all income the same, except for levying higher taxes on income gained from high risk, totally ignores the realities of creating risk capital and the needs of a growing economy.

Unlimited financial liability for actions taken under early technologies and regulations are stifling much of the industry and commerce today. The principle seems simple, the effects are enormous. Real estate, leases, and the equipment cannot be transferred without full examination of sites, including searches for former uses and effects of those uses. Assessment of costs and penalties for undiscovered environmental hazards, and the increasingly minute amounts of chemical contamination ruled to be hazardous have combined to make investment in any real property a serious financial risk. The continuing 15-year efforts of the US EPA to gain control over oil field operations through declarations of drilling fluids as hazardous materials suggests that worse risks are to come. The present exemption of oil field waste from hazardous material regulation must be retained in the reauthorization of the Resource Conservation and Recovery Act (RCRA). Retroactive application of regulations also threatens to stymie industrial development and must be examined in any public policy proposal.

State regulators need to have regional or state control over environmental matters without the threat of withholding federal funds. State regulators should have the right to provide feedback to the federal level that could lead to the modification, addition, or deletion of federal mandated environmental regulations imposed on the states.

Price

Fossil energy resources price is the major deterministic factor in production. The price of oil has varied wildly over the last seven years, ranging from futures prices over $40 per barrel to field prices below $10. The free fall of oil prices on worldwide oil futures markets in 1986 followed by numerous short term price fluctuations has created a great deal of uncertainty among oil operators and investors with regard to the future values of reserves both proven and unproven. Additionally, uncertainty and a lack of confidence with regard to the future value of reserves makes it increasingly difficult for an operator to secure financing from lending institutions for proposed operations. This uncertainty, coupled with unfortunate federal tax policies discussed in an earlier section, have resulted in a steady decline of drilling activity even though prices have been steadily, albeit erratically, tending upwards. At this writing, rig counts have fallen from over 4,000 to 639 nationwide. Recent developments related to the recent conflict in the Persian Gulf area served to drive futures prices upwards for a short time, but this was not sustained because producing countries like Saudi Arabia demonstrated the capacity to make up for global shortfalls through increased production.

As with any profit making business, oil operators cannot afford to drill a well in which there is less revenue than expense. As a result, price can be one of the most common factors in determining the economic life of any producing property. A small increase in price can materially slow down the abandonment of marginal wells and allow for the completion of maintenance activities that may not have otherwise been possible.

As mentioned before, fluctuations in oil futures prices can affect feelings of uncertainty among operators and producers with regard to the expected value of reserves. Trading of oil futures contracts began on a

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worldwide basis in 1983. As a result, oil prices have fluctuated considerably based upon perceived shortages or surpluses, profit taking, and contract purchases. Some operators have been able to hedge the value of their reserves produced by participating in this market. Most others, however, do not have the expertise to make the judgments necessary to take advantage of this market and must sell their oil for whatever the current market allows. Figure 6 shows how fluctuations in price have materially affected drilling activity in Kansas during the period from 1970 to date. Divergence between the two curves following 1981 and 1986 reflects the adverse effects of changes in federal tax laws. Figures 1 and 5 show how price has affected annual crude production for Kansas and the U.S. Dramatic decline in prices since 1986 has resulted in the abandonment of many stripper wells.

Gas is economic and profitable at prices of about $2 per thousand cubic feet (MCF). At present, natural gas prices range from about $.81 to about $1.25 per MCF, and those companies with focus on the resource are pulling back, reducing staff, and otherwise abandoning development of the resource, including some of those active in Kansas (although as of the date of this writing, the spot futures market has risen to about $2.00 or a little more in response to damages to producing facilities by hurricane Andrew). ARCO, Phillips, Exxon, and Shell have all given up on waiting for the fair value of natural gas to be reflected in the marketplace, and have reduced staff and programs. Somehow, the price of natural gas has to rise to reflect its BTU value. It is the most environmentally benign fossil fuel, it is easy to transport, supplies are stable, and supplies are in the domestic U.S. Kansas has an abundant supply of natural gas from the giant Hugoton Field in southwestern Kansas, as well as smaller supplies from other areas. It is a very important fossil energy resource in Kansas.

Equivalent prices for various energy sources may be based upon the million BTU (British Thermal Units) values of each. One current value for Kansas crude oil is about $17.10 per barrel. On this basis, the following BTU/value relationships in Table 19 would hold.

Table 19
BTU Value Relationships.

Crude Oil	$17.10 per bbl.
Natural Gas	$3.30 per MCF
Lignite	$42.00 per ton
Bituminous Coal	$84.00 per ton
Propane	$.27 per gallon
Gasoline	$.39 per gallon
Methanol	$.20 per gallon
Fuel Oil	$.45 per gallon
Electricity	$.01 per KWH

(Frank Novy, personal communication, January 28, 1992)

Development of Clean Coal Technology

Kansas has extensive reserves of coal, but high sulfur and ash content and thin coal beds have greatly limited the use of Kansas coal in normal combustion processes. The USDOE has focused much effort and money in developing clean coal technology so as to enhance the use of eastern and midcontinent coals. There is little effort foreseen from the state to enhance the use of Kansas coal. The best chance for increased use of Kansas coal would be in use of fluidized-bed technology in smaller power plants in eastern Kansas. When cheaper methods of sulfur removal from coal or SO_2 from the stack gases are developed, increased use of Kansas coal could result within Kansas and adjacent states. Coal does remain a significant resource for electrical power generation.

Additional Recovery from Existing Pools

USDOE estimates of oil remaining in Kansas reservoirs, after final commercial extraction has been accomplished, is on the order of 11 billion barrels of oil. This is a very large resource. Accessing this resource is partly research and partly application of existing technology through small independent operators who normally do not use advanced technology. Initiation of a full technology development and transfer function within the state may address this issue. Encouragement of the use of existing technology may recover some of the petroleum, but the present focus is to prevent the premature abandon-

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ment of the resource through the plugging of uneconomic stripper wells. This is a function of tax policy as well as technology. It is estimated by the USDOE that 80% of the 11 billion barrels will be permanently abandoned by the year 2000 if we do not promptly address this issue (USDOE, 1989).

Research Needs and Data Base Development

One of the most effective ways to brake the present slide in Kansas oil production is by development and application of new technology and knowledge to existing fields and development plays. Basic and applied geologic and economic research is now accomplished by the Kansas Geological Survey (KGS). Activities in improved oil recovery are being conducted in the Tertiary Oil Recovery Project (TORP). Staff shortages and high costs have hampered full development of the research, but studies already accomplished show that applied research and development of new concepts of oil occurrence can greatly extend production and find new resources. The independent petroleum industry has no research capability. Therefore, the corollary development of fossil energy research comparable to agricultural research could materially affect the decline of Kansas oil production and consequent negative economic impacts. Development of the new University of Kansas Energy Research Center by the KGS and TORP and other university academic groups promises assistance if funding can be developed for a permanent program of applied research and technology transfer. Data base development related to secondary recovery and overall improvements in operator data access and on-site assistance could be a beneficial result of the Energy Research Center (ERC).

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INTRODUCTION

The following recommendations reflect the combined ideas of the task forces and subcommittees for fossil energy. They embody the assumption that Kansas is not bound by national energy or tax policies and can pursue bold and innovative directions entirely on its own. Federal policies may eventually be redirected by actions of the several states. Kansas has an opportunity to lead.

Committee recommendations are grouped by policy area rather than by energy resource, because many issues and possible policy implementations affect several fossil energy resources. In many instances, suggestions may be more broadly applied to the encouragement of all business activities and economic development in Kansas.

Three examples that are recommended for encouragement of business activity in Kansas are:

1. *Institute a capital gains tax reduction in the Kansas income tax.*
2. *Encourage risk capital formation in Kansas by instituting investment tax credits for new ventures and high risk investment.*
3. *Require a cost/benefit review of all new regulations.*

All of these would serve to stimulate investment in Kansas, and may prove to be revenue generators through stimulation of business activity.

FOSSIL ENERGY POLICY RECOMMENDATIONS

Preceding Policy Recommendations

In 1990, Kansas Inc. commissioned a report entitled "Strategic Analysis of the Oil and Gas Industry in Kansas" by Arthur D. Little. The conclusions and recommendations in that report pertaining to the high overall tax load upon the oil and gas industry are relevant today, despite some progress through the new revenue measures for school taxes and the ad valorem adjustment for small stripper wells. Kansas should update the Arthur D. Little Kansas Inc. report and review its recommendations.

Alternative Fuels

4. *The State of Kansas should continue to exercise leadership in promoting CNG as an alternative fuel.*

One of the most promising opportunities for increasing the demand and market for natural gas is the promotion and support of compressed natural gas as an alternative fuel for use in motor vehicles. Governor Joan Finney has taken a series of actions to pursue this opportunity and exercised significant leadership in this area. The Governor has taken the following steps:

- In October 1991, Governor Finney initiated the State CNG project converting the Governor's van to a bi-fuel, CNG/10% ethanol vehicle, and seven state vans, one van-pool wrecker, 11 three-quarter ton vans, six mini-passenger vans, six half-ton pick-ups, and a 1992 Chevy Lumina.
- With the state's committment to convert vehicles in January 1992, in a joint venture with private industry, the state, Amoco, and Western Resources, Inc. opened a public CNG fill-station in Topeka. A CNG fill station was opened in Lenexa, KS on Aug. 5, 1992.
- In May 1992, the state of Kansas joined six other states in the Southwest Natural Gas Vehicle Zone.
- On June 9, 1992, Governor Finney issued an Executive Order encouraging all state agencies to use and experiment with alternative fuels, including CNG, wherever possible.

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- In June 1992, the Governor and the KCC hosted the first International Alternative Fueled Vehicle Round-up at Forbes Field in Topeka.

These actions are significant first steps to create a substantial new market for natural gas. Much more can be done, especially in the public sector, to promote expanded use of CNG in vehicles.

5. *Greater encouragement should be provided for the use of alternative clean-burning fuels such as CNG, LPG, LNG, propane, etc. by public and private transportation fleets.*

The States of Texas and Oklahoma (among others) have taken initiatives to encourage such conversion with tax incentives and interest-free loans. The funds were provided through the oil overcharge fund, and surcharges on energy cost savings. If such a program is implemented, it could reduce energy costs to state and local governments, provide an incremental in-state market for Kansas produced gas, and help clean up the environment.

6. *The governor should sponsor legislation to establish low-interest loans for the conversion of local government and school district fleets to CNG and to establish the infrastructure necessary to maintain and refuel such fleets.*

7. *A feasibility study should be conducted to explore the location of additional public CNG fill-stations in Kansas, with particular emphasis on locations on the Kansas Turnpike, Interstate 70, and in Johnson County and Wichita.*

8. *The State of Kansas should adopt policies that can lead to the expanded Use of Natural Gas by Kansas Utility Plants.*

Wilson Cadman, CEO of Kansas Gas and Electric, made a presentation to the Natural Gas Task Force on the potential expanded use of natural gas in Kansas electrical generating plants. It is clear that Kansas can profit by the expanded use of natural gas in its electricity generation facilities. Clean air legislation tends to favor natural gas turbines, and/or combined cycle combustion, using natural gas, as opposed to coal or fuel oil generation. Although Kansas does not have serious environmental problems today, it still stands to benefit from greater utilization of natural gas at idled or under-utilized facilities (for example, Murray Gill in Wichita, Gordon Evans in Colwich, and Neosho in Parsons). Also for growth in electricity demand within the state, natural gas technology offers shorter lead times in building new plants, and lower capital costs per KWH than other acceptable fuels.

9. *The state should inventory idled natural gas generating capacity, and develop strategies to bring these facilities back on-line.*

This capacity should be considered for generating excess electricity to be sold into the national grid (Electric power has become a saleable commodity with market demand and price-setting.) Also, there may be some benefits to extending the life of other units by rotating utilization with older natural gas units. These units must be factored into any plans for meeting growth in demand within the state.

10. *The state should consider a "gas standard" policy, that electricity generated for Kansas consumption should be generated using natural gas unless utilities can demonstrate that use of an alternate fuel is cleaner, cheaper, and more reliable.*

This standard should apply to existing generation, and should be introduced whenever supply contracts are considered.

11. *The state should work with local distribution companies and pipelines to improve rate and operating flexibility necessary to support the unique needs of the electric generating industry.*

Rates should be designed which recognize hourly peaks, and which exploit the advantages of natural gas transporters and merchants of moving substantial incremental volume in summer months. Also, increased access to natural gas storage, and creative utilization of compression should be considered in supporting the quick-response, high-pressure needs of the electric generating industry.

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Taxes

12. *The governor and the legislature should take steps to provide greater fairness and equity in taxation for the natural gas industry of Kansas. The Kansas Legislature should lower the rate of the state severance tax on natural gas to 4.33%.*

The State of Kansas severance tax on natural gas is set currently at a rate of 7.0 percent, while the rate on oil is currently 4.33 percent. The rationale for the differential rates between oil and gas was the presumed ability of producers to pass-through the tax to out-of-state consumers. The ability to pass-through the tax no longer exists primarily because of FERC Order 451.

The 1992 School Finance Act set a uniform 32 mill levy for all school districts causing property taxes on natural gas properties in some Southwest counties to rise dramatically. These changed conditions dictate the need for equity and fairness to relieve an unreasonable and non-competitive tax burden on natural gas in Kansas. A bill to reduce the severance tax rate on natural gas passed the House in the 1992 Session but failed to win Senate approval.

13. *Tax credits to business could also be provided for the costs of conversion of fleet vehicles to CNG.*

14. *The impact of the sales tax on utilities used in production should be re-examined by the 1993 Legislature to determine the extent of the economic burden it places on industries in the state and whether it has reduced the attractiveness of Kansas for industrial location.*

The 1992 Kansas Legislature enacted several tax changes to fund the School Finance Act, including a 2.5 percent tax on utilities consumed in production. This new tax has the potential of reducing the competitive advantage that Kansas provides through its relative low energy rates and plentiful supply of natural gas. The impact of the sales tax on natural gas and oil producers also needs to be reviewed in light of the added costs it imposes on production. (Estimates of increased costs in the range of $5 to $6 million annually have been made for the oil and gas industry.)

15. *Provide tax credits for construction of fluidized-bed combustion units.*

The best situation for increased use of Kansas coal at the present time appears to be the use of fluidized-bed technology in smaller power plants in eastern Kansas. New clean-coal technology under development in other areas of the country where high sulfur coal is used could also have an important future impact on Kansas power generation and possibly on improved Kansas coal production.

Use of tax credits to encourage the development of fluidized-bed combustion and use of Kansas coal in those units would be important to the Kansas coal industry. Small to medium-size power plants can use fluidized-bed technology, and those plants could burn Kansas coal in an environmentally acceptable manner. Location of these plants in eastern Kansas should allow Kansas coal to compete favorably with coal from outside the state, since coal supply to the smaller plants would not be by unit train.

Marketing

16. *The State of Kansas should create a Marketing and Promotional Program for Kansas Natural Gas.*

The State of Kansas should be as aggressive in promoting the marketing of its natural resources, such as natural gas, as it is in promoting the markets for its farm products. Other gas production states regularly participate in marketing forums or symposiums in the upper Midwest and Northeast regions. It would take aggressive action but Kansas has a lot to gain and very little to lose, and the timing could not be better with the heightened environmental consciousness across the country. The abundance of sources of energy should be a drawing card for the attraction of industry to Kansas. The Kansas Department of Commerce should take a leading role in this effort.

17. *The State of Kansas, through the Kansas Corporation Commission, should work to*

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encourage increased competitive access to gas supply by industrial consumers within the state.

A strong industrial base is critical to any state's economic success. Industries located in and attracted to Kansas must find competitive advantages. Proximity to a plenteous supply of low-cost natural gas is an attraction Kansas must exploit to sustain industrial development. Other gas-rich states–Texas, Louisiana, and Oklahoma, most notably–boast extremely competitive delivered gas prices to industrial consumers.

The state should work with local distribution companies to encourage flexible, competitively priced transportation of third-party gas to industrial users. Increased flexibility in charging for service to industrial consumers will preclude uneconomic bypass situations.

KCC regulations should permit equal intrastate and interstate access to gas consumers within the state, but should not be focused on creating subsidized, artificial competition. The power of the free-market to generate efficiency must be recognized, and allowed to work to the benefit of Kansas producers and consumers.

18. *The State of Kansas should promote the marketing and development of unique energy resources such as helium or other natural gas derivatives.*

Kansas has the capability to produce a significant portion of the world's supply of helium (i.e., used by NASA in the space program). Centana, a subsidiary of Panhandle Eastern Corporation, alone has the capability to provide approximately 20 percent of the world's supply from it National Helium Plant in Liberal, Kansas. The demand for helium is growing, and Kansas is in the unique position to be one of the few states able to provide the supply to meet this demand. Increased sales of helium, of course, means increased gas production, increased royalties, and in turn more revenues to the state, as well as indirect benefits to local economies.

19. *The Kansas Department of Commerce should explore the feasibility of establishing a department of gas marketing.*

Changed conditions brought about by the MEGA NOPR proposal may have lessened the ability of independent producers to compete with the major gas producers in Kansas in accessing transportation facilities and markets. A department of gas marketing could act as a clearinghouse or perhaps actually engage in the brokering of gas with the objective of assisting Kansas producers in marketing their gas, particularly to Kansas consumers.

The department could explore the present and prospective problems of producers in marketing their gas, whether the existing brokerage network is efficiently, effectively and reliably fulfilling the function of matching gas producers with gas consumers and the impact of keeping and attracting additional gas consuming industry and encouraging use of Kansas gas by industry versus less economical and pollution-free alternate sources of energy. The cost of providing such services should probably be borne by producers and consumers utilizing the service.

20. *The State of Kansas should develop a market information clearinghouse for the natural gas industry.*

The clearinghouse could gather new information on markets and projects, new interconnects, new receipt and delivery points, pooling points, and pipeline restructuring plans and rates. It could bring together producers and end-users on joint venture market projects, provide information on well connects, gathering or supply aggregation, and storage availability and capacity. This proposal should be considered in tandem with #11 above. FERC Order 636 will require pipelines to maintain sophisticated electronic bulletin boards so that all customers will be able to know current transportation information and "Firm Transportation" capacity releases. This proposal could support that requirement.

21. *Encourage the blending of Kansas coal with western coal.*

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With existing power plants using almost entirely low-sulfur western coal, use of a blend of Kansas coal with the low-sulfur coals would still provide an environmentally acceptable product.

Policy

22. *The State of Kansas must take a more aggressive and visible position in influencing national energy policy, including advocacy at the Federal Energy Regulatory Commission (FERC).*

The state, through the KCC, is active in rate and certificate matters on individual pipelines providing service in Kansas. However, the U.S. Congress and the FERC have and will be considering generic energy policy decisions which can have a significant impact on the Kansas natural gas industry.

FERC Order 555 issues focusing on new pipeline investment, have significant implications for the state, given its new potential for exporting gas to Northeast and other remote markets. The state should facilitate the construction of new pipeline connections to new markets. Also, the state should be working to encourage the simplification of the certification process for building new pipeline projects.

Kansas should consider retention of full-time representatives to influence and advocate federal energy legislation that supports the natural gas industry.

23. *The State of Kansas should support the expedited treatment of incremental or expansion pipeline projects at the FERC, and before state and local governments.*

The nation faces a major shift in regional gas flow patterns, based on new pipeline capacity, and reduced drilling activity in traditional supply basins. The net result of the shift in regional flows is a new window of opportunity for Midcontinent supply to compete for existing firm demand in Northeast U.S. markets. Expansion pipeline projects would open up markets for Kansas-produced natural gas as well as possibly providing higher wellhead prices by introducing more pipeline competition to the wellhead. Higher wellhead prices could stimulate more drilling and development of the Kansas natural gas reserve base.

24. *The State of Kansas should not impose restraints on the production and marketing of Kansas natural gas except for conservation purposes.*

Kansas should continue its historical practice of matching natural gas supply from prorated fields to market demand, and not act to supersede the natural, free-market interaction of willing buyers and willing sellers. The natural gas industry has a significant opportunity to enlarge its share of the nation's energy market if electric generators and other industrial users can be assured that natural gas will be available on a dependable, market-priced basis. The KCC does have an obligation to prevent waste of the natural gas resource and ensure that its regulations protect the rights of producers and ensure equity among them. Efforts should be made to modify any existing rules which inhibit full production of allocated volumes assigned by the KCC.

As a net exporter of natural gas, Kansas stands to reap significant, long-term benefits from the nation's return to this abundant, environmentally friendly, domestic fuel source. Kansas has the enviable position of offering the benefits of a mature, but uniquely prolific gas supply that is produced in an extremely efficient manner, and is not subject to disruption by the weather. The state should not forfeit the leverage it now holds on other gas producing regions (most notably the Gulf Coast, which is experiencing marked deterioration in deliverability, without replacement of those reserves) when electric generators and local distribution company purchasers are willing and ready to make long-term commitments.

Various interstate pipelines have initiated expansion projects aimed at increasing the access of Kansas supply to new, higher-value markets. Any action to restrict the availability of Kansas production will defeat the purpose of these projects.

25. *The state, if possible under the decontrolled railroad rates, should seek more equable railroad rates for transport of Kansas coals to markets, when comparing transport of*

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similar quantities of coal from producers outside of Kansas.

At the present rail rates, coals coming into Kansas from outside the state have much lower unit transportation rates than Kansas coal for similar size shipments. Railroads under present regulation are basically capable of setting rail rates at their choosing based on competition from other railroads.

Environmental

26. *Implement effective and responsible state environmental regulations that are consistent with federal law, maintaining continued emphasis on the necessity of state-managed programs, but require more federal funding to support federal-mandated programs.*

Although no specific new requirements for environmental regulations are suggested, it is important that the regulatory system for fossil energy continuously monitor national and local issues, promulgating regulations as appropriate and necessary to ensure that Kansas maintains its present environmental quality. A very serious issue has been the 20-year-long policy of the federal government to promulgate new regulatory programs and then expect the state to fund their implementation. Kansas should resist further imposition of regulatory load without accompanying funding. It is important that the state retain local control over new federal fossil energy environmental regulations, as well as the federal government bearing most of the additional costs.

27. *Create a forum to discuss the resolution of conflicting resource issues such as ground water protection concerns versus produced fluid disposal needs.*

Current law provides for the Kansas Corporation Commission to regulate the disposal of produced brines from oil and gas operations. Rules and regulations for this action are reviewed regularly by an oil and gas advisory committee. Membership of this committee should be reviewed to ensure that all interested state agencies and specific public interest groups are included in the activities of the committee.

An example of the need to maintain coordination and communication is the recent attempt by the Kansas Water Office to institute a new multi-agency approval process for oil and gas well drilling and salt water disposal well installation through a formal and tedious siting process through the Kansas Water Authority. The KWO is a member of the committee, but the Kansas Water Authority is not. Perhaps the Kansas Water Authority should be added to the membership of the advisory committee.

28. *Provide an environmental baseline and state standards, thus taking leadership from the federal establishment.*

State control of its environmental and economic regulations is best obtained by taking leadership in development of a comprehensive and orderly inventory of environmental quality through baseline data acquisition and development of an information-based "early warning system" to ensure that potential and increasing environmental problems are addressed at minimum costs to the state, its industry, and its environment. Federal crisis management response is not acceptable for Kansas fossil energy resource or environmental management.

Societal energy needs must be met without damaging the environment insofar as possible, not withstanding the continually increasing population of the state, the nation, and the world. The intent of all environmental regulations should be to prevent or halt environmental damage, and should be promulgated so as to create "win-win" settings for the state and the industries, people, or governmental units involved. Extraction of the maximum resource from deposits within Kansas is a desirable goal, but will be defeated if the environmental costs become greater than the return to Kansas' citizens from the extraction process.

29. *Provide legislation that will alleviate the extreme financial liabilities upon industry for actions taken under regulatory control. At present, even if operators follow regulations to the letter, they remain liable for damages resulting from their regulated activities. Prescribed actions by regulatory standard*

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practice should not be liable for punitive damages. Other mitigation costs should be shared or paid by the regulatory agency.

Such legislation would not only lighten the insurance and bonding burdens of operators, it would encourage adoption of best possible technology by regulatory agencies, and strongly encourage operators to carefully obey all regulations, so as to avoid exposure to major financial liability. Thus, the industry would be free of liability for actions taken in response to requirements from regulatory agencies, but very much inclined to adhere closely to the letter of all regulations in order to obtain that relief. The state wins, and the regulated industry wins. No one loses.

30. *Develop improved means to clean Kansas coal and encourage the market to purchase currently minable coal.*

Clean coal technologies are actively being studied and developed through programs funded mainly by the U.S. Department of Energy. These programs could have important implications in Kansas in the next few years. Encouragement of proven clean coal technologies that can and will use Kansas coal can be important to the coal industry, as well as the Kansas environment.

Education and Research

31. *The State of Kansas should support an education program for consumers and students that informs them of the uses and benefits of natural gas.*

This can be done in a cooperative venture with the energy industry. By having such participation in education, even at the elementary level, students would have access to energy industry expertise and business personnel, and business would be exposed to the needs of the educational system.

32. *Support research towards development of new environmental damage prevention and remedial techniques. Funding should be developed to allow the Energy Research Center and other entities to develop technology, which, when combined with state oversight, will help prevent adverse environmental effect from oil and gas activities.*

Fossil energy extraction and use requires disturbance of surface and subsurface materials. In the current legal and regulatory climate, it is sometimes difficult to identify actual effects of the extraction processes from natural chains of events, to determine how to minimize effects, and finally, how to mitigate any effects that do occur. Research organizations within Kansas, such as the University of Kansas Energy Research Center, have the capabilities to investigate these issues, but do not have the funding to initiate more than cursory programs. State interest requires that the research be conducted, focused on state issues, and be timely. State funding for this research is appropriate and encouraged.

33. *Develop educational programs for the public about environmental issues facing the industry and the industry's initiatives to addressing those concerns.*

Kansans, like all Americans, recognize that environmentally deleterious effects can occur from resource extraction, but most have little knowledge of actual effects, have few materials from which to gain an unbiased perspective of the issues, and no place to go to ask questions and get answers. The industry itself has taken initiatives to address the problems and the issues, but is frustrated by the lack of public perception of their efforts. It is the consensus of this body that an integrated effort be made to develop resource environmental education at all levels of formal and adult education, using a combination of fossil energy industry and public funds.

34. *Assist existing efforts to develop and apply technology which will improve recovery of existing Kansas energy resources in an environmentally benign manner.*

Kansas reputedly has over 10 billion barrels of oil in place in known fields, with more than two billion of these barrels being mobile oil, that are not now being extracted with current technology. The petroleum industry is now a greater than $2 billion industry in Kansas, and generates more than $200 million a year in state tax revenues. Development of the technology

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to permit extraction of these known resources is a good investment. The University of Kansas Energy Research Center has initiated research to gain access to these unrecovered resources, but is funded almost entirely by federal funds. In order to focus their activities on Kansas opportunities, rather than on national priorities, state funding must be increased to support the research of the ERC and its founding organizations, the Kansas Geological Survey and Tertiary Oil Recovery Project (TORP).

35. *Educate the public about real and perceived environmental issues which can be difficult, since the public sees as "real" some problems that the industry doesn't perceive as "problems".*

Although many citizens consider themselves knowledgeable about environmental issues, most have developed their ideas from biased and flawed information provided by special interest groups and popular media. This situation is detrimental to the development of sound and practical environmental protection and mitigation. There is a growing sense of frustration with the conflicting and frequently alarmist information the public receives, to the point that we face a danger of having cried "wolf" too often. Acid rain, global warming, radiation fallout, and probable "ozone holes" are issues almost completely obscured by exploitation led by business, environmental lobbying groups, and scientists, all of whom appear to be searching for dollars for their programs rather than effective analysis of the issues, with consequent development of useful alternatives in public policy, technology applications or development, or real research needs. This is a national issue, but one in which Kansas can take the lead through programs in public schools, media materials, and preparation of data for public use rather than agency or technical use. This panel recommends establishment of a permanent panel of distinguished Kansans who will work to develop practical methods of addressing the issues raised, and focusing upon the issues most important to Kansas, both long term and short.

36. *Provide for technical assistance to independent operators, similar to the technical support given to agriculture. Help develop a Kansas Energy Research and Technology Transfer Center.*

For many years the Kansas Geological Survey has assisted the energy industries with technology, ideas, and information, as part of its normal program. An expansion of these efforts is now warranted, to provide more and better services to the energy extraction industry of Kansas, similar to the services provided to the agricultural industry by the Agricultural Experiment Stations and Extension Service.

The University of Kansas, with the leadership of the Kansas Geological Survey and with the support of TORP has developed a request to the U. S. Congress for funding to construct a research and resources information access center in Lawrence, which purpose is to make available to the Kansas operators the benefits of research, development, and invention of new and existing, but unused, technology to enable the industry to perform better, both economically and environmentally. Concurrently, the U. S. Senate has passed a version of the energy bill that provides for the establishment of a Mid-continent Energy Research Center at the University of Kansas. Nearly $3 million in new federal funding has been awarded to the ERC by the U.S. Department of Energy in support of research and technology transfer programs to the operators of the state and nation. These initiatives have been accomplished without requesting additional industry or state funds.

State financial assistance in making these projects work through funding for building construction, development of a permanent statewide technology transfer system, and support for increased information collection and distribution could measurably add to the state's energy production and tax revenues.

37. *Develop information on economic potential of coalbed methane in Kansas.*

Because of the infancy of coalbed methane in Kansas, information on the coal quantity, quality, and distribution, as well as possible production methods would be an important start in evaluation of this new resource. This information could be supplied to interested oil and gas producing companies.

5701

38. *A study of the value of the petroleum industry to Kansas should be made as a basis for policy decisions.*

The petroleum industry in Kansas provides major benefit to the state's economy. The exact total has never been carefully evaluated. Knowledge of the value of the industry beyond its direct sales of around $2 billion per year should be calculated so that policy decisions can be effectively supported. Values of state, county, and local tax revenues, multiplier factors, supporting industry contributions, and other factors should be measured and calculated.

5871

Energy For Kansas

A report of the sub-committee (non-fossil fuel) to the Governor
Philip Madell, Chairman
October 1992

5991

Executive Summary

This report contains extensive information on energy matters in the following sections: Kansas's energy resources, state government, efficiency and energy use, agriculture, utilities, renewable energy, recycling, and energy research.

Much of what is provided has been known in specialized fields. Here it is brought together for comparative purposes and to provide an understanding of how some seemingly diverse issues are interrelated.

We recognize that in Kansas the economy, energy, and our environment are inextricably intertwined, and that none of these factors can be considered separately from the others. We want to ensure that any recommended public policy is, first of all, beneficial to all of our citizens, and secondly provides for a stable and reliable supply of energy, with special acknowledgment of our responsibility to future generations of Kansans.

Kansans use more energy than the national average, partially because we are a significant energy producing state and because energy is available at relatively low prices.

However, all sources of energy are finite and the quality of the life of future generations in Kansas will depend upon decisions made now.

Therefore, we should acknowledge that we must address our own problems and not wait, hoping for others to act in our behalf. Prudent action is required. Perhaps a critical arena in which to perform is within state government itself.

Some thoughtful courses have already been initiated in various sectors of state government. A few of these effective measures include the program converting 33 state vehicles thus far to use CNG; the energy conservation measures undertaken at several Regents schools, Emporia State being an outstanding leader; bonds issued for energy measures promoted by the state's Architectural Services division; the schools and hospitals institutional conservation program; and Kansas State University engineering extension services to the public.

Additional recommended actions include promoting an open discussion among all the affected interests in additional measures involving conservation, research, and alternative power sources through hearings and legislative recommendations. As a major owner/occupant of buildings in the state, energy use should be monitored and emphasized in every state facility. Departments should have individuals on staff primarily devoted to conserving energy, and dollars, saving sufficient funds to exceed the cost involved. Reimbursement formulas to agencies and schools should be amended to remove penalties for conservation and promote incentives for conservation. Energy saving policies in state transportation should be considered a priority. Data must be collected regarding energy use by state government for the executive and legislative arms to make continued decisions in the public's best interest. Purchasing policies should be flexible enough to permit common sense contracting for energy purchases, as well as endorse energy conserving products.

6091

Integrated Resource Planning (IRP) by regulated utilities must be given the emphasis as an important step in the development of a prudent plan for benefit in the near-term and for future generations.

Among the items recommended in the subsequent sections are the following:

- Value energy services, not energy consumption.
- Deal objectively with the externalities of energy production and use.
- Provide equal market and capital access to competing resources/technologies.
- Eliminate subsidies which disrupt market signals unless they achieve legitimate public policy goals in a clearly stated fashion.
- Improve energy policy analysis skills in state agencies.
- Reduce transportation energy use; shift to alternate fuels for transportation.
- Implement either building energy performance standards or an aggressive program to achieve better building energy performance through training and technology transfer for all appropriate building trades and design professionals.
- Revitalize rail transportation of freight.
- Encourage energy research.
- Encourage new energy technology business development.

Most important, the committee recommends the continuance of the initiative begun with the energy policy committee and research those areas referenced but not thoroughly examined. Form a responsible body to collect, monitor, and recommend continuous efforts in fulfilling a well-reasoned and responsible energy strategy for the state of Kansas.

6/81

Preface

Real energy prices have steadily declined for the better part of a decade. The energy crises of 1972 and 1980 are history, but reasons to be concerned about our energy future remain. Kansas and U. S. oil production is declining and we are again increasingly reliant on imported oil. Global oil resources, although very large, will likely be substantially depleted by the middle of the next century. That sounds like the distant future, but it isn't. We should start now, taking full advantage of our remaining fossil fuel reserves, to build an orderly and gradual transition to a more diversified and resilient energy economy that can sustain continued economic growth. Waiting for future price shocks and supply disruptions to force us into action would be a costly mistake.

This document is intended as only a starting point in what must become an on-going debate about our energy future.

The following citizens volunteered their time as part of the energy policy committee, non-fossil fuel subcommittee, however, any errors in the report remain the responsibility of the chair.

- J. Paul Jennings served as Chairman of the over-all project and provided moral support during the entire process. Jim Robinson, Chairman, Kansas Corporation Commission, was also highly supportive and encouraging throughout.

- Dick Hayter served as the subcommittee coordinator, and always willingly gave of his time, ideas, and dynamic leadership. Pete Loux also provided advice, especially in the developmental stage.

- Stan Clark brought his unique experience to the committee and was a significant contributor to the section on agriculture. Richard Nelson provided critical input, research, and commentary for the agriculture portion. John Craft also provided information and comment on the agricultural section.

- Tom Mulinazzi provided the overall framework for development of the transportation section. Dr. John S. Neuberger also assisted with the transportation section, as did James Stuck, who provided ideas for that section.

- Joe King, was instrumental in the development and crafting of the report; without his enthusiasm, persistence, and dedication to quality, the subcommittee's report would not exist.

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The members of the subcommittee were:

Margaret Bangs, Wichita;
Kevin Brown, GT & E Oil Company, Hutchinson;
William E. Brown, President, KPL Division, KPL Gas Service, Topeka;
Stanley J. Clark, Ph.D., Head, Department of Agricultural Engineering, Kansas State University, Manhattan;
Patrick I. Coyne, Ph.D., Professor & Head, Fort Hays Experiment Station, Kansas State University, Hays;
John Craft, Energy Researcher, The Land Institute, and, Kansas Natural Resources Council, Hillsboro;
Robert I. Egbert, Ph.D., Director, Center for Energy Studies,Wichita State University, Wichita;
Raymond G. Friend, VP of Finance, CFO, High Plains Corporation, Wichita;
Jack D. Goodman, President & General Manager, Midwest Energy, Inc., Hays;
Ken Groteweil, State Representative, Wichita;
Mark Hannifan, Program Manager, Meridian Corporation, Leawood;
Richard B. Hayter, Ph.D., Director, Engineering Extension Program, Kansas State University,Manhattan;
David Heinemann, J.D., State Representative, Garden City;
Thomas Hochstetler, Economist, Kansas Electric Power Cooperatives, Topeka;
Joseph King, AIA, Project Manager, Meridian, Lawrence;
Philip Knighton, J.D., Attorney, Wichita;
Mark R. Koester, Business Representative, International Machinist AFL-CIO, Wichita;
J. Paul Jennings, Chairman of the Board, K & E Petroleum Inc, Wichita;
Dennis M. Langley, President, The Bishop Group, LTD, Hutchinson;
Philip P. Lesh, Norton;
R. C. "Pete" Loux, Director, KEURP, Topeka;
Philip H. Madell, Energy Programs Section, Kansas Corporation Commission, Topeka;
David E. Martin, Director, Public Affairs, Kansas City Power & Light Company, Overland Park;
Margaret J. Miller, Citizens for Recycling, Wichita;
Tom Mulinazzi, P.E., Civil Engineering Depart., Kansas Transportation Center, University of Kansas, Lawrence;
Richard Nelson, Ph.D., Engineering Extension Programs, Kansas State University, Manhattan;
Dr. John S. Neuberger, a volunteer environmentalist with the Sierra Club, Overland Park;
Joseph T. Pajor, Natural Resources Director, City of Wichita, Wichita;
Gale Simons, Ph.D., Engineering Experiment Station, Kansas State University, Manhattan;
James Stuck, Director of Gas Marketing, Western Resources, Lawrence;
Lois Tully-Gerber, Manager, Technical Transfer, KEURP, Topeka;
Jere White, Executive Officer, Kansas Corn Growers Association, Garnett.

Among non-members who provided significant data were:

David R. Collins of the Kansas Geological Survey provided data on fossil energy resources;
Myron Reed, P.E., Facilities Management, The University of Kansas, Lawrence;
Lee McQueen, P. E., Assistant Director, Administration Engineering, Kansas State University, Manhattan;
Bill Hartman, Assistant Director, University Physical Plant, Emporia State University, Emporia;
Orion M. Jordon, Director, Facilities Management, State of Kansas, Topeka;
J. David DeBusman, State Architect, and staff, Architectural Services, State of Kansas, Topeka;
Kansas Corporation Commission staff, Topeka.

6371

Kansas is an energy producing state. *In 1990, Kansas was the 6th largest producer of natural gas in the U.S., accounting for 3.1% of total production. Kansas production totaled 574 billion cubic feet (BCF), of which the net equivalent of 39% was exported to other states. Kansas was the 8th largest producer of petroleum products, with 1.6% of U. S. production, pumping 55.4 million barrels. We imported an additional 26 million barrels to meet our petroleum needs. Kansas was the 24th largest coal producer, mining 721 million tons, equal to <0.1% of U.S. production.[1] We imported 13 million tons. We also used nuclear fuel equal to 4.2 million tons of coal, none of which was produced in Kansas. After accounting for exports of natural gas and electricity, Kansas imported four out of every ten units of energy consumed. Kansas is a net energy importer.*

Energy is the very life blood of our economy. Energy is, by definition, the ability to do work. As with any other resource-knowledge, capital, labor, land, or other natural resources-the skill and efficiency with which we use energy directly influences how profitable that work will be. In an increasingly competitive global economy, inefficiency in the use of any resource must be offset by greater efficiency in the use of others. The alternative is lower wages, lower profits, or loss of competitiveness. Kansans spend a considerable amount of money on energy. In 1989 our per capita energy expenditures were the 7th highest in the U. S. at $2,014. Approximately 12.5% of per capita income was spent on energy. We spent such a high percentage because we used more energy, not because our prices were higher. Among the 50 states our petroleum prices ranked 25th highest, motor gasoline 48th, natural gas 45th, coal 43rd, and electricity 20th.[2] In 1990, the Kansas economy consumed 20,000 British thermal units (BTU) for every dollar in gross state product. While this is 22% less than in 1970, it is the 10th highest in the U.S.[3]

Kansas in an energy producing state. In 1990, we produced 63% more natural gas than we consumed, 68% of our petroleum needs, and 3% of our coal use. Yet imports of oil, coal, and nuclear fuel meant we imported approximately four BTU of every ten we consumed, and one for every two produced. Like the rest of the country, we are far from energy independent at this time.

Kansas has long enjoyed comparatively low energy prices. Perhaps in part because of that, we consume more per person and per dollar of economic production than most other states and some nations. Per capita energy consumption in 1990 totaled 409 million BTU, the equivalent of 3,272 gallons of gasoline (nearly 1/2 a highway transport tank), 25% more than the national average. Energy consumption per dollar of gross state product was 33% higher than the national average. Our energy intensity may stem in part from climate, industry mix, and population distribution. Regardless of the reasons, higher consumption makes us more vulnerable to both potential price increases and energy shortages, whether from natural or political origin. Future increases in the real prices of petroleum and natural gas currently forecast by the Department of Energy (DOE) may benefit Kansas energy producers, lease holders, and related sectors of the economy. To mitigate the impact on energy consumers of all types, we must seek ways to improve energy efficiency, develop renewable resources, and shift fuels from imported petroleum to Kansas natural gas. This document is intended to provide an overview of Kansas's energy consumption, production, and resources, and to present some of the options which could be implemented to achieve long term energy goals. As such, it is not intended as a specific set of recommendations, but as the catalyst for serious discussion and debate.

[1] Coal Production 1990, DOE/EIA.
[2] State Energy Price and Expenditure Report 1989, DOE/EIA.
[3] State Energy Data Report 1960-1990, DOE/EIA.

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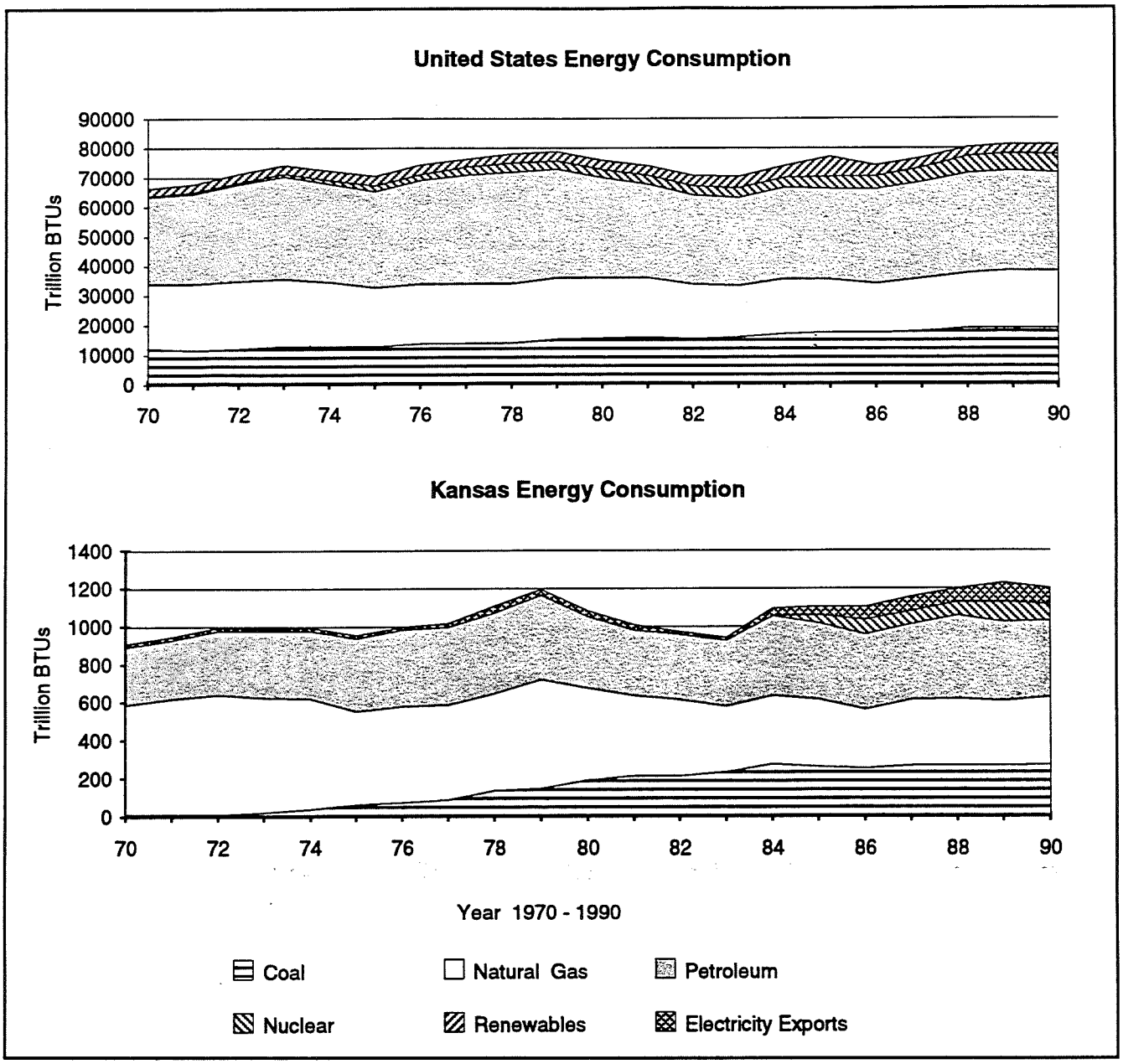

HOW MUCH ENERGY DO WE CONSUME?

Between 1970 and 1990, U. S. energy use increased 22% to 81.5 from 66.3 quadrillion BTU (quads). Coal consumption increased 55% to 19 from 12.3 quads. Natural gas consumption actually declined 11% to 19.3 from 21.7 quads, 21. 1 to 18.7 trillion cubic feet (6.8 cubic miles = 1 trillion cubic feet). Petroleum consumption peaked in 1979, but 1990s consumption of 33.5 quads (6.2 billion barrels) represented a 14% increase over 1970. Nuclear energy consumption increased even more dramatically than coal, roughly twenty-six fold to 6.2 from .24 quads in the same period. Renewable energy use from hydroelectric increased 11% to 2.9 from 2.7. Other renewable energy applications increased significantly, although their total measured contribution remains relatively small. Geothermal energy use increased to .181 from .011 quads, and wind solar thermal and biomass energy use increased to .021 from .004 quads. These numbers are based on energy used by electric utilities, and do not accurately reflect distributed uses of renewable energy which are reflected in reductions of purchased energy.

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Kansas Energy Vital Statistics

	1970	1990
Fossil Energy Production		
Oil Production		
Oil production, million barrels per year	84.9	55.4
Average price per barrel ($1990)	$11.04	
Oil production, percent of U.S. total	2%	
Oil production, percent of U.S. consumption		
Producing oil wells	44,665	
Barrels of oil per day per well	5.2	
Proven oil reserves (billion barrels)	.5	.7
Life of proven reserves at current production rate	12	12
Anticipated recoverable reserves		5.5
Life of anticipated recoverable reserves at current production rate (years)		100
Natural Gas Production		
Natural gas production, trillion cubic feet	.91	.59
Average wellhead price per MCF ($1990)	$1.28	
Natural gas production, percent of U.S. total	3.8%	
Natural gas production, percent of U.S. consumption		
Producing natural gas wells	8,660	
MCF per day per well (annual average)		
Proven natural gas reserves	13.3	9.4
Life of proven reserves at current production rate		16
Anticipated recoverable reserves	28.9	38.7
Life of anticipated recoverable reserves at current production rate (years)		66
Coal Production		
Coal production, million tons	1.6	.72
Average price per ton, FOB mine ($1990)	$18.87	
Coal production, percent of U.S. total		
Proven coal reserves		977.4
Life of proven reserves at current production rate (years)		1,358
Producing coal mines		
Nuclear Fuel		
Nuclear fuel production	none	none
Average price per million BTU	n/a	
Electricity Production		
Installed generating capacity (megawatts)		
Natural gas fired capacity (megawatts)		
Petroleum fired capactiy (megawatts)		
Coal fired capacity (megawatts)		
Nuclear capacity (megawatts)	none	1117
Million kiloWatt-hours generated		
Generated with natural gas	14,768	
Generated with petroleum	281	
Generated with coal	704	
Generated with nuclear	0	7,874
Exports of electicity (megawatt-hours)	3,967	9,547
Peak demand (megawatts)		
Reserve margin at peak		
Energy Consumption (trillon BTU)		
Total state consumption	875.1	1,030.2
Residential	178.9	179.2
Commercial	104.4	163.2
Industrial	341.2	405.8
Transportation	250.7	282.1

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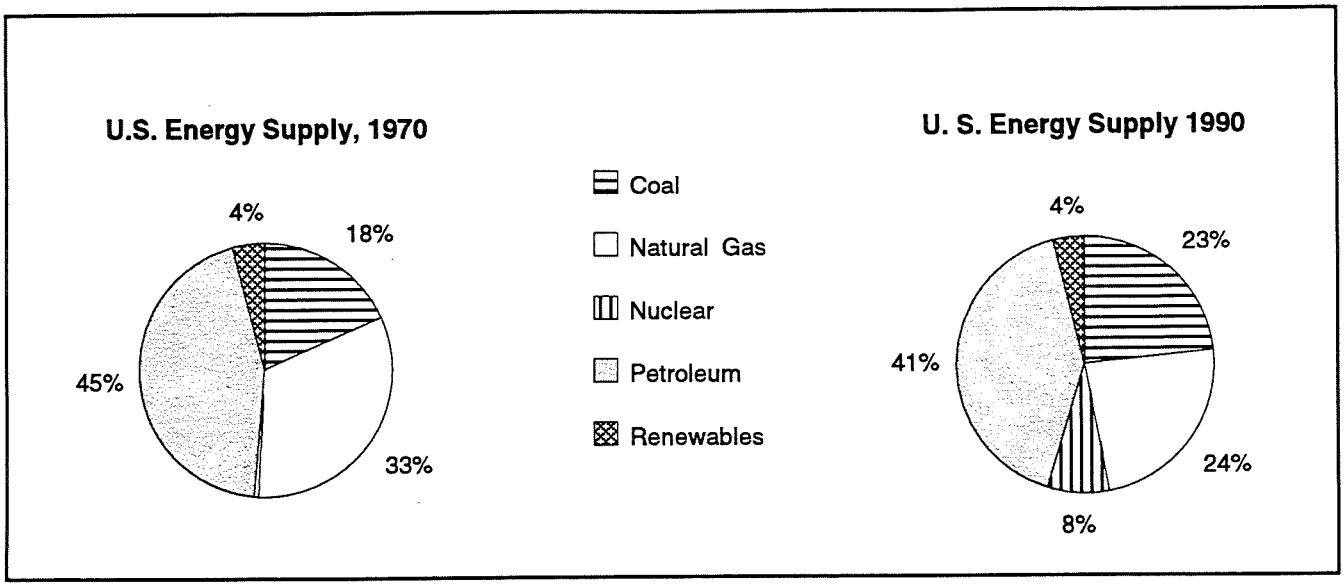
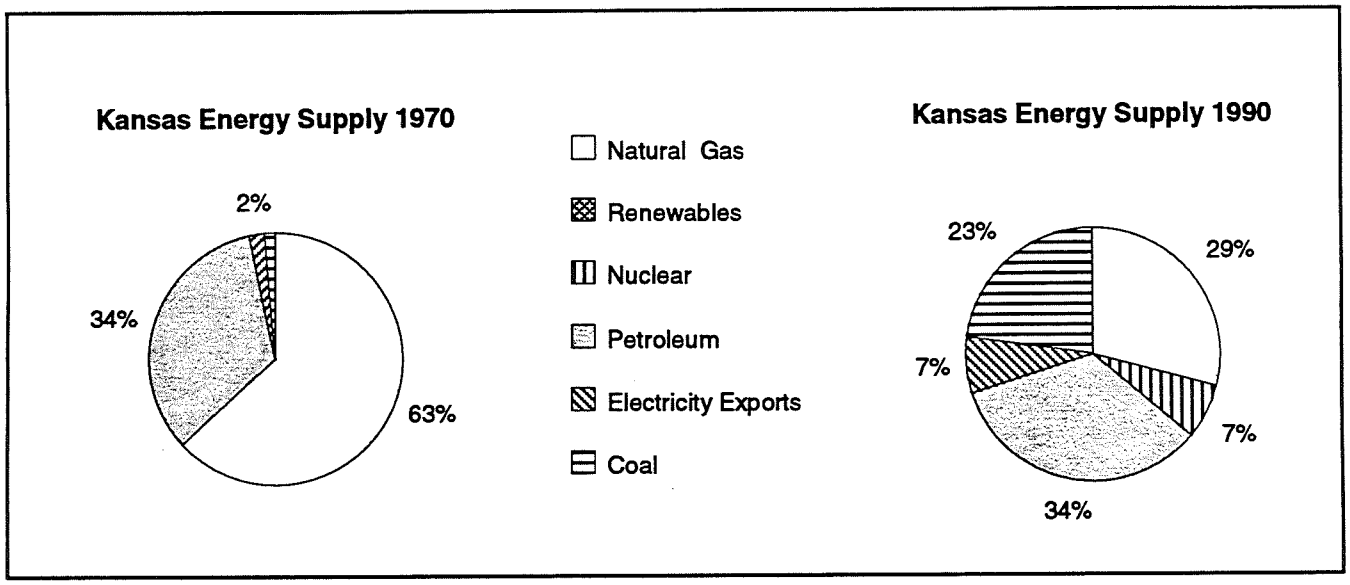
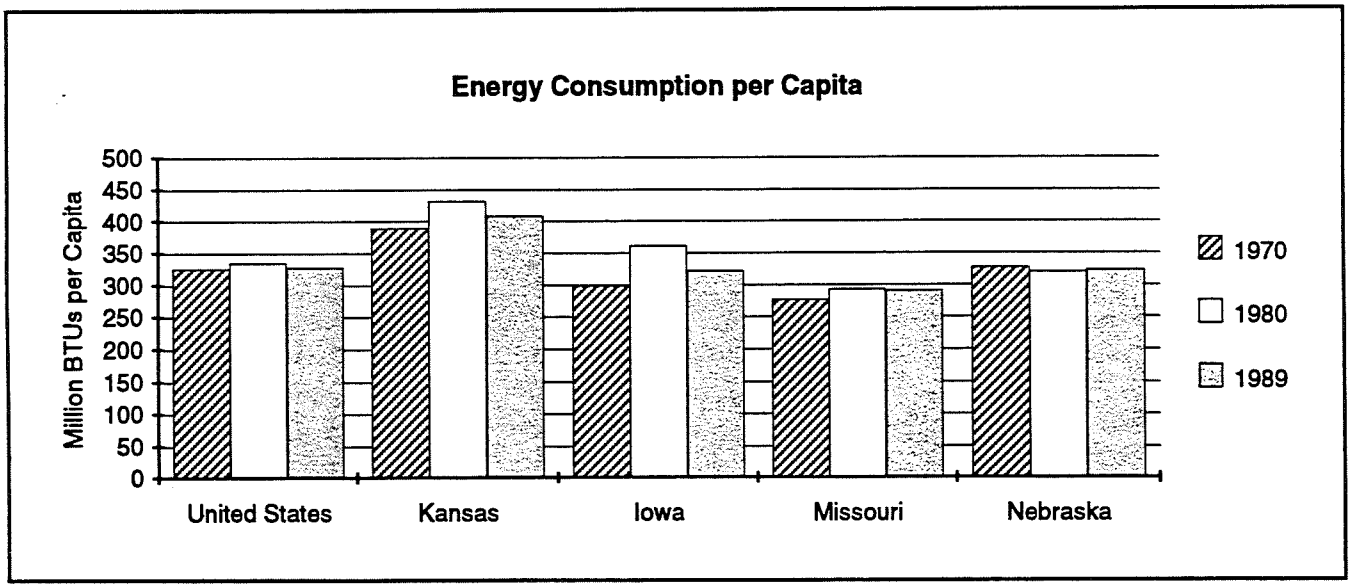
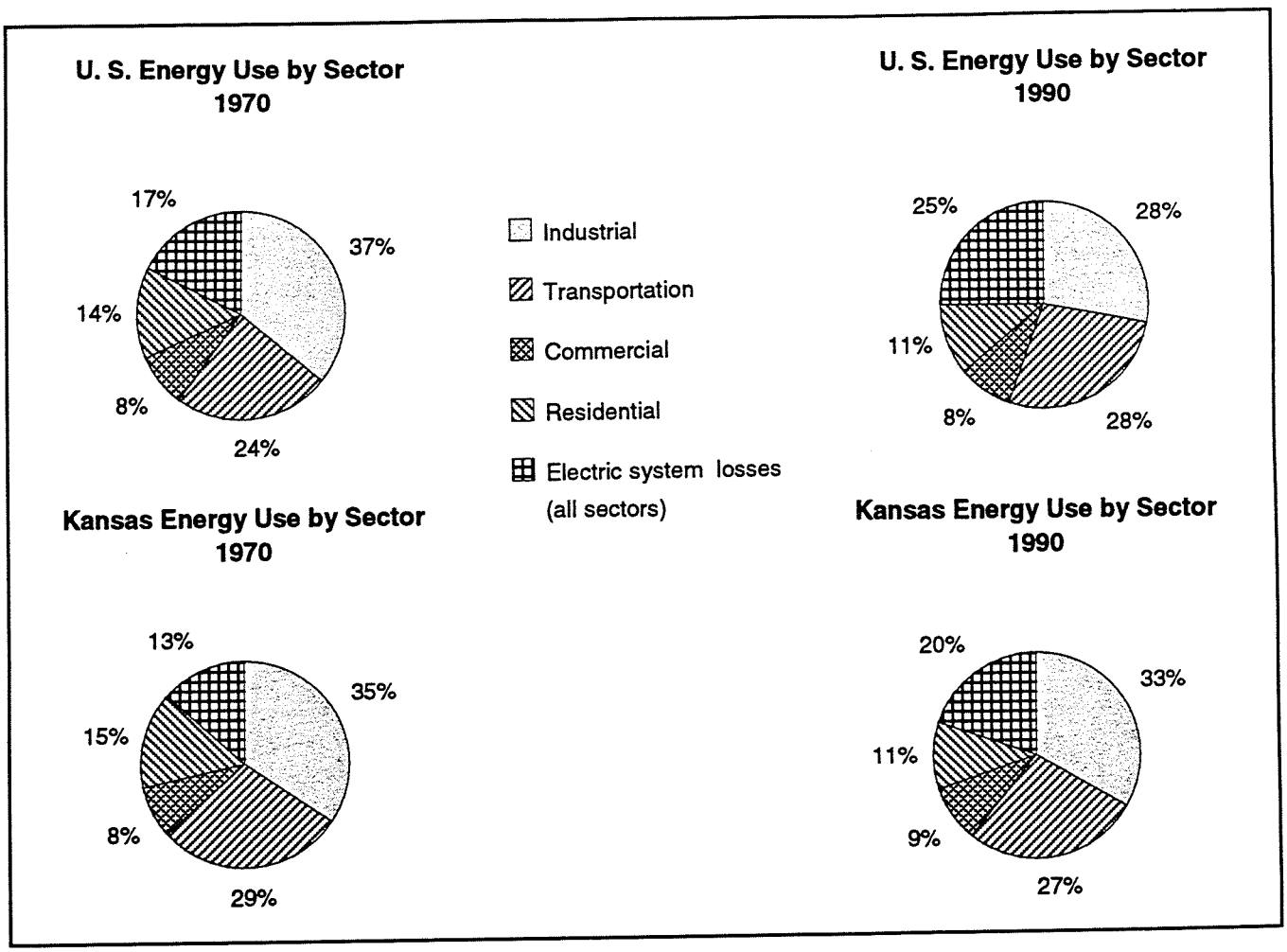

U.S. Energy Supply, 1970
4%
18%
45%
33%
Coal
Natural Gas
Nuclear
Petroleum
Renewables
U. S. Energy Supply 1990
4%
23%
41%
24%
8%


Kansas Energy Supply 1970
2%
34%
63%
Natural Gas
Renewables
Nuclear
Petroleum
Electricity Exports
Coal
Kansas Energy Supply 1990
23%
29%
7%
7%
34%


Energy Consumption per Capita
Million BTUs per Capita
500
450
400
350
300
250
200
150
100
50
0
United States
Kansas
Iowa
Missouri
Nebraska
1970
1980
1989

6791



During the same period, Kansas energy consumption increased 18% to 1.03 from .88 quads (or 1,030 trillion BTU), about 1.2% of total U. S. energy use. Coal use in Kansas increased a dramatic twenty-five fold from a mere 10 trillion BTU to around 273, most coming from Wyoming mines, and virtually all of it destined for electric utilities. Natural gas consumption declined 39%, to 353 from 575 billion cubic feet. By far the largest decline in natural gas use, 141 BCF, occurred in electric utilities, but gas consumption declined as well for residential (25.8 BCF) and industrial (26 BCF) uses. Commercial users of natural gas increased consumption about 3.5 BCF. Kansas petroleum consumption increased 32%, substantially more than the national average, moving to 407 trillion from 307 BTU (78 to 58 billion barrels). Decreases of 14.7, 1.9, and 2.5 trillion BTU in the residential, commercial, and utility sectors were offset by 55 trillion to increases in transportation and industry. Nuclear fuel, unused in 1970 in Kansas, totaled 84 trillion BTU in 1990. While renewable energy use expanded on a distributed basis, measured contributions remain limited to one active hydroelectric generating plant with annual production of approximately .1 trillion BTU.

Energy consumption is influenced by changes in population. The 22% increase in U. S. energy use between 1970 and 1990 actually reflects only an increase of less than 1% per capita. Because Kansas's population grew at a slower rate than the U. S. as a whole, its more modest 18% increase in energy use actually represents a greater increase per capita of 5%.

HOW DO WE USE ENERGY?

The leading energy consuming sector in the U. S. is industry at 37%, 29.8 quads of our total of 81.5 quads of primary energy consumption. Kansas follows this pattern with industry being the largest energy user,

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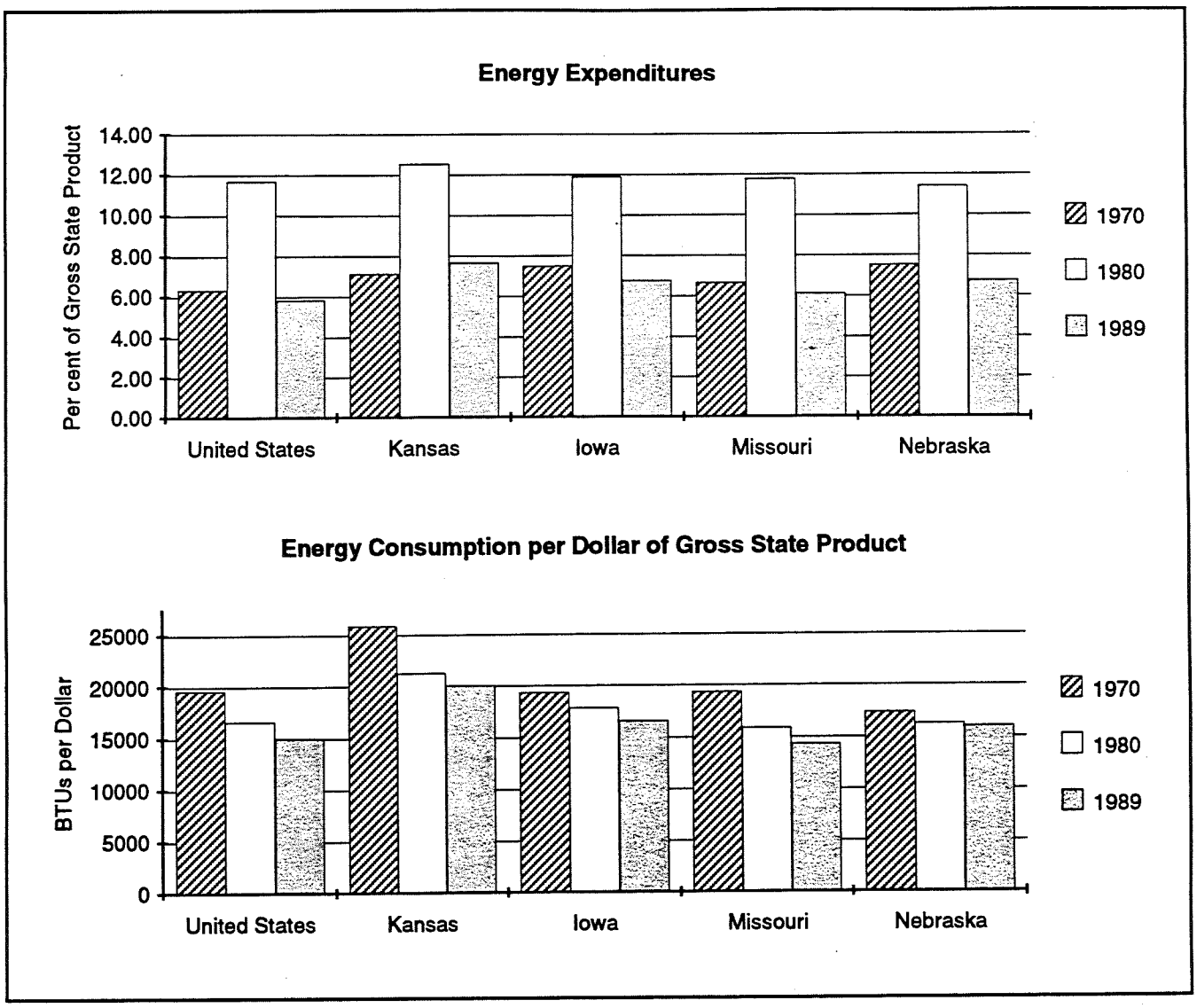

consuming 39% of primary energy use. The term primary energy use indicates that electric utility energy losses for the generation of electricity are included in the BTU value of total energy consumed by each individual sector. The pie charts in this section show electrical generation losses separately providing an additional perspective on energy consumption. Transportation follows at 22.5 quads for the nation, 28% of total primary energy use. In Kansas, transportation represents approximately 27% of total state primary energy use.

Kansas's transportation energy intensity use includes some 41 trillion BTU used for natural gas pipeline compression. Residential use is the second largest consumer of energy nationally and in Kansas, at 15.9 quads or 20% nationally and 17% in Kansas. Commercial use is the smallest energy consuming sector at 16% for the U. S., and Kansas. Over the past two decades U. S. industry's share of direct energy use has declined substantially. Transportation has increased its share modestly. Energy use by electric utilities has increased its share the most, although it should be noted that this energy is really "consumed" by the end user of the electricity produced. In Kansas industrial, transportation, and residential energy use have declined modestly, while energy use for electrical power generation has increased substantially.

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HOW EFFICIENTLY DO WE USE ENERGY?

Efficiency is the ratio between inputs and outputs. One measure of Kansas's sensitivity to energy price increases is the portion energy costs represent of our total gross state product. Since 1970, that ratio has declined for the U. S. as a whole and the adjoining states of Iowa, Missouri, and Nebraska, but has increased for Kansas. In 1990, Kansas energy costs equaled 7.7% of gross state product (GSP), 5.8 % for the U. S. as a whole, 6.8% for Iowa, 6.1% for Missouri, and 6.7% for Nebraska.

Another useful measure of energy intensity is energy consumption per unit of economic output, often expressed as BTU per dollar of gross state product (GSP). Kansas, the U.S., and the other nearby states mentioned above have all significantly reduced their energy intensity since 1970. In 1990, Kansas was the highest at 20,070 BTU/$, followed by Iowa at 16,570 BTU/$, Nebraska at 15,970 BTU/$, the U.S. average at 15,030 BTU/$, and Missouri at 14,300 BTU/$.[4,5] However, Kansas has decreased the ratio by 22% – greater than the average decrease by the other states.

The Kansas Energy System flow chart illustrates that industry, transportation, and electric generation are Kansas's major energy consumers.

ARE WE REALLY RUNNING OUT OF ENERGY?

Global proven reserves of petroleum are estimated at 99.2 billion barrels, enough for 45.4 years at current rates of use. Total recoverable reserves have been estimated at 1,744 billion barrels, or 79 years at current consumption levels. Global proven reserves of natural gas are estimated at 4,212 trillion cubic feet, a 56.8 year supply. Global coal reserves are enormous. Proven reserves are estimated at 2,024,755 million tons, a 388.6 year supply at current rates of use, and total recoverable reserves are estimated at 11,167,346 million tons, a 2,143 year supply. Solar energy in its varied forms is annually many times our entire fossil fuel use, for Kansas, the U. S., and the world. Describing energy reserves in terms of current rates of use helps put them in perspective, but global energy consumption is increasing rapidly.

The world is not running out of energy, but the supplies of inexpensively produced oil and gas are shrinking. The environmental consequences of current levels of energy use, and even higher levels forecast for the future, are increasingly problematic. The energy required to search for and produce additional energy is increasing in proportion to the amount of additional energy produced. But the most immediate concern is that remaining reserves of petroleum that can be produced profitably at current market prices are increasingly concentrated in a few countries. The probable result will be increasing prices for oil and eventually natural gas.

Oil and gas resources are generally classified as proven reserves, inferred reserves, and undiscovered resources. The latter two are sometimes grouped together as total estimated recoverable reserves. Proven reserves are the estimated quantities that, with reasonable certainty, can be produced in future years from known reservoirs.

❖ Petroleum Energy Resources

Petroleum production in Kansas rose to 120 million barrels in 1955, but has declined since except for a period of increased production in the 1980s due to rising world oil prices. Proven reserves are estimated at .33 billion barrels, a 5.8 year supply at current production rates. Total recoverable reserves are estimated at 5.5 billion barrels.

U. S. historical oil production totals an estimated 56 billion barrels. Proven reserves total 28.2 billion barrels, a 10.4 year supply at current production rates. Total recoverable reserves are estimated at 184.2 billion barrels with advanced technology and without access restrictions to coastal zones and public lands. This represents a 68.2 year supply beyond proved reserves at 1991 production levels. Total global recoverable reserves are generally estimated at around 999 billion barrels, but vary widely, and have increased in recent years as a result of revised estimates

[4] State Energy Data Report 1960-1990, DOE/EIA.
[5] Statistical Abstract of the United States of America 1991, Bureau of the Census.

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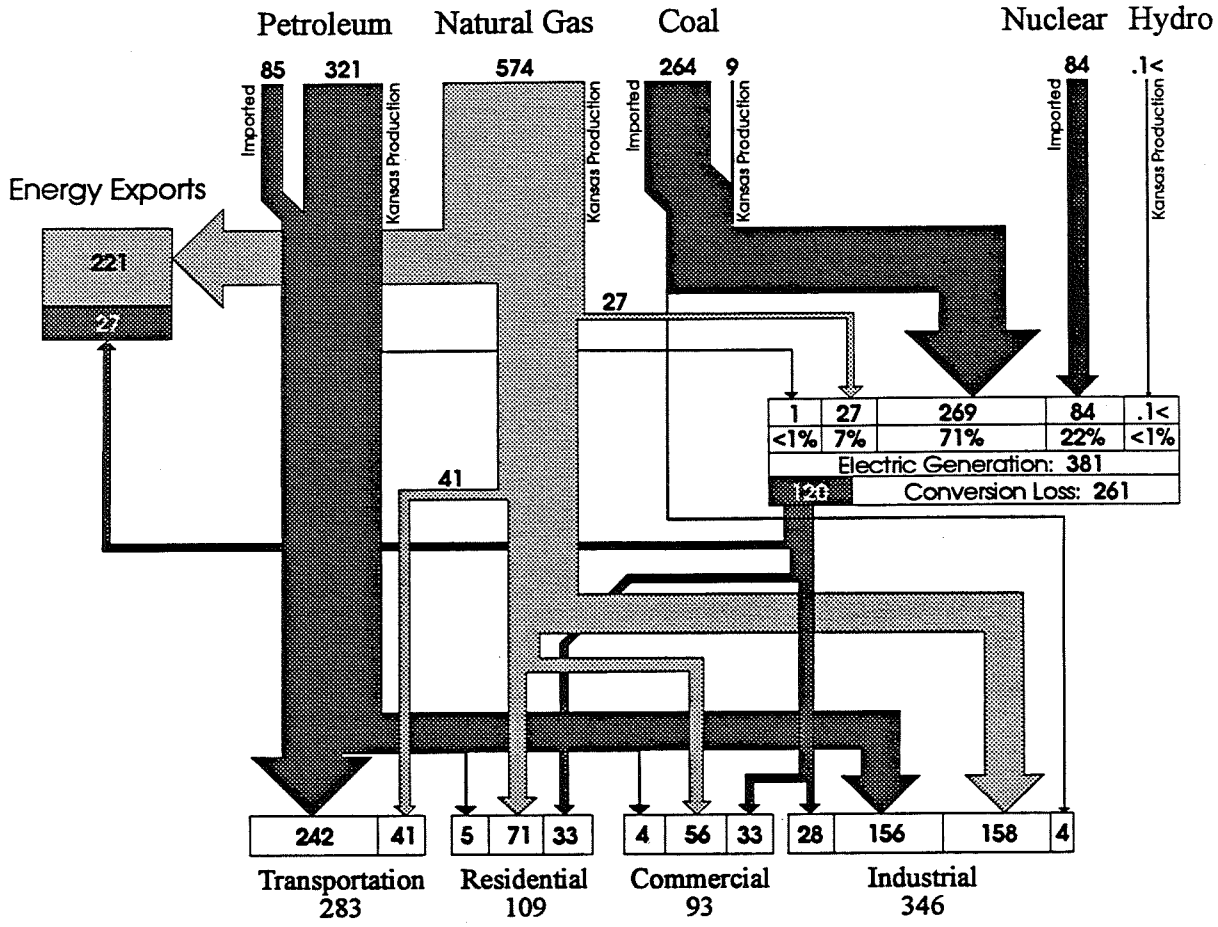
The Kansas Energy System



Sources: State Energy Data Report 1960-1990 DOE/EIA, Scientific American, September 1990.

Notes: 1) Energy units shown in Trillion BTU's ($1x10^{12}$).
One trillion BTU's ≅ 8,000,000 gallons gasoline.
2) Conversion and Transmission losses not shown.
3) Numbers may not add due to independent rounding.

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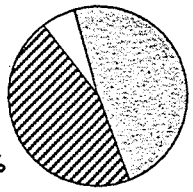
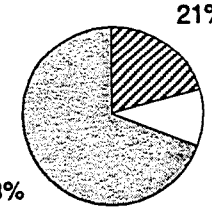
Kansas Petroleum Resources



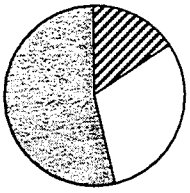
At the current annual production rate of 55 million barrels, Kansas's proven reserves would last 12 years, another 54 with total estimated recoverable reserves.

U. S. Petroleum Resources



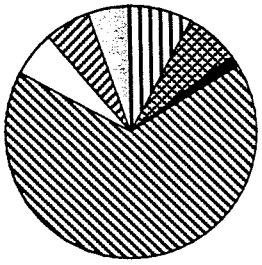
At the current annual production rate of 2.7 billion barrels, the U. S.'s proven reserves would last 10.4 years, another 58 years with total estimated recoverable reserves.

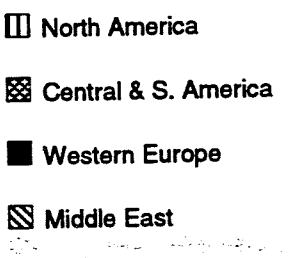
Global Petroleum Resources



At the current annual production rate of 22 billion barrels, global proven reserves would last 36 years, another 44 years with total estimated recoverable reserves.

World Oil Reserves





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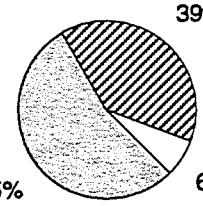
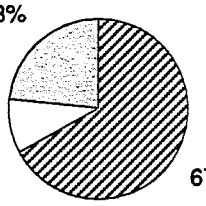
Kansas Natural Gas Resources



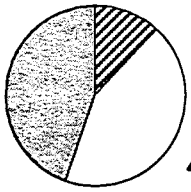
At the current annual production rate of 0.59 trillion cubic feet, Kansas's proven reserves would last 8 years, another 67 years with total estimated recoverable reserves.

U. S. Natural Gas Resources



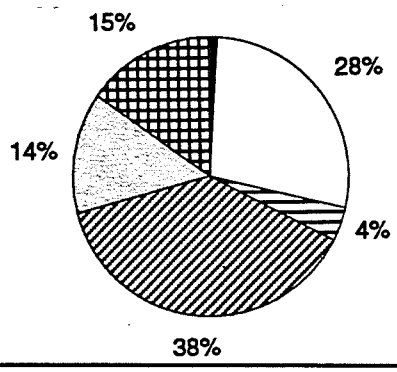
At the current annual production rate of 18 trillion cubic feet, the U. S.'s proven reserves would last 16 years, another 65 years with total estimated recoverable reserves.

Global Natural Gas Resources



At the current annual production rate of 74.3 trillion cubic feet, global proven reserves would last 53 years, another 58 years with total estimated recoverable reserves.

World Natural Gas Reserves



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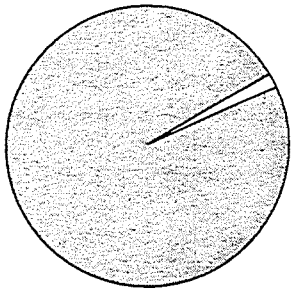
Kansas Coal Resources

53,534 million tons total estimated recoverable reserves

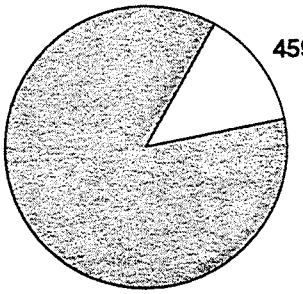


977 million tons proven reserves

At the current annual production rate of 0.721 million tons, Kansas's proven reserves would last 1,356 years.

U. S. Coal Resources

2,865,173 million tons total estimated recoverable reserves

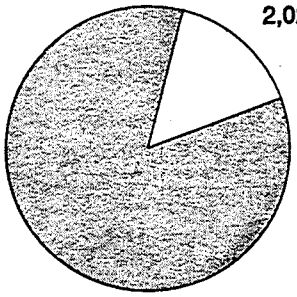


459,941 million tons proven reserves

At the current annual production rate of 1,029 million tons, the U. S.'s proven reserves would last 447 years, another 2,784 with total estimated recoverable reserves.

Global Coal Resources

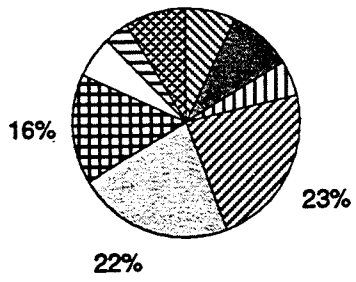
11,167,346 million tons total estimated recoverable reserves



2,024,755 million tons proven reserves

At the current annual production rate of 5,211 million tons, global proven reserves would last 389 years, another 2,143 with total estimated recoverable reserves.

World Coal Reserves



- Western Europe
- China
- Other Countries
- India
- South Africa
- Poland
- United States
- Australia
- Soviet Union

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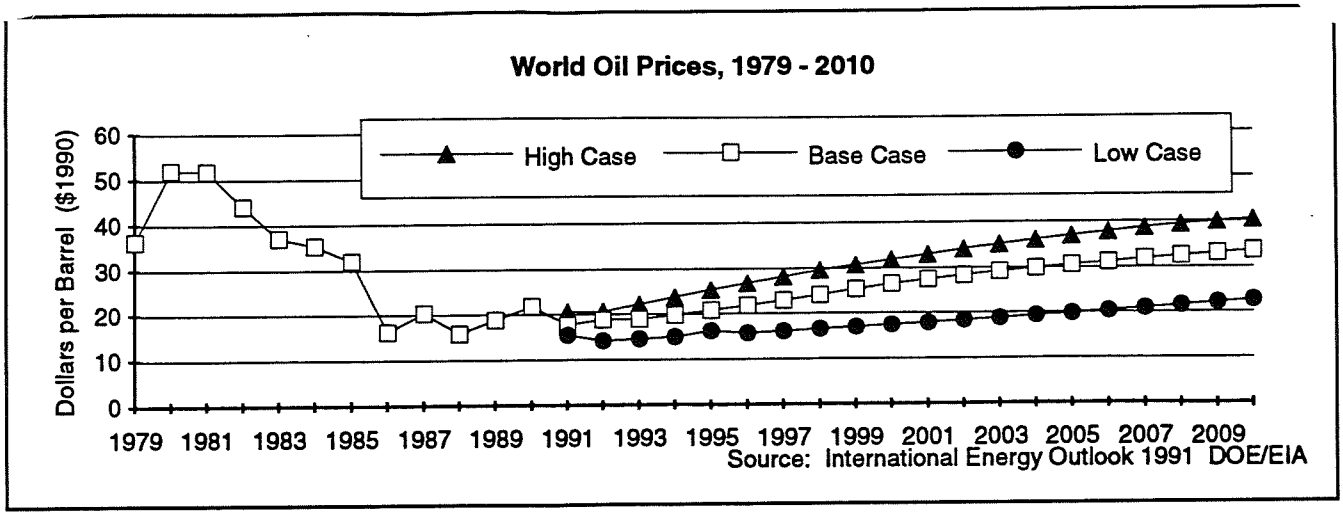

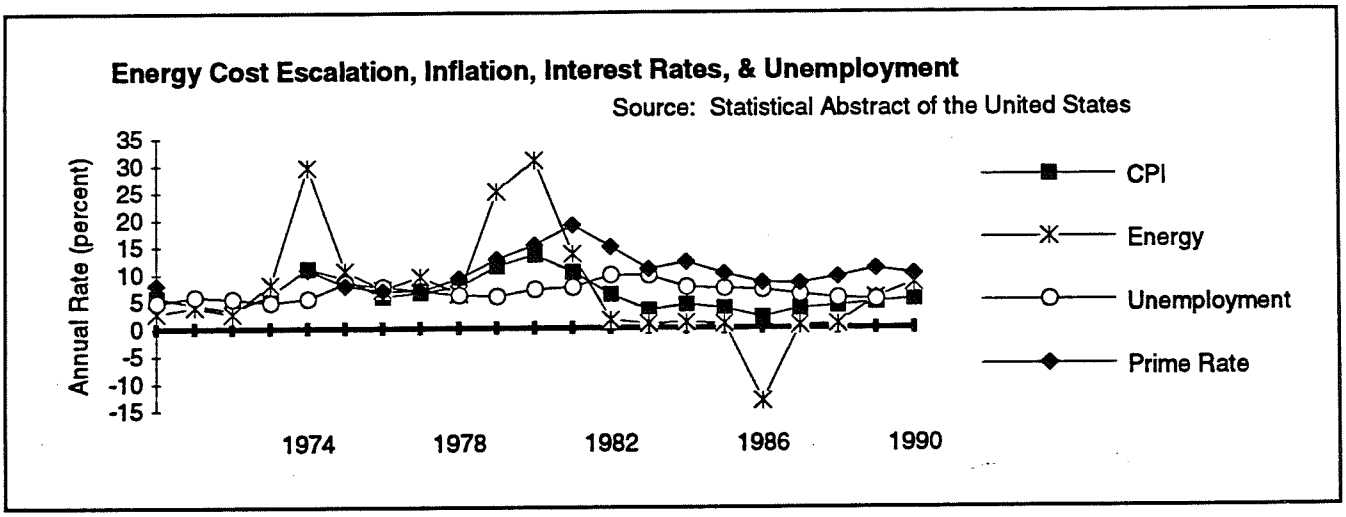

of Middle East reserves. The actual amount of recoverable petroleum can only be determined with additional exploration and development, and it will be directly related to the maximum price the market will pay before shifting to other energy sources or simply doing without. Two things are clear however. Remaining global petroleum resources, although vast, will be substantially depleted by the middle of the coming century, and most of the remaining oil is located in the Middle East. The Organization of Petroleum Exporting Countries (OPEC) controls 75% of the world's proven oil reserves, with the potential for discovering considerably more. "As long as world oil prices are below a sustained price of $30 to $40 per barrel, which would make alternatives to oil uneconomical, OPEC may regain its position of the 1970s. Overall, the end of 1990 OPEC reserve levels are the equivalent of about 95 years at current production rates compared with 10 years for the United States, 13 for the North Sea, and 14 for the 'Soviet Union'. Even at the high production rates forecast OPEC would have nearly 40 years of proved reserves remaining in 2010."[6]

❖ Natural Gas Resources

During severe winters of the 1970s many gas customers were curtailed. Schools closed. Factories shut down. Also during the 1970s, electric utilities were advised that future gas supplies were uncertain, and that they should shift to other fuels, a move that was later encouraged by congressional action. Fortunately, we now know that natural gas reserves, while finite, are larger than then believed. Cumulative historical gas consumption in Kansas totals an estimated 28.2 trillion cubic feet (TCF). Proven reserves

[6]International Energy Outlook 1991, DOE/EIA.

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of 4.6 TCF represent a 7.9 year supply at the 1991 production rate of .58 TCF. Estimated recoverable reserves total 38.7 TCF, a 67 year supply beyond proved reserves at current production rates.

Historical natural gas production in the U. S. totals an estimated 760 TCF. Proven reserves of 167 TCF represent a 9.6 year supply at the 1991 production rate of 17.6 TCF. Recoverable reserves are estimated at 1000-1300 TCF, representing 65 years supply beyond proven reserves at 1991 production rates. Kansas has 2.7% of U.S. proved gas reserves and 9.7% of total estimated recoverable reserves. Past global production of natural gas is estimated at 1,173 TCF. At 1991 production levels, proved reserves of 4,212 TCF represent a 56.8 year supply at current production rates. As with oil, global natural gas production rates are forecast to increase by many analysts, although at a more rapid rate, in part because of natural gas's environmental advantage.

World natural gas reserves are concentrated in the former Soviet Union, Iran, and other OPEC countries. U.S. natural gas reserves represent a small portion of world reserves. "Imports of natural gas to the United States are expected to grow in importance. Domestic production of natural gas is expected to peak in 2005. Growth in Canadian exports to the U. S. is anticipated in the early 1990s before becoming relatively stable. Mexico is also expected to become an exporter of natural gas to the United States around 2000."[7]

❖ Coal Resources

Proven coal reserves of 97.4 million tons represent a 1,356 year supply at current production rate of .721 million tons per years. Total recoverable reserves are estimated at 53,534 million tons. Kansas coal production has been seriously retarded by its high ash and sulfur content. Proven U. S. coal reserves are estimated at 459,941 million tons, a 447 year supply at current production rates. Total recoverable reserves are estimated at 2,865,173 million tons, an additional 2,784 year supply at current rates. Proven global coal reserves total 2,025 billion tons, a 389 year supply at current production rates of 5.2 billion tons. Recoverable reserves are estimated at 11,167 billion tons represent an additional 2,143 year supply at current rates. Unlike oil and natural gas, U. S. coal reserves are the largest of any country, at 23% of total global reserves. The former Soviet Union, China, and Australia have an estimated 46% among them.

Remaining world fossil fuel reserves are substantial, but oil, the most transportable and therefore the most preferred energy resource, is highly concentrated in a few countries. Kansas and most U. S. reserves of oil are located in mature production areas, where the cost of additional production will typically be substantially higher than Middle East production. As OPEC's market share increases, it will have greater flexibility in increasing costs.

What will energy prices be like in the near future?

No one really knows for certain what future energy prices will be. In constant dollars, energy prices for all energy resources have declined in recent years.

If prices increase, won't that encourage additional exploration, development of alternatives and greater energy efficiency? Of course it will. But rapid escalation of a crucial commodity like energy can result in significant inflation and high interest rates. Developing existing fossil and renewable energy resources, as well as implementing energy efficiency technology, are all capital intensive. Diversifying our energy options now with sensible long term strategy will be much less disruptive rather than waiting for it to be forced upon us. Sudden rises in energy prices have a direct adverse impact on employment and the economy.

How much should concern about the environmental impact of energy use, particularly global warming affect Kansas's energy strategy?

Kansas is fortunate. Climate patterns and population distribution provide us with good air quality. Only metropolitan Kansas City has significant air quality concerns, and it is generally regarded as having among

[7] International Energy Outlook 1991, DOE/EIA.

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the best air quality for a city of its size in the entire country. A substantial portion of our electricity is generated with coal, but pollution control equipment and the predominant use of low sulfur Western coal mean that our sulfur emission per unit of generation are among the lowest in the nation. Most analysis of the Clean Air Act indicate that Kansas will be in compliance through the second phase of implementation (2010).

Global warming is a much more problematic issue. There is little doubt that the enormous long term atmospheric emissions of the world's industrial economies are having an impact on global climate. The important questions are how much, at what rate, to what extent natural processes may mitigate the impact, and what measures could favorably mitigate the impact. The U.S. and other industrialized countries now have extensive research programs underway to develop more specific answers to these crucial questions. If these studies determine that dramatic reduction in global fossil fuel use is called for, an entirely new approach to energy policy may be essential.

Our response to the issue of global warming can be based on key policy points which are fundamentally sound on their own:

- *Aggressively pursue improvements in energy efficiency that already make economic sense based on a level playing field giving equal opportunity to the demand-side management.*
- *Maintain flexibility by making no commitments to additional large power plants, particularly coal fired units, for as long as possible.*
- *Increase efforts to develop cost effective ways to use Kansas's renewable energy resources.*
- *Support federal efforts to develop a new generation of safe, reliable, low cost, advanced nuclear power plants.*

Kansas is a state with many energy resources, but we cannot set ourselves apart from the nation and the world. Our future energy security and economic prosperity are intertwined with others, some more, but most far less fortune than us. This is not a "Chicken Little" story. The simple facts are that as a state and a nation our reserves of oil are rapidly declining. Natural gas reserves, far more plentiful than widely thought a mere decade ago, will be substantially gone in 60 years, sooner according to some sources. Coal reserves remain enormous, but the environmental pressures against using it are likely to grow.

These are not problems without solutions. Rapid evolution of technology is making dramatic improvements in energy efficiency not only possible, but financially attractive. Not long ago many thought extensive use of renewable technologies would only be feasible with a dramatic increase in fossil energy prices, an event they considered inevitable. Today the prospect of wind, photovoltaic, and biomass energy systems competing at current costs within the decade is not unrealistic. Innovative concepts in nuclear power, offering lower cost, greater safety, and less nuclear waste, can not be discounted. Even Flieschmann and Ponds "cold fusion" technology that was so ridiculed when first announced a few years ago, is receiving serious attention from researchers around the world with promising results.

In fashioning an energy strategy for a profitable growth-oriented sustainable future for Kansas, several key factors stand out, including:

- *Do not expect others to solve our energy problems.*
  Our lack of attention to energy issues suggests we do not recognize that they are genuine. Relying on the federal government or fallout from other states to address Kansas specific energy needs and opportunities will not protect our interests.
- *Recognize who has the resources.*
  Production of Kansas and other domestic U.S. oil and gas resources must be an important part of our energy strategy. But the finite limits of our resources and the ability of OPEC to set world oil prices means we must diversify our sources of energy. They have the oil and can produce it at much lower cost than U.S. oil producers.

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- *Value energy services, not energy consumption.* We must become less preoccupied with production of energy and more focused on using energy in the most cost effective manner.
- *Deal objectively with the externalities of energy production and use.* When the production or consumption of any form of energy results in other real costs to society, those costs should be communicated to the market so that decisions regarding energy costs allow market mechanisms to work effectively to achieve the lowest total real cost to society.
- *Provide equal market access to competing resources/technologies.* Many resources and technologies are now competing to provide energy services. For example, natural gas, and electricity, compete for the home space heating market. Utilities sometimes spend substantial amounts competing with each other. The cost is usually an operat ing expense paid for from gross revenues. The role of regulation in the future will stress maintaining a level playing field for competing technologies.
- *Provide equal capital access to competing resources/technologies.* Our current energy system is biased in favor of consuming energy, not using it in the most cost-effective manner to achieve the necessary energy service. Energy producers and utilities typically have access to capital at terms preferable to those available to investors in energy efficiency. There are legitimate historical reasons for this, but if we are to achieve a fair economic balance between consumption and conservation, methods of providing comparable access to capital must be devised.
- *Eliminate subsidies which disrupt market signals unless they achieve legitimate public policy goals in a clearly stated fashion.* Subsidies which give preference to one method of providing an energy service over another should be avoided unless there is an overriding public benefit. Our desire to help the Kansas farmer should not be used to justify a subsidy of ethanol from grain unless the energy gained from the seed to tank process of ethanol production actually produces an energy gain at acceptable cost. Our desire to help the home-owner deal with the cost of utilities should not be subsidized with a tax exemption on utility bills, when the cost and labor to install insulation and other energy efficiency measures is subject to sales tax.
- *Improve energy policy analysis skills in state agencies.* Development and implementation of sound public policy requires experienced analytical skills within responsible state agencies, regardless of the issue. Analysis should not be an end in itself, nor should analysts supersede the role of elected officials in setting major policy objectives. But we live in an increasingly complex world and for government to implement policy based on inadequate knowledge and understanding of essential issues is not acceptable. The knowledge and skills within Kansas government relating to a wide range of energy issues must be strengthened if it is to effectively meet its future responsibilities.
- *Expand energy research efforts.* Whether it is tertiary oil recovery, enhanced gas production methods, development of Kansas wind energy resources, or any number of other energy technology issues, getting smart about current technology applied to our own circumstances will be the key to our energy future. It is simply unrealistic to rely on someone else, somewhere else, to do our thinking about meeting Kansas's energy needs.

Key Action Items

- *Challenge state government to take the lead.* No one should expect government at any level to do for them what they are capable of doing for themselves. State government is big business. State government can and should, by the manner in which it operates, set a clear and well documented path toward greater energy efficiency, development of diversified energy

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resources, and rigorous analysis of important energy issues.

- *Reduce transportation energy use.*
  Transportation is our second largest energy user behind industry, and our largest user of petroleum products. Strategies that achieve lower transportation energy use without sacrificing traveler convenience should be strongly pursued. These range from increasing average fleet vehicle mileage, to encouraging land use patterns that accommodate pedestrians and bicycles, and prudent assessment of the feasibility of urban rail systems.
- *Shift to alternate fuels for transportation.*
  Rather than relying solely on oil-based fuels for our transportation needs, Kansas should expand its current efforts to diversify transportation fuels. Efforts to convert appropriate vehicles to natural gas or propane encourage the development of electric vehicles, and development of energy efficient biofuels should all receive rigorous attention.
- *Implement effective utility Integrated Resource Planning (IRP) programs.*
  Utilities can play a pivotal role in achieving a secure energy future if they are actively encouraged to give appropriate balance to supply sources and the energy service needs of their customers, not just sell energy, through the implementation of the IRP process. The process should be carefully developed to ensure the benefits of integrated resource planning are achieved at the lowest long term cost to all utility customers, while providing reasonable incentives for the utilities.
- *Implement either building energy performance standards or an aggressive program to achieve better building energy performance through training and technology transfer for all appropriate building trades and design professionals.*
- *Revitalize rail transportation of freight.*
  Rail moves freight at one-sixth to one-eighth the energy use per ton mile of trucks. Kansas is abandoning rail lines at an alarming rate, shifting not only freight, but commodity transportation—particularly grain—onto roads. In many cases, roads never designed for heavy use are deteriorating as a result. Methods of encouraging a competitive and diversified rail system should be aggressively pursued.
- *Encourage energy research.*
  Increased energy research activity should be encouraged through funding and recognition of individual achievement. Research efforts should serve to expand the skills and number of capable researchers within the state, encourage understanding and adoption of available energy technology by the energy consuming and producing sectors, and investigate Kansas-specific opportunities for improved energy efficiency and production of conventional and renewable energy resources.
- *Encourage new energy technology business development.*
  New energy related technologies, including more energy efficient products, renewable energy systems, and equipment to mitigate the environmental impact of energy use have enormous market potential. Economic development programs should encourage development of manufacturing and services businesses targeted on these markets.

1991

There is no clear vision of our energy future, consider:

The best projections of the energy costs of and energy returns on oil and gas exploration show, in fact, that by 2005 it will be pointless to continue exploring for oil and gas as energy sources in the United States: after that more energy would be used to look for these fuels than the oil and gas we found would contain.

John Gever in Beyond Oil

.... no doubt the dominance of oil in the global energy supply will continue for at least two more generations and that the exit from the oil era will be gradual.

Vaclav Smil in General Energetics

Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!

Rev. Charles Lutwidge Dodgson

Kansas has abundant energy resources. Oil, natural gas, coal, wind and sun are all present in substantial quantities. Although Kansas's hydropower resources are extremely limited by current standards, grain mills and eventually electricity generation tapped this resource. Wind powered additional grain mills during the early days of settlement, became the standard for water pumping, and provided electricity to farms before rural electrification. Oil and gas have been important factors in the states's development. As an energy producing state, Kansas has enjoyed an important source of employment, an expanded tax base, and energy costs lower than most of the nation.

As we search for ways to sustain our future economic viability, it will be necessary to better understand the real potential of all our energy resources, fossil, nuclear, solar, and efficiency, and to search for ways to use our remaining fossil energy reserves as a bridge to a future in which our energy sources are more diversified and secure.

FOSSIL ENERGY RESOURCES[1]

Oil

Oil was first discovered in Kansas in 1855 when oil springs were found near Osawatamie in Miami County. Today oil production occurs in 93 of Kansas's 105 counties. Crude oil and natural gas combined have a current annual value at the wellhead of approximately $2 billion dollars, representing just over 4% of Kansas's 1989 gross state product (GSP). Oil production peaked in 1955 at 120 million barrels. An estimated 123,700 producing oil wells have been drilled in Kansas, along with 96,142 additional dry holes. Today there are 45,410 producing wells. Average production per well is 3.34 barrels per day, for a total of 55.4 million barrels per year. Kansas is a mature petroleum production region. Oil production between 1981 and 1990 totaled 656.4 million barrels. Proven reserves now stand at 321 million barrels (six years at current production rates). Anticipated technically recoverable reserves are estimated at 2,385 million barrels (43 years at current rates). The portion of recoverable reserves which will actually be produced is in part a function of price.

Natural Gas

Natural gas production was first recorded in Kansas in the 1860s. Production continues today in all but twelve counties, although by far the largest production occurs in the southwest portion of the state. Natural gas production peaked in 1973 at 893 trillion cubic feet (TCF). An estimated 24,592 producing gas wells have been drilled in Kansas, and 14,043 wells are producing today. Production in 1990 totaled

[1]Fossil Energy Strategy for Kansas, Subcommittee on Fossil Energy, Energy Research Center, University of Kansas, 1992.

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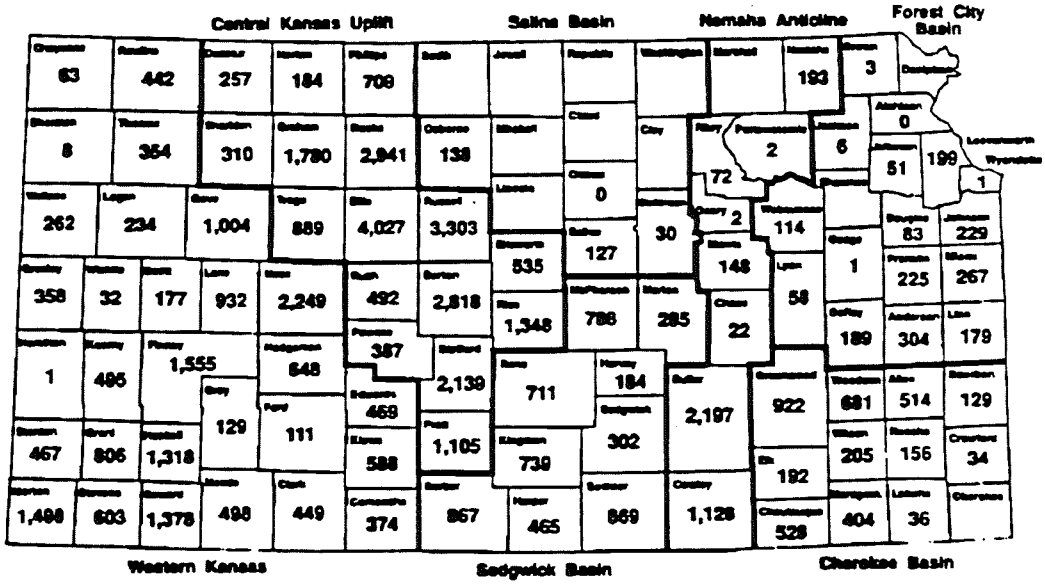
574.3 trillion cubic feet. Between 1981 and 1990, Kansas gas production totaled 5,256 TCF. Current proven reserves total 4.6 TCF (7.9 years at current rates). Anticipated recoverable reserves are estimated at 38.7 TCF (66.7 years at current production levels). As with oil, the portion of recoverable reserves which are ultimately produced will in part be a function of price.

Kansas Oil Production by County, 1990

Source: Kansas Statistical Abstract 1990-91

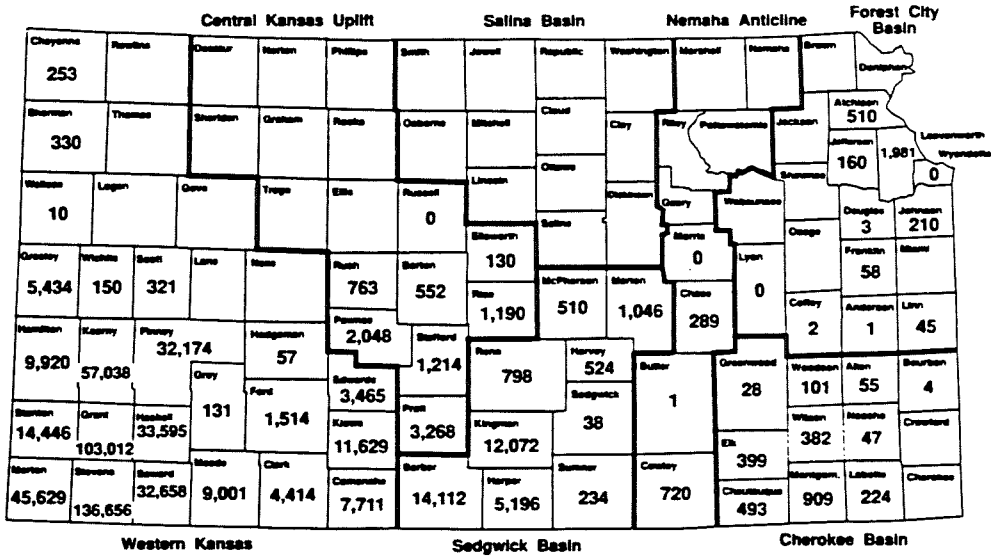
(in 1,000 barrels)



Kansas Natural Gas Production by County, 1990

Source: Kansas Statistical Abstract 1990-91

Kansas Gas Production by County, 1990
(in million cubic feet)



Source: Kansas Geological Survey, *Oil and Gas Production in Kansas, 1990*

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Coal

Coal deposits in Kansas have been commercially exploited since the 1850s. Nearly all of Kansas's coal resources are in eastern Kansas. Coal production peaked in 1918 at 7.3 million short tons. Coal production in 1990 totaled .721 million short tons. In 1992, only two coal mines are operating in Kansas, both in Crawford County. Kansas coal seams are generally thin, covered with a thick "overburden," and relatively high in sulfur (2.7-7.6%). High production costs and environmental limitations have made it difficult for Kansas coal to compete with coal from other states, particularly Wyoming, for many uses.

RENEWABLE ENERGY RESOURCES

Solar

Solar insolation falling on Kansas each day ranges from 3.5 KW-hrs/m2/day in the Northeast part of the state to nearly 5 KW-hrs/m2/day in the southwest corner. Desert areas of the southwestern United States have insolation levels as high as 5.5 KW-hrs/m2/day, while northeastern and northwestern states have 2.5 or less. That is the equivalent of 3.2-4.6 gallons of gasoline per year for each square foot of land. For the entire state, annual solar insolation is equal to approximately 1,000 times our fossil and nuclear energy consumption. Green plants in Kansas, with solar conversion efficiencies averaging less than 2%, "fix" solar energy equal to about 15 times our fossil energy consumption. We benefit directly from solar energy in many ways, but very little shows up in the measured energy economy.

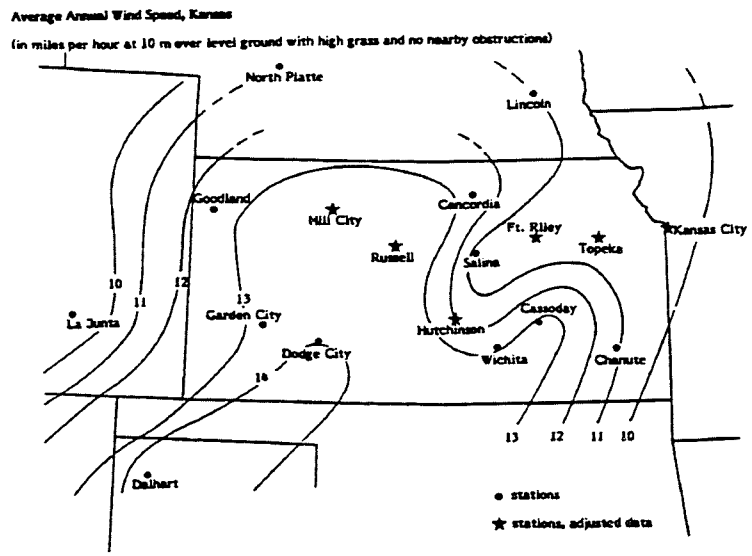
Wind

Kansas is rich in wind energy resources. The amount of energy carried by the wind, as with any moving fluid, is directly proportional to the cube of the wind's velocity. An increase in average wind velocity from 13 mph to 16 mph, a 23% percent increase in velocity, represents an 86% increase in available energy. Most of the wind energy development in the U.S. to date has taken place on class V wind sites in California. While California's premier wind sites are unique, (the result of the warm inland valley drawing cool oceanic air through narrow passes in coastal mountain ranges), California has far less total wind energy potential than plains states. Kansas has no known class V[2] wind sites, but it does have large areas of class III and IV

[2]There are seven wind power classes, ranging from class 1 (the lowest) to class 7 (the highest). Wind power density in a Verticle Plane (watt per square meter at 50 meters above ground) are segmented as follows: class 1 = <200; class 2 = 200-300; class 3 = 300-400; class 4 = 400-500; class 5 = 500-600; class 6 = 600-700; class 7 = >700.

Average Annual Wind Speed in Kansas
(miles per hour at 10 meters above ground level)

Source: Kansas Wind Energy Handbook



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wind resources. Pacific Northwest Laboratories has calculated that 12 contiguous plains states represent 90% of U. S. wind energy potential. Together, their wind energy resources could produce 360% of the country's 1987 electricity use. Among those 12 states, Kansas ranks third behind North Dakota and Texas, with a projected wind energy potential of 38% of the United States total 1987 electrical energy consumption.[3]

Over 50% of Kansas has average annual wind speed of 13 mph or greater at a height of 10 meters (33 feet), the standard height of a National Weather Service anemometer.[4] One square mile of land with 29 thirty meter diameter wind turbines, spaced 10 rotor diameters apart, could produce 17 million kWh annually, enough to meet the average electricity requirements of 1,750 Kansas homes. About 1,500 square miles would be required to produce the amount of electricity consumed by the residential, commercial, and industrial sectors. The actual turbine tower bases would consume less than 0.1% of this land, the rest remaining available for agricultural purposes. Achieving even a small portion of this potential represents a real challenge and economic opportunity for the future energy needs of the state.

Biomass

Approximately 2.6% of Kansas's 52.3 million acres of land are forested. Opportunities for energy production from forestry waste are therefore limited. Removeable crop residue represents the greatest potential biomass energy resource, as indicated in the table below. The potential seed oil and bioethanol is discussed in the Agriculture section.

Kansas Biomass Energy Resource [5]

Source	Tons per Year	BTU/pound	Total BTU (trillion)
Agricultural Crop Residue			
Irrigated corn	626,561	6500	8.14
Dryland corn	155,362	6500	2.02
Irrigated sorghum	245,684	6500	3.19
Dryland sorghum	592,812	6500	7.71
Irrigated wheat	898,093	6500	11.67
Continuously cropped wheat	2,975,008	6500	38.67
Forest Biomass			
Chippable residue	58,010	7500	0.87
Bark Residue	45,253	7500	0.68
Sawdust	30,524	7500	0.46
Conservation Reserve Program			
Existing plants	1,079,809	7500	0.46
TOTAL			87.44

Hydropower

"Falling water is one of the oldest and simplest sources of mechanical and electrical power for Kansas's energy requirements. In the late 1870s, over 190 grist, flour, and saw mills along Kansas's rivers were powered by low-head water power. Small scale hydroelectric generators were common across the

[3] Elliot, D. L., et. al., Wind Energy Potential in the United States Considering Environmental and Land-use Exclusions, Proceedings of the Biennial Congress of the International Solar Energy Society, Denver, 1991.

[4] Thomann, G. C., Meyers, J. A., Fulton, J. A., Kansas Wind Energy Handbook, Kansas Energy Office, 1981.

[5] Nelson, Dr. Richard, KSU Engineering Extension, data fax of October 26, 1992.

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state until the middle of this century. However, small scale hydroelectric generation fell into disuse as the cost of coal, oil, and natural gas became more competitive."[6] Today, only one hydroelectric plant remains in operation.

Kansas is rich in energy resources, but hydropower simply is not one of them. Many major streams have been dammed for flood control, recreation, water supply, and irrigation. The relatively low head height of the dams, and the highly variable water flow at the outlets, would limit power production. Installing hydro plants at the 34 best sites would yield an estimated 394 million kilowatt-hours per year, less than 1.5% of 1990 Kansas's net electrical energy consumption.[7] The capital intensive nature of hydropower development, combined with the low fuel cost enjoyed by most Kansas utilities, makes hydropower development in Kansas rather unlikely in the foreseeable future.

Energy production and use has environmental consequences. Our ability to productively exploit energy resources may be the foundation of our high standard of living, but it is increasingly apparent that it has not come without substantial environmental impact that represent very real costs to society. Mining and drilling can pollute land as well as surface and ground water. Combustion of fossil fuels produces a variety of air pollutants that can contribute to lung disease, plant damage and crop yield reduction, and perhaps even cause major climate changes. These issues are important, complex, and for the most part beyond the scope of this document.

One strategy for dealing with the environmental costs of energy use, which is being increasingly debated, is the concept of internalizing externalities. Harold Hubbard, a distinguished graduate of the University of Kansas recently offered the following insight on this issue in Scientific American[8]:

> The burdens that a barrel of oil or a kilowatt-hour of electricity imposes beyond its stated price are what economists call externalities: costs borne by people who are not parties to the transaction that imposes them. For more than two decades, environmental economists and ecologists have been struggling to identify and measure the external costs of energy production and consumption. Meanwhile conventional economics and current market policy ignore externalities, effectively setting their cost at zero.

Ignoring environmental and other social costs leads to what social scientist Garret J. Hardin has called the "tragedy of the commons." Market forces lead inexorably to overuse of underpriced goods, be they public grazing lands, village dumps, or free water supplies. Indeed Hardin has charted the progress of civilization in terms of the internalization of costs formerly viewed as external.

Perhaps the first external cost to be internalized was that of raw materials. Even in prehistoric times, rules of private property and land ownership protected such valuable resources as copper ore-not to mention fertile land itself.

Since then, lengthy and painful processes have internalized the cost of labor, (by the abolition of serfdom), the cost of raising and educating the labor force (first by free public education and now in many countries by maternity leave and child care) and the cost of workplace safety (by worker's compensation and insurance benefits). Today chemical and thermal wastes generated by industrial processes-and energy production in particular-pose a new challenge for internalization.

But calculating the actual cost of energy is not a simple matter. It is clear that consumption of different forms of energy generate costs beyond the market price, but the nature and amount of those costs are difficult to quantify.

[6]Hochstetler, T., and Noon, R., Kansas Hydropower: An Assessment of Low-head Hydroelectric Opportunities, Kansas Energy Office, 1981.
[7]ibid.
[8]Hubbard, H., The Real Cost of Energy, Scientific American, April 1991.

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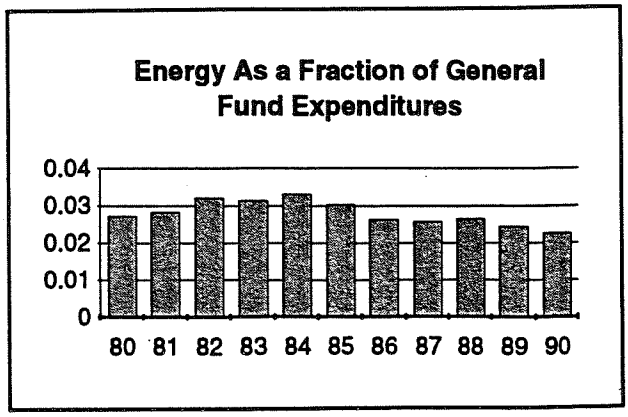
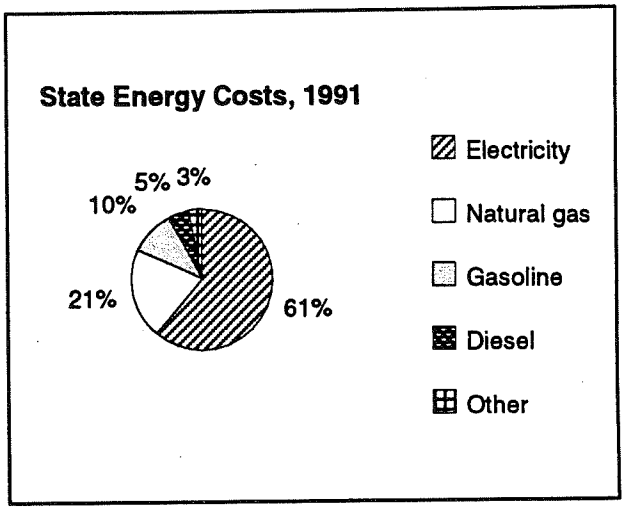
State leadership can yield results. *Many individuals think first of Washington D.C. when the issue of government's proper role in energy policy is raised. But in recent years state governments, closer to the real problems, and needs of their citizens and aware of actual local conditions, have been effective leaders. A top priority for many states has been to have state government set a positive example, providing leadership by action, not just mandates. Iowa has established a policy of life-cycle costing for state buildings, and set a goal of 10% of state vehicles using alternative fuels by 1994. New York and Connecticut have set minimum fuel economy standards for state vehicles and specific goals for reducing energy use in state buildings. New Mexico has set a goal of reducing state government energy costs by 20 % in five years.*

If improved energy efficiency is to be a cornerstone of state energy policy, state government must lead the way by implementing an organized program to reduce energy use in government operations. State government spends significant money on energy, most of it related to buildings. Between 1980 and 1991, energy expenditures rose 66% to 48.8 from 29.5 million dollars (current dollars), although adjusted for inflation, this is actually a decline. Energy expenditures for the period peaked at just over three percent of state general fund expenditures in 1984, but declined to less than two and one-half percent by 1990. Overall state energy use is tracked only by expenditure, not volume or energy units, making it difficult to evaluate how much energy is actually being consumed. As a result, it has not been possible to determine how much of the relative decline in costs has resulted from improved energy efficiency and how much from declining prices. Also, accounting methods may not identify all energy costs, such as utility costs included in building lease payments. Another factor reducing energy costs has been the aggressive purchasing practices of larger state institutions. Taking advantage of changes in federal regulations which have permitted direct purchases of natural gas by larger users, these institutions are now paying around $2.50 per MCF for natural gas, compared with $4.50 in 1983. Substantial cost savings have resulted, although these contracts are typically short term, leaving the institutions vulnerable to substantial increases in cost should current market conditions change. Unadjusted for inflation, expenditures between 1980 and 1991 rose 124% for electricity, 41% for natural gas, 200% for diesel fuel, and 240% for aviation fuel, but declined 21% for gasoline and 80% for steam. Adjusted for inflation, electricity expenditures rose 27%, diesel fuel 70%, and aviation fuel 92%.





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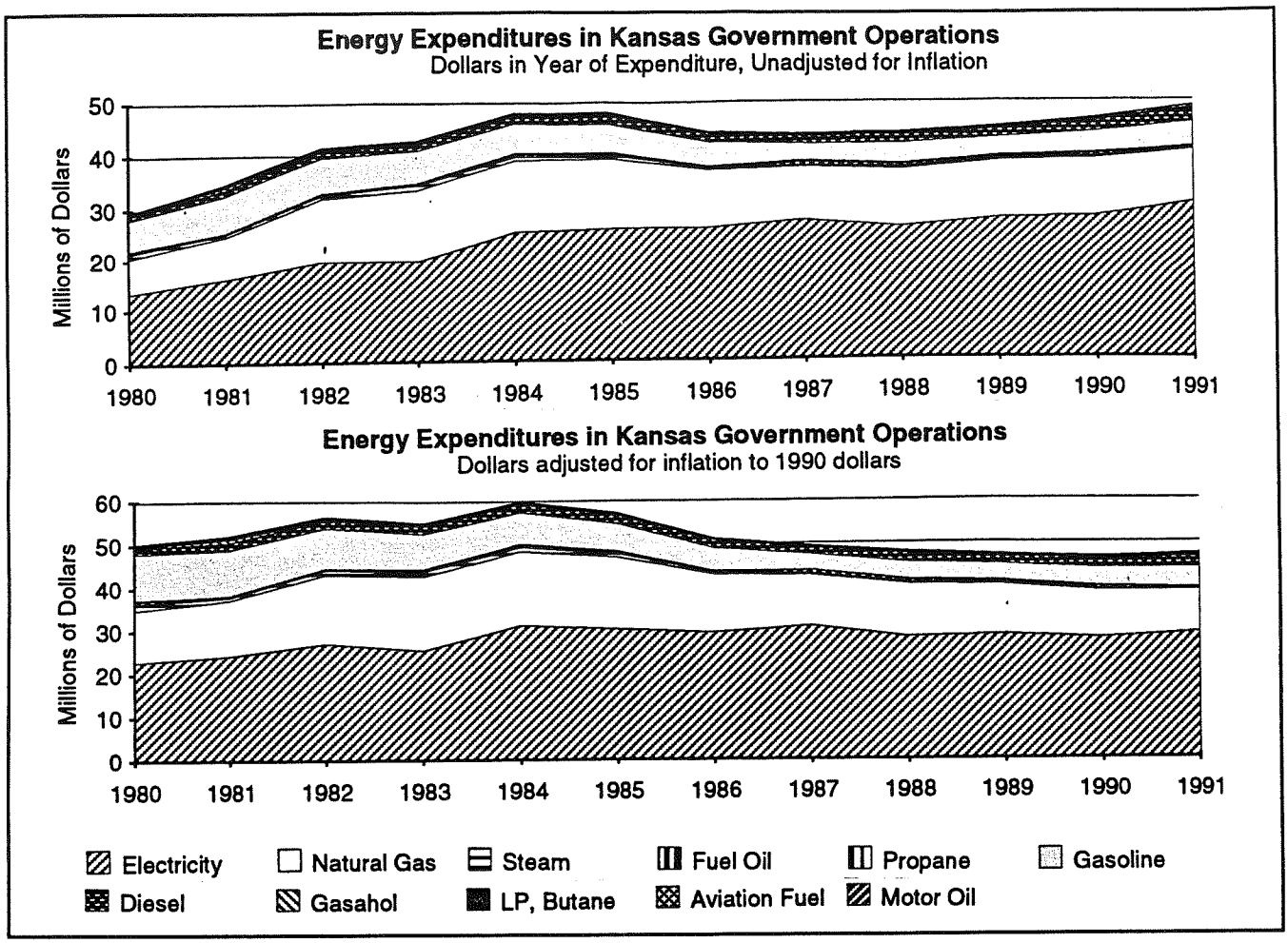

Kansas government has taken many steps in recent years to improve energy efficiency. Regents institutions have invested millions of dollars in energy efficiency improvement to existing facilities. The energy conservation bond financing program, established by statute in recent years, funded approximately $10 million in energy conservation projects at state facilities. The bonding program will con-tinue at a maximum annual rate of $5 million, limited only by the number and size of eligible projects that can be identified. Savings from these projects are used to pay for the bonds. State energy expenditures are concentrated among eleven of the larger agencies and institutions, that in 1991 accounted for $38 million of $48.8 million. Almost two-thirds of this occurred at state universities.

The two major campuses of the University of Kansas accounted for the single largest share at 28%. Kansas State University followed at 18%, Wichita State at 9%, and Emporia State, Pittsburg State, and Ft. Hays State with approximately 3% each. The Department of Transportation had the highest total energy expenditures of state agencies at 16%, followed by the Department of Administration at 9% and the Adjutant General at 6%.

The impact of improved energy efficiency can be seen in the energy index or BTUs consumed per square foot of gross floor space at several of the universities. Between 1977 and 1991 the energy index at Emporia State declined 17.5%. Between 1987 and 1991 the energy index of the University of Kansas Lawrence campus declined 9.6%, while the Medical School Campus index increased 7.5%. Between 1984 and 1991 Pittsburg State's energy index declined 19.5%. These values have not been corrected for variations in weather, but they do indicate a general trend of declining energy use in response to energy conservation investments. There is signifi-

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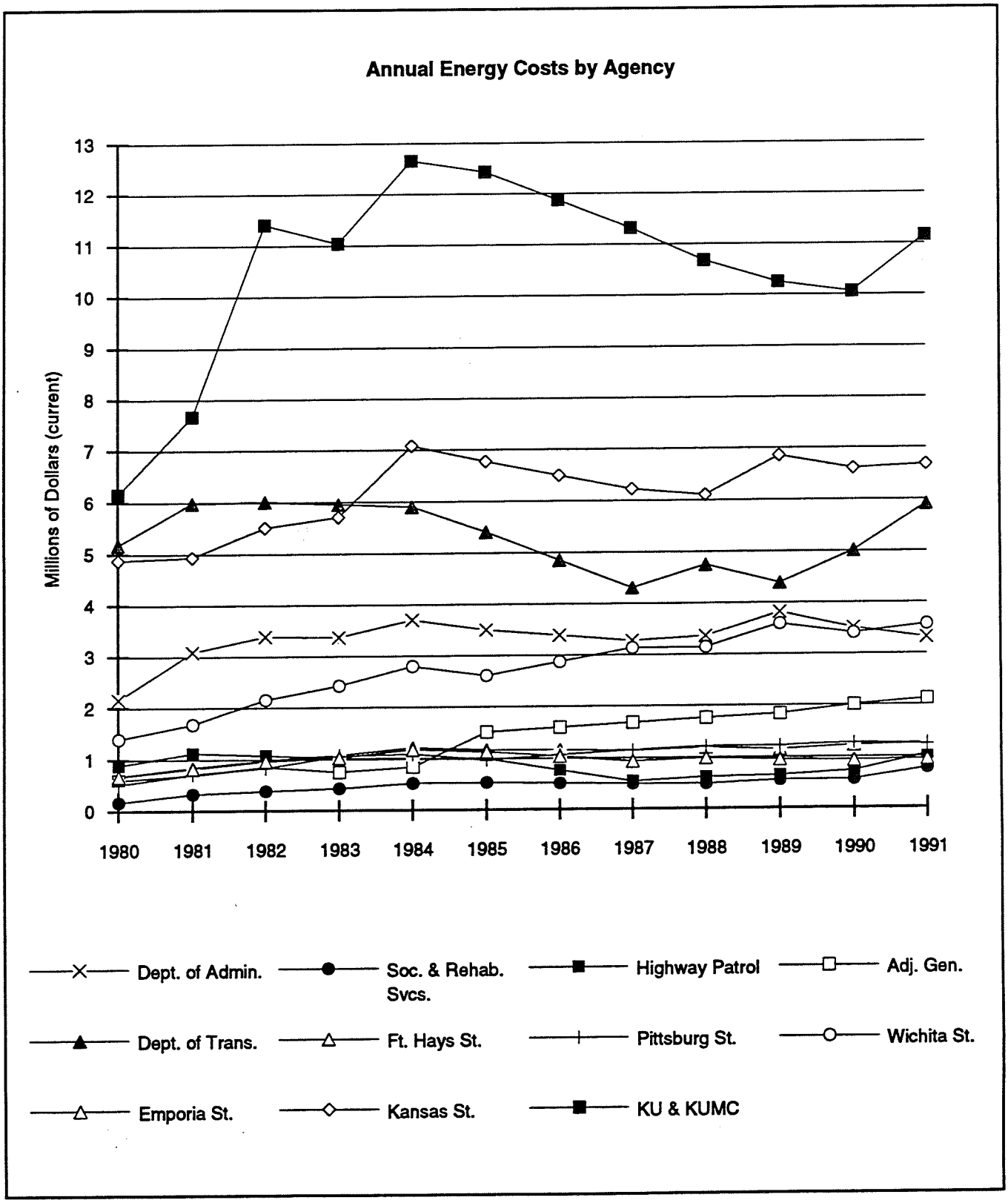
cant variation among campuses in energy intensity. These may indicate relative opportunity for additional energy efficiency improvements, but they also likely reflect in part the varying energy intensity inherent in different building types. Hospitals and laboratories consume considerably more energy than classroom buildings.



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BUILDINGS

The state is the largest building owner in Kansas with several thousand buildings, the largest portion of them at the campuses of the Board of Regents. The state also leases buildings with a total floor area of approximately one million square feet. Electricity, natural gas, and steam expenditures, primarily building related, accounted for 82% of state energy expenditures in 1991, totaling around $40.2 million. The actual energy use is difficult to estimate because records maintained by the Division of Accounts and Reports are based on expenditures, not energy units purchased. Many larger purchasers acquire natural gas and occasionally petroleum products at substantially less than average market price, making it difficult to estimate energy purchases based on total expenditures and average market price. While it is natural to expect that facilities managers will make achieving energy efficiency and reducing operation cost a priority, there are in fact many disincentives inherent in the current process.

- There is no financial incentive to the institution. All savings are returned to the State General Fund.
- There is no risk. All cost over-runs caused by weather variation or utility rate escalation are usually covered by additional appropriations.
- Energy efficiency improvements, such as energy management systems, may require increased maintenance, but with all savings being returned, these costs must be absorbed from other operating expenses. The institution is penalized, not rewarded.
- Improving energy efficiency does not have priority within the current system.
- Energy efficiency investments in new construction are often competing with other needs and expectations.

Options that could encourage more cost effective implementation of energy efficiency in state buildings.

- Make energy performance a priority in the design and construction of new state-owned and leased facilities by:
  - Making energy design skills an important factor in selection of design teams,
  - Requiring energy impact statements during each stage of the building programming and design process,
  - Establishing American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE) Standard 90.1 - 1989 as the minimum energy performance standard for new state buildings (nonresidential), until other standards are promulgated by Corporation Commission or statute,
  - Document ASHRAE 90.1 compliance review,
  - Requiring, where size and the complexity of the project warrants, testing and balancing and system commissioning to ensure proper operation of all energy consuming systems,
  - Learning from experience by comparing actual energy performance with forecast energy performance and disseminating the results.

- Develop and implement strategies to achieve energy efficiency greater than required by ASHRAE 90.1 where life cycle cost analysis justifies such investment.
  - Compensate design professionals for additional services required to achieve energy performance beyond code minimum,
  - Provide funding for enhanced energy performance above compliance with ASHRAE 90.1 through the energy conservation bonding program.

- Initiate a program to track energy use and expenditures of all conditioned buildings of significant size.
  - Meter all new buildings,
  - Retrofit existing buildings with meters,
  - Collect and evaluate metered data.

- Provide agencies and institutions with incentives to achieve better energy performance in the operation of their facilities.
  - Track energy use and cost by institution.

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- Adjust for weather variation and changes in utility rates.
- Allocate savings below the base year according to a formula, such as:
  1) Funds as required for retirement of bond financing for energy efficiency investments.
  2) 25% of remaining savings returned to the state General Fund.
  3) 15% of the remaining savings to an energy cost contingency fund to abate the impact of energy costs caused by unusual weather.
  4) 30% to unrestricted funding of physical plant maintenance and improvement, including investment in additional energy efficiency measures not funded by other means.
  5) 30% to unrestricted funding by the institution for any purpose not prohibited by statute.

- Develop and implement purchasing procedures that allow institutions to use a single a common vendor for building energy management systems.

TRANSPORTATION

Kansas agencies and institutions operate large fleets of automobiles and trucks. A major focus of energy policy should be to reduce petroleum consumption, and the concentrated control inherent in the operation of many of the state's vehicles makes it possible for the state have a visible impact in implementing programs to improve transportation energy efficiency and shift to non-petroleum fuels. The state's role should also extend to assisting its employees in reducing energy consumption in commuting to work.

Options to consider for improving transportation energy efficiency in Kansas government:

- Review vehicle specifications to ensure themost fuel efficient vehicles suitable for intended use are purchased, based on life cycle cost analysis. Standardize life cycle cost analysis procedures.
- Investigate ways to encourage telecommuting by state employees to reduce commuter travel.
- Use teleconferencing and video conferencing to reduce the need for official travel for meetings.
- Review fleet maintenance programs to ensure vehicles are operating at maximum energy efficiency.
- Evaluate the energy benefits of reduced mowing of highway right-of-ways.
- Provide reduced rates for vehicles with multiple passengers on the Kansas Turnpike.
- Consider the travel requirements of employees in the siting of new state owned or leased facilities.
- Provide secure bicycle parking at state owned or leased facilities.
- Investigate the potential for expanding the state employee van pool program.
- Allow agencies to retain a portion of savings in travel budgets for general operation expenditures.

Options for diversifying transportation fuel mix in Kansas government operations:

- Set specific goals, equal to or greater than those contained in the National Energy Policy Act of 1992, for shifting portions of the state vehicle fleet to alternative fuels.
- Designate a lead agency for each major category of alternative fuels - natural gas and propane, electricity, and biofuels.
- Provide preferential parking at state facilities for alternative fuel vehicles.

Procurement

State procurement policies could incorporate energy costs over the life of a product using life-cycle cost analysis.

- Evaluate the cost benefits of double sided copiers and printers to reduce paper consumption.
- Evaluate the benefits of specifying office equipment with automatic power down energy saving features.

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- Evaluate the potential for expanded use of recycled paper products.

Energy Policy Development and Data Analysis in Kansas Government

No strong focus exists today in Kansas government for non-utility regulatory energy issues. Analytical skills covering energy technology, federal and state government laws and programs, and historical and future energy use, are particularly limited. If Kansas is to effectively develop and implement a meaningful broad scope energy policy, a new or existing state agency must be assigned the responsibilities and the resources to provide sound analysis. Occasional use of consultants may be necessary, but they simply cannot substitute for the long term continuity - the institutional memory, necessary for effective policy. Rigorous, fair, competent analysis of the potential impacts, costs, advantages, and disadvantages of alternative energy policy strategies ranging from the potential effectiveness of building energy standards to the impact of fuel switching to reduce industrial petroleum consumption, is the best way to help key policy makers arrive at decisions which reflect the public's interest, not merely the most effective special interests.

State Energy Programs

The state operates a number of energy programs intended to assist other units of government, businesses, and individuals. Most of the programs are substantially federally funded, originating for the most part from federal energy programs initiated in the late 1970s. A brief summary of the major programs is presented below.

State Energy Conservation Program (SECP)

The State Energy Conservation Program (SECP) was established by an act of Congress to promote energy conservation and efficiency and reduce the rate of growth of energy demand by developing and implementing comprehensive state energy conservation plans, supported by federal financial and technical assistance and use of petroleum violation escrow (PVE) or oil overcharge funds.

States are required to (1) establish mandatory lighting efficiency standards for public buildings; (2) promote car pools, van pools, and public transportation; (3) incorporate energy efficiency criteria into procurement procedures; (4) implement mandatory thermal-efficiency standards for new and renovated buildings; and (5) permit right turns at red traffic lights.

States may propose additional measures consistent with the program's intent. Kansas is involved with a number of alternative fuel programs, waste reduction and recycling activities, energy audit programs, and public awareness programs.

Kansas Institutional Conservation Program (KICP)

The highly successful Kansas Institutional Conservation Program has provided significant benefit to Kansas through three major endeavors:

(1) It has significantly raised the awareness of energy conservation through practical measures documented by licensed engineers by technical analysis of a participating school or hospital's physical plant. These studies are two-fold in focus: (a) operation and maintenance procedures-methods of more efficiently using the present energy systems and are of minimal cost; and (b) energy conservation measures recommended-projects involving capital expenditures and which repay the initial cost in savings in a two- to ten-year period;

(2) Through hands-on workshops provided by experienced engineers to both maintenance personnel and decision-making administrators of both schools and hospitals;

(3) And through direct awarding of grants for institutions ßßto install energy conservation measures in schools and hospitals.

The KICP provides matching grants to public and non-profit schools and hospitals for projects that significantly reduce energy consumption and operating expenses. This federal program is funded by the U. S. Department of Energy and is administered by the Kansas Corporation Commission, using monies as directed by the legislature. It pays up to 50% of

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approved energy saving projects, awarded on a competitive basis. Recent grants were awarded for such projects as installation of computerized energy management systems, reducing light loads with high-efficiency lamps and ballasts, and retrofitting insulation.

The KICP has been in existence for the past fourteen years and has awarded grants exceeding $15 million to qualifying projects. All of Kansas's 105 counties have benefited from the KICP.

Energy Extension Service (KEES)

Since 1980 the Kansas Energy Extension Service has assisted Kansans in using energy efficiently. Through individual technical assistance, training, and publications, KEES has served residential, commercial, institutional, and industrial energy consumers.

In addition to the individual assistance available through a toll-free hotline, the engineering staff of KEES has been available for site visits upon invitation by businesses and institutions. Training programs are offered to meet the specific needs of a variety of target audiences ranging from homeowners to commercial building operators to engineers. Special publications range from weekly columns published in over 70 Kansas newspapers to the national award winning tabloid "Energy Ingenuity" to detailed fact sheets.

In cooperation with the Kansas Corporation Commission, KEES is a joint effort of the Kansas State University College of Engineering and the Kansas Cooperative Extension Service. This partnership gives access both to the technical expertise of Engineering and the delivery network of the Cooperative Extension Service.

A number of additional energy programs have resulted from the success of KEES. For example, training programs for contractors of low-income housing is provided in cooperation with the Kansas Department of Commerce and Housing. The training programs for commercial and institutional building operators is now offered as four state regional program in cooperation with DOE. DOE also provides support for a number of biomass energy demonstration programs. Lastly, KEES engineers provide technical support to the Kansas Division of Architectural Services regarding energy conservation in state-owned buildings.

Weatherization Assistance Program

Low-income energy assistance began in response to the Arab oil embargo crisis in 1973-74, codified in 1976, and is under the federal direction of the DOE. Funds are authorized for weatherization with 10% allowed for program administration.

The program has evolved from primarily no cost or low cost measures to more substantial intervention efforts. The budget has grown from $1.3 million its first full year in 1978 serving 2,547 dwellings to almost $6 million in 1991 for 2,736 units. The program has impacted approximately 44,000 dwelling units in Kansas.

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Efficiency and Energy Use

Society cannot live indefinitely on oil and gas. Those fossil fuels represent nature's savings accounts which took billions of years to form.

R. Buckminster Fuller, 1977

Men do not realize how great an income thrift is.

Cicero, Paradoxa Stoicorum, 46 B.C.

Like the old saying that "a penny saved is a penny earned," a unit of energy saved is one that need not be purchased or for that matter produced. Improved efficiency is a resource, just like a new well or mine.

When we consume energy we do so not to use the energy but to achieve specific benefits by its use. A furnace provides heat, the benefit is comfort. How much energy it consumes is a function of its efficiency. More efficient furnaces cost more initially. The least total cost of ownership occurs when we balance the value of money invested in a more efficient furnace and the future fuel savings from greater efficiency. It's an easy concept, but three important factors often make it difficult to apply. The first is confidence in equipment performance ratings. Will a condensing furnace really use 20% less gas than the cheaper model? People tend to discount savings projections, even when they are based on well established testing procedures. The second is the future cost of energy. During the oil price spike of the early eighties many thought energy prices would continue to rise, but they have declined. Many analysts now predict oil and gas prices will begin a steady long term rise this decade. How much should this uncertainty influence our purchase decisions? The third factor is availability of capital. More efficient equipment usually has a higher first cost. If funds are limited, and in most cases they are, it is often easy to view the energy supplier as a convenient source of a second mortgage for which one easily qualifies. Instead of paying hard cash or a higher mortgage payment, we pay more for utilities. These barriers apply to most energy efficiency improvement opportunities, from a complex industrial heat recovery system, to the home refrigerator.

Despite these barriers, improved energy efficiency has been the single largest new energy "resource" in the past two decades, according to J. Michael Davis, Assistant Secretary for Conservation and Renewables at the U.S. Department of Energy. Some believe the low cost energy efficiency improvement opportunities have been substantially exploited, and that continued economic growth will mean an upturn in energy use per dollar of output. Several factors suggest this may not be true. The oil price shocks of 1972 and 1980, combined with a wide variety of new technology from many sources, set creative minds in entrepreneurial businesses and government laboratories and agencies to work. The result is an expanding array of new technologies that permit more efficient use of energy.

Concepts that were at best laboratory prototypes 10-15 years ago are now widely available commercial products. Multilayer windows with low emissivity coatings and heavy inert gas fill can triple the thermal performance of windows; electronic ballasts for lamps produce twice as much light for the energy used, condensing furnaces squeak out 94% of the thermal energy in gas, nearly twice common performance of 1970; direct digital, sensors and controls that dim lights in response to available daylight can cut lighting energy use 50%; and variable speed heat pumps are 75% more efficient than 1970 models. This list is long and it continues to grow. Confidence in the performance and reliability of more efficient technology is also improving as more rigorous testing has been implemented by credible trade associations and independent laboratories. New federal minimum standards for a wide variety of energy appliances are also being phased in, reducing the pressure on manufacturers to cut energy performance in order to provide other features and still compete on first cost. For

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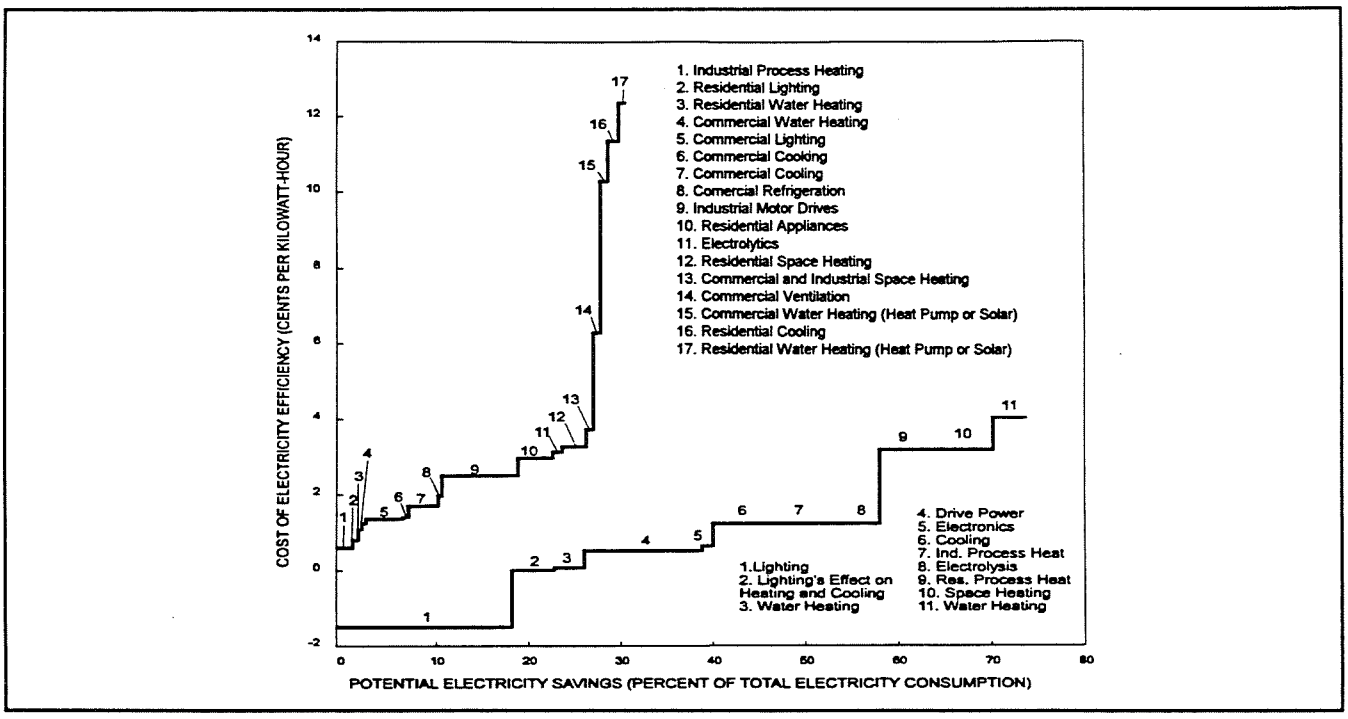
many applications, more energy efficient equipment is simply becoming the norm. It is better designed, technically more sophisticated, more reliable, cheaper to operate and environmentally more benign.

The real potential for improved energy efficiency has been a topic of serious debate in recent years. The Electric Power Research Institute (EPRI) estimates that "if by the year 2000 the entire stock of electric end-use were to be replaced with the most energy efficient electric end-use technologies, the maximum energy savings could range from 8,000 - 14,400 trillion BTUs, or 24-44% of electric energy consumption."[1] A review of projections of future U.S. primary energy consumption conducted for the National Energy Strategy showed a range of 50-125 quads in 2010, compared with around 85 quads today. Just how much will be gained from efficiency improvements will be the result of complex interactions among energy costs, the cost and reliability of efficiency improvements, interest rates, and government policy. Energy efficiency should be recognized as a resource, and given equal market access and treatment with other energy resources.

The diagram below indicates two differing analysis of the potential reduction in long term U. S. electricity consumption. The line on the left is based on estimates by EPRI, the one on the right is from the Rocky Mountain Institute. Both are in 1990 dollars.[2] The horizontal axis indicates the percent of total electricity energy consumption that could be saved by implementation of the measures indicated by the lines on of the diagram. The vertical axis indicated the cost of electricity savings. For example, the EPRI line indicates implementing all measures with a cost equal to or less than $.04 per kWh would reduce total electricity use by approximately 27%, while the RMI line indicates savings at that cost would equal 70%. The debate is not whether improved energy efficiency can dramatically reduce our future level of energy consumption, but about how much, how fast, at what cost, and how it can most prudently be accomplished. Demand for energy services will probably continue to grow, but the amount of energy required to provide those services will depend on how effectively we employ technology to provide those services as efficiently as prudent economic decision making will accommodate.

[1]Gellings, C. W, Efficient Electricity Use: Estimates of Maximum Energy Savings, Electric Power Research Institute, March 1990.
[2]Source of diagram: Scientific American, September 1990.



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Many options for achieving greater energy efficiency relating to specific categories or sectors of energy use are addressed in the following sections on residential, commercial, industrial, and transportation.

Options of a broad character covering more than one sector that Kansas could consider to encourage cost effective adoption of energy efficient technology include:

- Implement energy performance standards for new buildings.
- Encourage utilities to develop and implement integrated resource planning programs, including steps to provide utilities with an opportunity to profit from efficiency investments.
- Develop programs to provide financing for energy efficiency investments in all energy consuming sectors.
- Provide tax incentives for energy efficiency investments.
- Broaden existing public information programs to provide credible information on energy efficient technologies to help overcome public uncertainty about performance.
- Expand the range and sophistication of training programs for individuals providing services affecting energy use, from boiler maintenance technicians to plant engineers and building architects.
- Investigate the merits of certification and continuing education programs for individuals providing services with a significant impact on the efficiency of energy consuming systems.
- Implement an awards program, providing recognition and monetary rewards for important contributions in energy efficiency achievement. Such awards should be based on actual measured performance.
- Use state building projects to showcase building energy technology.

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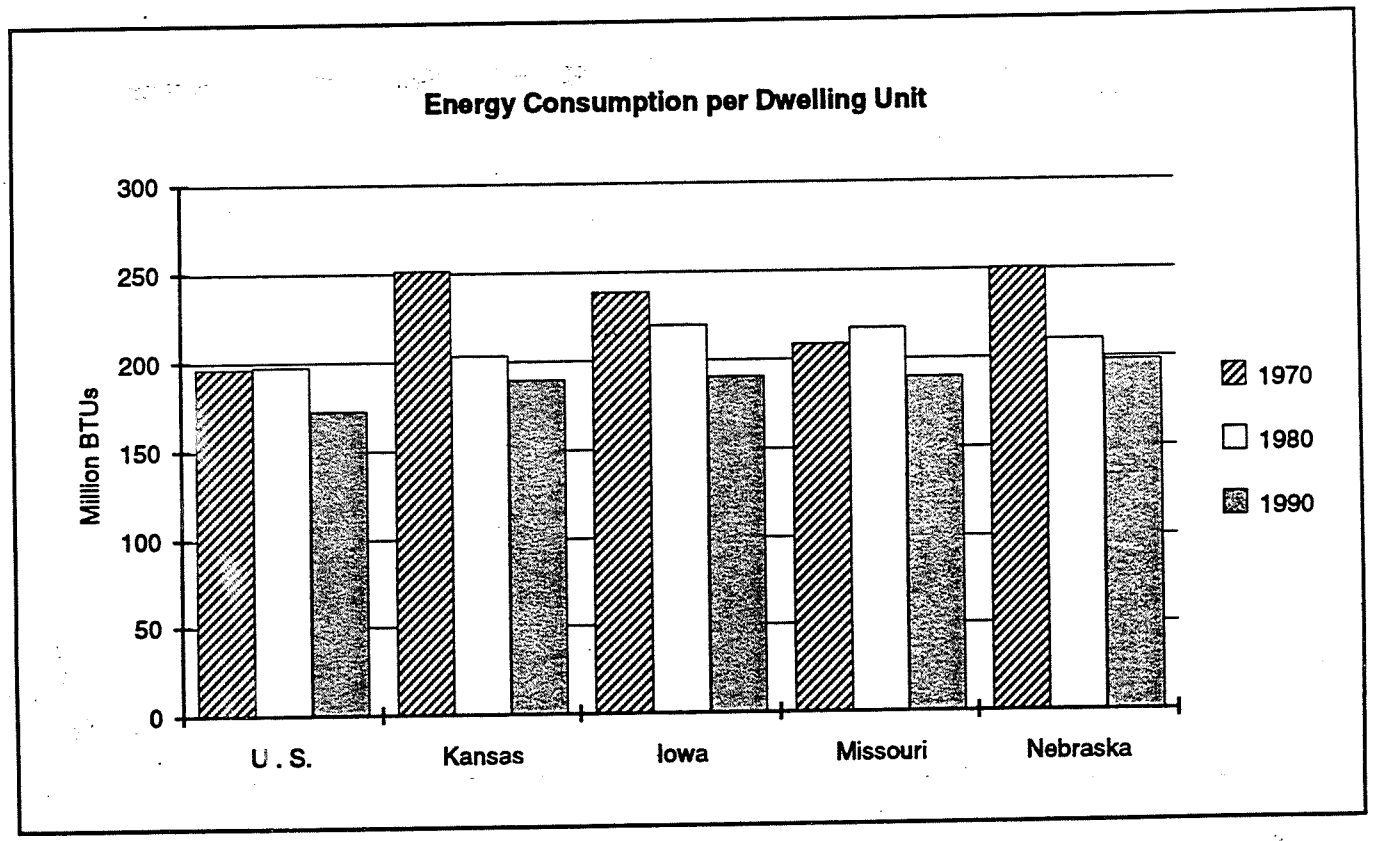
Home sweet home. *The average Kansas home consumes about 13% more energy than the national average, but almost the same as homes in Missouri and Iowa, and 4% less than homes in Nebraska. Average residential energy expenditures in Kansas are 2% less than the national average.*

Next to the price and availability of gasoline, home energy costs are the most direct personal barometer of energy change. Each of Kansas's 945,000 occupied homes consumed an average of 190 million BTU in primary energy in 1990[1] . That's the energy equivalent of 1,520 gallons of gasoline, but it indicates a clear trend toward improved efficiency. Between 1970 and 1990, Kansas's population increased 10.6% from 2,240,071 to 2,477,574. Total dwelling units increased an estimated 32% from 944,726 to 1,044,112, reflecting the trend toward smaller households. Yet total residential energy use increased a mere 0.2% to 179.2 from 178.9 trillion BTU[2] . A 35% decline in natural gas and petroleum use was partially off-set by a 79% increase in electricity use for a net average house-hold reduction of 25%.

During the same period, total U.S. residential energy consumption increased 19%, representing a reduction of 12% per dwelling unit, less than half the improvement achieved by Kansans. Kansas's per household energy consumption is almost identical with Iowa and Missouri, and slightly less than Nebraska. The steady reduction in per-household energy use represents the gradual installation of energy efficiency improvements in the existing housing stock, and the substantially improved energy performance of new dwelling units.

[1]State Energy Data Report 1960 - 1990, DOE/EIA.
[2]ibid.



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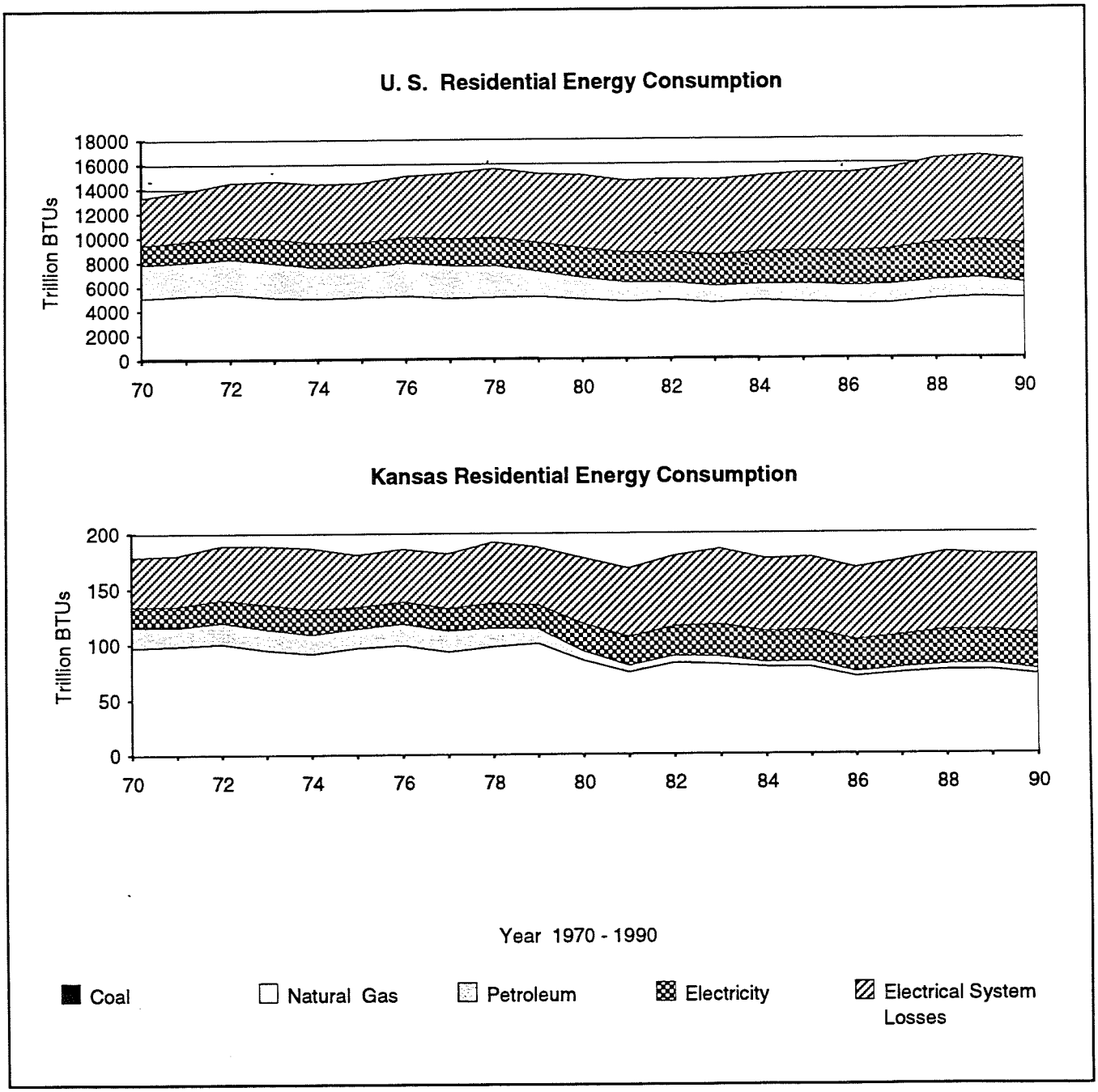
The average price of residential energy in Kansas increased 59% between 1970 and 1989 (in 1990 dollars), yet the average cost of energy per dwelling, declined 9.4% to $1,150 from $1,270 (1970-1989)[3]. In 1989, energy consumed 12.5% of average household income.

The oil embargo of 1972 and the energy price explosion that accompanied the Iranian revolution of 1979 let the genie of ingenuity out of the bottle. Nowhere is this more evident than in residential energy efficiency. Today we can build and equip homes which use only 20% of the energy of a comparable home built two decades ago, while providing greater comfort at lower cost. Within this decade it may be possible to build homes which, on an annual basis, actually produce more energy than they consume[4]. The challenge before us is to develop strategies that ensure new homes are built to the highest level of

[3]State Energy Price and Expenditure Report 1989, DOE/EIA.
[4]Report from Meridian Corporation to DOE/OPA, June 1992.



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performance that prudent economic analysis justifies, while working to upgrade the existing housing stock. Unlike automobiles, with an average life of around ten years, or personal computers with a life as short as three years, houses last a long time. What we build today will survive well beyond the current era

Kansas Residential Sector Vital Statistics

	1970	1990	Change
State population	2,249,071	2,477,574	+ 10.2%
Total dwelling units	789,735	1,044,112	+ 32.2%
Occupied dwelling units	715,750	944,726	+ 32.0%
Vacancy rate		9.5 %	
Owner occupied dwellings		641,760	
Renter occupied dwellings		302,966	
Occupants per dwelling		2.6	
Heating fuel			
Natural gas		75.9 %	
Propane		8.8 %	
Electric		11.8 %	
Fuel oil		0.3 %	
Other or none		3.2 %	
Air conditioned			
Central air			
Window units			
Energy per occpied dwelling (MMBtu)	252	190	- 24.6%
Natural gas per dwelling (BCF)	97	71	- 26.8%
Electricity per dwelling (MkWh)	5,348	9,515	+ 77.9%

New Home Typical Energy Performance

	1970	1990	Change
Building Envelope			
Attic insulation R-value	19	30	+ 58%
Wall insulation R-value	11	19	+ 64%
Window R-value	1	2	+ 100%
Floor insulation R-value	0	11	
Foundation insulation R-value	0	5	
Infiltration air changes/hr	1	0 .7	- 30%
Major Appliances			
Furnace efficiency	60 %	80%	+ 33%
Heat pump efficiency (HSPF)	3.4	6.5	+ 91%
Air-conditioner efficiency (EER)	6	8.3	+ 38%
Other appliances			
Refrigerator/freezer kWh/month	2000	1000	- 50%
Dish washer	1500	900	- 40%
Clothes washer	1400	900	- 36%
Clothes dryer	1000	1000	none

NOTE: Performance of most building components and appliances continues to improve, in some cases rapidly, in response to market pressure, and regulations implemented by the federal government and a number of states.

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of low cost fossil fuel. Constructing homes to perform as energy efficiently as technology and economics permit is a far more economical strategy than retrofitting the home when energy prices rise.

Home buyers have become increasingly knowledgeable regarding home construction features that affect energy use. Furnaces, heat pumps, air conditioners, water heaters, and other major appliances are now available in substantially more efficient models than a few years ago, thanks to federal standards and market demand. As a result new houses are, on average, substantially more energy efficient than a decade ago, despite generally increased use of energy-consuming appliances. Housing is, however, a very competitive market. Although home buyers frequently rate energy performance among their highest concerns, the final purchase decision is often linked to other amenities and the initial cost. Home buyers with a maximum purchase price limited by the size of the mortgage they can qualify for, find that reducing the purchase price by forgoing cost effective energy performance features allows them to have the equivalent of a second mortgage from the utility. Builders recognize these market pressures, and build accordingly. This is particularly true with housing constructed for the rental market, a market that today provides a greater share of housing for Kansans than twenty years ago. The result is that many homes actually cost more to own or occupy (principal, interest, taxes, insurance, and utilities) than they would if more had been spent on energy efficiency, increasing first cost, but resulting in sufficiently lower energy costs to more than offset the increase in principal and interest.

All but fourteen of the states have attempted to address this problem by establishing residential energy performance codes more comprehensive and current than Kansas's existing policy. Many states have used so-called model codes developed by national code organizations, while others have written state-specific standards. Some states with state-wide building codes do not have residential energy standards, and some states with standards do not have statewide code programs. The National Energy Policy Act of 1992 requires states to ensure that their residential and commercial building energy standards meet certain minimum standards.

Homeowners and home buyers have substantial incentive to consider a home's energy efficiency. They pay the mortgage and the energy bills. Owners of rental property do not have the same incentive. Typically they pay the mortgage, but the tenant pays the energy bills, handicapping normal market forces from achieving cost effective energy efficiency. Strategies to achieve the economic benefits of energy efficiency for all Kansans must address this problem.

Another portion of our population whose needs require a different approach is low income households, particularly those with elderly and children. In many cases, they have not benefited from the energy improvements of the past two decades. As a result, they spend a much higher portion of their income on energy whether occupying homes they own or rental property, and often lack the resources to make cost effective energy efficiency improvements.

Energy efficiency options for existing housing include:

- Adopt residential building energy standards. Kansas's current thermal standards, established by the Kansas Corporation Commission (KCC) in 1979, require new residential dwellings to meet the following requirement before connection or attachment of utility service:
  - The dwelling must be equipped with storm windows and storm doors or other satisfactory window and door thermal treatment.
  - Total heat loss, based on the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Hand book of Fundamentals, shall not exceed 35 BTU per square foot per hour of floor area of heated finished living space at a design temperature differential of 80 degree Fahrenheit with a maximum of 1-1/2 air changes per hour.
  - Air conditioners installed after November 1, 1979 must have an energy efficiency ratio

(EER) of 8.0 or more. Heat pumps installed after that date must have must have an EER of 7.5 or more.

These standards have been superseded by common building practices, and in the case of air conditioners and heat pumps, by federal appliance efficiency standards. While the certification forms are still collected by utilities, the standards, having become outdated, and never strictly enforced, have been reduced to a paperwork function. The stated fact that Kansas does have residential energy standards may actually mislead the consumer by implying that his or her interests have been protected when they have not.

The KCC, by its original promulgation of standards in 1979, established its jurisdiction regarding the standards issue. This jurisdiction was recognized by the Legislature when it extended to Commission's jurisdiction regarding thermal standards to municipal utilities in the late 1970s. Recognizing the substantial evolution of equipment, construction methods, design techniques, and utility planning concepts since the original standards, the KCC could investigate whether updated standards are appropriate. The KCC should consider the following as part of its deliberations:

- The need for any standard must be based on an understanding of how energy efficient the homes being built today are, and how much can be done cost effectively to improve their performance. A survey should be conducted to determine what energy efficiency features have been incorporated in a representative sampling of recently constructed housing, and how well they actually perform.
- The goal of standards should be the lowest total cost of homeownership, for the individual home owner, and all utility customers.
- The work, livelihood, and economic interests of many groups are affected by building energy standards. The KCC should seek the input of building owners, architects, engineers, contractors, builders, equipment suppliers, utilities, and local code officials.
- A low cost, but reasonably effective method of implementation and enforcement is required. Unenforced, a standard will tend to penalize those who comply by allowing those who do not to cut corners and appear more cost competitive than they actually are.
- If the KCC finds that market imperfections warrant implementation of a revised residential energy standards program, the program design should reflect that the goal is not merely to regulate, but to reduce the cost of home ownership.

- Establish a training program for home builders, designers, trades people, home lenders, and utilities.
  - Increased insulation levels, better windows, and more efficient appliances are all contributing to more energy efficient housing. Studies have shown, however, that merely adding these measures often does not result in the level of reduction of energy use anticipated. Quality control is essential for achieving the real potential.
  - Actual metered energy use and documented operating cost savings are the real measure of accomplishment, not adoption of standards. Development of skills and knowledge about how energy efficiency can actually be achieved is more important than merely documenting code compliance.

- Encourage utility investment in residential energy efficiency.
- Encourage lending institutions to provide mortgages which recognize the financial value of improved energy efficiency.
- Adopt a standard method of rating the energy performance of homes.
- Exempt labor and material for residential energy efficiency investments from sales tax or remove the sales tax exemption from residential utility bills.
  - Energy efficiency improvements are taxed, while consumption is not, creating an incen tive to consume rather than conserve.

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- Develop model guidelines for subdivision and zoning regulations intended to ensure residential building lots provide solar access and promote their adoption by Kansas municipalities.
  - Once contracted, buildings are costly to modify. One part of the urban fabric, lots and the streets providing access to them, are extremely difficult to change. Current urban development and subdivision design practices seldom attempt to preserve solar access permitting passive solar design or use of active solar systems.
- Require energy cost disclosure at time of sale (at leasing for rental property).
- Require upgrade to minimum standards at time of sale.
- Develop strategies for replacement of low efficiency furnaces, air conditioners, heat pumps and refrigerators as part of utility demand-side management programs.

Seeing a profitable opportunity. *Efficient lighting hardware is now available for almost any application. Most devices provide the same amount of light as older systems do, with less glare, less noise, more pleasant color and no flicker. These aesthetic improvements can unlock even bigger savings: improving productivity by 1 or 2 percent is usually worth more to an office's bottom line than eliminating electric bills.*

Fickett, Gellings, and Lovins, in "Efficient Use of Electricity," Scientific American, Sept. 1990

Commercial Energy Consumption in Kansas increased 56% between 1970 and 1990, compared with 54% for the U.S. as a whole. Natural gas use increased a modest 7%, but was offset by a 141% increase in the use of electricity. The increase in commercial electricity use mirrored a national trend. The sector is composed primarily of office and retail buildings, although other building types such as health care, education, and government are also included. The steady increase in energy consumption in this sector reflects the steady increase in the number of buildings of these types.

Commercial buildings generally reached their greatest energy intensity in the 1950-60 period with an average energy use per hour of operation of approximately 26 BTU per square foot.[1] That figure had declined to around 21 BTU per square foot per day by the late 1980s and the technology exists to achieve substantial additional improvements in energy efficiency. Heating and cooling equipment efficiencies continue to improve. Properly designed lighting systems consume a fraction of the energy common a decade ago. Sophisticated energy management systems ensure comfort while permitting building systems to consume energy only when necessary. Variable speed controls and fan and pump motors deliver the amount of energy required, but no more, and do it using less energy. The advent of the personal computer and other modern office equipment has contributed to the dramatic increase in commercial building electrical energy use, but here too things are changing. The U.S. Environmental Protection Agency (EPA) is encouraging computer manufacturers to incorporate automatic power down circuitry in desktop computers and other office equipment similar to the controls used to conserve battery power in portable computers, with projected savings over 50%.

Perhaps the biggest change has been the dramatic increase in our understanding of how commercial buildings use energy. The tools and skills now exist to make careful trade-offs between differing design strategies, the interaction of different building components, and the impact of different equipment options. What is the energy impact of a square plan or an elongated rectangle? What happens to peak load if the orientation is shifted? Will higher performance glass allow a smaller cooling system? Will reducing the air temperature for cooling reduce fan horsepower? How much more light will be required if the walls are dark, and what effect will that have on peak cooling load? These decisions are increasingly being made based on the results of research and computer simulation of the specific building, carefully weighing first cost against long term operating cost savings.

New buildings can be more efficient, and existing commercial buildings represent a substantial inventory of retrofit opportunities for reducing energy costs. There is considerable debate on how this can most fairly and economically be achieved. The National Energy Policy Act of 1992 requires states to

[1] Commercial Buildings Energy Consumption and Expenditures 1989, DOE/EIA.

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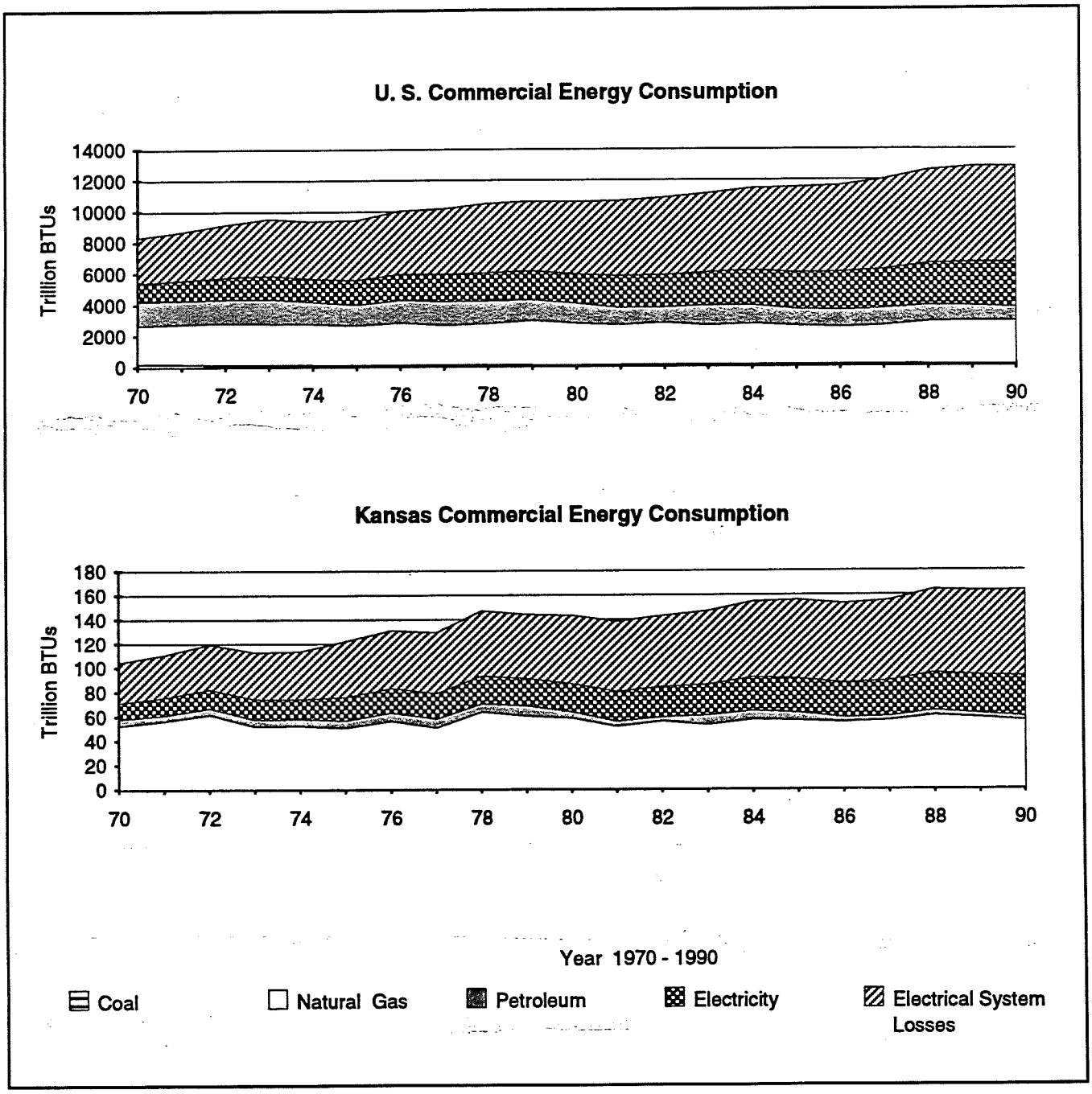
implement commercial building standards at least as stringent as the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Standard 90-89. The method of enforcing this requirement is not yet clear. Energy standards do represent an important component in achieving greater energy efficiency, but all of the concerns expressed in the Residential section regarding standards are equally applicable to commercial buildings. The real goal is to achieve cost effective improvements in building energy performance, not merely to regulate. Regulation may play an important role in achieving this goal, but training, technology transfer, competition, and access to capital for investments that provide desired energy services through greater energy efficiency instead of energy supply, are all important factors. The Kansas Corporation Commission, by prior action regarding building standards, has assumed responsibility for addressing this topic, and should revisit it in a timely fashion.



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Options for improving the energy performance of new commercial buildings:

- Adopt and enforce building energy standards.
- Adopt standards for building commissioning to ensure building systems actually perform in compliance with standards and design criteria.
- Participate in the establishment of a regional building technology demonstration center to provide technically sophisticated hands-on training for building designers, construction and maintenance personnel.
- Implement utility DSM programs to ensure all energy efficiency measures with a cost equal to or below utility avoided cost are implemented.
- Expand technology transfer programs to provide more information to building owners, designers, and contractors regarding energy efficiency options.
- Consider certification and continuing education programs for individuals directly involved in the design, installation, and maintenance of building energy systems.

Options for improving the energy performance of existing commercial buildings (in addition to the measures listed above):

- Adopt energy performance standards for retrofitted buildings.
- Adopt energy performance standards to be met at time of sale.
- Develop a mechanism for providing access to capital for investments in energy efficiency improvements in existing buildings.
- Encourage utilities to participate and invest in energy improvement retrofits of existing buildings by allowing them to earn a profit from such investment, taking care to ensure other rate payers are not unfairly required to subsidize such programs.

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Transportation

Cheap Gas. *In 1991, the average price at the pump for a gallon of gasoline was $1.04. Adjusted for inflation, the price would have been around $0.60 in 1980, $0.30 in 1970. Gasoline has become very cheap to purchase. Lower prices have benefited consumers, but sent the wrong message about our need to reduce petroleum use.*

Transportation is the very backbone of our economy. Not only is it essential for the movement of people and goods, the sector accounts for about 15% of gross national product (GNP) and nearly 15% of all jobs (it is also responsible for over $100 billion in trade deficit from oil and vehicle imports). Major disruption of our transportation system would have a profound effect. Transportation is also a vulnerable component in our energy system. It consumes 63% of the petroleum the country uses, and is 97% dependent on it. ***We import around 47% of our oil needs today, up from 22% in 1970 and 37% in 1980. By the year 2000 that figure is projected by DOE to rise to 57% and by 2010, 65%.***[1] The steady decline in the real cost of oil in recent years has engendered a sense of unjustified complacency. The recent victory in Desert Storm, a war fought to maintain access to low cost oil, should not mislead us. Our economic future remains vulnerable to the political turmoil of the Middle East. If oil prices, adjusted for inflation, were to return to their peak of 1980-81, gasoline would likely sell for $2.00 a gallon today. While such price escalation appears unlikely, DOE forecasts oil in current dollars will sell for $26 per barrel in 2000 and $34 per barrel in 2010, compared with $22 per barrel in 1992. The single most pressing factor in energy policy should be decreasing our reliance on petroleum, and nowhere is that more important than in the area of transportation.

Kansas has an extensive transportation system, dominated by roads and highways. The 15th largest state in land area, we have the fourth largest road network, and the third largest rail network. Almost all of it is powered by petroleum. Oil production is an important part of the Kansas economy, but that provides us little security. Not only does our consumption of approximately 80 million barrels per year exceed production by nearly 50%, oil is a fungible or interchangable commodity in a global economy.

Transportation in all forms accounts for about 27% of Kansas's overall energy use compared to 28% for the U. S. as a whole. The transportation sector is second only to the industrial sector in overall energy consumption, substantially outranking commercial and residential energy uses in both Kansas and the nation.

Transportation is the fastest growing energy use sector in the U.S. The nation's transportation energy use increased 40% between 1970 and 1990, and 12.5% in Kansas. While Kansas per capita transportation energy consumption of 112.3 million BTU exceeds the national average by 24%, Kansas per capita consumption has changed less than 1% in the past two decades while the U.S. average has increased 14.7%.[2] Yet more people are driving even more vehicles more miles per vehicle.

Kansas's Transportation Sector Vital Statistics

	1979	1990	Change
Urban roads (miles)		9,105	
Rural roads (miles)		124,473	
Total roads (miles)		133,578	
State ranking (road miles)		4	
Railroad track (miles)	7,715	6,492	
Airports		398	
Navigable river (miles)		120	
Total miles driven (million)	13,376	22,850	+70.8%

[1] National Energy Strategy: Powerful Ideas for America, U.S. DOE, Washington, February 1991.

[2] State Energy Data Report 1960-1990, U.S. DOE/EIA.

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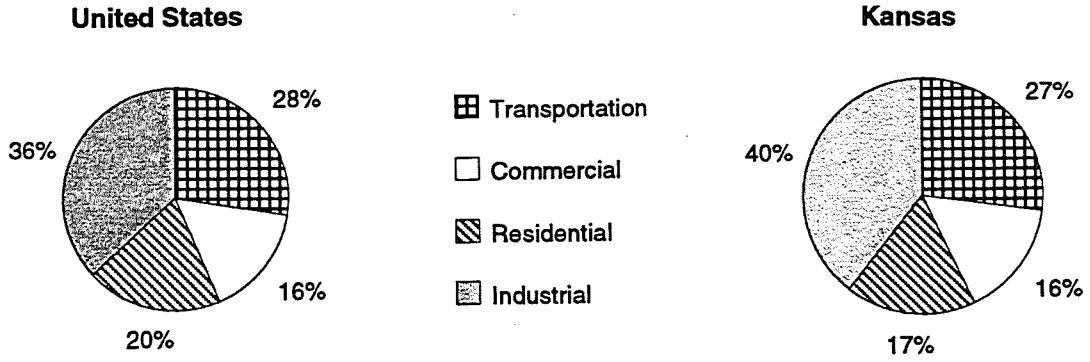
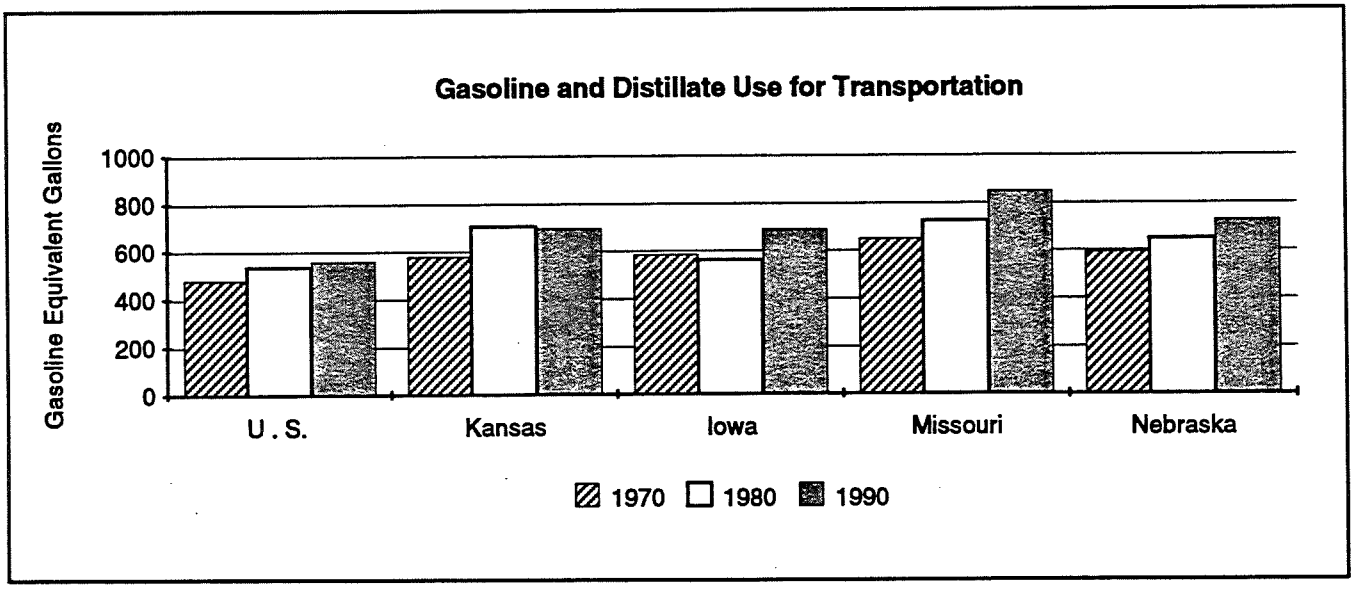


Between 1970 and 1990, Kansas's population increased 10.2% from 2,249,071 to 2,477,574.[3] The number of licensed drivers climbed to 1,737,311.[4] The number of passenger vehicles (cars and trucks) increased 38.6% to 2,129,818 from 1,536,909[5] (1989 data, 1990 not available) and the total annual vehicle miles traveled increased 70.8% to 22,850 million from 13,376 million. Despite this substantial increase in travel, transportation fuel use in Kansas increased only 33.2% (gasoline 63% and distillates 160.1%) from 163.1 to 215.8 trillion BTUs overall[6]. Per capita use increased 20.1% from 72.5 million BTUs to 87.1 million BTUs. Per capita transportation energy use in Kansas increased far less than miles traveled per capita because of significant improvement in vehicle fuel efficiency. However, light trucks gained an increasing share of the passenger vehicle fleet during that time and, although their efficiency increased, their increasing market share reduced the new vehicle fleet average. Vehicles are also staying in use longer, and as a result the average fleet performance has not increased as much as the new car performance rating.

DOE forecasts nationwide overall energy use for transportation will rise 1.7% per year from now until 2010, if energy policies remain unchanged[7]. This would represent an increase of 40% in two decades.

[3]U. S. Census Bureau.
[4]Kansas Department of Revenue, Bureau of Research and Revenue Analysis.
[5]Selected Statistics 1991, Kansas Department of Transportation.
[6]State Energy Data Report 1960-1990, U. S. DOE./EIA.
[7]National Energy Strategy: Powerful Ideas for America, U.S. DOE, Washington, February 1991.



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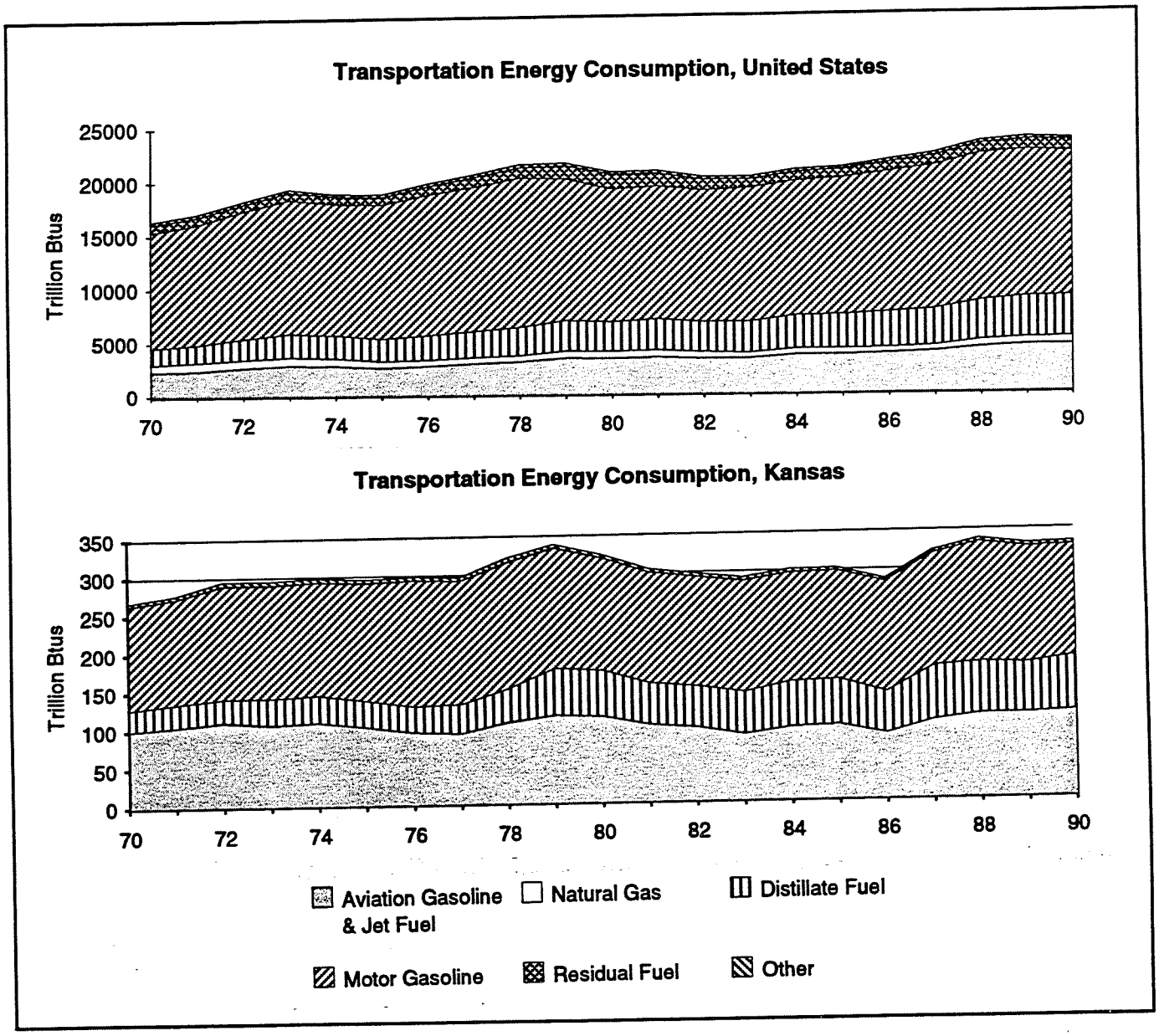
Natural gas used for transportation declined 46% to 40.6 from 73.2 trillion BTUs during the twenty year period.[8] While recently, there are vigorous efforts to encourage natural gas use in vehicles, almost all natural gas used in transportation is still for the compression of the gas in pipelines. The decline in natural gas use for transportation parallels a 35% decline in marketed Kansas gas. 1970 marketed production of Kansas gas was 886 TCF, and in 1990 it was 573 TCF.[9] The slightly larger decline in energy use may reflect a trend of more efficient equipment as well as a shift to electrically driven compressors. Data on energy use in transportation typically includes natural gas used in conjunction with pipelines.

Since natural gas makes up a larger portion of Kansas's transportation energy use than the national average, it must be taken into consideration when comparing transportation energy use with other states. In 1990, Kansas exported 51% of its 574 trillion cubic feet of natural gas production and 4-1/2 times that volume moved across its borders in interstate commerce.[10]

Motor gasoline consumption for transportation in Kansas increased 6.6% between 1970 and 1990, to

[8] State Energy Data Book 1960 - 1990, U. S. DOE/EIA.
[9] Natural Gas Annual 1990, U. S. DOE/EIA.
[10] ibid.



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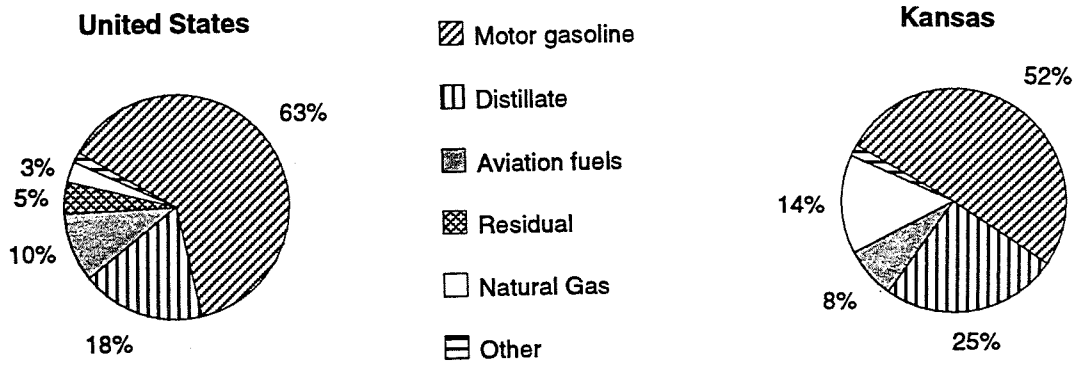

1.16 from 1.09 billion gallons, compared to a 26.7% increase for the entire U.S.[11] Average vehicle mileage has increased substantially, but a significant increase in the real cost of automobiles, combined with other market pressures, has resulted in their staying in use longer.

Transportation is also a major source of air pollution. Vehicles account for around 30% of volatile organic compounds and carbon dioxide, 43% of nitrogen dioxide, and 66% of carbon monoxide emissions in the U. S.

Kansas should set specific short-term and long-term goals for improving transportation energy efficiency, based on careful and objective analysis of transportation needs and efficiency options. Reducing overall transportation energy use per capita by 10 to 15% by the year 2000, and an additional 10% by 2010 appears to be a reasonable goal.

Kansas should also set specific goals for shifting a significant portion of future transportation energy needs to non-petroleum fuels. Shifting 5 to 10% of transportation energy needs to alternative fuels by the year 2000 and an additional 10% by 2010 appears reasonable.

We should pursue development of alternate transportation fuels. A number of states are taking bold steps to promote the use of alternate fuels. California leads the country, if not the world, in setting high standards. Texas and New York have adopted requirements very similar to California. Closer to home Colorado and Oklahoma are adopting similar, albeit less stringent, measures. The major factor behind almost all of these initiatives is urban air quality. Kansas's major urban centers, Wichita, Topeka, and Kansas City currently meet EPA air quality standards. Although reduced fuel use would improve air quality in these communities, the air quality we now enjoy allows us to look beyond programs intended to mitigate that specific problem to opportunities to reduce the vulnerability of our transportation system and encourage the use of Kansas resources at the same time. Natural gas and propane offer proven and available transportation fuel alternatives. Emerging electric vehicle technology should soon allow us to take advantage of available generating capacity for transportation. New methods for using biofuels derived from oil seeds, cellulosic crops, and even beef tallow may soon offer farmers expanded markets. These biofuels should have a substantially better net energy balance than current methods of making ethanol from grain, and unlike ethanol, be market competitive with little or no subsidy. Rigorous research and sound planning will be essential if we are to develop biofuel resources in a manner that conserves our soil and water resources. In the not so distant future we can look forward to using our abundant solar resources for transportation. Hydrogen, produced by electrolyzing water with electricity from solar photovoltaic cells or wind turbines, can be burned in fuel cells at two, perhaps three times the efficiency of an internal combustion engine, and produce essentially no pollution. Natural gas can be

[11] State Energy Data Book 1960 - 1990, U. S. DOE/EIA.

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"reformed" into hydrogen, and take advantage of the substantial efficiency improvement inherent in fuel cell technology. Natural gas can therefore serve as a transition fuel to the renewable energy systems essential for a clean and sustainable energy future.

NATURAL GAS AND PROPANE

Commercially available technology for using natural gas and propane in a wide variety of vehicles is readily available today. In Kansas, two natural gas refueling stations are now available to the public, and two more are expected to open soon. The major barriers to expanded use are the initial capital cost of converting vehicles (vehicles originally manufactured to burn natural gas or propane will be available from U.S. car manufacturers in 1994), a widespread refueling system, and public awareness. Converting 10% of our vehicular transportation needs would require the equivalent of approximately 5% of our gross natural gas production. Initial opportunities for natural gas in transportation are strongest for users of fleet vehicles operating within a limited geographic area, such as delivery fleets, and school buses. Fleets can make effective use of a central refueling facility and typically log sufficient annual miles to take advantage of the lower cost of natural gas.

The Kansas Corporation Commission has undertaken a number of initiatives to encourage the use of natural gas in transportation, including:

- Organizing an alternative fuels vehicle Round-Up to show case technologies.
- Encouraging fleet usage.
- Facilitating conversion of state automobiles to natural gas.
- Purchase of a demonstration natural gas bi-fueled automobile.

ELECTRIC VEHICLES

A new generation of electric vehicles is expected to become commercially available in 1995. Initially targeted at areas with serious urban air quality problems, advanced batteries expected to be available in the late nineties are expected to significantly broaden their market appeal. Electric vehicles are ideally suited for commuter travel, since they have essentially no "idling" losses, and energy can be recovered from braking in stop and go traffic. Kansas's electricity is also generated almost entirely from coal and nuclear power, so electric vehicles can help reduce our reliance on petroleum. With proper planning, most recharging of electric car batteries will occur at night during utility off-peak hours, improving utility economics and providing lower cost electricity for transportation. Electric vehicles will also offer a technology compatible with a renewable fuel source, electricity produced from wind and solar. Kansas could implement a variety of measures to facilitate the purchase of electric vehicles.

BIOFUELS

Bioethanol and biodiesel can be blended with conventional petroleum fuels, or in some applications burned neat. A broader review of biofuel development is presented in the Agriculture section.

PASSENGER RAIL

Kansas should develop passenger rail transportation. Passenger rail offers many advantages, including less energy use per passenger mile traveled, lower vehicle emissions, reliability, reduced congestion, less land use for transportation infrastructure, and the potential use of alternative transportation fuels.[12] However, the relatively low population density in Kansas, even in our three highly urbanized areas, combined with a superior road system and a general traveler preference for the flexibility inherent in the private automobile, pose major barriers to the development of economically self-supporting rail transit systems in Kansas today. Recognizing the major advantages rail offers, the continued population shift to urban areas, and need to develop long term strategies for less petroleum-intensive transportation, Kansas could encourage long term development of passenger rail systems.

[12] The Renaissance of Rail Transit in America, Regional Plan Associates, June 1991.

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Actually achieving serious transportation energy policy goals will not be easy. Kansas should develop the technical research and policy analysis resources necessary to assure that these goals are achieved.

Options for Improving Transportation Energy Efficiency:

- Increase fleet average miles per gallon performance of passenger vehicles.
  - Increase the fuel efficiency of new vehicles purchased by state and local government.
  - Modify vehicle taxes and registration fees to encourage purchase of higher mileage vehicles, using a revenue neutral strategy.
  - Pay a bounty for old automobiles. Older automobiles are less fuel efficient. Newer automobiles have gotten better, and vehicle mileage tends to decline with age. Yet new automobiles cost more in real terms than a decade ago and older ones are therefore staying in use longer. Older automobiles also pollute far more than new ones. Scrapping old automobiles would improve fleet mileage and reduce pollution.
  - Ensure regular vehicle performance check-ups. Proper vehicle maintenance can reduce fuel consumption 5-25 %. Measures as simple as replacing fouled spark plugs and dirty air filters or properly inflating tires can have significant impact.[13] Performance check-ups could be entirely voluntary (but promoted), or mandatory, either on a scheduled basis or at the time of sale.
  - Speed limit enforcement. Vehicles typically reach their peak fuel economy around 40 miles per hour. At 55 mph, economy has declined about 10%, at 65 mph 26%, and at 75 mph 40%.[14] Data collected in 1992 indicated about one-third of vehicles exceed the 55 mph speed limit statewide, but on urban routes 63% exceed 55 mph and on rural interstates 87% exceed 55 mph, and 14% exceed the 65 mph speed limit.[15] Achieving greater compliance with posted speed limits would improve vehicle fleet fuel economy. This may also make rail transit more attractive for shipping and commuting both.
- Increase commuter occupants per vehicle. Low vehicle occupancy means higher energy consumption per passenger mile. Increasing the current commuter vehicle occupancy rate represents a major low cost opportunity for reducing transportation energy use and decreasing congestion. In the past decade, the national average vehicle occupancy rate has fallen, at the same time car pooling rates have fallen. Similar data for Kansas is not available, but the trend is likely similar.
- Encouraging expanded use of carpooling and van pooling through incentives such as preferred parking and park-and-ride facilities.
- Provide disincentives for not carpooling, such as higher property taxes on parking lots in urban areas making parking more expensive.
- Reduce travel needs. The average annual miles driven per capita in Kansas has increased gradually. The average time spent traveling by Kansas commuting increased over 4% between 1980 and 1990.[16] Telecommuting is an effective strategy for reducing travel needs. Nationally an estimated 35% of passenger vehicle miles are work related. Flexible work place arrangements made possible primarily by computers and information networks allow many information and service related workers to perform productively at home, at least a portion of the work week, reducing commuting travel. Telecommunting saves not only energy, but time. It also reduces congestion and some studies indicate it often improves worker performance and satisfaction. Kansas could encourage telecommuting by:
  - initiating a telecommuting program for state workers where feasible, developing a work-

[13] Nebraska Energy Policy Plan, Nebraska Energy Office, Lincoln, 1992.
[14] Transportation Energy Data Book: Edition 12, DOE/OIT, Oak Ridge National Laboratory, Oak Ridge, 1992.
[15] Speed Study Quarterly Report, Kansas Department of Transportation, Topeka, June 1992
[16] New Perspectives in Commuting, U.S. Department of Transportation, July 1992.

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shop program to explain the advantages of telecommuting and what strategies have proven successful.

- Zoning and subdivision regulations that control development patterns in urban areas often require development in a manner that fully accommodates motor vehicles and precludes pedestrian, bicycle, or mass transit. Integrated community development planning and transportation planning can reduce traffic congestion, reduce reliance on vehicular transportation, and ensure pedestrian and bicycling are viable modes of transportation.

Options for encouraging increased use of natural gas as a vehicle fuel:

- Provide tax credits to off-set the cost of vehicle conversion would stimulate increased natural gas use for transportation. The credit could be self-funding from an incremental increase in motor fuel taxes (see Oklahoma Bill 1193).
- Implement a marketing assistance program to provide assistance to fleet vehicle users in negotiating direct pipeline purchases to increase the financial advantage of converting to natural gas.
- Require large vehicle fleets to convert a minimum portion of their vehicles within specified time periods. Provisions of the National Energy Policy Act of 1992 addressing fleet vehicle conversion should be fully employed.
- Guaranteed savings
  Medium term gas sales contracts with price caps set by a market prices of conventional transportation fuels could be encouraged to lock-in savings sufficient to ensure acceptable return on investment.

Initiatives the state could consider for promoting use of electric vehicles:

- *Tax Exemption*
  Sales tax exemption on incremental cost above comparable gas automobiles. All other features being equal, the cost of batteries will initially make electric vehicles substantially more expensive than comparable gasoline powered automobiles. The state could exempt this technology cost premium from sales and property tax until the cost of batteries is reduced.
- *Parking preference*
  A major concern for urban commuters is available convenient parking. Requiring a portion of all premium parking be reserved for electric, or perhaps all types alternate fueled vehicles in larger parking lots could represent an incentive for many potential buyers.
- *Public battery recharge*
  Recharge of current technology batteries requires several hours. While utilities anticipate that most recharging will occur at night, some public access to full day recharging facilities will be essential if electric car buyers are not to be discouraged by the limited range between recharging. Steps could be taken to encourage or require that a small percentage of existing and new parking spaces be equipped with credit card operated recharging hook-ups. A Kansas company is currently developing such a device.
- *Recharging rates*
  Most battery recharging will occur at night during electric utility "off-peak" hours. Since electricity costs less to produce during off peak hours, it can be sold for less, offering greater incentive for the purchase of electric vehicles. The Kansas Corporation Commission could consider a program to ensure all Kansas electric utilities have available, upon request, a time-of-day residential rate designed for electric vehicle battery recharge.

Options for encouraging development of rail passenger transportation systems:

- Consider having the Kansas Department of Transportation evaluate interurban and intercity passenger rail systems as an integral part of transportation planning, with such planning incorporating societal cost-benefit analysis methods in selecting preferred solutions.
- Develop strategies for encouraging long term development in the state urban areas in a pattern which can eventually support rail transportation.

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Options for encouraging greater use of rail freight transportation:

- Implement a long term strategy to achieve equity in public support between rail and truck transportation of freight.
- Investigate the potential for increased use of non-petroleum fuels in rail transportation.

The bottom line governs industrial energy performance. Most manufacturers view energy from a purely economic perspective. Accordingly, energy investments are subject to return on investment calculations and must compete with other projects for scarce capital. Energy investments are also subject to risk analysis because of volatility in energy prices. Ultimately what motivates manufacturer's actions with regard to energy is energy cost, rather than efficiency or consumption.

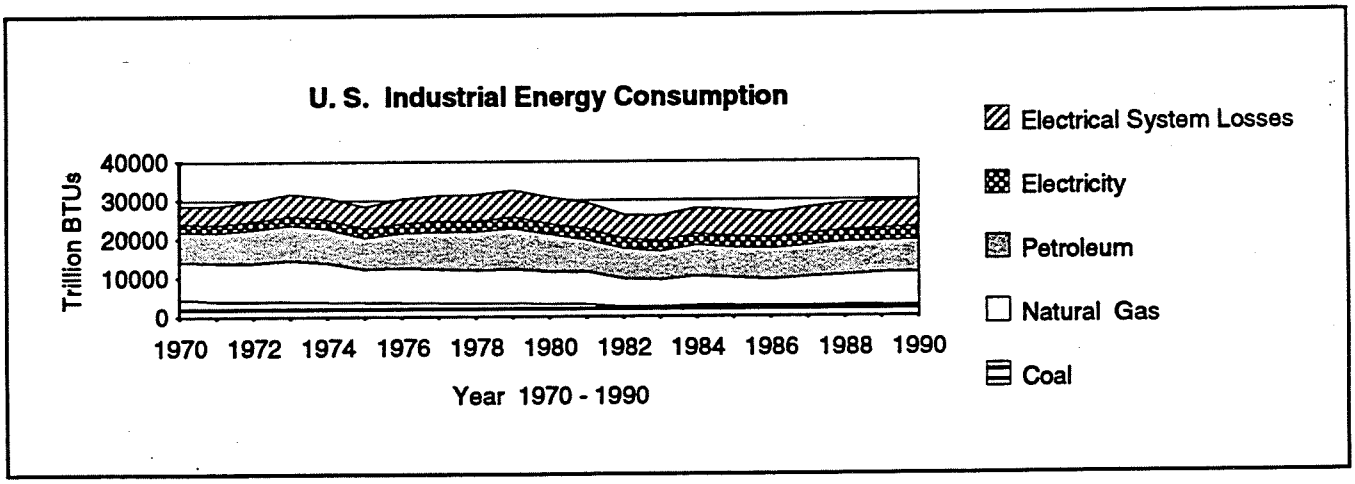
"Changes in Energy Intensity" in the Manufacturing Sector 1980-1988 DOE/EIA

Industry consumes more energy than any other sector in Kansas, and a larger share than industry in most other states. Industry's share of Kansas's total primary energy consumption in 1990 was 39.4%, compared with 36.4% in Iowa, 23.4% in Missouri, 25.3% in Nebraska, and 36.8 % for the entire U. S.[1] The difference has as much to do with the mix of industries in Kansas as it does with our relative overall industrial energy efficiency. Data on energy consumption in the industrial sector is difficult to acquire since many users request that it be treated as proprietary by the agencies collecting it. We do know that chemicals, petroleum refining, fertilizer manufacturing, cement and clay production, and food processing are among the major industrial energy consumers in Kansas.

Nearly 39% of the primary energy (45% if electrical generation losses are excluded) Kansas industry consumed in 1990 was petroleum based, almost 2/3^{rds} as much total petroleum as consumed by the transportation sector. By contrast Iowa's industrial sector's primary energy consumption was about 18 % petroleum, and the U. S.'s approximately 28%.

In the two decades ending in 1990, overall U.S. industrial energy consumption declined just over 4%, while Kansas industrial energy consumption increased by 19%. This is not to suggest that Kansas industry is less energy efficient. Much of this energy use may reflect development of the industrial base and the use of energy resources as feed stocks in industrial processes. It does suggest that a more detailed understanding of industrial energy use would be valuable in developing an informed energy policy addressing this important sector.

[1] State Energy Data Report, 1960-1990, DOE/EIA.



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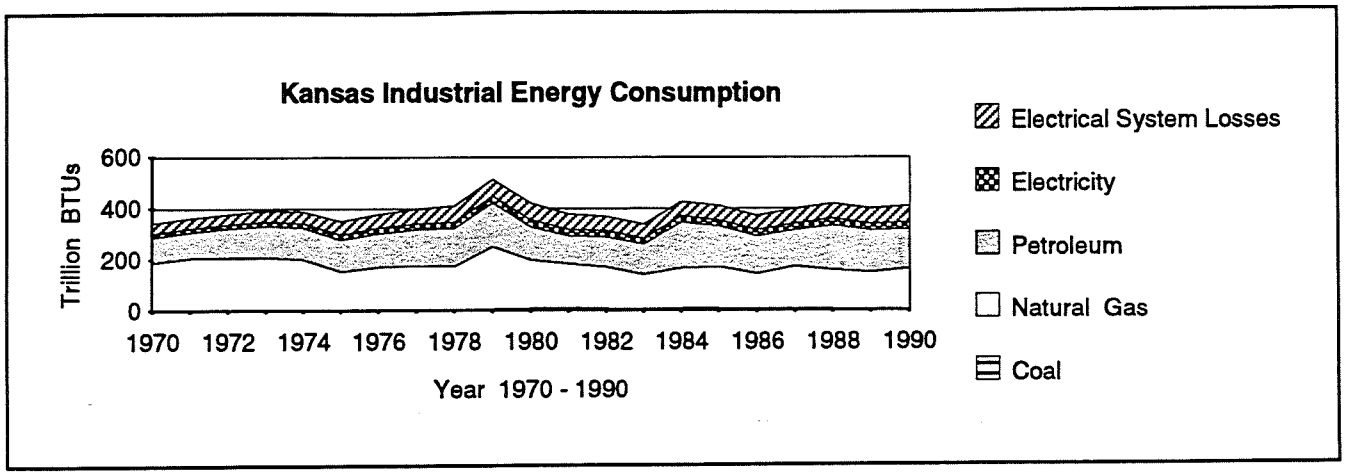
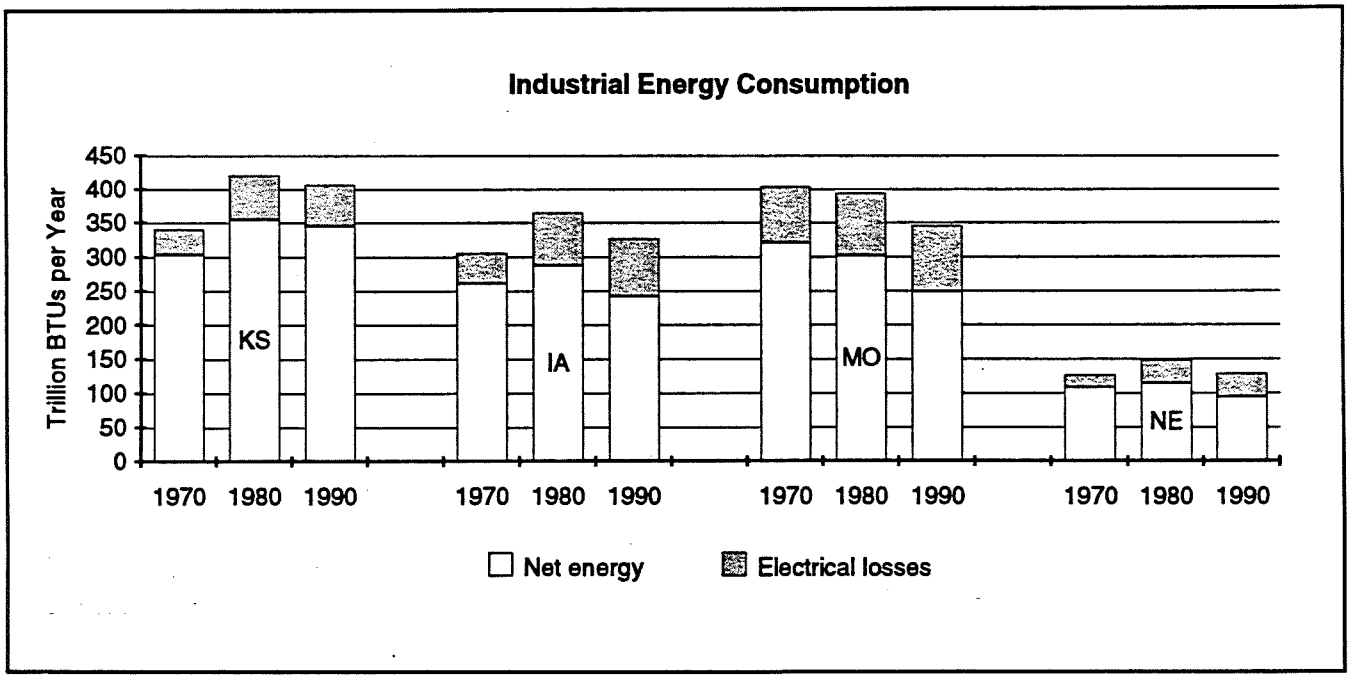


Industrial energy use is extremely diverse, and different industrial processes offer varying potential for improved energy efficiency. Efficiency gains often occur in surprising ways. Microwave drying of paint and freeze drying of food offer significant energy gains for example, even when the losses inherent in generating electricity are considered. The dominance of processes in industrial energy use should not detract from considering the potential for cost effective performance gains in industrial buildings.

The industrial sector has contributed a substantial portion of the energy efficiency gains that have been achieved in the United States during the past two decades, and substantial opportunities remain. "Numerous energy-saving processes, technologies, and programs can be cited in virtually all industries that illustrate the potential for energy conservation. There are domestic and foreign industrial plants that consume energy more efficiently than other plants."[2] Two technologies which are common to many industries, lighting and electric motors, have benefited from substantial efficiency gains in recent years, and could be key elements in efforts to improve industrial energy performance.

[2]Energy Consumption and Conservation Potential: Supporting Analysis for the National Energy Strategy, DOE/EIA 1990.



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In its 1991 report on energy intensity in manufacturing, DOE identified a number of factors that increase or facilitate energy efficiency improvements in industrial operations, stating:

- **Improved energy management** consists of better equipment maintenance, improved insulation, lower thermostats, routine energy audits, and conservation goals.
- **Computer control and instrumentation** allow companies to track energy use and keep processes running at optimal efficiency.
- **Heat recovery and heat exchange** involves lowering stack temperatures, the installation of waste-heat recovery boilers, and condensate recovery.
- **Improvement in electricity** cogeneration, including switching to gas turbines, have been an important factor in improving energy efficiency.
- **Increases, renovations, and turnovers in production capacity**, commonly incorporate technological advances and improved operational techniques that have allowed many industries to increase energy efficiency.

Recognizing that Kansas industry has not only a high energy intensity, but a high reliance on petroleum, implementation of programs to improve industrial energy efficiency and encourage diversification of industrial energy sources should be an important element of policy considerations.

Options for encouraging greater industrial energy efficiency in Kansas:

- Establish energy performance standards for industrial buildings.
- Provide technical assistance to industry. Existing programs, such as the Energy Extension Service at Kansas State and the Energy Analysis and Diagnostic Center at Kansas University could be enhanced to provide high quality energy audits and specific technical assistance to Kansas industries seeking to improve energy efficiency. Efforts to provide technical assistance should be structured to avoid displacing private sector services.
- Implement electric utility demand side management programs. Industrial energy consumers, because of their size and energy intensity, are major prospects for utility demand side management programs. Allowing utilities to profit from such investments would encourage their active pursuit of industrial energy efficiency investment opportunities.
- Improve access to capital for investments in industrial energy efficiency. As with all other sectors, cost effective energy efficiency improvements in industry often go unimplemented for lack of financing. A workable program for providing utility or other private sector financing for energy efficiency improvements could be developed.
- Encourage industrial waste reduction and recycling. Many large manufacturers have found that aggressive programs to recycle their own wastes has reduced cost, reduced solid and hazardous waste disposal problems, and reduced energy requirements.

Options for reducing oil use in Kansas industry:

- Focus programs to improve industrial energy efficiency on oil consuming industries and processes.
- Encourage fuel switching to natural gas from oil where technically and economically feasible.

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Agricultural Energy Intensity

BTU/Acre

Crop	Field Operations (tilling, planting, chemical, harvest)	Fertilizer	Pesticides	Yield/acre	BTU/bushel
Dry land					
Wheat	745,000	1,490,000	2,600	35.7	62,700
Corn	860,000	2,800,000	291,000	78.8	50,140
Grain Sorghum	724,000	1,730,000	208,000	60.7	43,850
Soybeans	751,000	550,000	99,000	24.6	56,900
Sunflowers					
Irrigated					
Corn				153.6	214,000
Wheat				53.8	
Grain Sorghum				94.8	245,000

moisture, corn has an efficiency of around 1.1%, trees 0.1%, and grasses 1.5%. Although these percentages sound low, the stored solar energy in the annual harvest of Kansas crops is approximately 800 trillion BTUs, equal to 80% of our total energy use.

The seeds of a number of crops which are or can be produced in Kansas are high in oil content. Soybeans, for example, yield approximately 1.35 gallons of diesel fuel substitute per bushel. These oils closely resemble diesel fuel, and with appropriate processing, they can be substituted 100% for diesel.

Kansas slaughters nearly 6.3 million head of cattle annually, second in the nation. Despite a move toward production of leaner animals, customer preferences have resulted in an increase in trimmed tallow per animal. This increased supply has depressed prices to $0.11 today from $0.16 per pound in 1988. Tallow production now totals 935 million pounds, containing approximately 15.8 trillion BTUs, the equivalent of 110 million gallons of diesel fuel. Animal tallow can be processed into a diesel fuel substitute.

National laboratories are actively pursuing development of technology for producing ethanol from cellulosic plant fibers. Producing ethanol from cellulose instead of grain will be an important step in expanding the role of liquid fuels derived from biomass. Cellulosic feed stocks typically cost less than grain, and can be produced from perennial crops suitable for erodible soils. But the biggest potential benefit from shifting to cellulosic feed stock is energy yield. Grain and ethanol production are energy intensive processes. While analysts differ on the amount of net energy gained from producing alcohol from grain, the net yield is not high enough to permit it to become a major contributor to our liquid fuel needs in the long term. Bioethanol can play a larger role in displacing petroleum, if the feed stock can shift from grain to plant fiber.

Opportunities for biofuels, as much any other renewable energy technology, are state specific. Soil conditions, climate patterns, farming practices, and local economic conditions must all be considered in developing biofuels. Establishment of a Kansas Biofuels Energy Research and Development Program to address these issues should be given careful consideration. Such a program could ensure that the full economic potential of biofuels development in Kansas is achieved, while ensuring that soil and other natural resource assets are safe guarded.

Between 1985 and 1992, approximately 3 million acres of highly erodible Kansas farm land were removed from agricultural production under the federal Conservation Reserve Program (CRP). In exchange for planting the land with plants not intended for

Agriculture

Horsepower. *Seventy years ago, most Kansans lived on farms along with two horses. There were few tractors. A good team could plow two acres in a day. Feeding horses required the output of 20% of a typical farm's land. Today a 200 "horsepower" tractor can plow 80 acres in a day, but consumes 160 gallons of diesel fuel produced off the farm. There aren't as many horses, and only 2% of Kansans still live on farms.*

Modern agriculture relies on energy. Tilling, planting, fertilizing, control of weeds and insects, and harvesting all require energy. Agriculture is not only our source of food, it is an important sector of the state's economy, and a major source of exports. Agriculture has also become a very energy intensive process, highly reliant on oil and gas. A bushel of irrigated corn requires the equivalent of nearly two gallons of gasoline in energy inputs. Even dry land wheat requires the equivalent of half a gallon. Fuel and the energy embedded in fertilizers and chemicals are also significant production costs.

Kansas Agricultural Sector Vital Statistics

	Acres	Rank Among States
Production		
Cultivated land	31,385,000	2
Irrigated land		
Center pivot systems		
Wheat	12,400,000	1
Corn (total)	1,450,000	11
Corn (irrigated)	457,000	
Grain sorghum (total)	2,800,000	1
Grain sorghum (irrigated)	434,000	
Corn and sorghum silage	240,000	
Soybeans	1,950,000	10
Sunflowers	75,000	4
Oats	160,000	
Alfalfa	800,000	
Other hay	1 ,700,000	
Livestock		
Cattle on feed	6,245,000	
Cattle slaughtered	6,258,000	2
Hogs	1,500,000	10
Sheep	213,000	16

The energy required to process and transport food is often estimated at two times the energy required to produce it. Future energy cost increases will have a direct impact on the profitability of production agriculture. Developing and implementing production techniques requiring lower energy inputs should become a key element in our agricultural policy. Strategies that reduced energy inputs can often actually produce greater net profits, even if gross yields decline.

There are opportunities for reducing agricultural energy requirements. Changing tillage practices, including low-till, no-till, and conservation tillage, in which crop residue remains on top of the soil and weeds are suppressed with herbicides, have gained wider acceptance in recent years. These practices yield energy savings and reduce erosion. Preventing erosion not only protects a valuable natural asset, but provides energy savings since loss of topsoil results in increased energy use for tillage.

Approximately 10% of Kansas crop land is irrigated, 50% with center pivot irrigation systems. Irrigated land accounts for 69% of Kansas corn production and 15% of grain sorghum production. Water pumping for irrigation annual consumes an estimated 7.92 trillion BTUs at an estimated cost of $ 204 million. The need to conserve water and the cost of pumping has already resulted in substantial efforts to improve irrigation efficiency. Kansas could consider intensifying efforts to achieve additional irrigation energy efficiency.

Current agricultural production methods require substantial fossil fuel inputs, but at its core agriculture relies on the productive use of renewable solar energy. Each year every acre of Kansas farmland receives the equivalent of approximately 180,000 gallons of gasoline in solar energy. Plant species vary in the efficiencies with which they convert sun light to stored energy. On an annual basis, with adequate

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harvest, but to prevent erosion, land owners have been paid an annual "rent" by the federal government. Land placed in the CRP program will loose its eligibility after ten years. Land placed in the first year, 1985, will therefor leave the program in 1995. Strategies should be considered to encouraging use of CRP land for long term energy production. Such strategies should recognize the erodible nature of CRP land. Planting and harvesting of individual crops must take place within a relatively short time period. Inadequate fuel at these crucial times could have a profound impact, not only on individual farmers and the state's agricultural economy, but the price and availability of agricultural products. While the likelihood of such an emergency now appears remote, the state's energy emergency plan should incorporate specific contingency plans for providing adequate fuel for agriculture during these crucial periods.

There is a significant lack of detailed understanding of patterns of energy flows use in Kansas agriculture. The development and wide scale adoption of agricultural practices which ensure the highest long term economic gain with the lowest vulnerability to changes in energy prices and availability requires a full understanding of energy flows in agricultural processes.

Options for better understanding agricultural energy requirements and use patterns:

- Fund research to better understand energy requirements for each stage in the production of major Kansas crops and livestock, and to identify options for reducing reliance on fossil fuel inputs.

Options for improving agricultural energy efficiency in field operations:

- Encourage the use of conservation tillage to reduce energy use and overall cost.
- Conduct research to determine the most economically productive conservation tillage practices for different crops and different Kansas production zones.
- Expand research to develop methods of using global positioning systems and detailed sensors and records to permit precise application of fertilizer and agricultural chemicals.
- Use currently existing agricultural organizations to disseminate information on energy saving techniques and opportunities.

Options for encouraging greater energy efficiency in irrigation:

- Expand efforts to improve irrigation system mechanical efficiency. Better maintenance of engines, selection of more efficient electric motors, proper pipe sizing, and maintenance of other system components can all contribute to pumping energy efficiency. Develop program for testing irrigation wells for water use and energy efficiency. Consider a circuit rider concept for well testing.
- Promote irrigation management practices designed to achieve maximum economic yield by reducing pumping costs. Past irrigation practices often resulted in unnecessarily heavy water application. Adjusting pumping rates based on frequent monitoring of crop, soil, and weather conditions can provide water and energy savings with limited impact on yield.
- Encourage conversion to low pressure irrigation systems.
- Conduct research on crop varieties that require less water, for both irrigated and non-irrigated use.
- Develop a program to provide access to financing for irrigation system improvements that improve energy efficiency.

Options for encouraging adoption of other energy efficient agricultural practices:

- Encourage use of desuperheaters on milk cooling systems for dairy water heating.
- Encourage use of high efficiency lighting in livestock confinement operations.

Options for encouraging diversified motor fuels for agriculture:

- Develop a program to encourage use of propane and natural gas fueled tractors.

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- Investigate the feasibility of local cooperatives for processing seed oil for diesel fuel substitute to be used in farm equipment.

Options for encouraging the use of renewable energy in agriculture.

- Solar water heating for dairying.
- Encourage use of wind and photovoltaic systems for stock water pumping instead of line extensions for conventional electrical service where cost effective.
- Develop cost effective new methods for methmane gas production from animal manure produced in confined feeding operations.
- Develop cost effective methods of solar grain drying.

Options for encouraging development of low input agricultural methods

- Support equitable market access for organic producers.
- Promote biologically sound manure management practices to gain maximum nitrogen benefit from livestock waste.
- Promote topsoil conservation practices which reflect the additional energy required to gain production from depleted soils.

Options for developing agriculturally produced liquid fuels:

- Establish a Kansas Biofuels Energy Research and Development Program, whose activities might include:
  - Identify plant species most suitable for Kansas soil and climate conditions.
  - Design production strategies which maximize net energy production and other benefits.
  - Evaluate fuel production alternatives suitability to Kansas, with appropriate consideration of energy production, environmental impact, and economic benefit.
  - Identify market opportunities for Kansas biofuels.

Options for encouraging the use of biomass for direct combustion for heat:

- Conduct research on woody plants and perennial herbaceous crops to identify highest combustible biomass yield plant types and produc tion strategies for different Kansas production zones.
- Investigate the feasibility of using CRP land or reclaimable mined land for energy production purposes. Biomass could be used for direct combustion or ethanol production.

Options to ensure fuel will be available for agriculture during crucial planting and harvesting seasons during energy emergencies:

- Develop a contingency plan for monitoring the availability of essential fuels for agriculture.
- Develop a contingency plan for providing essential fuels for agriculture during crucial harvest and planting seasons.
- Develop strategies to prevent fuel hoarding.

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Making Electric Efficiency Profitable. *State regulatory commissions currently set rates using formulas which reward utility companies for increasing sales – nothing more and nothing less. Investing capital in the nation's electric supply network and finding productive new uses of electricity were worthy goals for the first 70 years of this century, but these goals are no longer sufficient. Since the early 1970s, the regulatory prescription and the needs of the country have been steadily diverging. It is time electric utility companies enable to profit from helping their customers use electricity more efficiently.*

Dr. Stephen Wiel
Public Utilities Fortnightly
July 1989

It's a poor sort of memory that only works backwards.

Rev. Charles Lutwidge Dodgson

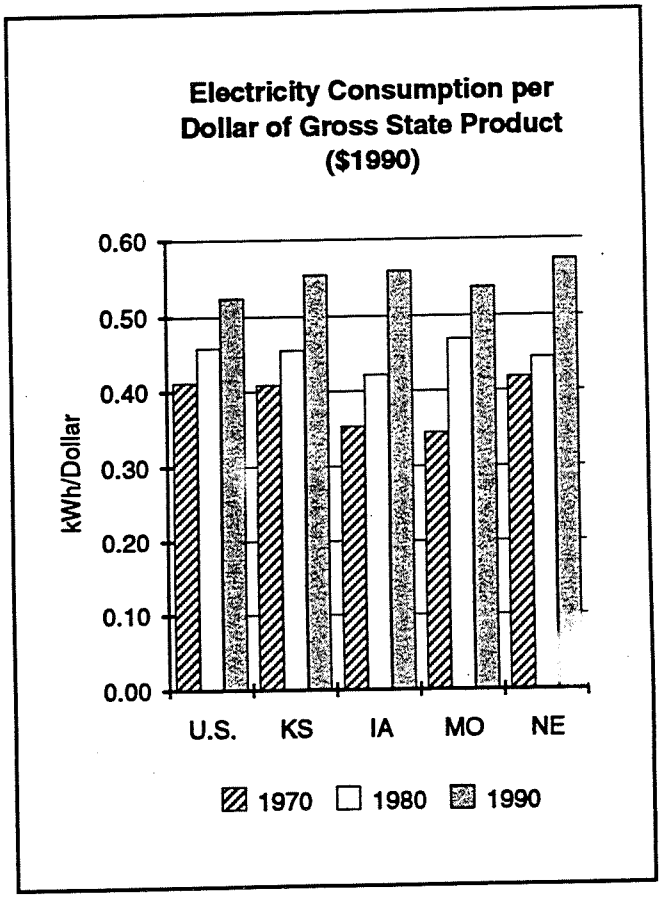
Electricity is an exceptionally versatile form of energy. It can provide heating and cooling, power motors for a myriad of tasks, and is absolutely central to modern media and information systems. Our lives would be profoundly different without it. Reliably supplying electricity has been a major accomplishment we too often take for granted.

While overall energy use in the U. S. increased 22% between 1970 and 1990, energy used for electricity generation grew 81%. In Kansas, the difference was more profound, with overall energy use increasing 18% and energy use for electricity generation in creasing 112%. National per capita electricity use increased 59% during this period, while it increased 75% in Kansas. The pattern of increased electricity use has occurred in all sectors, with residential use increasing 78%, commercial 141%, and industrial 78%.

Our economy is becoming more electricity intesive. Energy intensity, in BTU per dollar, has declined overall, both for the nation and for Kansas. Electricity intensity, however, has increased. Between 1970 and 1990, U.S. electricity consumption per constant dollar of gross state (national) product increased 27%. In Kansas, this ratio increased 36% during this same time period. Increased electrical intensity has a profound impact on total energy use, since approximately three units of energy are consumed to produce one unit of electricity.

The other major factor in Kansas electricity use has been the nearly total shift away from natural gas as a generating fuel to coal and nuclear.

Kansas electric utilities initiated substantial power plant construction programs in the 1970s based on



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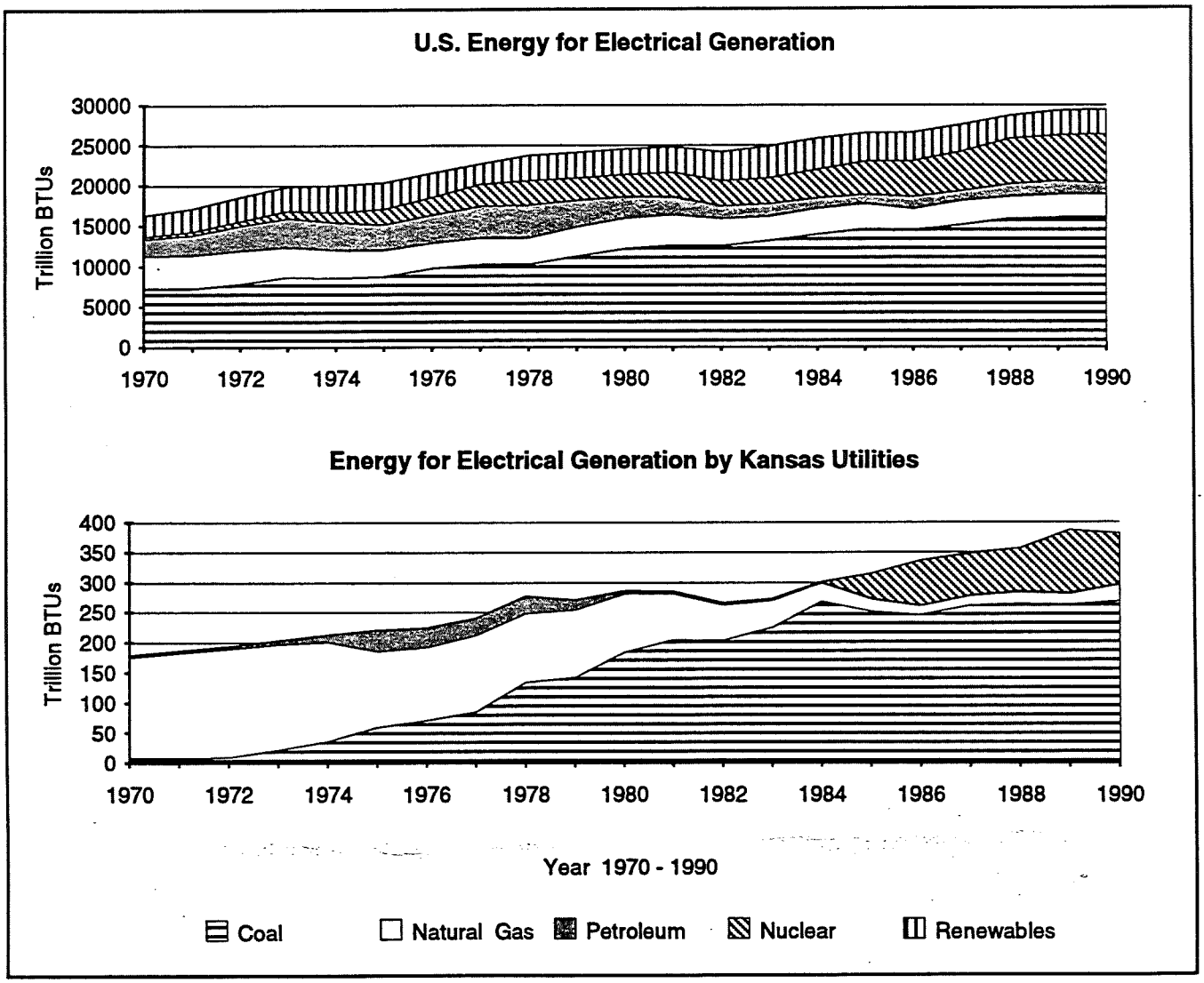
projected load growth and anticipated shortages of natural gas which was by far the dominant generating fuel at that time. This change was later supported by the Fuel Use Act that sought to discourageuse of natural gas for electrical generation because natural gas supplies were then widely thought to be declining rapidly. In 1975, Kansas generating capacity totaled approximately 5900 M.W. Electrical generation in 1975 was 10% coal, a decade later this had increased to nearly 92%.[1] Lacygne No. 2, a 686 MW coal unit came on line in 1977. Jeffrey no. 1, a 720 MW coal unit came on line in 1978, followed by two additional units of equal size, Jeffery no. 2 in 1980 and Jeffrey No. 3 in 1983. The Holcomb plant, a 320 MW coal unit also came on line in 1983, and in 1985 Wolf Creek, an 1117 MW nuclear plant, was placed in service. Between 1975 and 1992 aging natural gas plants were retired, and some gas capacity was "mothballed". 1992 generating capacity in service totaled approximately 80 MW, over 80% more than in 1975. Natural gas capacity had declined substantially.

The rapid expansion in generating capacity that accompanied the move away from natural gas as a generating fuel resulted in an abundance of generating capacity by the mid 1980s. Demand for electricity grew, but not at the rate anticipated. Slower economic growth, market resistance to higher electric prices, saturation of some major electrical appliances, and more energy efficient technology all caused demand to fall short of that forecasted.

[1]Kansas Energy Resources Data, KCC, 1985



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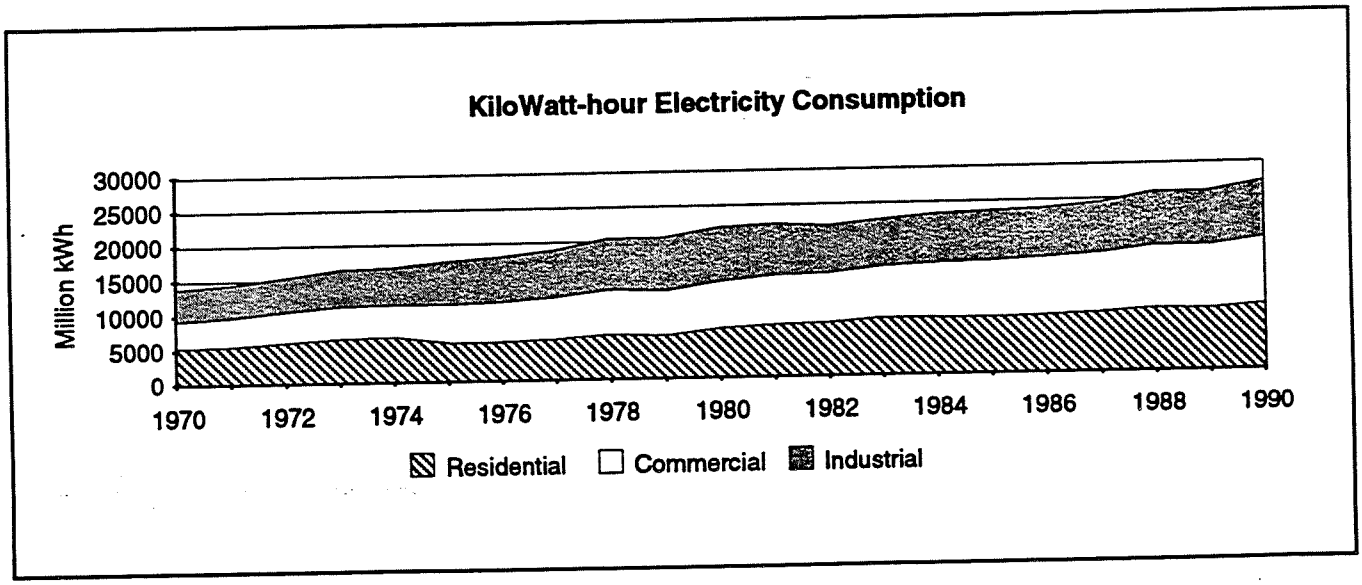
The addition of nearly 5,000 MW of generating capacity between 1975 and 1985 represented a huge investment by Kansas electric utilities. The prevailing strategy was to encourage increased use of electricity, thereby distributing the fixed costs over a larger number of kilowatt hours, and limiting the increase in per kilowatt-hour price. Strategies for increased sales included economic development rates intended to attract new electric consumers by offering low electricity prices, and marketing programs intended to help compete with natural gas for space and water heating. Case by case rate agreements were also made with individual customers to prevent expansion of cogeneration and loss of electric load. Programs to promote efficiency and load management tended to be given less priority. The abundance of generating capacity delayed encouraging the electricity consuming side of the system toward evolving energy efficiency plans.

The reserve margin for Kansas's major electric utilities is decreasing, which could lead to the need for additional investments in electric generating capacity. The recently completed Missouri-Kansas Power Pool (MOKAN) 1992 Long Range Planning Study states that, based on projected plant retirements, loss of existing purchase contracts from other utilities, and load growth, "About S,100 MW of additional generating capacity (including reactivations and upgrades) will be needed by MOKAN by 2014. Of this, slightly more than 4,700 MW will be new capacity."

To meet this projected demand, the study presents several options. The preferred plan calls for 2,020 MW of base load coal fired plants, with expenditure of funds for engineering design first occurring in 1997 and construction of the first unit beginning in 1999. Other capacity included 1,920 MW of gas combined-cycle intermediate load plants, with expenditure of funds for engineering design of the first unit beginning in 1995 and construction beginning in 1996. An additional 800 MW of gas turbine peaking capacity is also included, with engineering design of the first unit beginning in 1996.

Reliable and affordable electricity is essential for our economy and our way of life. While it must be recognized that there is considerable divergence in the current and forecast capacity reserve margins of individual Kansas electric utilities, the prospect of constructing additional capacity for a MOKAN pool member in the near future suggests it is time to reassess past strategies intended to "use up" generating capacity rather than conserve it. Once the commitment is made to construct additional capacity, the flexibility to meet future demand by other potentially more cost effective strategies, be it improved efficiency, renewable energy, or greater sharing of existing resources, is severely constrained, if not eliminated.

Utilities are increasingly being asked to perform conflicting, even contradictory roles. Investor owned



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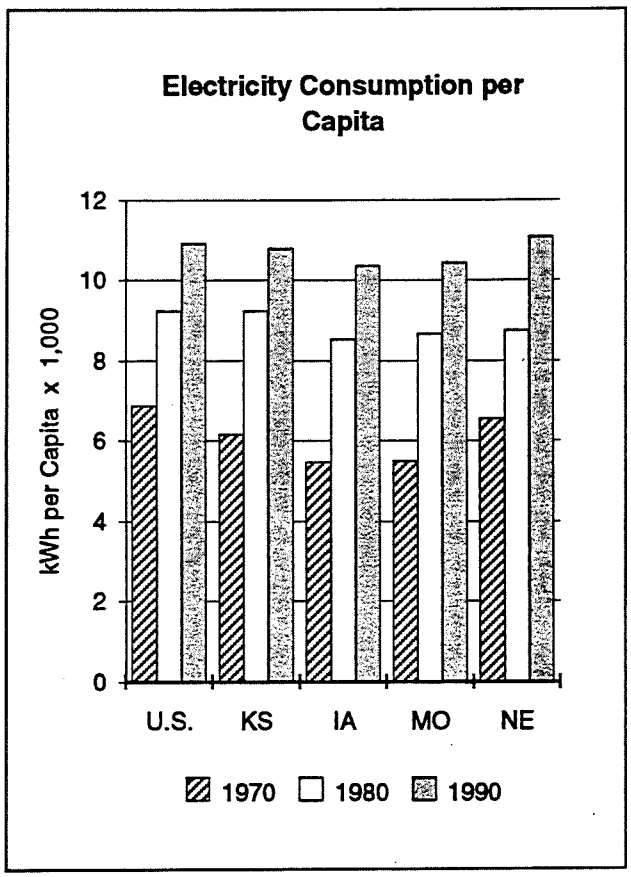
utilities must answer not only to regulators, but to their stockholders. If they are to perform a more significant role in developing a more efficient system of using as well as producing electricity, lead in the cost effective development of renewable energy, address the issue of external environmental costs, while maintaining reliable service at acceptable costs, then it will be necessary to provide investor owned utilities with fair and reasonable financial incentives to redefine their business strategies and address these issues effectively.



Options for deferring additional generating capacity as long as prudently feasible:

- Develop a rigorous understanding of current electric utility load growth patterns and evaluate the potential for deferring capacity requirements through demand-side management programs.
- Implement a long term integrated resource planning (IRP) program.
- Provide utilities with financial incentives to invest in energy efficiency and load management.
- Encourage full effective use of existing generating resources within the region.
- Investigate requiring utilities to take bids for non-utility generation (NUG) such as cogeneration, in competition with plant expansion alternatives.

Options for minimizing the long term cost of electricity:

- Encourage wholesale competition as provided for in the National Energy Policy Act of 1992.
- Investigate central dispatch based on minimum incremental cost of generation.

Options for encouraging electric utilities to pursue development of renewable resources (see renewable energy section also):

- Encourage utilities to participate in wind and photovoltaic interest groups.
- Provide financial incentives for investing in prototype projects designed to gain real operating experience with renewable energy technology in Kansas.
- Consider requiring utilities to acquire a specified portion of their energy requirements from renewables by a specified date. A requirement of two percent by the year 2002 would encourage utilities to become actively involved in development of renewable energy, while minimizing financial risk.

Options for encouraging utilities to participate in developing electric transportation:

- Allow utilities to deduct as an operating expense up to 50% funding of studies to investigate the feasibility of urban electrified rail transportation systems.
- Investigate allowing utilities to capitalize and rate base investments in electrical vehicle recharging facilities.
- Encourage utilities to establish time-of-day rates for electric vehicle recharging.

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Options for encouraging utilities to reduce emissions:

- Investigate the potential for "green utility rates" in which the customer agrees to pay a higher price to ensure the utility acquires a portion of their energy requirements from renewable resources.

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It is not a question of either/or. *Some renewable energy advocates argue that solar energy can and should totally displace fossil energy use within the next few decades. Some fossil and nuclear energy advocates think solar energy can never contribute significantly to our energy needs. Neither is right. The new generation of solar technologies now moving from the laboratory to the field are no more science fiction than going to the moon. An important facet of a sustainable future will be the rational integration of these technologies into our energy infrastructure over time - and it will take a long time. We should begin this gradual process now, while adequate fossil fuel reserves permit an orderly transition to a more diversified energy economy. To wait for yet another crisis before we begin the process would not be prudent public policy.*

Kansas has enormous renewable energy resources. A common perspective has been that eventually, after fossil fuel reserves have been significantly depleted, the rising price of conventional fuels will intersect the declining price of renewable energy technology, making renewables economically attractive. Renewable energy technologies are declining in cost. With increasing concern about the environmental cost of burning fossil fuels and the prospect that such external costs will be incorporated into decisions regarding which energy source to use, renewables are expected to begin their long awaited expansion in contributing to our energy requirements. The gradual integration of renewable energy systems into our energy infrastructure is an important component of a strategy to achieve long term energy security. Despite anticipated price declines, renewables will remain capital intensive. Ignoring the opportunity to begin the transition toward renewables until the price of fossil fuels is substantially higher runs the risk that high interest rates which typically accompany rapid increases in energy costs will make the capital required for renewable energy too expensive to permit its development.

Despite our wealth of renewable resources, Kansas ranks low nationally in our development of them. Some studies have ranked Kansas last in renewable energy development. Such studies must be viewed carefully since they are usually prepared from a particular viewpoint or agenda. In addition, such reports are unbalanced by the dominance of hydroelectric and wood waste from forestry, (two resources Kansas does not have), and the unique circumstances of wind energy development in California. The lack of visible renewable energy development in the private sector, the absence of any real focus for renewable energy development in state government, and the declining research activity related to renewable energy in Kansas points to a clear trend of declining resources directed toward renewables.

Options for encouraging the development of Kansas's renewable energy resources:

- Provide financial incentives, such as sales tax exemptions, property tax abatements, and income tax credits, based on actual metered energy production, for individuals and businesses that own and use renewable energy systems.
- Provide financial incentives for utilities to invest in renewable energy research and development and demonstration.
- Establish a coordinated effort to conduct research into the expanded development of Kansas' renewable resources, similar to the recently established Iowa Energy Center.

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THE POTENTIAL FOR INDIVIDUAL RENEWABLE ENERGY TECHNOLOGIES

Solar

Solar energy can be used in many forms. Daylight can displace electric light in buildings. The heat of sunlight can heat water for domestic, commercial, or industrial use, or provide building space heating in both passive and active forms. Solar heat can be concentrated to drive turbine generators in schemes ranging from power towers surrounded by mirrors, to single dish mirrors powering small stirling engines. Sunlight can be directly converted to electricity with photovoltaics, or used to split water into hydrogen and oxygen. Sunlight can be stored in plant growth or as heat in salt ponds. The options are numerous. The challenge is to develop methods to use solar that are truly cost competitive. The options raised below focus on only a few of the more technically advanced technologies.

Solar Energy in Buildings

Lighting in commercial buildings can consume 30-50% of all energy used by the building, both directly and indirectly as heat load for air conditioning. Properly designed daylighting systems integrated with a buildings lighting control system can save 30-60% with a payback of four years or less. Design strategies which optimize winter solar gain and control summer gain can reduce annual heating and cooling bills by 20-30% at little or no additional cost. More aggressive passive strategies can achieve greater savings with paybacks of five to seven years. Solar domestic hot water systems based on recently developed designs are less expensive than earlier models.

Options to encourage use of solar energy in Kansas buildings:

- Implement building lighting standards which encourage the cost effective use of daylighting.
- Implement building codes that encourage cost effective use of passive solar building design.
- Encourage utilities to provide financing for cost effective solar domestic water heaters as part of their demand-side management programs.

Photovoltaics (PV)

Electricity produced from sunlight by photovoltaic cells has steadily declined in cost from $10 per kiloWatt-hour twenty years ago to around $.25-.40 today. Global production is now increasing about 15% annually, reaching 68 megaWatts in 1991. The United States share of this market has declined from 80% in the early 1980s to 35% in 1991 as Japanese and European firms have begun to aggressively compete for the rapidly expanding market. The Department of Energy's goal is to reduce the cost of electricity from photovoltaics to $.12 per kWh before the year 2000, and $.06 per kWh by the year 2030. While these are challenging goals, rapid technology development occurring here and around the globe, particularly in the area of low cost thin film materials, may make it possible. As with any other high tech product, the potential for cost reduction lies in mass production, and the prospect for mass production is limited by a market defined by current prices. As photovoltaic manufacturers forge ahead to crack this "chicken and egg" barrier, the decline in cost will continue. Today cost effective applications for PV are concentrated in applications where the use of PV permits the avoidance of other costs, such as line extensions or large voltage drop transformers for small loads, not just the cost of the energy produced. Remote homes, stock water pumping, pipeline cathodic protection, electric utility substation support, and transmission line sectionalizing switches, are a few of the PV applications which are often cost effective. Many states and electric utilities are taking gradual steps to learn about PV technology and understand its practical potential, positioning themselves to take cost effective advantage of the technology as prices decline further in the future.

Options to encourage the development of photovoltaics in Kansas:

- Consider requiring utilities to conduct a photovoltaic feasibility analysis of low load or long single customer line extension projects when the ratio between anticipated energy consumption and line cost is beyond economically defined criteria. The Colorado Public Utilities Commis-

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sion promulgated such a requirement in March of 1991. Such a requirement would ensure that customers are aware of the economic competitiveness of potential PV applications.

- Encourage Kansas utilities to enter the photovoltaics development business along the lines of Idaho Power, Inc. An investor owned utility, Idaho Power has been authorized by the Idaho Public Utilities Commission to implement a three year, $5 million PV development program. Idaho Power's stated objective is to design, install, own, maintain, and earn a profit on stand alone PV systems that provide cost effective service to their customers. The program is targeted at providing service where the cost of extending the power line to the customer exceeds the cost of a photovoltaic system on a life cycle cost analysis basis.
- Encourage Kansas electric utilities to participate in emerging industry groups being established to find cost effective ways for utilities to help foster the expanded use of photovoltaics.
- Encourage Kansas utilities to investigate the potential for cost effective photovoltaic applications as part of their own systems for applications ranging from sectional switching to transmission and distribution support.

Wind

The use of modern electricity generating wind turbines has expanded dramatically in recent years. Wind turbines with a total generating capacity of around 2,000 megawatts are now producing electricity for the utility grid around the world. More than 80% of this wind capacity is in the U.S., almost entirely in California "wind farms" that now have some 16,000 operating wind turbines. "In 1990, California wind power plants generated about 2.5 billion kilowatt-hours of electricity. They averted emissions of more than 2.5 billion pounds of carbon dioxide, a major greenhouse gas, and 15 million pounds of other pollutants associated with fossil fuel generation."[1] California attracted wind energy development before other states for several reasons. A small number of very high quality wind resource sites offered high energy output that matched well with utility needs. Utilities were anticipating substantial load growth, but were constrained by serious air quality problems. California also offered a state tax credit. Today the state tax credit has been terminated, utilities load growth has slowed, causing them to lower payments for new wind projects, and the best sites have already been substantially developed. As a result, wind energy development in California has slowed, although many analysts are predicting a second wave of wind energy development in the immediate future.

The lessons learned from California wind farms and research by private wind companies and the U.S. Department of Energy are spawning a new generation of high technology wind turbines equipped with advanced aerodynamic blades and sophisticated controls. The cost of wind produced electricity, now around $.08 per KWH, is expected to fall below $.05 by 1995, and below $.035 before the end of the decade.[2] Interest in wind energy development has not been limited to California. The Bonneville Power Administration recently announced intentions to acquire 50 megawatts of wind capacity and four utilities in Washington state are working together on a seperate 50 MW project. Iowa-Illinois Gas and Electric Co. has launched a joint venture with a wind manufacturer to develop wind resources in the Midwest. Minneapolis based Northern States Power, a company with an 11-year old wind research program, expects to meet part of its mid-1990s energy needs with wind, a move motivated in part by a new Minnesota law exempting wind turbines from property taxes and requiring external environmental costs to be included in determining avoided costs.[3] In October 1992 Congress passed legislation with several provisions expected to further enhance wind energy development. The National Energy Policy Act provides a $.015 federal payment per KWH of electricity produced from renewable energy.

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[1]Phillips, J. A., Wind Power's Coming of Age, The Electricity Journal, April 1992.

[2]Hock, S. M., et al., Potential for Far-term Advanced Wind Turbines Performance and Cost Projections, Proceedings of the Biennial Congress of the International Solar Energy Society, Denver, 1991.

[3]Phillips, J. A., Wind Power's Coming of Age, The Electricity Journal, April 1992.

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According to a 1991 survey by the KCC, there are approximately 39 privately owned wind turbines producing an estimated 62,250 kWh annually. There are no wind farms selling the output of multiple machines to electric utilities for resale. Such wind energy development in Kansas has been impeded by several factors. The wind is not always coincident with utility demand, and is therefore not considered by utilities to have firm capacity value, only energy savings, and energy costs for Kansas electric utilities are generally quite low, less than $.02 per kWh. Some have argued that more careful analysis might show that widely dispersed wind systems have significant capacity value since the wind blows at different speeds in differing locations. While Kansas possesses enormous wind energy resources, there are no premier sites of class V or greater, like those in California. New equipment capable of greater output at lower cost at class III and IV sites will be essential for development of wind energy in Kansas. Significant development of wind energy for production of electricity has always involved active participation of electric utilities. Kansas utilities, with abundant generating reserves and low fuel costs, have thus far shown little interest in developing wind energy resources.

Options for encouraging wind energy development in Kansas:

- Investigate the potential for "co-fired" generating systems using wind turbines, backed up by natural gas fired turbines for capacity. The 1992 National Energy Policy Act amends the Public Utilities Regulatory Policy Act to permit up to 50% of annual electrical production to come from fossil fuels. A wind/gas hybrid system would have exceptionally low environ mental emissions.
- Incorporate the external costs of energy production in making regulatory decisions regarding long term energy supply planning.
- Investigate the market for low environmental impact "green" energy sales to interested consumers and utilities facing pollution abatement requirements.
- Rekindle expertise in wind resource assessment and wind technology within one or more of Kansas's universities.
- Encourage Kansas's electric utilities to become active participants in the Utility Wind Interest Group (UWIG). Supported by Electric Power Research Institute (EPRI) and DOE, the groups functions to provide current information about wind power to utilities.
- Sponsor research on energy storage methods, such as compressed air in salt caverns and hydrogen from electrolysis, that would allow wind energy to provide reliable capacity.

Biomass

Biomass energy in the form of fuels from seed oils, animal fats, and cellulosic crops for ethanol production have significant potential for Kansas. Because biofuels represent a potential economic opportunity for agriculture, they are discussed in that section.

Hydropower

While several of Kansas's dam sites may eventually be economically feasible to develop, or in some cases redevelop, the potential is not significant.

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Source Reduction Saves Energy. *An average trash truck (holding five tons) may get fuel mileage of five miles per gallon of diesel fuel. If the truck must travel 24 miles to collect and dispose of the trash, then the energy consumed per ton of trash amounts to one gallon of fuel. Under these circumstances, every ton of waste that is not generated saves at least one gallon of fuel.*

New Mexico State Energy Policy 1991

Reduction, reuse, and recycling offers real opportunities for reduced energy use, as well as addressing other environmental concerns. Kansans generate approximately 3.5 pounds of municipal solid waste every day for each of our 2,477,574 people. The annual total is about 1.58 million tons, virtually all of which is now landfilled.

Reduction in waste volume by preventing its generation in the first place is the most effective strategy for avoiding the loss of energy resulting from land filling of municipal waste. "Source reduction is the design, manufacture, purchase, and use of materials and products in a way that reduces their volume and/or toxicity before they enter the waste steam."[2] Reusing waste is the next most energy conserving strategy. A refilled glass container, for example, is the least energy intensive beverage container. Recycling a material, whether it is asphalt pavement or aluminum cans, almost always consumes less energy than the use of virgin material. Reduction, reuse, and recycling, in addition to energy savings, also offer substantially reduced environmental emissions when compared to consumption of virgin materials. The final option is combustion of waste to recover the energy value of the material before it is lost forever by landfilling.

Energy Consumption per Use for 12-Ounce Beverage Containers[1]

Container	Energy Use (BTU)
Aluminum can, used once	7,050
Steel can, used once	5,950
Recycled steel can	3,880
Glass bottle, used once	3,730
Recycled aluminum can	2,550
Recycled glass bottle	2,530
Refillable glass bottle (used 10 times)	610

The average energy content of municipal solid waste is about 6,000 BTU per pound, which means the state is burying the energy equivalent of 27% of the natural gas consumed in the residential sector. In some areas of the country where the cost of waste disposal and natural gas are substantially higher than in Kansas, waste to energy plants have proven economically feasible. Until the cost of such facilities declines, or the cost of trash disposal or natural gas increases, such plants will not be common in Kansas.

With the passage of H.B. 2801 in the 1992 session of the Kansas Legislature, the state begins the task of complying with the Resource Conservation and Recovery Act (RCRA), Subtitle D, which regulates landfill operations in operation on and after October 9, 1993.

Every county, or group of counties, will have to form a solid waste management committee. A plan, approved by the Kansas Department of Health and Environment, will be required to reduce waste volumes through consideration of source reduction, reuse, recycling, composting and land disposal. Each plan will also have to develop programs for proper disposal of lead acid batteries, household hazardous wastes, white goods containing chlorofluorocarbons, pesticides, motor oil, and yard waste.

[1]Brown, L.R., et. al., Saving the Planet: How to Shape an Environmentally Sustainable Economy, Norton/Worldwatch, 1991.
[2]New Mexico State Energy Policy, 1991.

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A fee of $1.50 will be placed on each ton of waste dumped in the state, and most of this money will go to develop and manage the waste plans. Planning grants covering 50% of the costs will be available to individual counties, while grants up to 90% will be available to counties joining other counties in regional plans.

Other options to reduce the solid waste stream include:

- Legislation to encourage manufacturers, industry, and local units of government to provide incentives to encourage recycling and develop markets for recycled products. Funding should be provided at the local level with the use of tipping fee (dumping) surcharge to be incorporated into county budgets as an "Enterprise Fund" and used strictly for waste reduction, recycling and market development.
- Establish funding to maintain a recyclable materials list subject to revision as technology and marketing changes. Many Kansans are demanding accurate and current information.
- Revise KSA 65-3405 to mandate that boards of County Commissioners will be permanently responsible for landfills, waste stream reduction, and providing locations for storage of recyclables prepared for marketing.
- Require all recycling centers to be registered with the state to promulgate rules and regulations for registration to quantify monitoring or recycling and buy-back centers. There are existing market locations that are not conducive to clean health and environment.
- Establish a permanent combination of Keep America Beautiful (KAB) and Earth Day programs through the Recycling Coordinator position in the Department of Commerce and Housing.
- Utilize education facilities available to Kansas citizens through the Kansas Advisory Commission of Environmental Education (KACEE), Cooperative Extension Service, and all of the Board of Regents institutions.
- Require communities to develop a recycling commission or task force of community leaders to work with the cooperation of the city and county public works departments in the implementation of integrated waste management systems.

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Research to develop new energy resources and improve the efficiency with which we use all energy resources will be essential if we are to find and implement ways of meeting our future energy service need at acceptable economic and environmental costs. Identifying specific research needs was beyond the scope of this report. Energy related research programs of particular interest in Kansas include:

Utility Research Programs

- ***Kansas Electric Utilities Research Program***

The Kansas Electric Utilities Research Program (KEURP) is a joint venture among Western Resources (KPL Gas Service and Kansas Gas and Electric), Kansas City Power and Light Company, West Plains Energy, The Empire District Company, and Midwest Energy; to undertake and encourage applied research and development projects which may enhance reliability and minimize cost of electric service in Kansas. These utilities are members of the Electric Power Research Institute (EPRI), a national research organization for electric utilities. The annual KEURP budget is approximately three-quarters of a million dollars.

1991 Kansas Electric Utility Research and Development Expenditures
(source: KCC)

Utility	Internal	External	Total	Kansas Amount
Kansas Power & Light		$1,930,253	$1,930,253	$1,930,253
Empire District Electric		536,471	536,471	536,471
Kansas City Power & Light	187,790	2,762,889	2,950,679	956,876
Kansas Gas & Electric	300,513		300,513	300,513
West Plains Energy		67,173	67,173	67,173
NCK Rural Electric Coop		902	902	902
Smoky Hill Electric Coop		591	591	591
TOTALS	$488,303	$5,298,279	$5,786,582	$3,289,900

- ***Gas Utilities Research Program***

1991 Gas Utility Research and Development Expenditures
(source: KCC)

Utility	Internal	External	Total	Kansas Amount
Kansas Power & Light	$3,826		$3,82	$3,826
KNEnergy		854,794	854,794	128,134
Williams Natural Gas		4,367,759	4,367,759	2,693,160
TOTALS	$3,826	$5,222,553	$5,226,379	$2,825,120

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EPSCoR

The Experimental Program to Stimulate Competitive Research (EPSCoR), was started in response to the concern that federal research and development (R & D) funding has become concentrated in a few states. Ten states received 61% of federal R & D support in fiscal year 1989. On a per capita basis, these top ten states averaged $40, while the EPSCoR states averaged less than $15. The national average is $33.

Kansas, along with Nebraska, became an EPSCoR state in 1991. Federal agencies with EPSCoR programs include the National Science Foundation (NSF), The Department of Defense, the Environmental Protection Agency, and the Department of Energy. The program has specific goals, including:

- Develop increased public and private support for high quality science and engineering.
- Effect improvements in the quality of the academic research environment that will ensure increased competitiveness for additional research and development funds by the states research universities.
- Ensure that improvements achieved through EPSCoR initiated activities continue beyond the end of the EPSCoR grant period.

The DOE/EPSCoR program is important as Kansas looks forward to increasing its skills and competitiveness in energy research. In 1992, Kansas was awarded about $250,000/yr. for a minimum of two years for DOE traineeships to support 11 graduate students at the three Kansas research universities. To participate in the initial phase of the DOE/EPSCoR program, Kansas must provide financial support matching federal funding totaling between $1-1.5 million annually.

Options for encouraging more energy research focused on Kansas:

- Establish a working group on energy research needs and opportunities composed of representatives from key state agencies, research universities, and the private sector. The group should be charged with identifying specific energy research need specific to Kansas.
- Establish an annual energy research conference to communicate the results of Kansas energy research to other researchers, state policy decision makers, and the public.
- Encourage the establishment of a gas industry counterpart to the Kansas Electric Utilities Research Program (KEURP). Energy research funds are collected from Kansas gas producers under a surcharge authorized by the Federal Energy Research Commission (FERC). The surcharge contributes to the operation of the Gas Research Institute, located in Chicago. Kansas could investigate the potential for retaining a portion of those funds in Kansas, similar to the KEURP-EPRI relationship. Such funds could be used for research addressing both Kansas specific gas production and improved energy efficiency in gas consumption.
- Review energy research programs in other states. Iowa recently established the Iowa Energy Center, funded from a surcharge on utilities. The center is focused on improving energy efficiency and development of renewable resources in Iowa. Wisconsin established its Center for Demand-side Management several years ago. Also funded from a utility surcharge, it focuses on improving electrical efficiency. Other state programs exist, and valuable lessons might be gained from reviewing these programs for their effectiveness and potential applicability to Kansas.
- Provide EPSCoR matching funds.
- Identify research opportunities which could lead to development of new businesses in Kansas. Energy efficiency and renewable energy technologies have large potential markets for businesses that can provide them at a competitive price. Some of these technologies may be uniquely well suited to development in Kansas.

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Report of the Kansas Commission on Natural Gas Policy

January 1993

E & N R
March 18, 1993
Attachment 2

SENATE CONCURRENT RESOLUTION No. 1633

A CONCURRENT RESOLUTION relating to the commission on natural gas policy; extending the date for the commission's written report to be presented to the governor and to the Kansas legislature; amending chapter 301 of the 1991 Session Laws of Kansas.

Be it resolved by the Senate of the State of Kansas, the House of Representatives concurring therein: That chapter 301 of the 1991 Session Laws of Kansas be amended to read as follows: "That a Commission on Natural Gas Policy shall be appointed to conduct a study and review of the policies, laws, and regulations of the state of Kansas, other natural gas producing states and the federal government as the same affect the natural gas industry and to recommend to the Governor and Legislature such actions as may be taken by the state of Kansas to enable this state to participate with other natural gas producing states in the design of new state and national energy policies affecting natural gas; and

Be it further resolved: That such commission shall be authorized to inquire of and consult with the Kansas Corporation Commission in order to devise a method of developing reasonable estimates of the state's natural gas reserves and of the cost to find and develop new natural gas reserves within the state and to meet with similar commissions or task forces that may be established by other producing states to design new energy policies relating to natural gas; and

Be it further resolved: That such commission shall be comprised of 12 members. The Governor, or the Governor's designee, shall be a member. The President of the Senate and the Speaker of the House of Representatives shall each appoint one member from their respective house of the Legislature. The Kansas Corporation Commission shall appoint one member. The President of the Senate and the Speaker of the House of Representatives shall each appoint four nonlegislative members. Each appointing officer's nonlegislative members shall include one representative from each of the following groups: Major gas producers, small gas producers, royalty owners and transporters of natural gas; and

Be it further resolved: That the commission shall, in cooperation with the Kansas Corporation Commission, provide data and assistance to the Governor in the formation of a Kansas energy plan and in the formation of policy statements to present to the Congress and the President of the United States with regard to a national energy strategy which furthers the interests of the United States and the state of Kansas.

A written report including a recommendation of proposed legislative alternatives shall be presented by the commission to the Governor and the Kansas Legislature no later than January 31, ~~1992~~ *1993*; and

Be it further resolved: That the Governor, or the Governor's designee, shall call the first meeting of the commission and at that time the members of the commission shall elect a chairperson and a vice chairperson and set an agenda for future meetings. Primary staffing for the commission shall be provided by Kansas, Inc.; and

Be it further resolved: That legislative members shall receive compensation and mileage as authorized by the Legislative Coordinating Council; that nonlegislative members shall receive no remuneration, except for any expenses incurred which may be paid by Kansas, Inc., out of any private contributions provided therefor; and that all other expenses of the commission shall be paid by Kansas, Inc., out of private contributions provided therefor; and

Be it further resolved: That copies of this resolution, *as amended*, be distributed to the Governor, the President of the Senate ~~and~~, the Speaker of the House of Representatives, *each member of the commission on natural gas policy and the chief executive officer of Kansas, Inc.*

I hereby certify that the above CONCURRENT RESOLUTION originated in the SENATE, and was adopted by that body

January 30, 1992

Paul E. Burke Jr.
President of the Senate.

Pat Saville
Secretary of the Senate.

Adopted by the HOUSE May 4, 1992

Maurice L. Carlin
Speaker of the House.

Janet E. Jones
Chief Clerk of the House.

Acknowledgements

On behalf of the members of the Commission on Natural Gas Policy, I would like to express our appreciation to the Kansas Legislature for establishing the Commission and providing the opportunity to analyze the challenges and issues facing the natural gas industry of Kansas. The members of the Commission have devoted over a year to its analysis of the natural gas industry through several meetings where a broad spectrum of views and analysis were considered. This effort was led and staffed on a volunteer basis; no state funds were provided to reimburse expenses, compensate members, or publish the final report. I would like to thank the members for their dedication to this task. I would also like to express special appreciation to Mesa Limited Partnership and the Anardarko Corporation for their financial contributions to support the Commission's modest expenditures. Special thanks is given to Dennis Langley and Rick McCollum for their work in the preparation of the draft report, and to Western Resources and James Ingram and John DeCoursey in their drafting and preparation of the final report. I would also like to extend the Commission's appreciation to Charles Warren and Kansas Inc. for their staffing and administrative support of the Commission.

William R. Bryson
Chairman
Commission On Natural Gas Policy

Kansas Commission on Natural Gas Policy

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Executive Summary

The Kansas Natural Gas Policy Commission (Commission) was established pursuant to Concurrent Resolution 1626 of the 1991 Kansas Legislature and extended by Concurrent Resolution 1633 of the 1992 Kansas Legislature. It is the goal of the Commission to provide the Legislature and the Governor with a strategy which will assist the state and its citizens to obtain the full economic potential of its substantial natural gas reserves. The state must take steps supporting the development and production of this resource, and create incentives to encourage the timely consumption of natural gas. The natural gas industry is a fundamental industry for the state. It has a large work force generating good incomes for thousands of employees in the industry with the substantial multiplier effect emanating therefrom. The natural gas industry is also a substantial contributor to the state's treasury through severance taxes and taxes on the incomes of people associated with the industry. If the industry can be expanded, the beneficial economic impact will be multiplicative.

In the Commission's opinion, both in-state and out-of-state markets can be further expanded if the state becomes an active advocate of Kansas natural gas and Kansas based natural gas consuming industries. To increase consumption of Kansas natural gas, there must be a clear natural gas strategy. That strategy will require the involvement of industry, utilities, regulators and private citizens. The industry and state can control their own destinies through a mutually beneficial relationship.

It is the Commission's belief that there are significant opportunities for an expanded natural gas market. With the enactment of the Clean Air Act Amendments of 1990 and the National Energy Policy Act of 1992, the demand for natural gas, an environmentally friendly fuel, will increase. Significant opportunities to increase sales of natural gas lie in the field of electric generation and natural gas vehicles. The state should take steps to encourage the increased utilization of clean, domestic natural gas.

The state must remove the disincentives toward using natural gas which currently exist and adopt the attitude that promoting natural gas is positive for the state, the environment and the nation's balance of trade. This can be done by assisting with the development of a compressed natural gas infrastructure through creation of natural gas-fill stations and correspondingly promoting the development of natural gas vehicles through tax and other incentives. An analogous situation for the natural gas vehicle market today can be seen in the recycling industry. Citizens across the country have actively participated in recycling, but too often their efforts were in vain as their recycling efforts ultimately ended in the landfill because of a lack of demand. Legislatures are now encouraging the demand-side of the recycling equation. The Kansas Legislature must look at all sides of the equation in the natural gas vehicle market. There must be a reliable supply of natural gas for vehicles, i.e. fill stations, and there must be a market for those fill stations to pay for their installation costs, i.e. natural gas vehicles. Both must be promoted at the same time.

Electric generation represents another significant area of growth. Regulators must take steps which encourage the utilization of natural gas at electric generating facilities. These steps range from operational considerations to financial considerations such as incentives for using a more environmentally friendly fuel.

Finally, the state must recognize that it must assist the industry in its fundamental development. Clearly, taxes are too high and are being borne solely by the producer. The

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incentive to finding gas is declining. Wells are being abandoned earlier than they should be and potential prospects are being ignored. It is important to the state that the resource be fully developed. One of natural gas' major marketing problems is concern over supply and reliability. If consumers are unsure about either, they will go elsewhere. We are faced with the perverse possibility that an abundant natural resource will not be fully developed and prematurely abandoned because of skepticism over its future availability. Such fears have some basis due to past regulatory and tax practices which created an artificial shortage both in production and delivery. If such tax and regulatory barriers are reduced, the full opportunities for this valuable resource can be realized.

Given below is a brief background for the natural gas industry and specific recommendations taken from the accompanying report. These recommendations promote the natural gas industry with special emphasis on production incentives, the natural gas vehicle market, electric generation and helium production. By giving attention to both the supply and demand-side, the state, the industry, its employees and the citizens of the state will be mutually benefitted.

Background

It is estimated that the proven reserves for natural gas in the lower 48 states are sufficient to last approximately 60 years. It is estimated that Kansas' reserves will last an equivalent period of time given the extensive amount of reserves in the Hugoton field and the potential for further reserves in the Hugoton area below 2500 feet.

These estimates of reserves are dependent on an adequate price being paid, normal demand and improvements in technology for the finding, drilling and recovery of natural gas.

In order to promote the increased utilization of natural gas, thereby increasing the economic wellbeing of the state of Kansas and its citizens, the following recommendations are made.

Economic Development Recommendations

1. The offsetting credit to state mineral severance taxes equivalent to that given to oil, should be implemented for natural gas. The net result will be that severance tax on natural gas will be reduced to 4.33%.

When the mineral severance tax was enacted in the 1980's, the rationale for the higher net tax on natural gas was the presumption that the burden could be passed on. The market has not functioned as originally contemplated. Producers are either bearing the burden of severance tax through a lower net price or sales are diminished or eliminated because natural gas' price becomes uncompetitive with other energy alternatives. The abnormally high tax burden places Kansas producers at a distinct disadvantage to other energy suppliers, and the cost margin created by the severance tax deters continued investment in the Kansas natural gas industry.

2. The state should eliminate the 2.5% tax on utilities consumed in production.

The 1992 Kansas Legislature enacted several tax changes to fund the School Finance Act, including a 2.5% tax on utilities consumed in production. This new tax reduces the competitive

7/92

advantage that Kansas provides through its relative low energy rates and plentiful supply of natural gas. Such tax places disadvantages on the state's oil and gas industry as it makes our products more expensive to produce as many stages of the industry from oil pump to refinery are large consumers of electricity.

3. To overcome concerns about supply reliability and price, the KCC should permit the costs and benefits of futures contracts for natural gas to be flowed through the Purchase Gas Adjustment (PGA) clause.

The use of such futures contracts should be for hedging purposes only and not for speculative purposes. By using futures contracts for hedging purposes, utilities can more easily predict and determine the price of natural gas it will pay and reduce volatility in the price. With uncertainty over price and its volatility reduced, consumers should be more comfortable in selecting natural gas as their energy of choice, thereby increasing gas consumption relative to other forms of energy.

4. The KCC should encourage LDC's and pipelines to enter into long term gas supply contracts with producers as part of a portfolio of short, medium and long term supply arrangements.

It is in the best interest of utilities, their customers and producers that long term contracts should be part of an LDC's or pipeline's supply portfolio. If a utility prudently enters into a long term supply contract it should not be punished later on when the price under the long term contract is periodically above the price under short-term contracts. This will inevitably occur over a 20 year period as there will be periods of excess supply and thus lower spot prices. Such a policy is also good for producers as they have difficulty in obtaining financing for drilling if there is no long term market for their gas.

5. To further promote the development of natural gas markets, reasonable promotional expenditures by local distribution companies and pipelines should not be discouraged by KCC rate making principles and should be fully recognized in retail rates.

It is in the interest of all customers that consumption of natural gas be encouraged in off peak periods thereby spreading fixed costs over more units, thus keeping utility rates lower overall. To generate such off peak sales, it may be necessary for LDC's and pipelines to promote such sales. Such promotion will not be made if the LDC and pipeline is not allowed to recover the cost, thereby foregoing the opportunity for lower rates.

6. The State and the KCC should take a more aggressive and visible position in influencing national energy policy. The State and the KCC should support at the state and national level increased pipeline capacity which is vital to allow maximum utilization of natural gas.

The KCC should support pipeline certification hearings at the Federal Energy Regulatory Commission (FERC) which will increase the access of Kansas natural gas to new and growing markets when appropriate. Expansion pipeline projects can open up markets for Kansas produced natural gas as well as possibly providing higher wellhead prices by increasing the number of buyers bidding for Kansas gas. To help support such projects and other energy matters of interest to the state of Kansas, the state should also consider retention of full-time representatives to influence and advocate Federal energy legislation that supports the natural gas industry.

7. The State should not impose restraints on the production and marketing of Kansas natural gas reserves except for prevention of waste and the protection of correlative rights.

Kansas should not act to supersede the natural, free market interaction of willing buyers and sellers. The natural gas industry has a significant opportunity to enlarge its share of the nation's energy market, if electrical generators and other industrial users can be assured that natural gas will be available on a dependable, market-priced basis.

8. The Kansas Department of Commerce should develop a coordinated promotional policy which supports and utilizes the resources of industry, government, producers, local distribution companies, pipelines, brokers and customers.

This promotional policy should focus on educating the public about the benefits of natural gas. The state should also encourage the development and relocation to Kansas of industries that utilize natural gas.

Recommendations for Compressed Natural Gas

The state should support the development of the natural gas vehicle market through utilization of compressed natural gas. There are three barriers which have impeded the maturation of the compressed natural gas vehicle market:

- Lack of infrastructure;
- Lack of conversion investment capital;
- Lack of knowledge.

To promote the development of natural gas vehicles, the state should implement the following programs:

9. The state should begin the conversion of centrally fueled vehicles to compressed natural gas, both through conversion of currently owned vehicles, and purchase of vehicles dedicated solely to compressed natural gas. The latter alternative should be the ultimate long term goal for vehicles which operate in a limited radius.

The conversion of the states' several thousand vehicle fleet is an optimal opportunity to display the feasibility and benefits of NGV's. Legislation should also be enacted to establish low-interest loans for the conversion of local government and school district fleets to compressed natural gas if such governmental units are unable to obtain alternative private financing.

10. The state should develop incentive programs to encourage the development of a compressed natural gas infrastructure. Through a combination of tax and regulatory incentives, the state should encourage the construction of fueling stations for centrally fueled vehicles and the state should sponsor tax incentives for conversion to CNG vehicles

The Federal government has provided tax incentives for the construction of fueling stations for clean burning fuels such as natural gas through The National Energy Policy Act. The Legislature

should ensure that the state income tax code for individuals and businesses ensures that such tax benefit is provided at the state level.

The Natural Energy Policy Act has provided tax incentives for the conversion of vehicles to compressed natural gas with income tax deductions up to $2,000 per motor vehicle and income tax deductions up to $50,000 for large trucks, vans and buses. The legislature should ensure that the state income tax code for individuals and businesses ensures that such tax benefit is provided at the state level.

11. Compressed natural gas should not be burdened with taxation at the pump during its developmental stage. State taxes at the pump should be eliminated or reduced for natural gas. Utilities should be encouraged to develop homefill leasing programs.

The state currently levies a tax on compressed natural gas at the rate of 17 cents per gallon. The elimination of such tax can be a significant boost to the compressed natural gas market as it will encourage conversion of vehicles to CNG as individuals compare the price of CNG to regular gasoline at the pump. Consideration should be given to providing utilities incentives to sponsor homefill unit leasing programs.

12. Public utilities should be allowed to rate base and earn an incentive rate of return for conversion of utility service fleets to compressed natural gas pursuant to K.S.A. 66-117(d).

Public utilities maintain large fleets of vehicles and conversion of such vehicles to compressed natural gas should be considered through this incentive.

13. The state should promote compressed natural gas and clean fuel vehicles through public education programs.

14. The state should develop an incentive program to create an interstate compressed natural gas refueling infrastructure and urban compressed natural gas infrastructure.

To expand the CNG market, vehicle owners need assurance that fueling stations will be available on interstate highways as they travel from city to city. Fueling stations in urban areas are also necessary as many of the passengers traveling interstate conduct business and take vacations in urban areas. The state should cooperate with other states and the federal government to encourage the construction of these fueling stations which will help them improve their air quality.

Recommendations for Utilization of Natural Gas at Electric Generating Facilities

The state should support electric utilities to meet growing customer needs for electricity through increased utilization of natural gas at currently existing and potential natural gas fired electric generation facilities. To promote such increased utilization, the following recommendations are made:

15. The KCC should work with local distribution companies and pipelines to improve rate and operating flexibility necessary to support the unique needs of the electric utility industry, thereby increasing utilization of natural gas at electric generating facilities.

Rates should be designed which recognize hourly peaks, and which exploit the advantages of natural gas transporters and merchants of moving substantial incremental volume in summer months. Also, increased access to natural gas storage, and creative utilization of compression should be considered in supporting the quick-response, high pressure needs of the electric generating industry.

16. The state should encourage the development and utilization of combined cycle or combustion turbines to meet increased electric peak loads.

On an incremental basis, to meet peaking needs, the cost of electricity from combined cycle and combustion turbine units fired by natural gas are more likely to be cheaper than other forms of generation such as coal. The KCC should look favorably upon this form of generation during IRP hearings and site approval hearings for new generating units.

17. Existing gas units should be refired before any new supply-side unit additions are made by utilities if economical.

The KCC has the authority to approve the construction of any new generating facilities. The KCC should consider the option of refiring idled gas units or increasing utilization of other natural gas units before permitting the construction of a new unit if it is economical to do so.

18. The KCC should look favorably upon utilization of Kansas natural gas in meeting growing customer needs for electricity.

The KCC should recognize that Kansas gas for Kansas consumers such as electric generating facilities, is good for the state as a whole. The money remains in the state and the state's treasury is increased rather than having capital sent elsewhere.

19. The state should promote the utilization of Kansas natural gas in regional independent power production facilities.

Although there is sufficient generating capacity in the state for the foreseeable future, this should not be an impediment to the construction of Independent Power Production facilities in Kansas utilizing Kansas natural gas with the resulting electricity being sold elsewhere. As a result of the National Energy Policy Act, IPP's will have greater access to transmission lines thereby increasing the state's ability to move "gas by wire."

Recommendations for Integrated Resource Planning

Integrated Resource Planning (IRP) is the process by which a utility chooses the combination of supply-side and demand-side resource additions which can be expected to provide safe, reliable, efficient and adequate energy services to customers at the least costs. IRP is expected to be a

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significant factor in determining the state's energy supply mix. The KCC is currently developing rules and regulations for integrated resource planning. The Commission supports the concept of integrated resource planning and urges the KCC to adopt rules and regulations which satisfy the needs of the customers and utility shareholders.

The Commission believes that IRP represents a significant opportunity to improve the environment by conserving natural resources through demand-side conservation measures. Overall, the Commission believes that IRP will increase the market share of natural gas in meeting customers' energy needs. The Commission believes that the KCC should give utilities incentives, at least initially, to vigorously adopt IRP.

20. The KCC's rules for IRP should incorporate pre-approval.

With pre-approval, utilities will enter into demand-side and/or supply-side projects after consultation with and approval by the KCC. There will be periodic reviews of these plans. If the periodic review determines that the approved plan should be changed or abandoned, the utility should be allowed to recover the costs incurred to date, assuming that the prior expenditures were prudently incurred in accordance with the prior approved plan.

Recommendations on Fuel-Switching

Residential, commercial and industrial consumers have significant opportunities to obtain lower priced energy sources and at the same time improve the environment. This benefit can be achieved by individuals acting on their own, through the assistance of utilities and tax credits as they select fuel sources.

21. Fuel switching should be established as part of the demand-side measures considered in Integrated Resource Planning.

An example of fuel switching is demonstrated when an electric utility with low reserve margins chooses to pay customers to install natural gas air conditioners rather than build additional generating units. The overall cost to the electric utility can be less in certain circumstances by avoiding construction of costly generating facilities. Utilities should be encouraged to recognize that alternative fuel sources can be the best option for customers and shareholders in developing Integrated Resource Plans. One incentive for utilities in this regard is to allow the utilities to recover through rates the cost of fuel switching, such as the payment for the air conditioner, plus lost sales which result after installation of the gas air conditioner.

22. The KCC should work with local distribution companies and pipelines to improve rate flexibility to meet the needs of commercial and industrial customers which utilize boilers.

Just as pipelines need rate flexibility to meet competitive forces for gas-fired generation facilities as discussed in number 15 above, the same flexibility is needed to compete with residual oil and propane for commercial and industrial boilers.

Recommendations for Helium

The state has a valuable commodity in the helium found in the natural gas in the Hugoton field. Kansas is one of the leading producers of helium throughout the world. The extraction of helium is dependent on the production of natural gas. The following recommendation is made to promote the development of helium in the state of Kansas.

23. Helium and natural gas liquid extraction should be encouraged to the extent economically and operationally practicable. The state should encourage the development of additional helium and natural gas liquid extraction facilities in the state.

One significant measure which the state can take is to remove helium extraction from inclusion in the state's severance tax on natural gas. Helium is an inert gas which is found along with natural gas but can only be obtained through the extraction process at natural gas liquids plants. Such action will promote the development of helium and the expanded development of natural gas liquids facilities, thereby increasing development of natural gas.

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Introduction

Pursuant to Concurrent Resolution 1626 of the 1991 Legislature and Concurrent Resolution 1633 of the 1992 Legislature, the Commission on Natural Gas Policy (Commission) was appointed to:

> *conduct a study and review the policies, laws and regulations of the state of Kansas, other natural gas producing states and the federal government as the same affect the natural gas industry, and to recommend to the Governor and the legislature such actions as may be taken by the state of Kansas to enable this state to participate with other natural gas producing states in the design of new state and national energy policies affecting natural gas.*

When the Commission on Natural Gas Policy was formed, Kansas natural gas was being sold in the interstate market at a deep discount to competing fuels and at prices below the cost to develop new reserves. A valuable resource was being depleted to the detriment of Kansas and its citizens.

Following the establishment of the Commission, several significant events have occurred: (1) regulations have been issued further defining the Clean Air Act Amendments of 1990 (CAAA); (2) the Kansas Corporation Commission (KCC) has instituted a docket on Integrated Resource Planning (IRP) with rules being developed presently; (3) the National Energy Policy Act of 1992 was signed into law, (4) the Federal Energy Regulatory Commission (FERC) issued Order 636 which completes the transformation of interstate pipelines from merchants to common carriers; (5) the New York Mercantile Exchange (NYMEX) has become a significant factor in the establishment of prices for natural gas; (6) prices on the spot market for natural gas went from a low of $.90 per MMBtu in February of 1992 to a high of $2.75 per MMBtu in September of 1992.

Natural gas has many uses: home heating, fuel for electric generating stations, transportation fuel, feedstock for the chemical and fertilizer industries, and for cooking, cooling, and refrigeration. For many of these uses, natural gas competes with oil, coal, and uranium. Natural gas is a newcomer for some of these uses and an established fuel for others.

For all of these uses, global, economic and environmental concerns will drive all of us to conservation and efficiency. The possibility exists that the growth and energy needs of the world will be slowing; however, natural gas' opportunity to increase its market share in various industries is significant due to its environmentally friendly attributes. It is the hope of the Commission that the recommendations contained in this report will help the state and the nation meet their energy needs in an efficient manner with due consideration to the impact on the environment, and at the same time allow the state and its citizens to reap the economic benefits associated with this valuable natural resource.

The Commission has established three goals for this report:

1. Identify the political, regulatory, environmental and legal framework within which natural gas policy functions.

2. Identify and highlight the basis for a comprehensive natural gas strategy.

3. Identify policy options that could positively affect the future of Kansas natural gas.

Organization of the Study

Chapter One provides the analytic and informational framework for the study. In this chapter we will examine, (i) the status of U.S. and Kansas natural gas reserves; (ii) recent Environmental and Energy legislation; (iii) FERC Order 636. Chapter Two examines specific policy options for natural gas. This chapter will analyze: (i) economic and revenue issues for the state of Kansas related to natural gas; (ii) compressed natural gas (CNG) for transportation fuel; (iii) gas-fired electricity generation; (iv) integrated resource planning; (v) fuel switching; (vi) helium extraction.

Chapter 1 U.S. and Kansas Natural Gas Industry: Analytical/Informational Background

1. Natural Gas Supply

Substantial controversy exists concerning the United States' and Kansas' natural gas reserves. Some analysts claim only 20 years' supply remains, while others profess that virtually endless reserves exist within the U.S. This debate over the extent of reserves has far reaching consequences. Buyers could have qualms over entering into long term contracts with producers; utilities may be reluctant to undertake more electrical generation with natural gas, and consumers may be concerned about future price stability due to shortages in supply. If consumers do not believe there is an adequate supply of natural gas to meet the expected life of their capital equipment, they will turn to other sources of supply to meet their needs.

Just as there are numerous predictions of a 20 year supply, there are many forecasts of 60 to 200 year reserves. In 1988, a Department of Energy Study found a 60 year supply in the lower 48 states[1]. This positive outlook is shared by Enron Corporation which estimates a 60 year reserve, NARUC's 40 year forecast, a forecast by Chevron of a 100 year supply, and a 200 year projection from the Columbia Gas Distribution Company[2].

An increase in our nation's and our state's natural gas proven reserves is dependent upon three factors: technology, price and the demand for natural gas. A fluctuation in any of these variables has the ability to independently affect the level of proven producing reserves.

The Technological Relationship

Technological innovation holds an important role in increasing accessible reserves. For example, proven reserves added per completed well increased markedly after 1985. These reserves have helped to offset the decrease in wellhead prices and gas well completions. This was a direct result of developments in reserve discovery and recovery technologies and contradicted earlier forecasts that reserves would fall.

Locating new areas of natural gas has also benefitted from technological improvements. Even in areas that have been extensively drilled and were considered mature, new geological/ geophysical instrumentation and interpretive techniques have found new and material discoveries. These techniques use three dimensional modelling by computers and make reevaluation of data possible. The same technology has been used in non-mature areas with impressive results. These developments have led to more efficient drilling with fewer dry holes and an enhanced success ratio for the industry. Improved technology assisted the industry in replacing the amount of natural gas used by consumers last year with 1,000 drilling rigs. Five years ago it would have taken 2,000 and ten years ago it would have taken 3,000[3].

Technology has given the producer a larger chance of drilling a successful well. Future developments hold the promise of further increases in our proven reserves with minimal increases in overall finding costs.

The Price Relationship

Price sensitivity also governs the ability to recover gas reserves. The deeper a producer has to drill, the more expensive it becomes. Without a natural gas selling price that assures the producer of a profit, potential wells will not be started. The price of gas must be high enough to provide producers with the incentive to drill new wells. As demand rises and the price of natural gas reacts correspondingly, more gas will be added to the natural gas reserves through drilling.

The Demand Relationship

The level of demand for natural gas impacts production and reserves. Historically consumers have used the fuel of most convenience, with little regard for the impact such fuel selection has on the environment and our economy. Today, gasoline is the fuel of choice for transportation despite the smog it creates and the capital which is sent overseas to obtain the fuel. Attitudes, however are shifting and such shifts will inevitably increase the demand for natural gas. Environmental concerns are being considered increasingly in fuel selection and are being legislatively mandated. It is expected that demand for natural gas will increase as a result of the CAAA and the National Energy Policy Act of 1992. These two pieces of legislation will promote the use of natural gas in electric generating facilities and natural gas vehicles. With an increase in demand for natural gas, there will be increased incentives to find natural gas if the government allows the free market system to operate.

Kansas Natural Gas

Natural gas is going to be a primary energy source for the future, and Kansas has an ample supply. The Hugoton gas field is the largest in the nation. It extends 150 miles north and south and 50 miles east and west running through Kansas, the Oklahoma Panhandle and into Texas. Eleven counties in Kansas contain Hugoton gas: Finney, Grant, Gray, Hamilton, Haskell, Kearney, Morton, Seward, Stanton, Stevens, and Wichita. This field has 2,654,844 producing acres with an average production depth of approximately 2,500 feet[4].

Within the confines of the Kansas Hugoton Field and from the formation lying below the field lies the Panoma-Council Grove Gas Field. It has defined limits of 2,000,000 acres with 1,474,082 producing acres and an average depth of about 3,000 feet[5]. These two fields constitute a major portion of Kansas' gas production.

Kansas has one of the largest reserve bases of any of the gas producing states, behind only Louisiana, Texas, and Oklahoma. When examining the state of Kansas' reserves of natural gas, the amount has remained relatively stable. The EIA shows proven reserves in 1986 at 10,509 Bcf, at 10,104 Bcf in 1988, and at 9,614 Bcf in 1990[6]. These numbers refer to proven reserves and are subject to the same scrutiny as the overall numbers of United States' reserves, particularly in light of the lack of deep horizons drilling (below 2500 feet). Hugoton contains one of the largest on-shore blocks of deep reserves in the lower 48 states. New technology, increased prices, and increased demand, each have the capacity to spur exploration of Kansas' reserves and thereby shift the proven reserve numbers upward.

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Estimate of Reserves

Based on comments from those in the industry listed above and studies reviewed, e.g. 75 years to hundreds of years;[7] 100 years according to DOE[8] and a DOE estimate of 1,059 TCF additional reserves in the lower 48 states given current technology in drilling equipment[9], it is estimated that the proven reserves for natural gas in the lower 48 states are sufficient to last approximately 60 years. Given that the estimated life for natural gas production by many experts in the industry is from 20 to 200 years, our estimate of 60 years is conservative. It is estimated that Kansas' natural gas reserve base will be coterminous with such 60 year life span given the extensive reserves found in the Hugoton field and the additional exploration opportunities below 2500 feet in the Hugoton area. This life span is well beyond the expected life of capital equipment which would use natural gas or other fuels. There are sufficient reserves in the U.S. so that government and business planners today, and well into the future, can invest in natural gas consuming equipment with confidence that the fuel will be available well beyond the expected life of the equipment.

2. Environmental and Energy Legislation

Clean Air Act Amendments of 1990

The Clean Air Act Amendments of 1990(CAAA) contain stringent pollution reduction requirements and strive to create a balanced strategy to enable the nation to attack the problems of air pollution. These amendments give the states ample time to meet air quality standards and also forces them to make constant progress in reducing emissions. This legislation and its implementation by government and industry leaders represents one of the most significant opportunities to increase sales of natural gas.

Title II and Title IV of the CAAA have the most significant implications for the natural gas industry. It is these two key sections which will directly promote natural gas use in the future. Title II establishes the market for gas in natural gas vehicles (NGV's), requiring fleets larger than 10 vehicles that are capable of being centrally fueled to be converted to natural gas. This program affects 22 metropolitan areas and accounts for 31% of the entire U.S. fleet population. The number of vehicles to be converted total between 800,000 to 1.3 million and have the potential to boost demand by 140 to 200 Bcf[10].

Title IV will also result in increased demand for natural gas. This title sets out two phases. Phase I requires 110 of the highest pollutant emitting power plants to reduce SO2 emissions to 2.5 pounds per MMBtu. Phase II applies to all additional utility units whose level of energy output is greater than 25 megawatts. These plants must reduce their SO2 emissions to 1.2 pounds per MMBtu. Utilities can meet this requirement in a variety of ways, including acquiring allowances from other sources which have achieved emission reduction. It is estimated that Title IV will increase consumption of natural gas from 14 Bcf per annum for Phase I to 200 Bcf per annum for Phase II[11].

Energy Policy Act of 1992

The National Energy Policy Act of 1992 is one of the most significant pieces of energy legislation since the National Energy Act of 1978. This law focuses on stimulating domestic energy production, promoting energy efficiency, increasing competition in the electricity sector, reducing consumer energy costs, promoting renewable and alternative fuels, and reducing dependence on foreign oil.

The extent of this law and how it will impact the natural gas industry and other industries is still being studied. A brief summary of relevant sections of the Act which may impact the natural gas industry is given below.

- Title I of the act promotes energy efficient buildings and building improvements; new rate making standards for Integrated Resource Planning and Demand Side Management; appliance and end use equipment energy efficiency standards; industrial energy efficiency programs, federal agency energy management and energy information.

- Title VII promotes the development of independent power plants by giving their owners greater access to the nation's transmission grid. This will possibly increase the utilization of natural gas through increased construction of independent power plants fired by natural gas.

The National Energy Policy Act of 1992 will have significant ramifications for the country's energy and environmental policies. The Act promotes conservation and efficiency in our economy and a greater reliance on domestically produced energy resources. The Commission believes that the National Energy Policy Act of 1992 will have a beneficial impact on the country in general and natural gas in particular. The Act represents a marketing challenge for the natural gas industry because the goal of the Act is to decrease the overall consumption of energy and to promote other energy sources like wind, biomass and solar. However, the overall tenor of the Act will be to increase the demand for natural gas as it is a fuel that is available for use today in sufficient quantities at an economical price.

Summary

The consideration of environmental costs and benefits will move natural gas to the forefront of the energy supply mix. Of cost effective supplies, natural gas is by far the cleanest fuel. Whether used as CNG for transportation or as fuel for electrical generation, natural gas produces less pollutants per unit of energy. This Commission foresees a future of increasing demand for natural gas which should increase its price to the benefit of Kansas gas producers and the Kansas treasury.

3. FERC Order 636

On April 8, 1992, FERC issued Order 636, making substantial changes that affect producers, pipelines and LDC's. The following is a summary of its significant requirements:

- Unbundling of sales, storage, peaking, load following, and transportation services with separate, stated rates for each service.

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- Establishment of no notice service, allowing buyers to receive up to contracted peak day transportation levels without prior nomination of requirements.
- Requirement that the quality of all transportation be equal, regardless of from whom the gas is purchased.
- Inclusion of storage in the definition of transportation, effectively making storage open access and unbundled as well.
- Implementation of capacity release programs to allow reallocation of unused capacity.
- Provision of downstream firm transportation shippers to nondiscriminatory capacity access.
- Establishment of pre-granted abandonment authority given premature contract termination.
- Adoption of the straight fixed variable method of cost classification with all fixed costs billed to firm customers through a reservation charge.
- Establishment of non-discriminatory access to information on electronic bulletin boards.

Order 636's stated purpose was to complete the transition to a competitive wellhead market for natural gas. This transition had started with several earlier orders, such as Order 436, which required pipelines, which provided transportation service, to do so on a non-discriminatory basis. Order 636 has effectively removed some of the pipelines from the merchant function for natural gas. Producers and brokers will now sell directly to LDC's and industrial consumers. Both buyers and sellers will be responsible for securing storage and transmission access on the interstate pipelines. The opportunities and responsibilities for natural gas producers are significantly increased as a result of Order 636.

Chapter 2

Natural Gas Policy Options for Kansas

1. Economic and Revenue Issues for the State of Kansas

The most direct benefit to be derived from a comprehensive natural gas policy is the enhancement of the Kansas economy and the Kansas treasury. Natural gas is a basic industry in the Kansas economy, contributing a significant amount of capital, employment, and tax revenue. Kansas should recognize the economic assets of natural gas and formulate a policy to capitalize on these assets.

Policy Recommendations

It is recommended that the following actions be taken to promote the economic development of the natural gas industry.

Recommendation One: Kansas Fuel Initiatives

Kansas should develop a comprehensive policy to maximize the use of Kansas natural gas whenever such use is shown to benefit the state's economy as a whole. Economic incentives, using a combination of tax credits and rate incentives, should be provided to encourage the use of Kansas produced natural gas. The legislature should consider economic benefits to the state economy and enhance treasury revenues when formulating specific energy policies.

Recommendation Two: Reduction in Severance Tax

The legislature should enact legislation which provides an offsetting credit to the state severance tax on natural gas which is equivalent to that given to oil. The net result will be that severance tax on natural gas will be reduced to 4.33%.

Recommendation Three: Elimination of Sales Tax on Utilities Consumed in Production

The legislature should enact legislation which eliminates the 2.5% sales tax on utilities consumed in production, i.e. gas, electricity and water. This sales tax makes Kansas produced goods less competitive than they otherwise would be and increases the cost of producing and refining oil as oil pumps and refiners are significant buyers of electricity.

Recommendation Four: Gas Purchasing and Sales Practices

Perhaps the most important barrier to natural gas consumption is concern about supply reliability and price. To minimize those barriers, two specific recommendations are given.

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First, the KCC should permit the costs and benefits of futures contracts for natural gas to be flowed through the Purchase Gas Adjustment (PGA) mechanism of Kansas LDC's. This use of futures contracts should be for hedging purposes only, not speculative investing. This will help reduce the price volatility of natural gas.

Second, the KCC should encourage LDC's and pipelines to enter into long term gas supply contracts with producers as part of a portfolio of short, medium and long term supply arrangements. It is in the best interest of utilities, their customers and producers that long term contracts should be part of an LDC's or pipeline's supply portfolio. If a utility prudently enters into a long term supply contract, it should not be punished later on when the price under the long term contract is periodically above the price under short-term contracts. This will inevitably occur over a 20 year period as there will be periods of excess supply and thus lower spot prices. Such a policy is also good for producers as they have difficulty in obtaining financing for drilling if there is no long term market for their gas.

Third, since development of natural gas markets is largely influenced by the promotional practices of LDC's, these promotional expenditures should be encouraged by KCC ratemaking principles. Accordingly, reasonable marketing expenses incurred by LDC's should be fully recognized in retail rates.

Recommendation Five: Pipeline Expansion

On both the state and national level, increased pipeline activity is vital to allow maximum utilization of natural gas. The KCC should, on the state level, expedite treatment of pipeline projects which help attain this goal. Additionally, on the federal level, the KCC should participate in the Federal Energy Regulatory Commission (FERC) pipeline certification dockets which can help export Kansas natural gas to the Northeast and other markets.

Recommendation Six: Prorationing

The state of Kansas should not impose restraints on the production and marketing of Kansas natural gas reserves except for prevention of waste and the protection of correlative rights. Kansas should not act to supersede the natural, free market interaction of willing buyers and willing sellers. The natural gas industry has a significant opportunity to enlarge its share of the nation's energy market, if electric generators and other industrial users can be assured that natural gas will be available on a dependable, market-priced basis.

As a net exporter of natural gas, Kansas stands to reap significant, long term benefits from the nation's return to this abundant, environmentally friendly, domestic fuel source. Kansas has the enviable position of offering the benefits of a mature, but uniquely prolific gas supply that is produced in an extremely efficient manner. The state should not forfeit the leverage it now holds on other gas producing regions most notably the Gulf Coast, which is experiencing market deterioration in deliverability without replacement of reserves.

Recommendation Seven: Marketing Strategy

Kansas should have a coordinated marketing policy which supports and utilizes the resources of industry, government, producers, LDC's, pipelines, brokers and customers. This

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marketing strategy should focus on educating the public about the benefits of natural gas, how natural gas is different from other fuel sources, and encouraging consumers to choose natural gas over other energy sources where appropriate. Based on its experience in such development matters, the Commission recommends that the Kansas Department of Commerce should take a leading role in this effort.

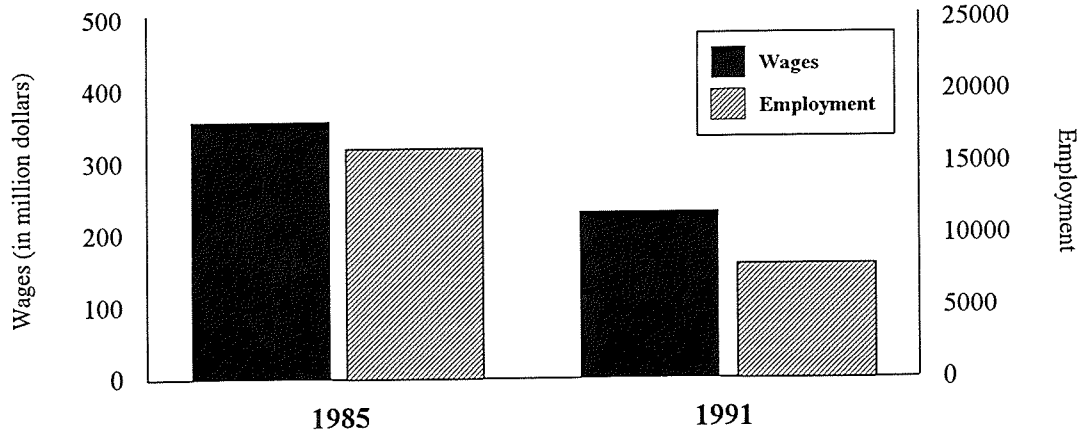
Background - The Economic Importance of Natural Gas

The Kansas Economy

- Gas and oil create 8,700 Kansas jobs.
- Gas and oil create $227,000,000 in Kansas wages.
- Gas production generates millions in royalty revenues.
- Gas production multiplies economic activity to exponentially stimulate general economic activity.
- Gas production provides over $50,000,000 in severance tax revenues.

Kansas natural gas has a profound effect on the general Kansas economy. Its economic health can stimulate economic growth in the overall Kansas economy and particularly in southwest rural Kansas. In 1991, the oil and gas industry employed 8,700 Kansans and paid out over $225,000,000 in wages.[12] Although this amount was a considerable decrease from the 1980's (15,046 employees and $356,000,000 in wages in fiscal year 1985), it is still a substantial sum.13 Importantly, jobs in the natural gas industry are comparatively high paying at over $25,000 per year on average. The industrial decline from 1985 through 1991 removed 6,346 jobs from the Kansas economy and over $130,000,000 in wages alone.

Wages and Employment
(1985 and 1991)



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The personal income produced by natural gas employment plays an important part in the Kansas economy. The wages are a source of revenue for the state treasury, and are translated into secondary purchases which in turn stimulate secondary employment and thus secondary revenue for the state treasury. Employment and wages in the natural gas industry are responsible for a much larger portion of economic activity than primary purchases alone as they anchor a wide range of secondary economic activity. One study estimated that for each job lost in the natural gas industry, 6.7 were lost in the local economy.[14] Kenneth Lay, CEO of Enron, has estimated that for each 100,000 barrels of imported oil per day that can be replaced by natural gas, 16,000 jobs and $400,000,000 in new capital investment will be produced.[15]

Natural gas activity is responsible for a significant amount of capital investment in the Kansas economy. Natural gas drilling, production and processing are extremely capital intensive and account for a large amount of investment in the Kansas economy. In addition, pipeline compressor construction sustains capital inflow even further. Importantly, these funds are spread throughout the state and represent most of the investment dollars spent in southwest Kansas. As with wages, the capital intensive production and transmission of natural gas stimulates an array of secondary purchases which further boost economic activity.

The issue of economic multipliers is critical to understand natural gas' true importance as a resource. Natural gas production brings an enormous quantity of capital to not only state producers, but also the royalty owners and the communities they support. The increased production of natural gas not only stimulates economic growth by investment and industrial activity, but facilitates increased revenues for Kansas citizens. These dollars stimulate secondary purchases. The product of a total system is a cycling of funds that produces more capital for the state economy. It is estimated that each direct dollar stimulates three to four in additional capital.[16] Natural gas production is the foundation of the multiplier. If the industry can be expanded, the beneficial economic impact will be multiplicative.

It is also important to realize that much of Kansas' natural gas is exported to other states. In 1985, Kansas produced 513 Bcf while consuming 355 Bcf. Natural gas as an export commodity increases the revenues of the state's treasury and income for the state's population via direct consumption of a Kansas product by the rest of the country.

The Kansas Treasury

- Over $50,000,000 in mineral severance tax receipts.
- Several million in ad valorem and income taxes.

The mineral severance tax on natural gas is one of the single largest revenue sources for the state treasury. Fiscal year 1991 revenues topped $55,000,000.[17] Given the direct relationship between natural gas production and state severance revenues, the state should consider natural gas a primary economic asset. Of course, natural gas's contribution to state funds goes far beyond the obvious severance tax revenues. The sizeable economic chain produced by natural gas production contains a parallel chain of additional tax revenues. For each dollar invested in natural gas production, several more are produced in the economy. Of these new dollars, a percentage is translated into state revenues. The increase in capital investment produces more tax revenues; the increased wages produce more tax revenues; the new end use markets produce more tax revenues. The treasury benefits of natural gas go far beyond severance taxes. In fact, severance taxes probably comprise less than half of the revenues that exist due to natural gas production.

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Kansas Economic Policy

The state of Kansas has received enormous economic benefit from the production of native natural gas resources. This benefit has been achieved, however, by circumstances and not by targeted effort. Policy makers should regard natural gas policy as an intrinsic element of the state's economic and industrial policy. Natural gas can, and should be, used as a vehicle to enhance the state economy and state government's financial health. Kansas should formulate a marketing strategy and an economic development program to further realize the economic potential of natural gas resources.

2. Natural Gas Vehicles

Recommendation One: State, Local Government and School District Fleet Conversion

The state of Kansas should begin the conversion of centrally fueled vehicles to compressed natural gas, both through conversion of currently owned vehicles, and purchase of vehicles dedicated solely to CNG. The latter alternative should be the ultimate long term goal for vehicles which operate in a limited radius.

The state should play an important role through leadership and example. Its several thousand vehicle fleet is an optimal opportunity to display the feasibility and benefits of NGV's. Also, the initial increment will be an excellent entry point into the market. This initial step would allow feasibility information to be gathered, stimulate the development of CNG business relationships within the state, and signal Kansas' commitment to supporting the environment and the natural gas industry.

Legislation should also be enacted to establish low-interest loans for the conversion of local government and school district fleets to compressed natural gas if such governmental units are unable to obtain alternative private financing.

Recommendation Two: Incentives for Conversion

The state should develop incentive programs to encourage the development of CNG infrastructure. Through a combination of tax and regulatory incentives, the state should encourage the construction of fueling stations for centrally fueled vehicles. Similarly, vehicle conversion or outright purchase of solely dedicated CNG vehicles, should be stimulated by tax and regulatory incentives.

State incentives are critical to the conversion of private fleets. The Kansas government's employment of tax and regulatory incentives for the conversion of business fleets and individually owned vehicles are the necessary counterbalance to investment barriers and reluctance to change. The federal government has already begun the process through the National Energy Policy Act of 1992 with its tax deductions for conversions and construction of fueling stations.

It is also important that CNG not be burdened with taxation at the pump during its developmental stage. It is recommended that the state tax at the pump of 17 cents per gallon be eliminated or reduced for natural gas. Consideration should also be given to providing

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utilities incentives to sponsor homefill unit leasing programs.

Recommendation Three: Utility Conversion

Utilities should be allowed to rate base the cost of converting their service fleets to CNG. The KCC should consider allowing such costs of conversion to earn an incentive rate of return under K.S.A. 66-117(d). Utility fleets are a particularly appropriate starting point for NGV conversion. Utilities must maintain relatively large fleets and have a vested interest in a healthy NGV market. Utility conversion will stimulate infrastructure development and NGV awareness.

Recommendation Four: Public Education

The state should promote the utilization of compressed natural gas and clean fuel vehicles through public education programs. Public awareness about CNG advantages must be stimulated. Consumers' (initially fleet operators then individual operators) participation is essential to a workable NGV market. It is in the state's economic interest to either sponsor, or encourage a utility to sponsor, a public education campaign highlighting the economic, environmental, and social merits of conversion.

Recommendation Five: Long Term Policies

The state should eventually develop incentive programs to create an interstate CNG refueling infrastructure and urban CNG infrastructure. The development of interstate refueling stations will eventually lead the way to urban refueling stations. The proliferation of infrastructure will further encourage individuals to participate.

To help start this process of infrastructure development, a feasibility study should be conducted to explore the location of additional public CNG fuel stations in Kansas, with particular emphasis on locations on the Kansas turnpike, Interstate 70, and in Johnson County and Wichita.

Background

Natural Gas Vehicles

Faced with increased air pollution standards and an ominous dependence on foreign oil imports, the energy community has begun to seek alternatives to gasoline and diesel transportation fuel. A leading contender for a substantial share of the alternative fuel market is compressed natural gas. Natural gas can capture a vast majority of new market shares created by the move towards clean fuels. CNG is an inexpensive, safe and environmentally friendly fuel. Kansas policy makers should vigorously pursue options to develop this market. CNG has recently received considerable attention from the energy industry and other state governments, particularly in other gas producing states. Texas requires nearly all fleet vehicles to begin operating on clean fuels. Oklahoma provides tax credits and other incentives to encourage the use of natural gas vehicles and Louisiana has developed similar programs. Kansas has taken several steps to initiate this process as well. Governor Finney has joined six other states in establishing a Natural Gas Vehicle zone to encourage the construction of fueling stations. In January, 1992, in a joint venture with private industry, the state, Amoco, and Western Resources, Inc. opened a public CNG fuel station in Topeka. On June 9, 1992, Governor Finney issued an executive order encouraging all

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state agencies to use and experiment with alternative fuels, including CNG, wherever possible. In June, 1992, the Governor and the KCC hosted the first International Alternative Fueled Vehicle Roundup at Forbes Field in Topeka.

While these efforts are to be applauded, Kansas must not stop there. Due to the CAAA, several major metropolitan areas have begun CNG programs to reduce transportation emitted air pollution. Additionally, numerous communities, school districts and businesses, have independently moved to the use of NGV's for purely financial reasons. Recognizing the benefits of NGV's as fleet vehicles, a number of cities currently unconstrained by the CAAA are encouraging conversion to improve ambient air quality before being forced to do so by regulation. The federal government has announced that it will convert many of its new fleet vehicle additions to CNG capability.

It is important to note that conversions to CNG have occurred for different reasons in different places, displaying the whole range of benefits to an NGV system. Kansas should join this national trend and develop a framework to facilitate the development of this market from relative infancy to a major Kansas industry.

Overview of Issues

- A CNG infrastructure can substantially contribute to the Kansas economy.
- Compressed natural gas can significantly reduce foreign oil dependency.
- Compressed natural gas is environmentally cleaner than gasoline and diesel fuel.
- Compressed natural gas is safer and can be more economically feasible than other alternative fuels.

Natural Gas Vehicles in the Kansas Natural Gas Market

Natural gas vehicles promise to provide a needed increase in the consumption of Kansas gas. National estimates project that new total fleet conversion could increase annual consumption by 1.7 Bcf per year[18]. Consumption averages from pilot NGV fleet programs have indicated that small NGV's have annual consumption loads equal to 1.2 average residential homes. Larger NGV's have consumption loads that range from 1.3 to 2.3 homes[19]. As the Kansas NGV market gains momentum, each vehicle represents the natural gas equivalent of one to two more homes using gas. Importantly, consumption would be stable throughout the year, adding a needed summer market. In addition to increased severance tax revenues from sales of natural gas for CNG vehicles, a considerable capital infusion would occur from the development of the CNG infrastructure. New stations would be built, new equipment would be added to existing stations, and an infant industry would be brought to maturity. The Kansas treasury would benefit from increased property tax revenues and increased income tax revenues.

Foreign Oil Displacement

Current transportation fuels are derived, substantially, from imported crude oil. Given the volatility of the world oil market and its susceptibility to politically motivated manipulation, it is

important to encourage a reduction in import dependency. As the Persian Gulf conflict displayed, it is not alarmist to have serious reservations about the U.S.'s high degree of dependency.

Earlier this year an Office of Technological Assessment report examined the economic impact of the current trend toward increased import dependency[20]. This report predicted the U.S. would import $10 trillion in foreign produced oil by the year 2010. The final conclusion of the OTA report was that if the United States does not remedy oil dependency, the nation would experience an economic collapse due to capital flight.

Natural gas promises to be the most practical and beneficial mechanism to reduce vulnerability. Many of the markets which are currently dominated by oil can be supplemented by natural gas. Analysts estimate that through the utilization of domestic natural gas, the U.S. can reduce oil imports, resulting in a reduction in the national security threat posed by supply interruptions.

Environmental Effects

Perhaps the most important impact of NGV's is improvement in ambient air quality. The CAAA required the nation's dirtiest 22 cities to develop clean fuel vehicle programs. In the majority of cases, the programs selected have been NGV's. These cities, and a host of others, are plagued by smog which impedes visibility and produces negative health effects. Tailpipe emissions are responsible for a large part of urban smog. Also, much of the nitrous oxide emitted into the atmosphere is from transportation sources. CNG combustion can notably reduce these harmful pollutants. In fact, currently CNG has proven to be one of the economically and technologically feasible alternatives to gasoline and diesel. The natural properties of CNG make it cleaner than other transportation fuels.

Emission Reductions from NGVs[21]

Carbon Monoxide(CO)	99%
Nitrous Oxide(NOX)	65%
Reactive Hydrocarbons	92%

The environmental benefits of CNG vehicles suggest two reasons Kansas should vigorously pursue NGV development. First, it is simply good for our ecosystem. Second, Kansas can profit economically by providing the resources to satisfy environmental concerns.

Safety

A widespread misconception about NGV's is that they represent a safety risk. In fact, the opposite is true. NGV's have several impressive advantages when compared to gasoline. This fuel is lighter than air. If a leak occurs, it will rise and dissipate into the air. Gasoline, as a liquid, puddles and presents an increased explosion and fire hazard. CNG also requires a much higher temperature before it will ignite, 700°C or higher. Gasoline ignites at 450°C[22]. In conjunction with the high ignition temperature requirements, CNG must be at a 4 to 14 (CNG to air) ratio for combustion[23]. The ratio is narrower than gasoline's ratio. Gasoline is far more likely to cause a fire or explosion than natural gas. The most important safety advantage is in CNG tanks' construction. By law, these tanks must be built to hold extreme pressure and are tested at 5,000 lbs. per square

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inch or higher[24]. Tests have shown NGV tanks will not explode when exposed to fire, dynamite, rear-end collisions, or even gun shots. The American Gas Association found no fires or explosions caused by CNG in 180 rear-end collisions to CNG vehicles[25]. Italy, which has over 250,000 NGV's, has not experienced a single death or injury due to CNG[26]. Existing U.S. NGV's have displayed decreased injury rates by eighty-four percent (84%)[27]. Overall, natural gas vehicles are safer than existing gasoline fueled vehicles.

Costs

Even without a consideration of NGV's other merits, cost benefits alone warrant program development. Conversion to CNG requires an initial capital investment of $1,500 to $,2500 per vehicle[28]. To help offset the initial cost, the National Energy Policy Act of 1992 has provided federal tax deductions for clean fuel vehicles up to $2,000 and for the construction of qualified clean fuel vehicle refueling property up to $100,000. Furthermore, the cost of compressed natural gas is around 50¢ to 90¢ per gasoline gallon equivalent, which represents a dramatic reduction in fuel costs[29]. Even adjusting for gasoline taxes, CNG still maintains a price advantage. The reason for CNG's cost advantage is simple. It takes less capital to convert the raw material into the consumed fuel and the raw material, natural gas, is cheaper than oil. Even accounting for the possibility of lower miles per gallon for CNG, it is still cheaper to use per mile of travel. Officials at San Diego Gas Electric, who recently announced the conversion of its service fleet, has estimated that the company will save $1,000 per year per vehicle in fuel[30].

In addition, the physical degradation of a vehicle occurs at a much slower rate with NGV's. Because natural gas burns cleaner, less engine corrosion occurs and there is less oil viscosity breakdown. Service associated costs are substantially reduced by the same factors that make CNG environmentally safer, i.e. less matter is emitted and less is deposited in the engine. The vehicles continue to have an operating cost advantage over their entire extended life span. The combination of both fuel costs, low operation and maintenance expenses, and extended vehicle life gives CNG vehicles a total cost effectiveness margin over gasoline and diesel vehicles.

Summary

- CNG use can reduce reliance on oil imports.
- Natural gas vehicles are less polluting than gasoline and diesel vehicles.
- NGV's are safer than gasoline vehicles.
- Natural gas vehicles are more cost effective than gasoline and diesel fueled vehicles.

Barriers to CNG Development

Three barriers have impeded the maturation of the CNG vehicle market: lack of infrastructure, lack of conversion investment capital, and lack of knowledge.

First, the lack of supporting infrastructure to sustain NGV's has proven to be a significant deterrent to market evolution. The natural gas industry recognizes the value of the NGV market,

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but are unwilling to commit investment dollars to an infrastructure without vehicles to consume natural gas. Some consumers recognize the cost effectiveness of NGV's, but are unwilling to invest without a developed infrastructure. Automakers also see potential and have developed NGV's but they are hesitant to produce the vehicles in large quantities because no infrastructure or consumer demand exists. As a result, the industry is in a "Catch 22."

Second, the conversion of vehicles requires a capital outlay of $1,500 to $3,000. The cost effectiveness of NGV's allows a two to three year recovery on the initial investment, but the up-front capital is often a prohibitive amount[31]. A considerably more efficient system is being sacrificed because of inadequate financing opportunities.

The third barrier is insufficient knowledge. The general public, as well as many industry leaders, are underinformed about the merits of NGV's. Many potential consumers believe natural gas vehicles would expose them to explosion risks, despite safety verification in pilot programs. Some fleet managers have reservations about the supply of natural gas, despite a near consensus as to its longevity. A large scale commitment to CNG development is thwarted by misconceptions and the simple lack of knowledge.

This situation is a prime example of a condition requiring government involvement to benefit the public welfare. An analysis of infrastructure development and public service programs immediately suggests that NGV infrastructure falls within the tradition of necessary government action. Industries such as rail transport were made possible by the ability of state action to provide the necessary jump-start to free market mechanisms. Like the rail service and even public energy utilities, NGV infrastructure is a system that has enormous potential for the general public welfare. Accordingly, the government can use its unique institutional position to prime the free-market pump. Currently, the market has manifested imperfection, artificial entry barriers and financial gridlock. The benefits to the general public will only be realized if government seizes the opportunity by recognizing its obligation to cultivate latent markets which benefit the public at large. Only government action can break the gridlock and allow a functioning market.

In fact, the areas that have been able to benefit from CNG have only been able to do so with assistance during the transition. British Columbia was able to increase the use of CNG substantially with government incentives to start the program. Oklahoma has been able to stimulate initial involvement by the utilization of government incentives.

However, it is essential that the appropriate limits on government action be stringently respected. A free-market is the most efficient and appropriate mechanism to allocate resources. The only role for the government is to correct temporary market imperfections. State involvement in CNG vehicle development must not affect any party disproportionately and it must be short lived. The smothering effect of protracted government involvement will stifle entrepreneurism and be as ultimately ineffective as the current stagnation. The market must be quickly corrected and the government must return to a passive role.

A comfortable medium must be found between total involvement and neglect. Government should stimulate the market to a workable stage and then allow market incentives to build the most efficient system. Experience with NGV programs has illustrated this point. The market has given strong indications that CNG will flourish if an infrastructure is established. It is the state's responsibility, and in the state's economic interest, to become the stewards of the transition to NGV's. As the transition to a workable system is made, government involvement is unneeded and

counterproductive. NGV infrastructure development is sound economic, environmental, and social policy.

3. Natural Gas for Electricity Generation

Policy Recommendations

Recommendation One: The KCC should work with local distribution companies and pipelines to improve rate and operating flexibility necessary to support the unique needs of the electric utility industry, thereby increasing utilization of natural gas at electric generating facilities.

Rates should be designed which recognize hourly peaks, and which exploit the advantages of natural gas transporters and merchants of moving substantial incremental volume in summer months. Also, increased access to natural gas storage, and creative utilization of compression should be considered in supporting the quick-response, high pressure needs of the electric generating industry.

Recommendation Two: The state should encourage the development and utilization of combined cycle or combustion turbines to meet increased electric peak loads.

On an incremental basis, to meet peaking needs, the cost of electricity from combined cycle and combustion turbine units fired by natural gas are more likely to be cheaper than other forms of generation such as coal. The KCC should look favorably upon this form of generation during IRP hearings and site approval hearings for new generating units.

Recommendation Three: Existing gas units should be refired before any new supply-side unit additions are made by utilities if economical.

The KCC has the authority to approve the construction of any new generating facilities. The KCC should consider the option of refiring idled gas units or increasing utilization of other natural gas units before permitting the construction of a new unit if it is economical to do so.

Recommendation Four: The KCC should look favorably upon utilization of Kansas natural gas in meeting growing customer needs for electricity.

The KCC should recognize that Kansas gas for Kansas consumers such as electric generating facilities, is good for the state as a whole. The money remains in the state and the state's treasury is increased rather than having capital sent elsewhere.

Recommendation Five: The state should promote the utilization of Kansas natural gas in regional independent power production facilities.

Although there is sufficient generating capacity in the state for the foreseeable future, this should not be an impediment to the construction of Independent Power Production facilities in Kansas utilizing Kansas natural gas with the resulting electricity being sold elsewhere. As

a result of the National Energy Policy Act, IPP's will have greater access to transmission lines thereby increasing the state's ability to move "gas by wire."

Background

Natural Gas for Electricity Generation

The use of natural gas to fuel electric generation facilities, both utility and non-utility owned, represents the largest immediate growth sector for the gas industry. Gas fired generation has the potential to be a major player in satisfying the requirements of Title IV of the CAAA. The National Energy Policy Act of 1992 enables further development of independent power producers (IPP). These IPPs' represent a growing share of the electric generation market. EIA estimates that 1/5 of the new capacity in the next twenty years for electrical generation will be satisfied by IPPs. A large percentage of these IPPs will be gas fired.

Gas Fired Electrical Generation in the Kansas Natural Gas Market

As in many end use areas, other states are showing tremendous initiative in promoting the use of natural gas in the electric generation fuel mix. Numerous states are employing existing gas powered generation and 25% to 30% of gas fired generation's growth is from existing units (a 1.5 Tcf increase in consumption is expected)[32].

Kansas currently has several natural gas fired electric generating facilities in place, eg. the Murray Gill and Gordon Evans stations located around Wichita and the Judson Large Plant in Dodge City. Coal burning facilities such as those located at Lawrence and Tecumseh can utilize natural gas also.

The utilization of gas in these facilities today is low in comparison to previous utilization in the 1970's. The primary causes of such low utilization are the cost of natural gas in comparison to the marginal cost of coal and nuclear fuel and the availability and deliverability of natural gas in periods of peak heating. With increasing loads on utility systems in the state of Kansas, customer needs will be met with greater utilization of these facilities and therefore greater utilization of natural gas.

As load for electric utility systems continues to grow, there will be a need for additional generating facilities, through facilities such as combined cycle or combustion turbines. The state should encourage the development and utilization of these types of generating facilities to meet peaking needs for customers in the state of Kansas. The KCC should encourage the utilization of natural gas in these facilities when siting hearings for such facilities are held.

Also, the Commission recommends that existing gas units be refired before any new supply-side unit additions are made by utilities if economical. As stated above, the KCC has the authority to approve the construction of any new generating facilities. The KCC should consider the option of refiring idled gas units or increasing the utilization of other natural gas units before permitting the construction of a new unit if it is economical to do so.

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Non-Utility Generators

Non-utility generation (NUG), which includes both IPPs and qualified facilities, is playing an increasingly important role in meeting the national demand for power. By the mid 1990's, electrical demand is expected to exceed capacity, even with projected construction at 50,900 megawatts by 2002[33]. Analysts predict a 200,000 megawatt shortfall by 2010[34]. NUG's are rapidly filling the void. In 1986 they accounted for only 3.5% of the total electric generating capacity in the United States[35]. By 1990, NUG's were producing 32,700 megawatts with the equivalent of 5% of the total U.S. capacity. This ascent will continue; by the end of the decade NUG's will be supplying 12% of the entire U.S. supply[36].

Kansas policy makers should note that of this projected increase, over 50% of the additional 46,000 megawatt planned capacity will be natural gas fired[37]. This is because gas fired plants are easier to permit and cost less in the construction stage.

Development of NUG's will be enhanced by the National Energy Policy Act of 1992. This Act exempted utility owned or affiliated independent power producers from the Public Utility Holding Company Act and greatly increased the FERC's authority to order wheeling to wholesale customers. With the ability to market their power through utility transmission systems to wholesale customers, IPP's will have greater operational and marketing flexibility.

Kansas can encourage the utilization of Kansas natural gas in these facilities either by encouraging such facilities to be constructed within the state of Kansas or by encouraging the development of rate making incentives to move natural gas to those facilities located in other states. Since electric utilities are permitted to construct and operate IPP's, the state should give special consideration to encouraging gas fired IPP projects by Kansas' electric utilities to maximize total benefits to the state.

4. Integrated Resource Planning

Recommendation One: The KCC should approve rules and regulations implementing Integrated Resource Planning for the public utilities it regulates.

By adopting rules for integrated resource planning, the cost of energy to customers should be reduced and utilities and customers will become more efficient in their energy utilization. The efficiency and conservation aspects associated with IRP will have a positive impact on the environment.

Recommendation Two: The KCC's rules and regulations should incorporate pre-approval.

When Integrated Resource Plans are implemented following KCC review and approval, the decision to enter into various programs should not be second-guessed and the utilities should not be penalized through negative rate treatment when subsequent Integrated Resource Plans require that prior approved plans be modified or abandoned. This policy is necessary to give utilities the incentive to fully embrace IRP and its significant initial investment of time and money.

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Background

Integrated resource planning (IRP) is the process by which a utility chooses the combination of supply-side and demand-side resource additions which can be expected to provide safe, reliable, efficient and adequate energy services to customers at the least cost.

Implementation of integrated resource plans by utilities requires significant time and effort. Historically, utilities have strived to search out the most cost effective methods of supply. IRP considers demand side as well as supply side options. In demand side options, reducing demand functions the same as increasing supply. Integration of these two alternatives, using quantifiable and even nonquantifiable costs and benefits, provides the best mix for meeting energy needs. Determining which options are preferable is the focus of the IRP process.

Integrated resource planning represents risks and benefits to the natural gas industry in Kansas and will require the KCC to modify the method in which it regulates utilities. One of the risks to the natural gas industry is that IRP changes the focus of meeting electric utility customer demand from only supply sources to considering both supply and demand reduction in meeting customer needs. With reductions in customer demand, through conservation encouragement measures, it is likely that there will be reduced need for natural gas. However, there will be opportunities for increased sales of natural gas through fuel switching. An example is the potential to increase summer sales of natural gas for gas fired air conditioning which reduces an electric utilities' peak during the summer. It is also possible that on the supply side, there will be increased utilization of natural gas to meet growing electric load.

The Commission recommends that the KCC approve rules and regulations implementing Integrated Resource Planning for the public utilities it regulates. Integrated Resource Planning represents a significant opportunity to conserve our natural resources through demand-side management and will likely expand natural gas' market share of the overall energy market.

The natural gas industry should become actively involved in the filings of integrated resource plans by both LDC's and local electric utilities to ensure that natural gas has been properly considered in the utilities' development of these plans.

The Commission believes that the KCC's rules should incorporate pre-approval of IRP plans. With pre-approval, utilities will enter into demand-side and/or supply-side projects after consultation with and approval by the KCC. There will be periodic reviews of these plans. If the periodic review determines that the approved plan should be changes or abandoned, the utility should be allowed to recover costs incurred to date, assuming that the prior expenditures were prudently incurred in accordance with the prior approved plan.

5. Fuel Switching

Consumers, residential, commercial and industrial, have significant opportunities to obtain lower priced energy sources and at the same time improve the environment. This benefit can be achieved by individuals acting on their own, through the assistance of utilities and tax credits as they select fuel sources.

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Policy Recommendations

Recommendation One: Fuel switching should be established as part of the demand-side measures considered in Integrated Resource Planning.

An example of fuel switching is demonstrated when an electric utility with low reserve margins chooses to pay customers to install natural gas air conditioners rather than build additional generating units. The overall cost to the electric utility can be less in certain circumstances by avoiding construction of costly generating facilities. Fuel switching is a fundamental aspect of developing the optimal integrated resource plan. If utilities are not encouraged to recognize that alternative fuel sources can be the best option for both customers and shareholders in developing integrated resource plans, then everyone will be a loser, with customers incurring rates higher than they otherwise would. Fuel switching in such circumstances should be encouraged by allowing utilities to recover through rates the costs of fuel switching including lost sales.

Recommendation Two: The KCC should work with local distribution companies and pipelines to improve rate flexibility to meet the needs of commercial and industrial customers which utilize boilers.

Industrial and commercial customers which utilize fuel boilers, understand the benefits of natural gas with its competitive price, environmental impact, and minimal wear and tear on boilers. Natural gas' main competitor for sales to industrial and commercial boilers is residual oil and propane. The rate flexibility required by local distribution companies and pipelines to satisfy the requirements of the electric utility industry discussed above is equally applicable to industrial boilers. Such rate flexibility will assist natural gas' competitiveness relative to residual oil in addition to its other clear attributes listed above.

6. Helium Extraction

Recommendation One: Helium Extraction

Helium extraction should be encouraged to the extent economically and operationally practicable. The state should provide support to encourage the development of additional helium extraction facilities in the state. Incentives for new plant construction or upgrading current plants will help establish the helium industry as a Kansas revenue generating activity. As the Kansas Hugoton field is a primary supplier of helium for the federal government's helium reserve, the state already has several processing plants which were developed to extract crude helium. Many of these plants also have purifiers which process the crude helium into Grade A helium. Several of these helium extraction plants have been shut down or are not running at full capacity since the loss of government contracts. Encouraging utilization of these plants will enable helium extraction to occur without forcing every producer to build an extraction plant. New plants will need to be constructed, which require significant outlays, and tax incentives should be provided to offset some of the initial capital costs. One significant measure which the state can take is to remove helium extraction from inclusion in the state's severance tax on natural gas. Helium is an inert gas which is found along with natural gas but can only be obtained through the extraction process at natural gas liquids plants. Such action

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will promote the development of helium and the expanded development of natural gas liquids facilities, thereby increasing development of natural gas.

Background

Kansas' natural gas industry plays another role: one that is silent but important in the United States economy. That role is the processing of helium, a colorless, odorless, tasteless, and non-toxic associated product of natural gas. It has a strong, stable market and is necessary to several important U.S. industries. Yet no state, not even Kansas, has a policy designed to maximize the refinement of this product. Kansas is the leading state in reserve levels of helium. Ninety percent of the world's helium is contained in the helium rich natural gas of the Hugoton gas fields[38]. The majority of that ninety percent falls within Kansas' borders.

The markets for helium already exist and are awaiting development. The uses are varied and constantly expanding. The breakdown of applications is as follows[39]:

Application	Percent of Total U.S. Consumption
Cryogenics	25%
Welding	25%
Purging and Pressuring	12%
Controlled Atmospheres	23%
Leak Detection	2%
Synthetic Breathing Mixtures	2%
Other Uses	11%

Cryogenics is an area of scientific work at low temperatures, usually below -240°F. Helium is necessary to achieve temperatures from -430°F to almost absolute zero (-459.6°F). No other substance can substitute for helium at these temperatures. Superconductors, space simulation chambers, preservation of cancer specimens and cooling targets in nuclear radiation research all depend upon helium to maintain working environments. 1992 consumption is expected to be around 625 MMcf.

Helium, alone or when mixed with other gases, is used as a shield in welding aircraft, ships, spacecraft, storage tanks and even diesel engine parts. Welding, along with cryogenics, account for the largest portion of helium consumed in the United States. Welding consumption will be close to 625 MMcf.

Twenty three percent of helium use will be in the area of purging and pressurizing. This accounts for 575 MMcf. Most of these applications are space exploration related; pressurizing fuels and oxidizers on boosters on spacecraft. Pressurization is also done on electronic components which would otherwise fail at high altitudes.

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Three hundred MMcf is used in maintaining controlled atmospheres for cooling vacuum furnaces and fuel processing elements of nuclear reactors. Helium also makes it possible to create the atmosphere necessary for growing transistor crystals.

Leak detection and synthetic breathing mixtures each consume 50 MMcf yearly. Because helium permeates microscopic openings and is easily detectable even in minute quantities, it is often used to detect leaks in airplane oxygen apparatus, power plant condensers, chemical processing systems and semi-conductor devices. In synthetic breathing mixtures, helium can be blended with oxygen, creating a mixture which reduces the time necessary for decompression from deep dives and prevents what divers refer to as "the bends."

The remaining eleven percent of the helium consumed, around 275 MMcf, is used for heat transfer, treating respirator elements, interaortic balloons for heart attack victims and as a lifting gas.

Production and Reserves

The production process for helium purifies natural gas, benefitting the natural gas producer by increasing the Btu level and thus raising the gas' value. Most processing plants liquify or upgrade natural gas by extracting helium from natural gas. To arrive at the separate products, a low temperature gas liquid separation process is used. The natural gas is cooled to a temperature below the liquification of hydrocarbons, but not of helium (around -240°F). The gas separated by this process is called crude helium, a mixture of 50% helium and 50% nitrogen. Pressure swing absorption is used to purify crude helium into grade A helium.

When analyzing helium projections, it is necessary to recognize that the reserve of helium is dependent upon the reserve of natural gas. Large scale production of helium for its own sake has rarely been pursued. The rate of helium production is set by the production rate of natural gas. For this reason, helium production may be greater than or less than demand. This relationship is a major factor that must be considered when examining statistics. Production and reserve numbers only reflect the amount of helium found in current natural gas production.

Helium reserves have risen slowly, following an 83% jump between 1980 and 1983[40]. In 1986, reserves were estimated at 496 Bcf[41], at 534 Bcf in 1986[42], and 1990 levels were 541 Bcf[43]. This reflects the estimation of natural gas reserves and the changes those estimates have undergone in the last fifteen years.

Production is also dictated by natural gas production. Helium production peaked in 1987, experiencing a sharp decline thereafter. This was a direct result of fluctuations in the natural gas market. Annual production rates have recovered from this downfall and, just as demand for natural gas stimulated natural gas production, it also spurred helium production. Current production levels are at 3.2 Bcf annually, with 2.9 Bcf coming from the private sector and .4 Bcf from government stored supplies[44].

Exports

Helium is an energy source for which there are no international competitors. The United States possesses almost the entire stock of helium in the world. World production, excluding the U.S., is only 250 MMcf. Most of this is extracted from Poland and the Commonwealth of the Independent

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States. This amount is not expected to grow and the helium is used internally by these producing countries. On the other hand, the United States is an active exporter of this product. Exports have grown 116% between 1983 and 1989[45]. The only prevention of higher growth rates is the uncertainty of production levels from year to year.

Price

There are two levels of prices for helium. Helium sold from the federal government's reserve is currently set at $55.00 an Mcf, recently raised from $37.50[46]. The private sector does not enjoy the privilege of a set price, but market prices tend to follow the government's lead. The current sales price for grade A helium is between $45-$50 an Mcf[47]. These prices make helium extraction a profitable possibility.

Kansas' Role

As stated above, Kansas is one of the leading producers of helium in the world. Kansas' natural gas is rich with helium, with a content of 3/10ths(.3%) percent. With this level of helium concentration and the vast amount of reserves available, helium recovery may be accomplished at a profit.

Yet Kansas does not extract all of its potential helium and does not have any policies designed to encourage this development. Some corporations, such as Panhandle Eastern, are modernizing their natural gas liquid extraction facilities to extract helium. The Panhandle Eastern project is capable of producing 800 MMcfs or the equivalent of 20% of U.S. supply[48]. These types of upgrades in processing provide necessary additions to the nation's helium supply. The helium market belongs to Kansas, policy makers can use it to its fullest potential or they can continue to allow haphazard operation.

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Notes

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[5] Nordling, supra note 4, p. 2.

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[24] "America's Plentiful Energy Resource," supra note 5, p. 105.

[25] "America's Plentiful Energy Resource," supra note 5, p. 105.

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[27] Patrick Crow, "Alternate motor fuels debate peaks as action on Clean Air bill nears" (Oct. 9, 1989), p. 21.

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[43] Armond A. Sonnek, quoting 1990 data, supra,note 2.

[44] Armond A. Sonnek, quoting 1992 data, supra note 2.

[45] William D. Leachman, "Helium," Minerals Yearbook (1989), p. 507.

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[47] Armond A. Sonnek, quoting 1992 data, supra note 2.

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BRIEFING FOR THE HOUSE ENERGY AND NATURAL RESOURCES COMMITTEE, March 18, 1993

The Kansas Energy Policy Committee Report
J. Paul Jennings, Chairman

My name is Lee Gerhard. I am the State Geologist and Director of the Kansas Geological Survey, Co-Director of the University of Kansas Energy Research Center, and for purposes of this briefing, Fossil Energy Subcommittee Chair, Energy Policy Committee.

Paul Jennings, Chairman of the Energy Policy Committee, is unable to be with us today, and has requested that I provide this briefing on the Energy Policy Committee Report to the Governor. This report is the product of many people's work, but for service to this all-volunteer effort, I would like to single out the following people, some of whom are in the room.

Philip Madell, my counterpart, Subcommittee Chairman, Non-Fossil Energy, whose subcommittee is responsible for the second part of the report. Phil will address you later and make other recognitions.

The fossil energy subcommittee worked by way of task forces. **Donald P. Schnacke**, **David Pope**, **Charles Warren**, **Larry Richardson**, and **Dennis Woolman** served as task force leaders. **Dr. Lawrence Brady**, **Dr. Lynn Watney**, and **Dr. David Collins** served as technical staff to these task forces.

The mission of the committee is the first page of the report, and I quote it to you.....

Other states have developed energy strategies and policies, but none have done it as a volunteer public effort. The Kansas effort is an equivalent contribution of several hundred thousand dollars of volunteer time. More than 80 people participated in the committee work.

The report is finished. Now, it's time to examine, select, and implement the recommendations for change arising from the report. Some recommendations may be left on the table, others will be adopted. Some need implementation by executive action, others by legislation. The philosophy represented by the fossil energy report is that of expanded production and increased overall business activity.

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The non-fossil energy report encourages the development of alternate energy and conservation practices within the state. Both reports stress the need to use the natural gas resources of Kansas more widely and to encourage and support energy research at the state's universities.

Leadership means different things to different groups. Leadership by Kansans and Kansas in energy policy implementation can have a positive impact on federal policy, upon national problems, and upon the welfare of all. Kansas is presented with the opportunity for taking leadership with this Energy Policy Report. The impacts will not only be in energy, but can be across the board in stimulation of additional economic activity in Kansas, which most of us recognize is necessary to the maintenance of our state standard of living and provision for public services.

We are quite cognizant of the impending loss of aerospace jobs in Wichita, but we remember quietly losing over 8000 jobs in the petroleum industry between 1985 and 1990, jobs that have gone overseas, and are not returning.

We give you opportunity for Kansas.

Fossil Energy Recommendations

I am grouping the recommendations of the fossil energy report rather than going through them in detail. They, and their justification, are in the report for your contemplation, and are outlined in the executive summary.

First, the report suggests three means for increasing business activity in Kansas.

1. Capital gains tax reduction in Kansas income tax.
2. Investment tax credits
3. Cost/benefit review of all new regulations

These three policy changes could stimulate all industry and assist to recruit new industry to the state. The federal government is loathe to replace these former business stimuli, and consequently the national economy stagnates. There is no incentive to take financial risk in today's tax environment.

Would Kansas be interested in taking the lead, increasing its attractiveness to all industry and business investment? If so, here is a significant starting point. These suggested tax changes derive from the energy industry, but are equally important to all business investment, including aerospace.

Just because the federal government can't get its act together doesn't mean that Kansas can't exploit that weakness to its own advantage.

Second, Kansas has an abundance of natural gas. The Hugoton gas area is one of the largest in the world. Production, and consequent severance, property, and income tax revenues from that resource have been limited for many years by pipeline access and fuel use regulation. These are no longer problems, and aggressive marketing and production incentives can gain a larger share of a potentially much greater national demand for natural gas. Kansas can lead the way in development of a CNG vehicle fuel market, conversion of other energy-consuming facilities to natural gas, and participation in technology development for expanded natural gas use. These actions may have federal support, judging from statements by national leaders.

Various other tax revisions could materially aid the expansion of the Kansas energy producing industry, including the gas severance tax bill currently before the legislature. Unfair taxation and unequal tax loading hamper operators and producers; the legislature has the opportunity to address these issues, several of which are documented in the report.

Third, marketing of Kansas energy resources is not now a state priority, but the Department of Commerce and the Corporation Commission could materially assist in that endeavor. Kansas could be marketed as the location of a second strategic petroleum reserve as well.

Fourth, Kansas can take a lead in development of federal policy by aggressively advocating changes in federal policy that hinder development of the state's energy resources, and push for federal changes that favor Kansas rather than permit other states and other resources to dominate federal policy. Greater Washington representation of Kansas interests is required.

Environmental issues are not as great in Kansas as they are for some states, but the development of effective and responsible regulation and avoidance of unnecessary or unwise regulation is required. There is a leadership role for Kansas here also. Legislation that would alleviate the present unlimited financial liabilities for actions taken in a regulated climate should be removed. The public responsibility for regulated activities should protect those industries that actively and genuinely adhere to good regulatory practice. These entities should not be penalized, but rather encouraged as examples of governmental and industry cooperation.

This requires the establishment of baseline standards for environmental issues, so that progress and problems can be more easily defined, standards developed, and control over the state's environment taken by the state, rather than the federal establishment.

Where federal regulations prevail, the costs of enforcing those regulations must be assessed against the federal government, rather than against the state's economy.

Finally, education and research can go a long ways to enhancing the state's economy. Education is needed about the resources, their impacts, and their benefits. Too much national hyperbole creeps into the realities of energy policy: Decisions must be good for the poor as well as the advantaged.

There are several actively growing and important energy research efforts in Kansas. The EPSCOR program is one that may help direct more federal research revenues into the state, and the University of Kansas Energy Research Center is actively working to gain access to the estimated 8-11 billion barrels of oil remaining in known Kansas reservoirs and to create opportunities for gaining new resources through advanced technology. Research in alternate uses of existing resources, environmental impacts and mitigation of energy development, and facilities for conducting the research are all issues that need to be addressed.

Phil Madell will speak to you now about the non-fossil energy portion of the report.

Summary:

We commend this report to you. There is much to think about, and much to work with. Implementation of the results of the committee work depends on both the executive and legislative branches of state government taking the lead. It is our hope that the governor and the legislative leadership will appoint a joint working group to screen these issues, develop implementation mechanisms and schedules, and bring the economy of Kansas forward. We would be happy take any questions you may have.