MINUTES

JOINT COMMITTEE ON ENERGY AND ENVIRONMENTAL POLICY

September 29-30, 2009
Room 783—Docking State Office Building

Members Present

Senator Carolyn McGinn, Chairperson
Representative Carl Holmes, Vice-chairperson
Senator Pat Apple
Senator Janis Lee
Senator Roger Reitz
Representative Forrest Knox
Representative Cindy Neighbor
Representative Tom Sloan
Representative Vince Wetta

Members Absent

Senator Mark Taddiken
Representative Mitch Holmes

Staff Present

Mary Galligan, Kansas Legislative Research Department
Raney Gilliland, Kansas Legislative Research Department
Melissa Doeblin, Office of the Revisor of Statutes
Sean Ostrow, Office of the Revisor of Statutes
Mike Corrigan, Office of the Revisor of Statutes
Renae Hansen, Committee Assistant

Others in Attendance

See attached list.

Tuesday, September 29
Morning Session

Chairperson Senator Carolyn McGinn called the meeting to order at approximately 10:15 a.m. and reviewed the agenda for the day. She noted that the Committee had been provided with information from the National Conference of State Legislatures (NCSL) entitled, "The Water-Energy Nexus: Overview Legislative Summary" (Attachment 1).

Overview of Kansas Water Law

Chairperson McGinn recognized David Barfield, Chief Engineer, Division of Water Resources of the State Department of Agriculture, who described the Kansas water system (Attachment 2). He explained the differences between surface water and groundwater supply. He reviewed some of the Kansas water laws and the history of the law governing water appropriation. He noted that the law allows for the use and development of water resources.

Mr. Barfield talked about the remaining capacity in the Kansas water sources. He identified four rivers in the State that remain open to new water rights: the Missouri, the Kansas, the Big Blue, and the Spring Rivers. He explained how water law in Kansas has evolved. His presentation described some of the details of those changes. Finally, he explained how water is transferred from one area to another area in accordance with the Water Transfer Act.

The Water-Energy Nexus

The Chairperson recognized Peter Pfromm, Professor of Chemical Engineering, Center for Sustainable Energy at Kansas State University. Dr. Pfromm gave a brief overview of the energy conversion process. He explained how water is involved in this process. He noted how one could compare the energy balance used versus the mass balance. This is an unassailable tool to compare processes in a transparent and visual manner (Attachment 3).

The Chairperson recognized Nancy Jackson, Executive Director of the Climate and Energy Project. Ms. Jackson discussed projections of water availability in the future. Ms. Jackson noted that some estimates are that by the year 2030, 47 percent of the world's population will experience severe water shortages. Ms. Jackson commented that we are getting better at using less water to produce our energy sources. For example, increases in wind for energy in the future could reduce the amount of water used for energy production by 17percent. She noted that the Climate Energy Project is promoting a balanced look at the production of energy, using energy efficiency, wind, and other sources to make a common sense solution as a society (Attachment 4).

Availability of Water for a Wolf Creek Expansion

The Chairperson recognized Mark Schreiber, Director of Government Affairs, Westar Energy, who spoke briefly about the potential construction of a new nuclear power plant at Wolf Creek. He said that Westar plans to be a fast follower, rather than a leader, in the next wave of constructing nuclear power plants in the United States (Attachment 5).

The Chairperson recessed the meeting until 1:30 p.m.

Afternoon Session

The meeting reconvened at 1:35 p.m. The Chairperson recognized David Barfield, Chief Engineer of the Division of Water Resources of the Department of Agriculture. Mr. Barfield discussed the availability of water to support another nuclear power plant at Wolf Creek. He described water usage at the current Wolf Creek plant. He noted that if more water is needed it might be possible for Wolf Creek to buy water rights from Melvern Lake, the Marais Des Cygnes River, or the Kansas River (Attachment 6).

The Chairperson recognized Tracy Streeter, Director of the Kansas Water Office who discussed water resources that might be available if more water is needed for a second nuclear power plant. The Water Office is looking at the possibility of raising the lake pool level by 2 feet which would gain about 10,000 to 15,000 more acre feet (AF) of water. He noted that dredging the John Redmond lake to gain 52,000 AF of water would be a long-term project and that such a project could take 5-10 years just for the preparation work. Mr. Streeter noted that building a new lake also would be an option to gain more water to support a second nuclear reactor. He noted that transferring water from one place to another will not create more water. We will need to find more ways to store water for usage (Attachment 7).

Water Use and Conservation Efforts by the Energy Industry

Electric Utilities

The Chairperson recognized Mark Schreiber, Director of Government Affairs, Westar Energy, who described the uses of water by Westar Energy for energy generation, now and in the future. His presentation included examples of water conservation practices that Westar has implemented (Attachment 8).

The Chairperson recognized Paul Ling, Manager of Environmental Services, Kansas City Power and Light (KCPL), who described the utility's water usage in energy production. He noted that the company generates 90 percent of its energy from coal or nuclear fuel. KCPL uses water for: wet scrubbers, non-potable and sanitary processes, boiler condensate makeup, dust suppression, conveyance, large pumps, and boiler condensers. KCPL will need additional water in the future for wet scrubber replacement, and replacement of once-through cooling with closed-cycle cooling with cooling towers. He described examples of water conservation practices (Attachment 9).

The Chairperson recognized Jim Epp, Manager of Water Operations and Acting Chief Administrative Officer, Kansas City Board of Public Utilities, who described the Missouri River Risk Mitigation project, horizontal collector wells, and conservation practices used to meet the utility's need for water. He showed the Committee a large poster demonstrating an alluvial water well pump used by the utility. He commented that their well pumps about 40 million gallons a day and is virtually safe from spills into the river and droughts in the area because the well is 100 feet deep (Attachment 10).

The Chairperson recognized Kyle Nelson, Executive Vice President and Chief Operation Officer of Sunflower Electric Power Corporation, who described the factors that a power company considers when determining when and how to expand energy production. He also described water usage considerations Sunflower applies as it plans for providing more electricity to its customers (Attachment 11).

Refineries

The Chairperson recognized Jim Loving, Plant Manager for National Cooperative Refinery Association (NCRA), who described water use during oil refining processes. He enumerated ways in which NCRA works to conserve water used in production processes. He also described the methods NCRA is exploring to reduce water consumption (Attachment 12).

Renewable Generators

The Chairperson recognized Tom Robb, Manager of Institutional Relations, Abengoa Bioenergy, who presented testimony via telephone. He described what Abengoa does to conserve water, success of their efforts, and future plans for water conservation. He noted that significant water savings in bio-fuel production will come in the crops that are used to produce those bio-fuels. He commented as you move from corn to sorghum to switch grass as the fuel source, the amount of water-per-acre needed to grow the crops decreases dramatically.

The Chairperson recognized Greg Krissek, Director of Government Affairs, ICM, Inc., who presented information about water use in the fuel ethanol industry. He also provided an overview of the fuel grade ethanol industry and ethanol production process from a water use perspective. He noted that poor water quality leads to use of more water in the ethanol production process (Attachment 13).

The Chairperson recognized Steve McNinch, Board Chairman, Kansas Association of Ethanol Processors, who explained the amount of water used for ethanol production. Additionally, ethanol plants sell wet distillers grain to feedlots which allows the feedlots to use 10 percent less water for the animals. He noted that of the 4.6 million acre-feet of water Kansans use per year, Kansas ethanol plants use only 4,049 acre-feet, or .09 percent of the total (Attachment 14).

Agriculture

The Chairperson recognized Brad Harrelson, State Policy Director, Kansas Farm Bureau, who presented information regarding the need for increased agricultural output in the future. He noted that in the next 40 years the world will need to double its agricultural production to meet the increasing food and energy demands (Attachment 15).

The Chairperson recognized Vara Prasad, Kansas State University, who presented an overview of precipitation and water resources in Kansas. He noted specific projects that K-State is researching concerning water usage and crop production. Additionally, he offered a short paper on improving water use efficiency and drought tolerance of Kansas crops (Attachment 16).

Allan Fritz, Professor of Wheat Breeding, Kansas State University, spoke to the Committee on the systems approach to crop production improvement. He noted that part of the process is attributed to genetic improvement and the other part is attributed to improved management practices (Attachment 17).

The Chairperson adjourned the Committee at 5:02 p.m.. She reminded the Committee that the meeting would resume tomorrow at 9:00 a.m..

Wednesday, September 30
Morning Session

The Chairperson called the Committee to order at 9:00 a.m..

Update on Federal Stimulus Funding (ARRA) for Energy

The Chairperson recognized Thomas Wright, Chairman of the Kansas Corporation Commission (KCC), who described how the KCC is using the $50 million they received from the Department of Energy as part of the American Recovery and Reinvestment Act of 2009 (ARRA). Mr. Wright noted that approximately $38 million of the funds will be used to implement Efficiency Kansas, a revolving loan program that provides funds for purchase and installation of energy efficiency improvements in residences (Attachment 18).

Mr. Wright noted that banks and utilities have been recruited to participate in the program. Six banks with 66 locations statewide have agreed to make loans for the program. He noted that until more energy auditors are trained, there might be a shortage of energy auditors in certain parts of the state. Mr. Wright said he would provide the Committee a list of energy auditors. The KCC estimates that an energy audit will cost the consumer somewhere between $350 and $700. He noted that the energy efficiency website has more information.

Mr. Wright said he would provide a copy of the ARRA language that places conditions on the state regarding use of the energy efficiency funds. The KCC is documenting program activities to ensure accountability for use of the federal funds. In regard to the rate structure effort related to energy efficiency, Mr. Wright said the KCC will address the matter by developing a policy base that will be applied on a case-by-case basis.

The Chairperson recognized Stephen Weatherford, President, Kansas Housing Resources Corporation (KHRC), who described how ARRA funds are being expended for housing weatherization and appliance replacement. Kansas received approximately $56 million in ARRA funds for weatherization over a three-year period. Those funds are in addition to the $7.9 million received from the U.S. Department of Energy for the 2009 plan year. KHRC designated $16 million of the ARRA funds for a multi-family housing weatherization program to be managed by KHRC staff. That program will focus on weatherizing Tax Credit properties, USDA Rural Development properties, and project-based Section 8 properties that had no direct HUD funds for energy-efficiency improvements. The $40 million balance is expected to be used by the network of providers for single-family dwellings (Attachment 19).

Mr. Weatherford commented that an audit has to be done on the low income units and the typical route of efficiency improvements is: sealing the home, installing insulation, and making improvements to ensure that carbon monoxide is expelled from the house. Generally, there is not sufficient money to replace windows.

The Chairperson recognized Caleb Asher, Deputy Secretary, Kansas Department of Commerce, who discussed grant opportunities for increasing "green jobs" in the State. The Department's state workforce task force is working to establish a definition of "green jobs" and identify how that definition may vary for the five regions in Kansas. This study is headed up by Dr. Ed Berger at Hutchinson Community College.

He reported that the Department has been working to get people who lost jobs during the early stage of the recession back to work. They hope to incorporate the green training of new

workers via the technical schools. They also are attempting to get more contractors to include "green processes" in their construction work by offering $1,200 scholarships to attend training classes. The Department hopes there will be greening of all jobs in the construction business, advanced manufacturing, and all other key industries in the State.

The Department has received approximately $500,000 to support careers in energy and energy efficiency and renewable energy in the form of grants from the federal government. In addition, other funds are available through the Department of Labor. The Department of Commerce is trying to track those funds and make sure qualified businesses are applying for these monies. Additionally, they are partnering with United Way in Kansas City to provide training for green jobs in low income areas, and with the Department of Corrections to provide training to released prisoners who are reentering the workforce. The Department of Commerce applied for a grant to bring in national speakers for workshops to help build capacity for green skills in the workforce. A public-private partnership group is determining what components to put into that grant and how to monitor the outcomes if the grant is awarded to Kansas. Some of the partners include the State Work Force Board, the State Energy Office, the Departments of Commerce, Labor, and Corrections, the Board of Regents, the Technical Education Authority, utility companies, labor unions, nonprofit organizations, and economic development boards around the state.

They will be focusing on:

- Energy efficiency and renewables;
- Transmission and smart grid development;
- Natural gas efficiency;
- Wind energy production and manufacturing, including training for all aspects of building and manufacturing of the components; and
- The use of other renewable energy sources in production.

The Department of Commerce has asked the partnership group to narrow its focus to what it should be working on as a group. They are trying to determine how to disseminate information about green jobs via the construction industry, the manufacturing industry, and actual energy production companies.

Richard Gaito, Kansas Department of Administration, submitted written testimony pertaining to grant money available for to assist the State in the purchase of fuel efficient vehicles. The Department concluded that it would not be cost effective to participate in the federal program (Attachment 20).

Committee Discussion

Chairperson McGinn began a discussion on where the Committee would go from here. She noted the limit on the number of authorized meeting days, and she would try again to attain an extra day for committee work. If that extra day is approved, the Committee will discuss proposed CO_2 sequestration rules and regulations. The issue is whether the state should assume responsibility for sequestered CO_2.

Mary Galligan noted that at its next meeting, the Committee will explore its other charge from the LCC, which is to consider moving energy efficiency programs from regulated utilities to an independent administrator. As part of that effort, the Committee is to study a 2009 bill that would create a not-for-profit organization whose only purpose would be to achieve the reduction in the use of energy.

Additionally, Committee members noted that they are unsure about meeting the requirements set out by the federal government for the ARRA money Kansas is receiving for energy purposes and noted that further discussion of that matter may be required.

The Chairperson adjourned the meeting at 12:15 p.m..

The next meeting is scheduled for October 28 and 29, 2009.

Prepared by Renae Hansen
Edited by Mary Galligan

Approved by Committee on:

May 7, 2010
(Date)

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John Donley	KS Lusk Assn
Wes Ashton	Black Hills Energy
Martin Hawver	Hawver's Capitol Report
Corey Mohn	Kansas Commerce
CLARE Gustin	Sunflower Electric Power
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Sean Miller	Capitol Strategies
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Marge Petty	KCC
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Kevin Bakewell	Park City
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The Water-Energy Nexus: Overview Legislative Summary

September 21, 2009
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Introduction

State legislatures and natural resource managers have traditionally addressed water and energy as two separate issues. However, water and energy are deeply connected and sustainable management of either resource requires consideration of the other. Thus, resource managers and lawmakers across the country are beginning to take a comprehensive and interdisciplinary approach to the management of water and energy. This report provides overview information about the nexus between water and energy and provides a summary of state legislation addressing this issue.

Water Energy Nexus Overview

Water and energy are critical, mutually dependent resources- the production of energy requires large volumes of water and water infrastructure requires large amounts of energy.

Water is required to generate energy. Thermoelectric cooling, hydropower, energy mineral extraction and mining, fuel production (including fossil fuels, biofuels, and other non-conventional fuels), and emission controls all rely on large amounts of water. In the United States, the electricity industry is second only to agriculture as the largest user of water. According to the National Renewable Energy Lab, electricity production from fossil fuels and nuclear energy requires 190,000 million gallons of water per day, accounting for 39% of all freshwater withdraws in the nation. Remarkably, in many regions of the country, we use as much water turning on the lights and running electric appliances in our homes, as we use in taking showers and watering lawns.

On the other hand, water supply also requires energy use. A large amount of energy is needed to extract, convey, treat, and deliver potable water. Additionally, energy is required to collect, treat, and dispose of wastewater. Approximately 4 percent of U.S. power generation is used for water supply and treatment and about 75 percent of the cost of municipal water processing and distribution is electricity, according to the Department of Energy.

Water and energy are both multifaceted issues with many variables impacting their supply, demand, and management. Lawmakers should consider the following variables that add complexity to the management of water and energy:

- *Growing population:* According to the 2001 National Energy Policy, our growing population and economy will require an additional 393,000 MW of new generating

capacity. This generating capacity equates to 1,300 to 1,900 new power plants by 2020 that will require additional water withdraws.

- *Agriculture:* Water demands will increase as agricultural demands increase with the need to feed a growing population. In 2000 irrigation accounted for about 40 percent of fresh water withdraws in the U.S., according the U.S. Geological Society.

- *Geographical water demand:* Water supply and demand are not geographically linked. During the 1990's, the largest regional population growth, 25%, occurred in the mountain West, one of the most water deficient regions in the United States. In comparison to the Southeast, where population increased by 14% and the Northeast which only experienced a 2% growth in population. Additionally, water consumption in the western U.S. is much higher than other regions due to agricultural demands. It is estimated that it takes over 1 million gallons of water a year to irrigate one acre of farmland in arid conditions. In other words about 86 percent of irrigation water withdrawals were in western states in 2000.

- *Climate Change:* The impacts of climate change may also impact water supply and availably. It is predicted that the timing of spring rains and winter snows may change in many regions, impacting stored water, agricultural production, and water supply. For instance, in the northwest climate change may cause more winter precipitation to fall as rain instead of snow, increasing streamflow and decreasing the winter snowpack, in turn impacting hydro-ecltrcity capacity and water supply.

As water and energy demand and supply shift, managing the two resources in tandem will help states maintain reliable and sustainable supplies of both energy and water. To sustain energy production and a dependable water supply, the U.S. must gain a detailed understanding of the interdependencies of water and energy systems, balance the needs of all users, and develop technologies to reduce water use and loss (i.e. water conservation and efficiency). These goals can be achieved through advancing water and energy system prediction and forecasting, scientific and technological innovation, and the implementation of technologies and management systems. State lawmakers and constituents will be critical in this process given their responsibility formulating policy, convening stakeholders, facilitating negotiations, and ratifying reached agreements.

Summary of Water Energy Nexus Statutes

At least nine states (AZ, CA, CO, CT, NV, SD, WA, WV, and WI) have statutes that recognize the nexus between water and energy. AZ, CA, and NV have statutes that mention the appropriation of water for generating electricity. A detailed summary of the statutes in each state follows below.

State	Statute	Summary
Arizona	§ 45-156 Legislative authorization for appropriation of water to generate power: change in use	Requires legislative authorization for the appropriation or use of water to generate over 25,000 horsepower of electric energy.
	§ 45-166 Approval for appropriation of waters for generating electric energy	34,100 acre feet of water per year maybe appropriated for the operation of thermal generating plants. The operation of thermal generation plant means the use of water for the thermal generation of electric energy.
	§ 45-1450 Consideration	All beneficial uses of the state's water and other

	of water uses in studying flood control projects	natural resources, such as, irrigation, generation of electric energy, municipal and industrial consumption of water and power, recharge of groundwater basins, preservation and development of fish and wildlife resources, and recreational facilities, shall be considered when studying flood projects.
California	§ 25008 State policy; energy and water conservation; alternate supply sources; energy or water facilities at state-owned sites	Intent of the Legislature to promote all feasible means of energy and water conservation and all feasible uses of alternative energy and water supply sources. In recognition of recent and projected increases in the cost of energy and water from traditional sources, it is the policy of the state to use available resources at state facilities which can substitute for traditional energy and water supplies or produce electricity or water at its facilities when use or production will reduce long-term energy or water expenditures. Outlines criteria for analyzing proposed actions.
	§ 25402 Reduction of wasteful, uneconomic, inefficient or unnecessary consumption of energy	Outlines actions the commission shall take to reduce the wasteful, uneconomic, inefficiency, or unnecessary consumption of energy, including the energy associated with the use of water.
	§ 371 Definitions. Allocation-Based Conservation Water Pricing	Procuring water supplies to satisfy increments of water use in excess of the basic use allocations for the customers of the public entity, including supply or capacity contracts for water supply rights or entitlements and related energy costs for water delivery.
	§ 522 Further Findings; reduction of energy consumption	The Legislature further finds and declares that waste or unreasonable use of water imposes unnecessary and wasteful consumption of energy to deliver or furnish the water, and it is necessary, therefore, to determine the quantities of water in use throughout the state to the maximum extent that it is reasonable to do so in order to reduce that energy consumption.
	§ 5001 Notice; necessity of filing; exception	Information concerning extracting groundwater or surface water for generating electricity are exempt from submitting a "Notice of Extraction and Diversion of Water".
	§ 90-29 Cooperation with United States, state, municipalities, districts, etc.	The Nevada County Water Agency may co-operate and contract with the US, State of CA, any municipality, district, public or private corporation, or any person in the sale or acquisition of water for the purpose of conserving and transporting waters for beneficial uses and purposes, including the generation of electric energy.
Colorado	§ 23-41-114 Colorado energy research institute-- creation	Creates the CO energy research institute of the CO School of Mines. It is the duty of the Institute to maintain liaison with the state to identify important regional energy and energy-related minerals problems,

		including their relationship to the use of the waters of the states.
	§ 40-2-123 New energy technologies- consideration by commission- incentives- demonstration projects- definitions- legislative declaration- repeal	Energy is critically important to Colorado's welfare and development and its use has a profound impact on the economy and environment. In order to diversify Colorado's energy resources, attract new businesses and jobs, promote development of rural economies, minimize water use for electric generation, reduce the impact of volatile fuel prices, and improve the natural environment of the state, the general assembly finds it in the best interests of the citizens of Colorado to develop and utilize solar energy resources in increasing amounts.
Connecticut	§ 16a-4a Office of Policy and Management. Duties and powers	The Office of Policy and Management shall prepare state-wide or interregional plans for the physical, social, and economic development of the state. The plan may include land use and water considerations and as well as energy capabilities and requirements.
Nevada	§ 533.372 Approval or rejection of application to use water to generate energy for export	Based upon the public interest and the economic welfare of the State of Nevada, the State Engineer may approve or disapprove any application of water to beneficial use or any application which contemplates a change in the place or beneficial use of water to a use involving the industrial purpose of generating energy to be exported out of this state.
Pennsylvania	§817.22 Enactment of compact	The Great Lakes- St. Lawrence River Basin Water Resources Compact. Definition of "environmentally sound and economically feasible water conservation measures" means those measures, methods, technologies or practices for efficient water use and for reduction of water loss and waste or for reducing a withdrawal, consumptive use or diversion that, among other things, are environmentally sound, reflect best practices applicable to water sector, and consider energy impacts.
South Dakota	§ 45- 5- 21.1 Permits for energy industry use- Period for application of water to beneficial use	Section does not apply to permits issued to South Dakota Conservancy District for energy industry use or permit/ right held by energy industry acquired pursuant to assignment by the director. Periods for completion of construction or application of water to beneficial use for rights transferred by the district to energy industry users shall be fixed in the instrument of transfer but may not exceed ten years from the date the contract is executed for application of water to beneficial use.
	§46A- 1- 71 Legislative findings regarding need for program of statewide water development and financing	The Legislature finds that the proposed use of Madison formation water for widespread energy development in Wyoming presents an immediate threat to ground and surface water supplies and agricultural, domestic, environmental, and other beneficial water uses in western South Dakota.
	§46A- 2- 18 Acquisition	

	of water rights by district- rights to appropriate water for energy industry use §46A- 2- 19 Transfer of water rights or permits to appropriate water for energy industry use to users- contract provisions	Notwithstanding any other provision of law, the district may acquire, by obtaining a permit or permits from the water management board, rights to appropriate water for energy industry use for marketing to energy industry users for such consideration and under such terms and conditions as are fixed by contract or instrument of conveyance. The district may not acquire rights to appropriate more than fifty thousand acre-feet of water for energy industry use per year. The district may sell, grant, convey, assign, lease, or otherwise transfer perfected water rights or permits to appropriate water for energy industry use to energy industry users for such consideration and under such terms and conditions as are fixed by contract or instrument of conveyance. Such contracts shall represent the entire financial obligation for the use of water owed by an energy industry user to the State of South Dakota and no further fee, tax, or assessment shall be levied against such user except for an ad valorem tax as assessed under chapter 10-37.
Washington	§90.82.070 Water quality component	Watershed planning under this chapter shall address water quantity in the management area by undertaking an assessment of water supply and use in the management area and developing strategies for future use. Strategies for increasing water supplies in the management area, which may include, but are not limited to, increasing water supplies through water conservation, water reuse, the use of reclaimed water, voluntary water transfers, aquifer recharge and recovery, additional water allocations, or additional water storage and water storage enhancements. The objective of these strategies is to supply water in sufficient quantities to satisfy the minimum instream flows for fish, provide water for future out-of-stream uses for water, and ensure that adequate water supplies are available for agriculture, energy production, and population and economic growth under the requirements of the state's growth management act.
West Virginia	§ 5B-2F-2 Purpose	Creates the Division of Energy as a state agency under the Department of Commerce. The division shall hold public hearings and meetings to receive public input regarding proposed energy policies and development plans. The energy policy and development plans shall address increased efficiency of energy use, traditional and alternative energy, water as a resource and a component of energy production, energy distribution systems, the siting of energy facilities, the increased development and production of new and existing domestic energy sources, increased awareness of energy use on the environment and the economy, energy infrastructure, the development and

		implementation of renewable, clean, technically innovative and advanced energy projects in this state.
Wisconsin	§281.343 Great Lakes-St. Lawrence River Basin Water Resources Compact §281.344 Water conservation, reporting, and supply regulation; when compact is not in effect §281.346 Water conservation, reporting, and supply regulation; after the compact takes effect	Ratifies the Great Lakes-St. Lawrence River Basin Water Resources Compact. Definition also applies to statutes that apply when the compact is not in effect and after the compact takes effect. Definition of "environmentally sound and economically feasible water conservation measures" means those measures, methods, technologies or practices for efficient water use and for reduction of water loss and waste or for reducing a withdrawal, consumptive use or diversion that, among other things, are environmentally sound, reflect best practices applicable to water sector, and consider energy impacts.

Summary of Pending Water Energy Nexus Legislation Introduced in 2009

CA has nine 2009 bills pending that mention or address the intersection of water and energy. The bills address water and energy planning, mention that water conservation is a benefit of energy conservation and vise versa, and establishes a Commission responsible for energy and water use. Four bills were introduced in FL that would have permitted water use in renewable energy facilities, all four bills failed.

State	Title & Status	Summary
California	AB 212; Energy: Building Standards: Zero net energy buildings; Pending	Requires the State Energy Resources Conservation and Development Commission to adopt building design and construction standards and energy and water conservation standards to require new residential constructions to be zero net energy buildings. Requires the standards to be adopted to reduce the wasteful, uneconomic, inefficiency, or unnecessary consumption of energy, including energy associated with the use of water.
	AB 1371; Reasonable use of water; generating facilities; Pending	Declares that the use of potable domestic water for cooling towers that are part of a generating facility that is an eligible renewable energy resource is a reasonable use of water if certain conditions are met.
	AB 1016; Energy: Commission and Department; Pending	Creates the Department of Energy, the State Energy Commission, and the Office of Energy Market Oversight within the department. Outlines steps the commission should do to reduce the wasteful, eneconomic, inefficient, or unnecessary consumption of energy, including the energy associated with the use of water.
	AB 300; Subdivisions: water supply; Pending	Requires a public water system, or, if none exists, a local agency, to review and verify for accuracy a housing subdivider's water savings projections attributable to voluntary demand management measures. States that more efficient use of water statewide also will reduce the energy necessary to pump, transport, and treat water with potentially significant corresponding reductions in greenhouse gas emissions.
	AB 40; Water reasonable use: electrical generation facilities; Pending	Declares that the use of potable domestic water for cooling towers that are part of a generating system that is an eligible renewable energy resources is a reasonable use of water if certain requirements are met.
	PAB 2; Water conservation: urban and agricultural planning; Pending	Requires the State to achieve a 20% reduction in urban per capita water use by a specified date. Requires an incremental process towards such goal. States that reduced water use through conservation provides significant energy and environmental benefits, and can help protect water quality, improve streamflows, and reduce greenhouse gas emissions.

	AB 49; Water Conservation; Pending	States the intent of the Legislature to enact legislation to establish a 20% water efficiency requirement for the year 2020 for agricultural and urban water users. States that reduced water use through conservation provides significant energy and environmental benefits, and can help protect water quality, improve streamflows, and reduce greenhouse gas emissions.
	SB 279; Local government: community facilities districts; Pending	Authorizes a community facilities district to finance and refinance the acquisition, installation, and improvement of energy efficiency, water conservation, and renewable energy improvements to or on real property and in buildings. Reduced water use through conservation provides significant energy and environmentally benefits, and can help protect water quality, improve streamflows, and reduce greenhouse gas emissions.
	AB 33 c; Energy: Commission & Department; Pending	Abolishes the State Energy Resources and Conservation Commission and the Electricity Oversight Board. Creates the Department of Energy, and the Energy Commission and the Office of Energy Market Oversight. The commission shall take steps to reduce the wasteful, uneconomic, inefficient, or unnecessary consumption of energy, including the energy associated with the use of water.

United States Congress

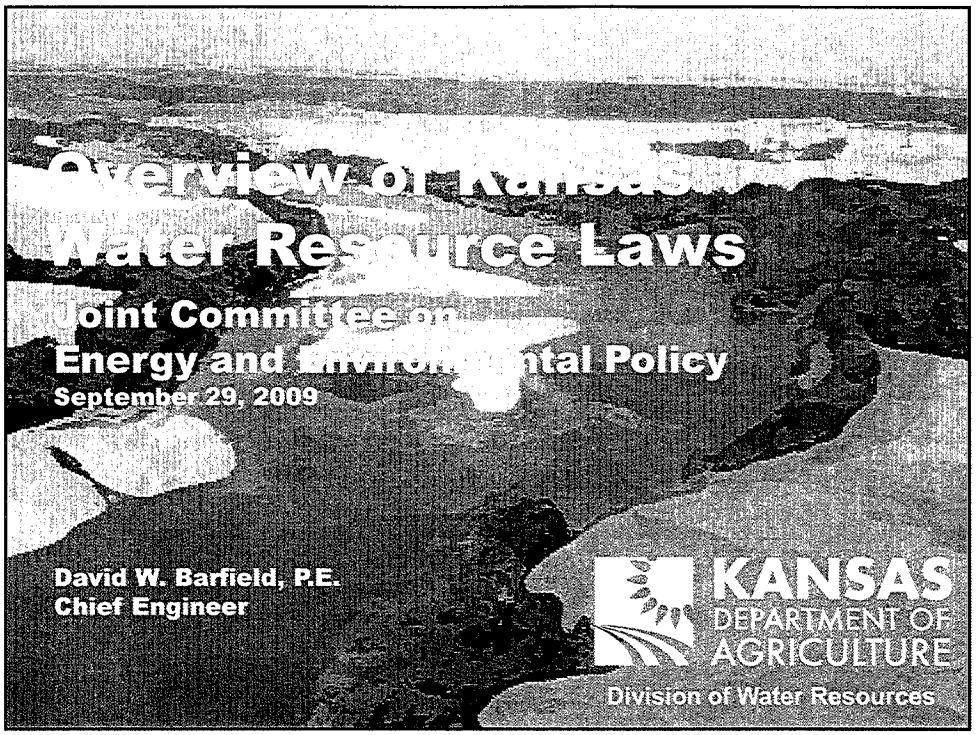
U.S. Senator Bingaman introduced two pieces of legislation in the U.S. Senate that address the integration of water and energy.

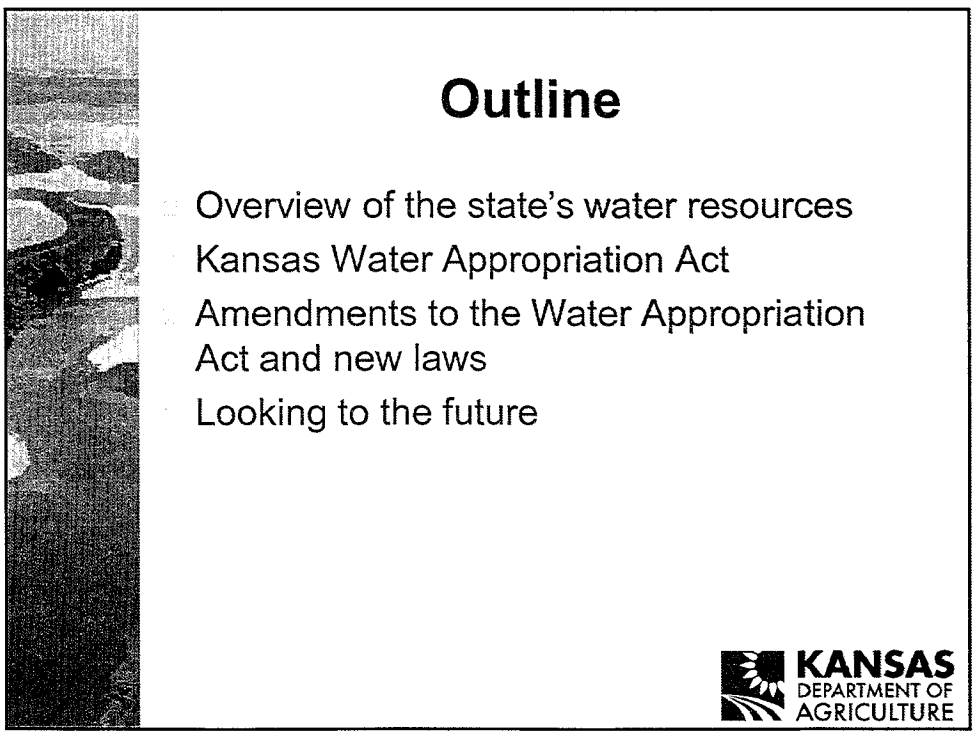
Author & Title	Status	Summary
S 531	Pending	Provides for the conduct of an in-depth analysis of the impact of energy development and production on the water resources of the United States, and for other purposes.
S 1462	Pending	Relates to clean energy technology development, vehicle technology deployment, enhanced energy efficiency, state energy efficiency grant programs, improved energy security, energy innovation and workforce development, energy markets, energy and alternative fuels studies and reports. Addresses energy and water integration and power plant water and energy efficiency.

Helpful Resources

NCSL does not endorse the following resources, however they maybe helpful

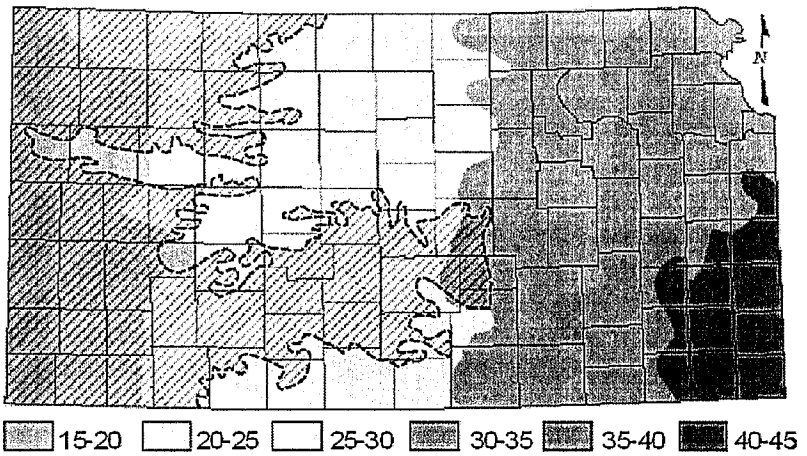
- Sandia National Laboratories – Energy-Water Nexus Overview
- The National Resource Defense Counsel – The Water-Energy Nexus
- Water Energy Technology Team – Energy-Water Nexus
- National Renewable Energy Laboratory – Exploring the Energy-Water Nexus: A Stakeholder Dialogue for Identification of Critical Issues
- Argonne National Laboratory (Ppt) – The Inextricable Linkage of Water and Energy





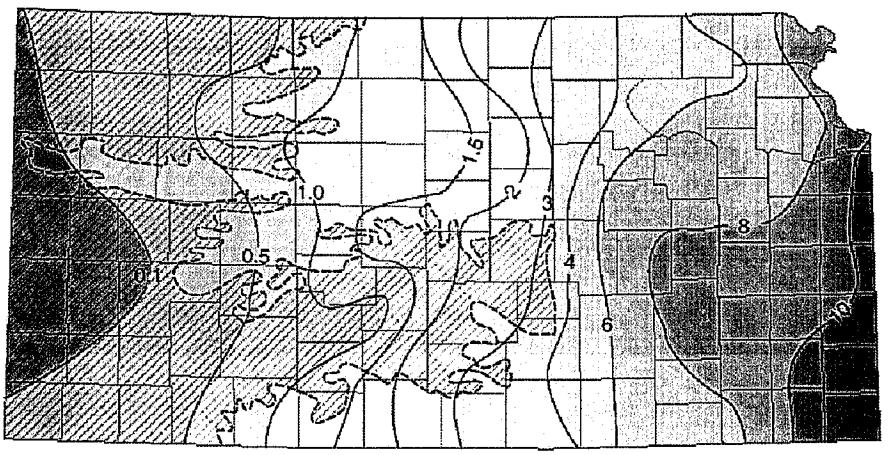
Joint Committee on Energy and Environmental Policy
Date 29 SEPT 2009
Attachment # 2

Normal Annual Precipitation



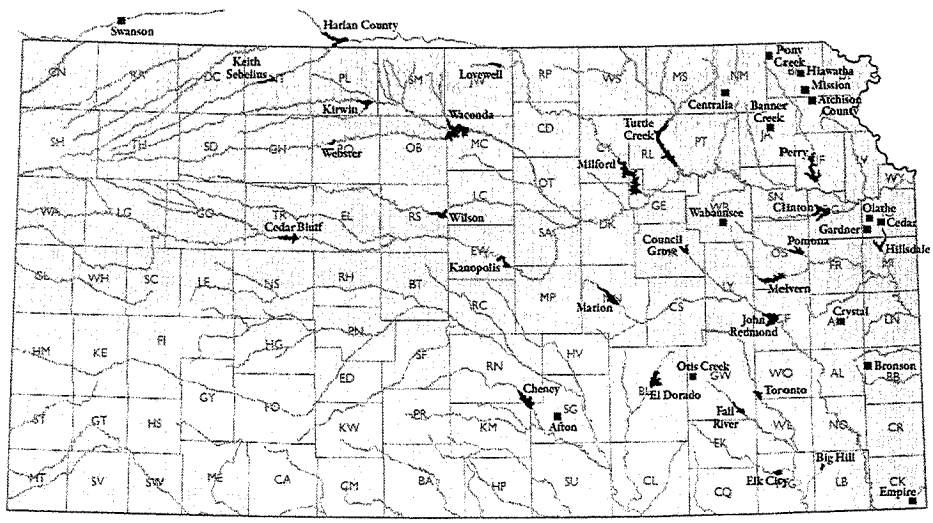
The area west of the dashed line shows the extent of the High Plains aquifer in Kansas (from Goodin et al., 1995)

Average Annual Runoff (Inches)



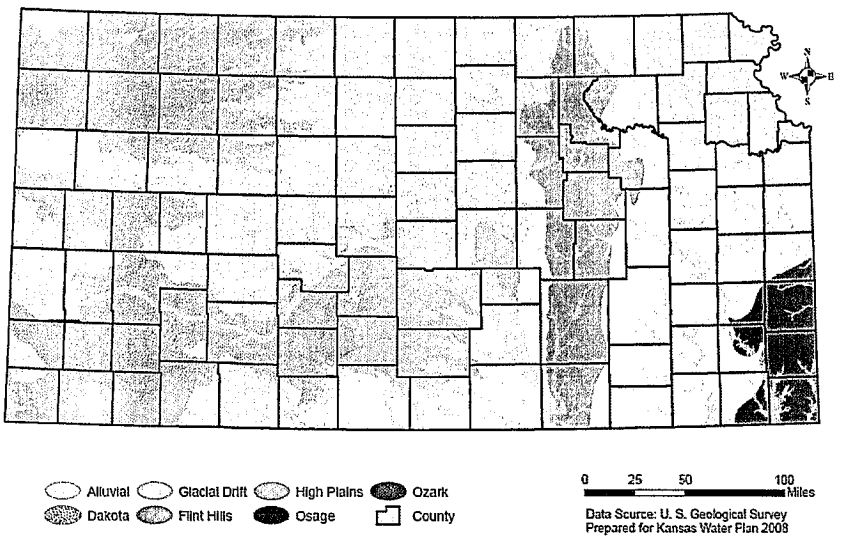
The areas west of the dashed line shows the extent of the High Plains aquifer in Kansas (adapted from Wetter, 1987).

Reservoirs in Kansas



Groundwater Supplies

Major Kansas Aquifers



Kansas Water Appropriation Act (1945)

- All water dedicated to use by Kansans
- Right to use water is based on Prior Appropriation or "First in time, First in Right"
- Limits rights to reasonable needs
- Allocated for beneficial use and to protect minimum desirable streamflows
- Protects investments, property rights and the resource

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Water Appropriation Act

Single priority system for groundwater and surface water

A "water right" is not to the ownership of water, but it is a real property right to divert and use water for beneficial purposes with certain limitations

Domestic use allowed without a permit

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Water Administration

Chief Engineer is charged with administering the act

- K.S.A. 82a-706: The Chief Engineer shall enforce and administer the laws of this state pertaining to the beneficial use of water and shall control, conserve, regulate, allot and aid in the distribution of the water resources of the state for the benefits and beneficial uses of all its inhabitants in accordance with the rights of priority of appropriation.

KANSAS DEPARTMENT OF AGRICULTURE

Water Administration

- During periods of shortage, junior water rights may be curtailed to satisfy senior rights and minimum desirable streamflow
- Releases from storage protected

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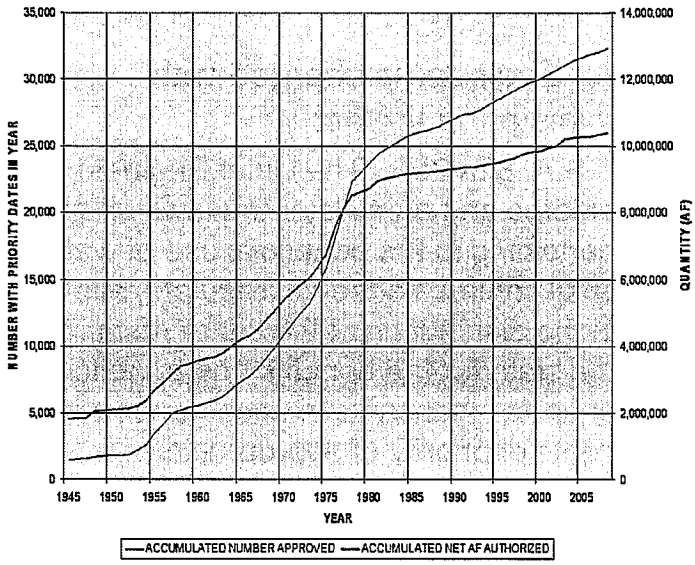
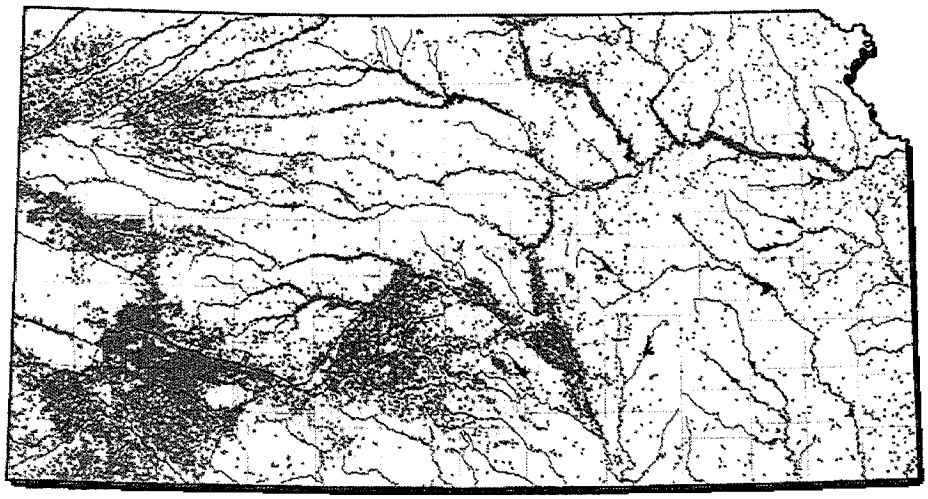
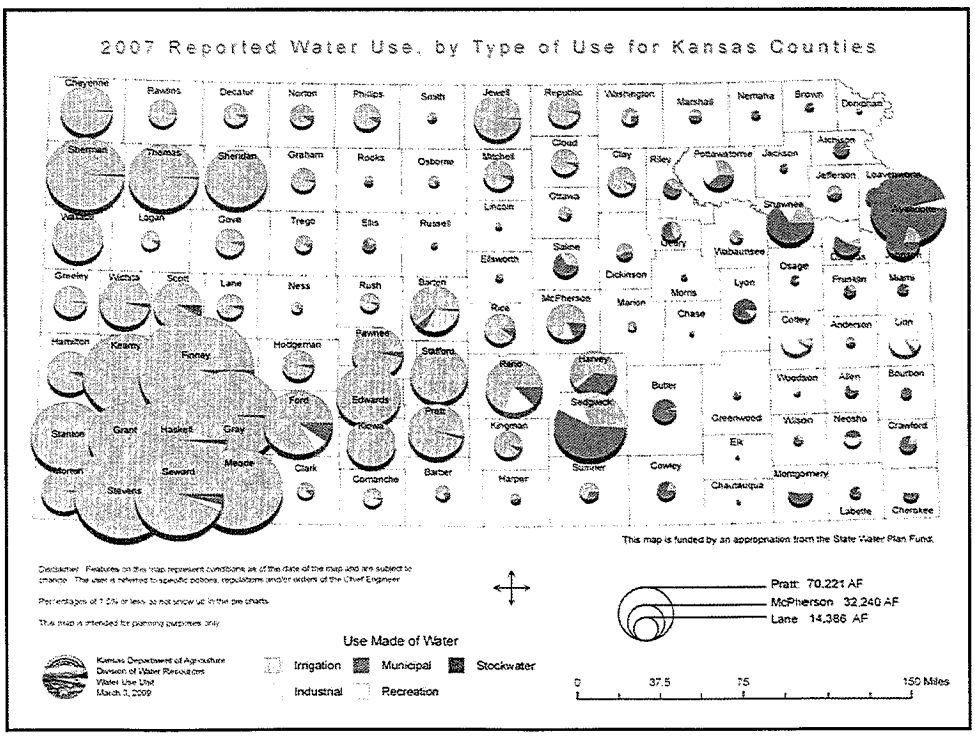
Water Resource Development

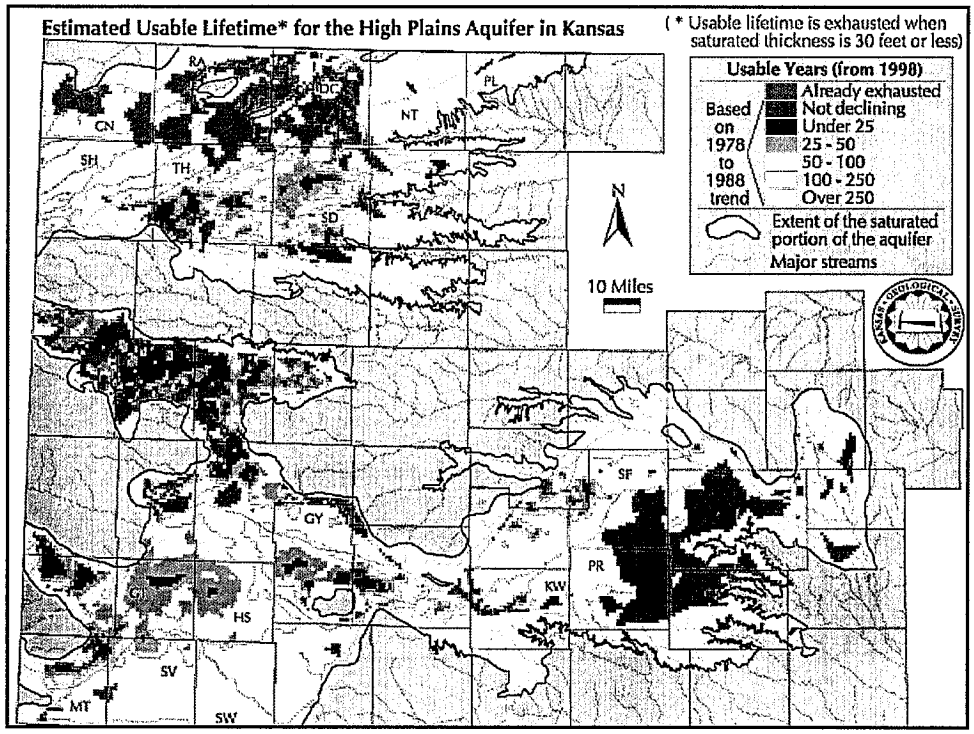


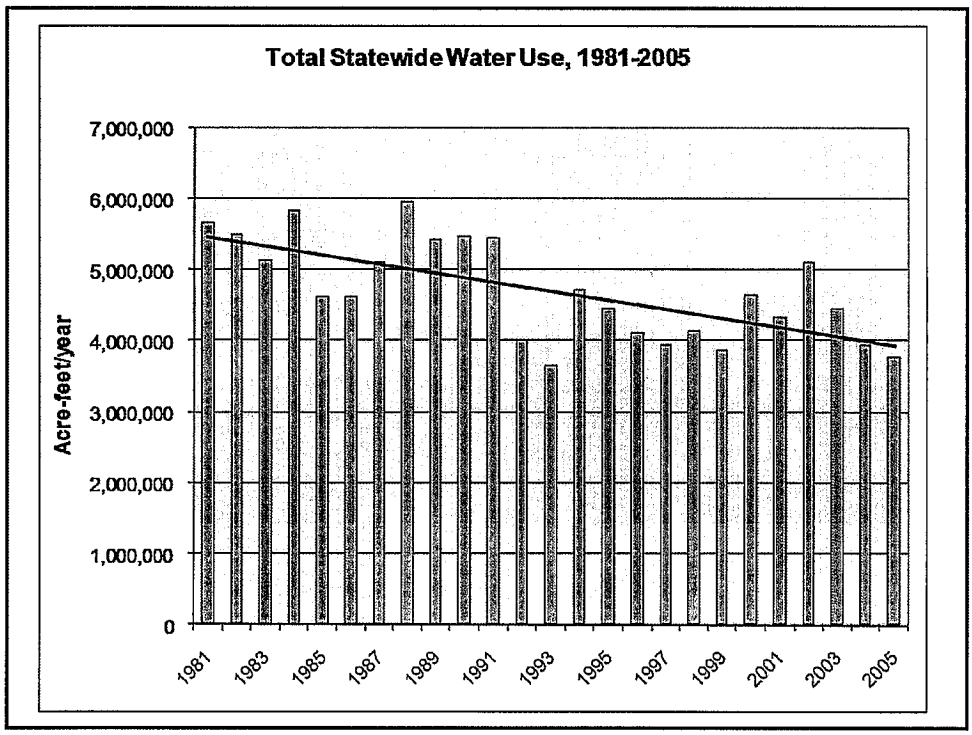
Accumulated number of water rights and authorized quantities.

Diversion Points






Estimated Usable Lifetime* for the High Plains Aquifer in Kansas
(* Usable lifetime is exhausted when saturated thickness is 30 feet or less)
Usable Years (from 1998)
Based on 1978 to 1988 trend
Already exhausted
Not declining
Under 25
25 - 50
50 - 100
100 - 250
Over 250
Extent of the saturated portion of the aquifer
Major streams
N
10 Miles
RA
GHDC
PL
NT
CN
SH
TH
SD
GY
SF
PR
KW
HS
SV
MT
SW


Total Statewide Water Use, 1981-2005
Acre-feet/year
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005

Water Availability

In areas closed to new water rights, additional water use for population growth or new industry can only be accommodated through purchase and conversion of existing water rights

Changes must pertain to the same local source of supply

Changes from irrigation to another use such as municipal must not increase consumptive use

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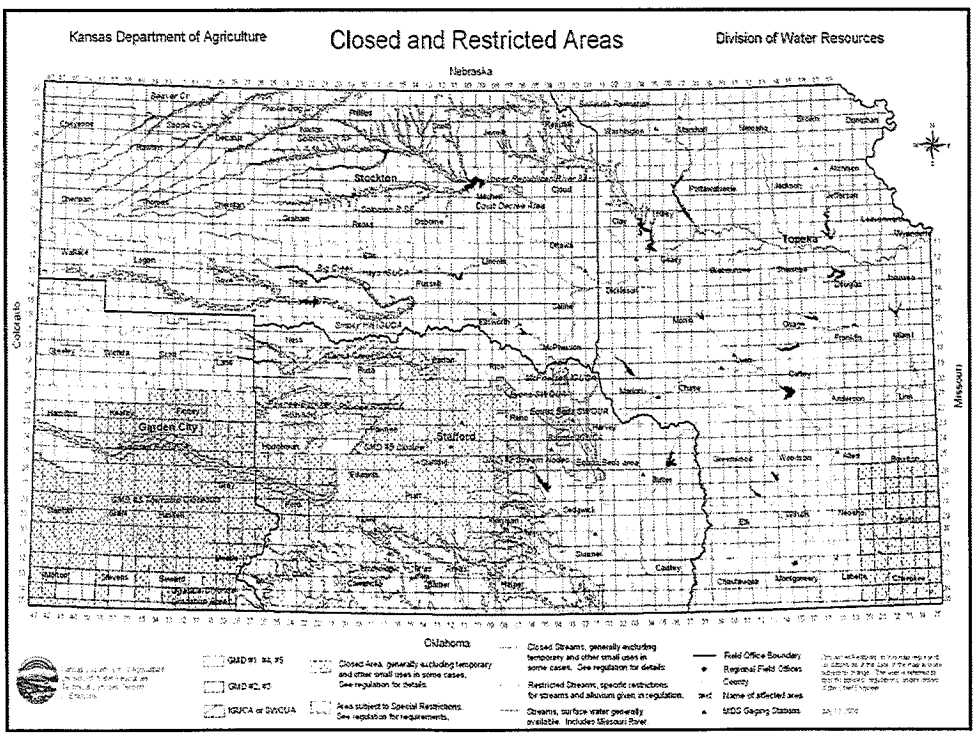

Water Law Changes

Year	Updates to Water Laws
1973	Groundwater Management District Act
1978	KWAA amended to require water rights for all non-domestic uses
1978	GMD Act amended, IGUCA provision added
Early 1980s	Significant new restrictions for new water rights (e.g., safe yield)
1984	Minimum desirable streamflows established
1989	Water use reporting improved via penalties for failure to report
2000	Significant new KWAA regulations

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Groundwater Management District Act

- Allows local control of groundwater policy within the bounds of state law
- Water users and landowners vote; Board elected and local funding
- Must adopt management program
- May recommend rules and regs, as well as IGUCAs
- The Chief Engineer must approve management plan and ensure policies do not conflict with the basic laws of the state

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Intensive Groundwater Use Control Areas (IGUCA)

- Water management tool that works in conjunction with the Kansas Water Appropriation Act
- Provides alternatives to strict administration of water rights by priority
- Allows for flexible solutions
- Chief engineer can amend an IGUCA in the public interest

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Intensive Groundwater Use Control Areas (IGUCA)

- Eight IGUCA's are located in the state
- Formal public hearings are held
- KDA recently developed a regulation that provides for an independent hearing officer to decide initiation of an IGUCA
- If an IGUCA is designated, corrective control provisions are implemented through an order

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Intensive Groundwater Use Control Areas (IGUCA)

- Advisory committees/task forces have been established to make recommendations
- KDA also developed a new regulation to require formal reviews of IGUCAs to determine whether they should be continued

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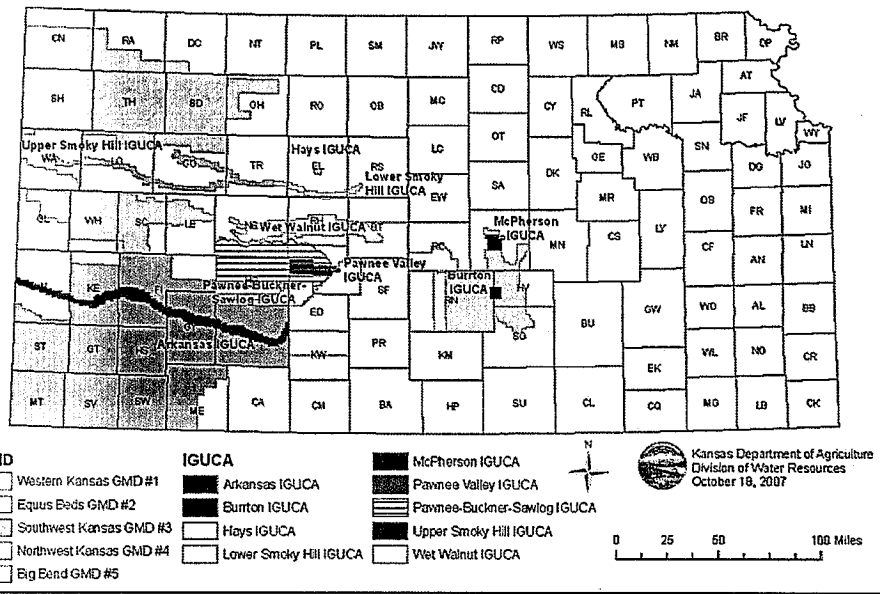
Intensive Groundwater Use Control Areas in Kansas



State Water Plan Storage Act

- Authorizes state-controlled storage in federal reservoirs
- Yield based on 2 percent chance of drought
- Considers existing and future needs of applicants
- Releases made pursuant to contracts
- Releases protected from use by other users

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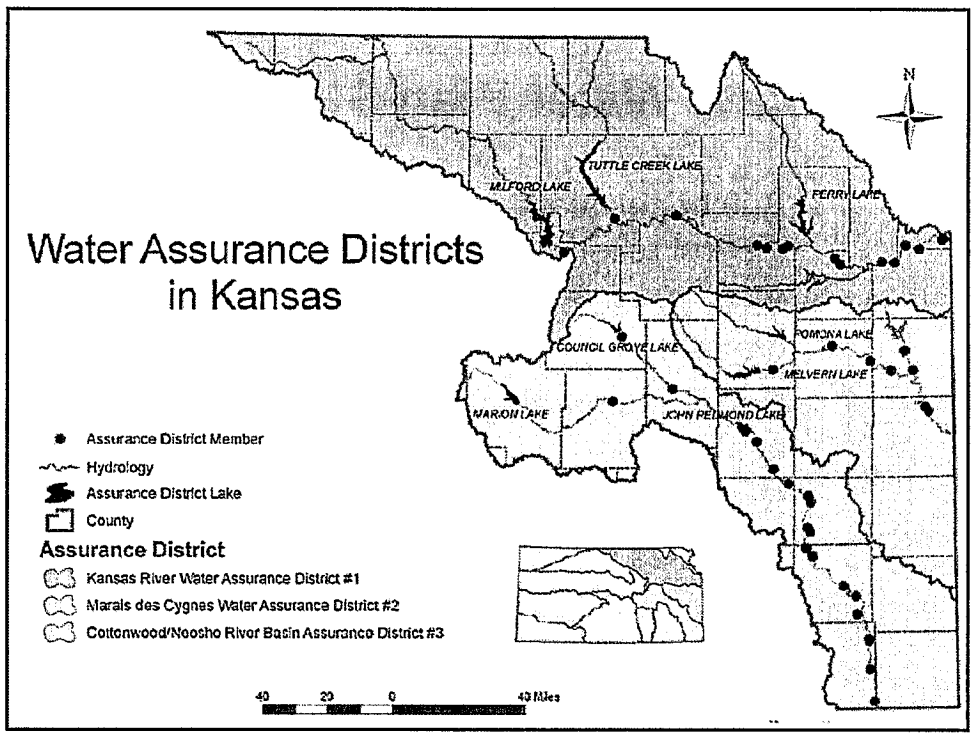
Water Assurance Program Act

- Based on 1985 agreement with the Corps of Engineers
  - Requires state to protect water quality releases
- Allowed state to acquire additional storage at original cost
- Operate reservoirs as a system to meet downstream needs
- Limited to municipal and industrial water rights

KANSAS DEPARTMENT OF AGRICULTURE



Water Transfer Act

- Requires a hearing for any proposal to divert and transport 2,000 acre-feet of water or more per year for beneficial use at a location greater than 35 miles from the source
- Does not include a release of water from a reservoir to the water's natural watercourse for use within the natural watercourse or watershed, made under the authority of the state water plan

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Water Transfer Act

- Presiding officer conducts a hearing and renders an initial order approving or denying an application for water transfer
- The review of the hearing officer's order is made by a panel consisting of the Chief Engineer, the Director of the KWO and the Secretary of KDHE or Director of the Division of Environment, which shall constitute the final order

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Current Management

- All areas now closed or subject to "safe yield", comparing the source of supply vs. existing water rights
- Changes to water rights cannot increase consumptive use or impair other water rights
- Improved compliance and enforcement, water use reporting

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Looking to the Future

- The state has a good set of laws to regulate water development and use, but challenges remain
  - Non-sustainable development in western Kansas resulting in declining baseflow to streams, inflows to reservoirs; increased impairment complaints; uncertainty on future supplies
  - More firm supplies to meet future needs
  - Reservoir sediment reducing yields

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Looking to the Future

- Kansas required to meet interstate compact commitments in addition to in-state needs
  - Using state-of-the-art computer modeling to evaluate supplies and management
  - Coordination and policy development through Kansas Water Authority and water plan processes, interaction with GMDs and other districts and stakeholders
  - Local input important, state control necessary

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Looking to the Future

Agencies charged to administer water laws need adequate resources and support

- Division of Water Resources has experienced a 20 percent State General Fund budget reduction in fiscal years 2009 and 2010, which is resulting in a 20 percent staff reduction
- Modest fee increases to sustain current services requested in 2009 were not passed

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Topics for the Presentation in Afternoon

- Water use for energy production
- Water resources near Wolf Creek
- Wolf Creek water rights and assurance district contracts
- Options for securing additional water
- Kansas Water Office will discuss regional supplies

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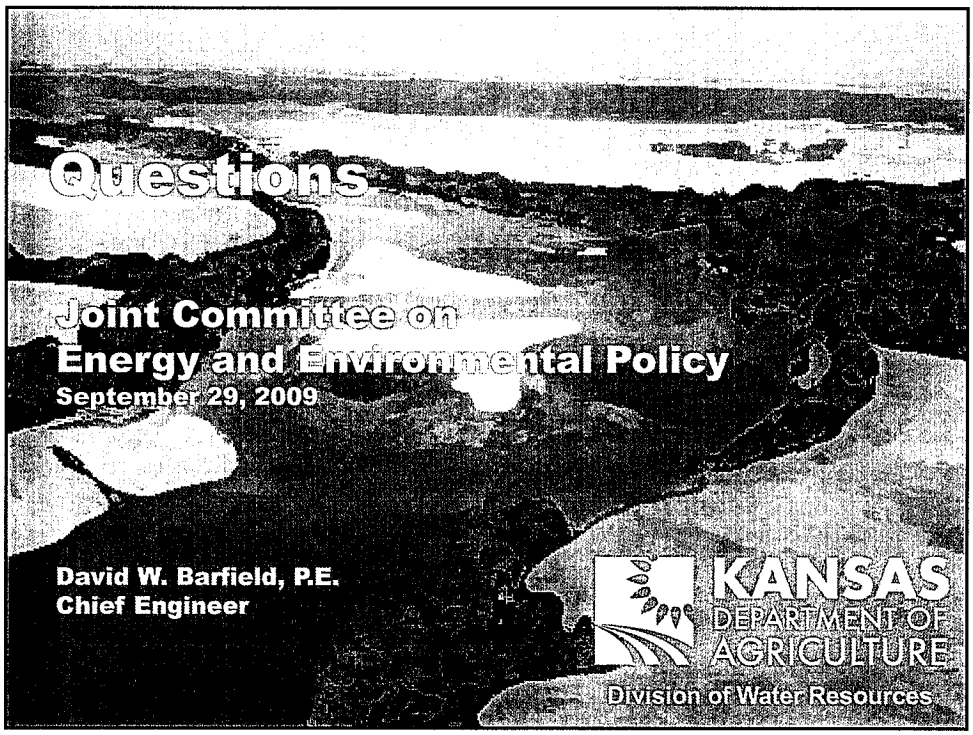
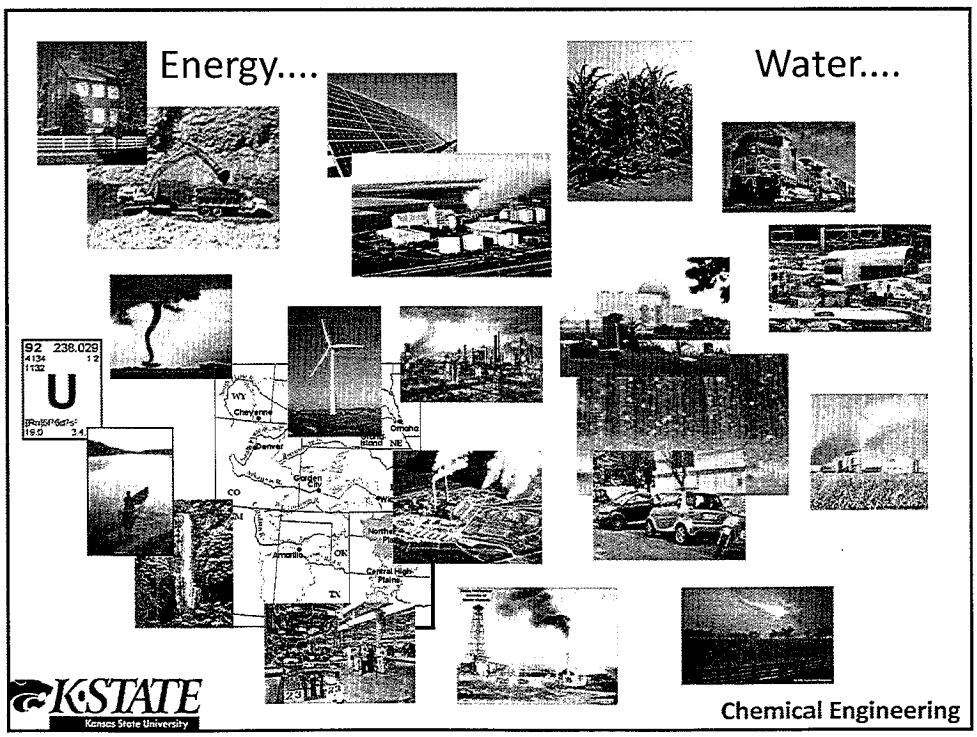

Questions
Joint Committee on
Energy and Environmental Policy
September 29, 2009
David W. Barfield, P.E.
Chief Engineer
KANSAS
DEPARTMENT OF
AGRICULTURE
Division of Water Resources

The Energy-Water Nexus

Presentation to the
Joint Committee on Energy and Environmental Policy
September 29, 2009

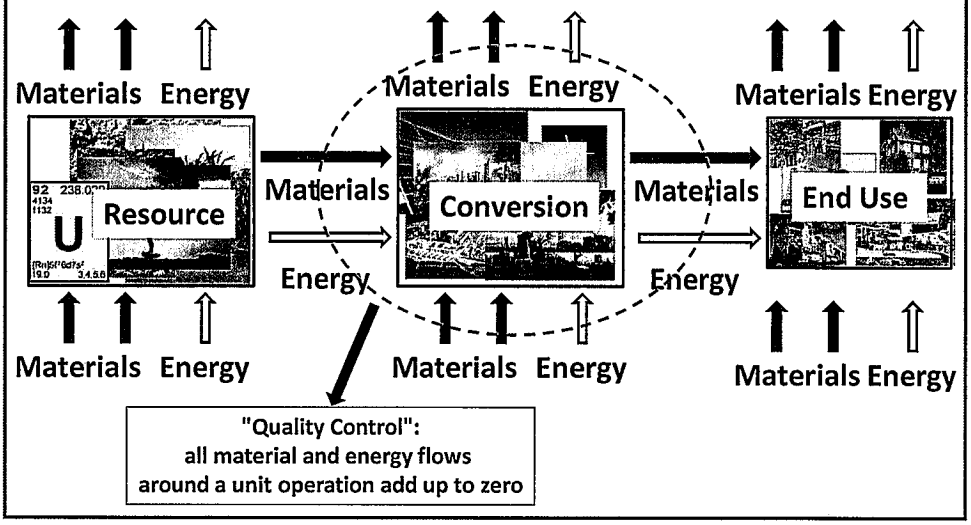
Peter H. Pfromm
Professor
Department of Chemical Engineering
Kansas State University

K-STATE Kansas State University
Chemical Engineering



Joint Committee on Energy and Environmental Policy
Date 29 SEPT 2009
Attachment # 3

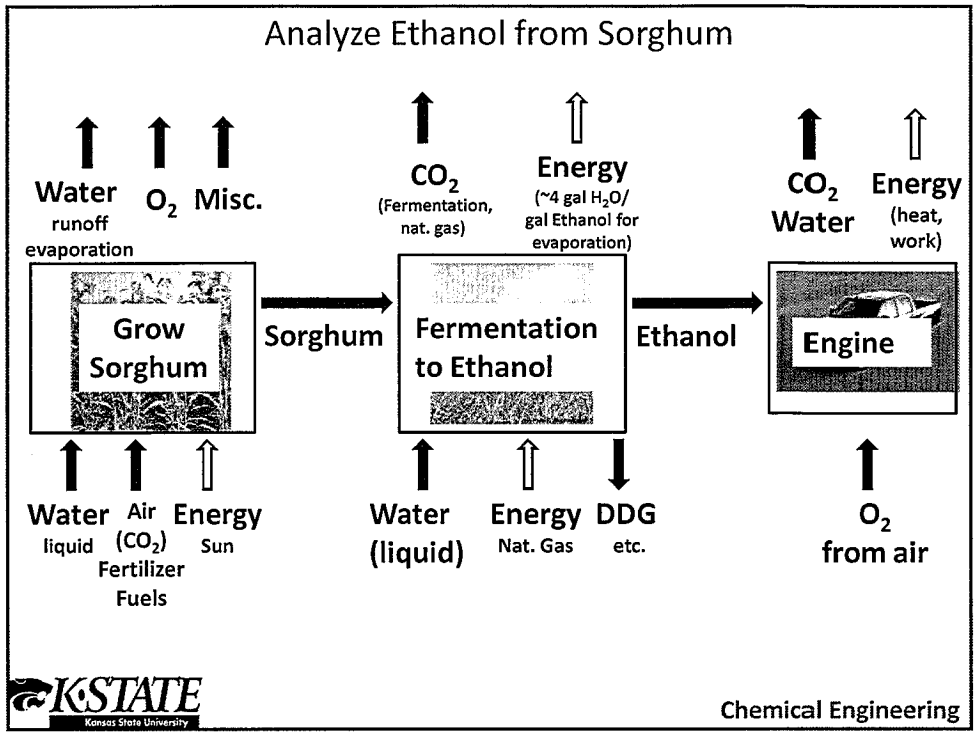
"Unit Operations"
conservation of mass, conservation of energy:
"In equals Out" at steady state, an unassailable approach

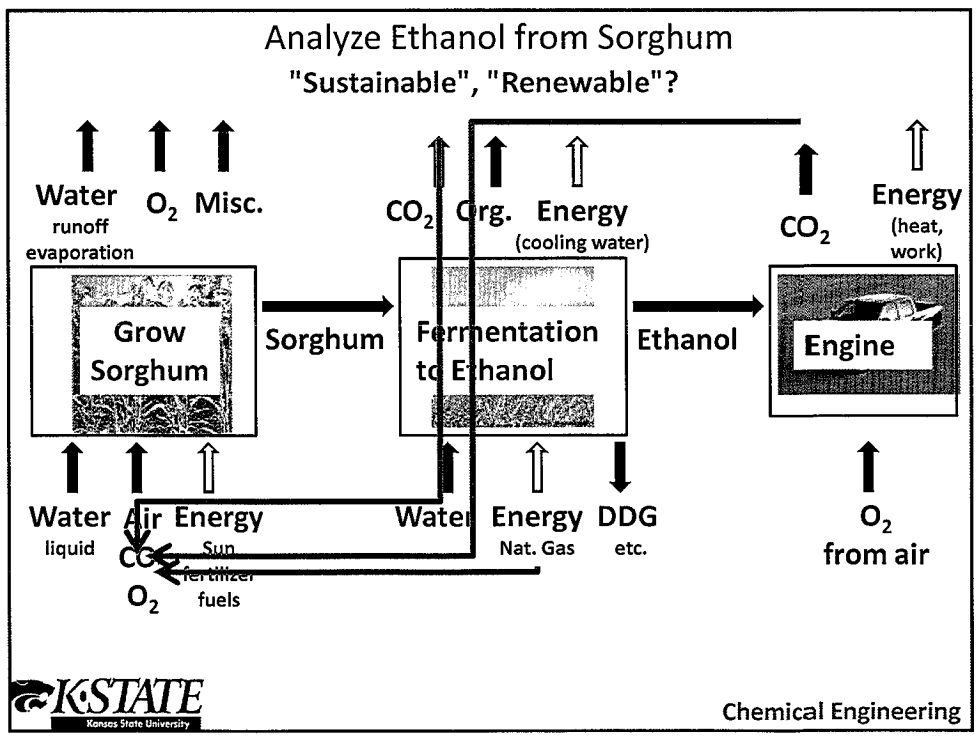


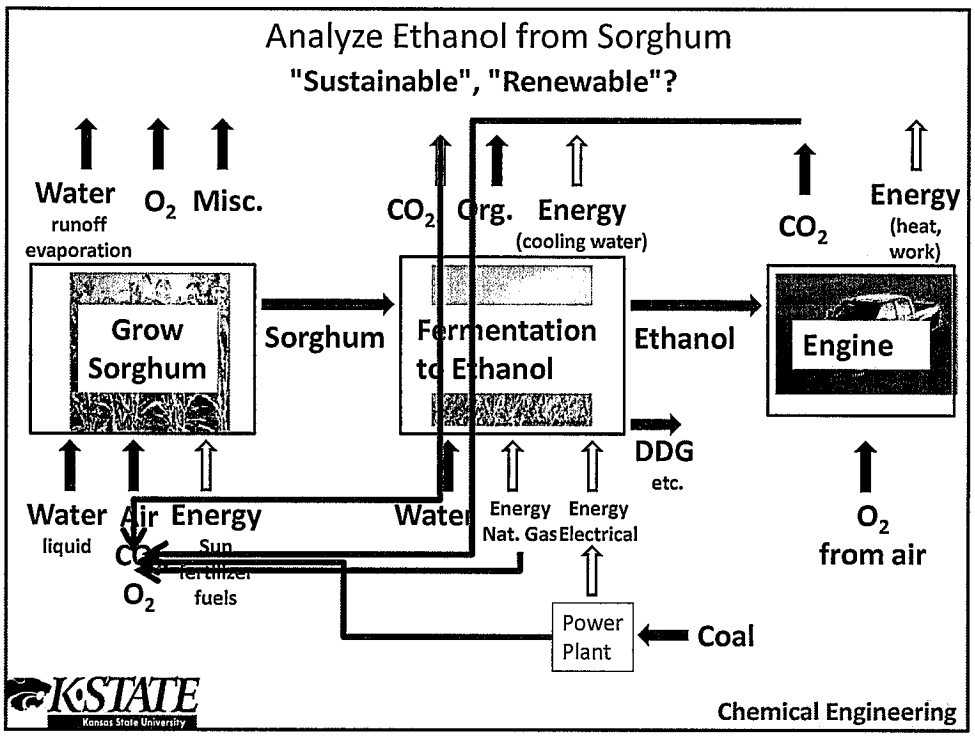
Energy, unit: Joule [J], BTU etc. (time is no object)

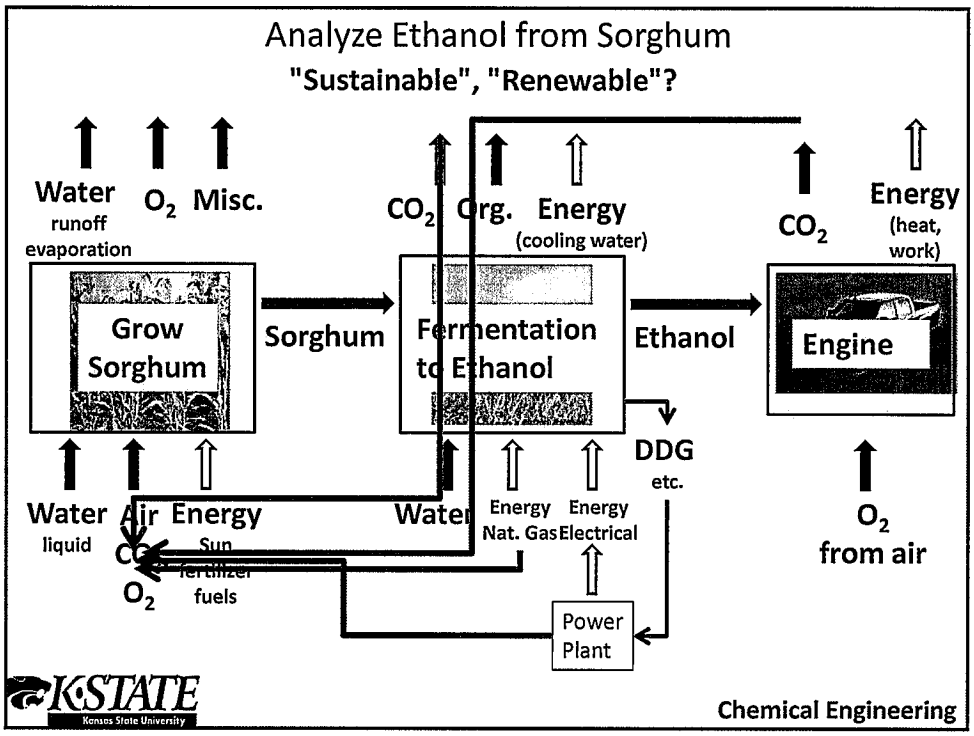
Power, unit: Joule per second = 1 Watt

Example coal fired power plant:	1000 MW_{el}
Hair dryer	0.0019 MW_{el}
100 Million Gallon per year Ethanol from Corn (state of the art, with DDG):	~43 MW_{el}
One large windmill (GE):	~1.5 MW_{el}
Sun, 1 m^2 area solar panel:	~0.0002 MW_{el}
Boeing 747 cruising Mach 0.9, 40,000 ft:	~65 MW_{mech}


Analyze Ethanol from Sorghum
Water
runoff
evaporation
O_2
Misc.
CO_2
(Fermentation, nat. gas)
Energy
(~4 gal H_2O/ gal Ethanol for evaporation)
CO_2
Water
Energy
(heat, work)
Grow Sorghum
Sorghum
Fermentation to Ethanol
Ethanol
Engine
Water
liquid
Air
(CO_2)
Fertilizer
Fuels
Energy
Sun
Water
(liquid)
Energy
Nat. Gas
DDG
etc.
O_2
from air
KSTATE
Kansas State University
Chemical Engineering


Analyze Ethanol from Sorghum
"Sustainable", "Renewable"?
Water
runoff
evaporation
O_2
Misc.
CO_2
Org.
Energy
(cooling water)
CO_2
Energy
(heat, work)
Grow Sorghum
Sorghum
Fermentation to Ethanol
Ethanol
Engine
Water
liquid
Air
CO_2
O_2
Energy
Sun
fertilizer
fuels
Water
Energy
Nat. Gas
DDG
etc.
O_2
from air
KSTATE
Kansas State University
Chemical Engineering


Analyze Ethanol from Sorghum
"Sustainable", "Renewable"?
Water
runoff
evaporation
O_2
Misc.
CO_2
Org.
Energy
(cooling water)
CO_2
Energy
(heat,
work)
Grow
Sorghum
Sorghum
Fermentation
to Ethanol
Ethanol
Engine
DDG
etc.
Water
liquid
Air
Energy
Sun
fertilizer
fuels
Water
Energy
Nat. Gas
Energy
Electrical
O_2
from air
O_2
Power
Plant
Coal
K-STATE
Kansas State University
Chemical Engineering


Analyze Ethanol from Sorghum
"Sustainable", "Renewable"?
Water
runoff
evaporation
O_2
Misc.
CO_2
Org.
Energy
(cooling water)
CO_2
Energy
(heat,
work)
Grow
Sorghum
Sorghum
Fermentation
to Ethanol
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Water
liquid
Air
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Sun
fertilizer
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from air
O_2
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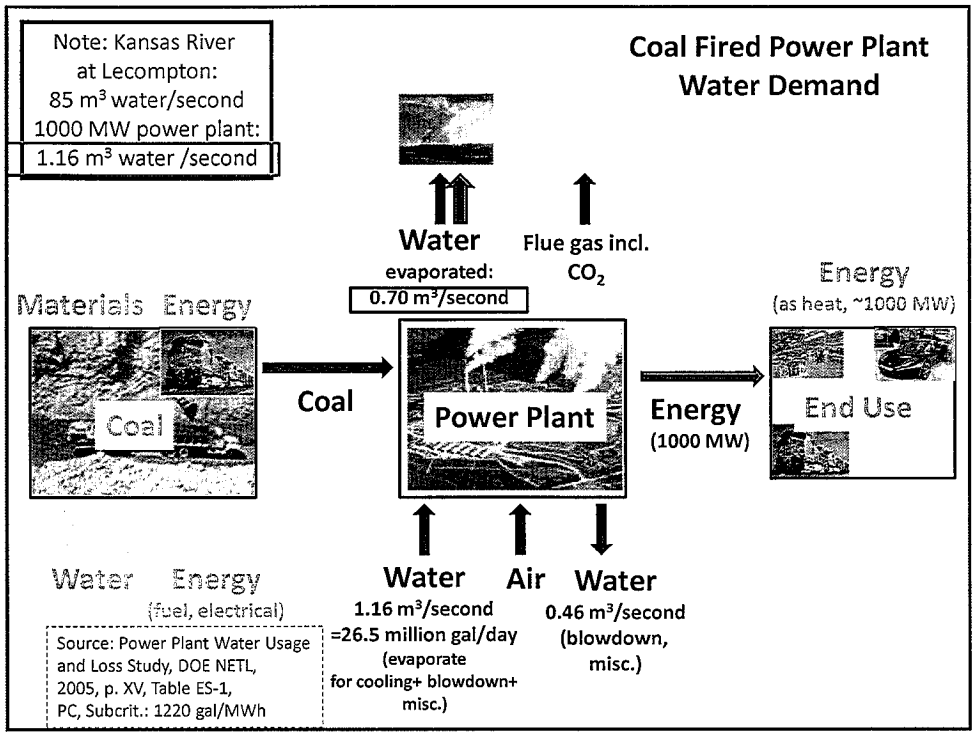
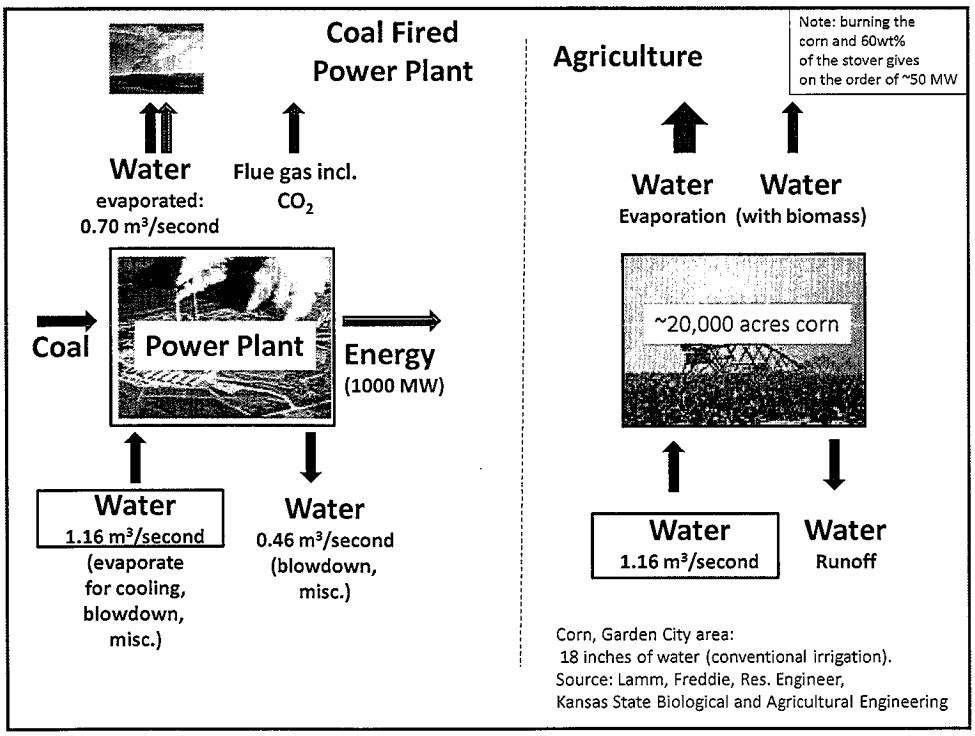
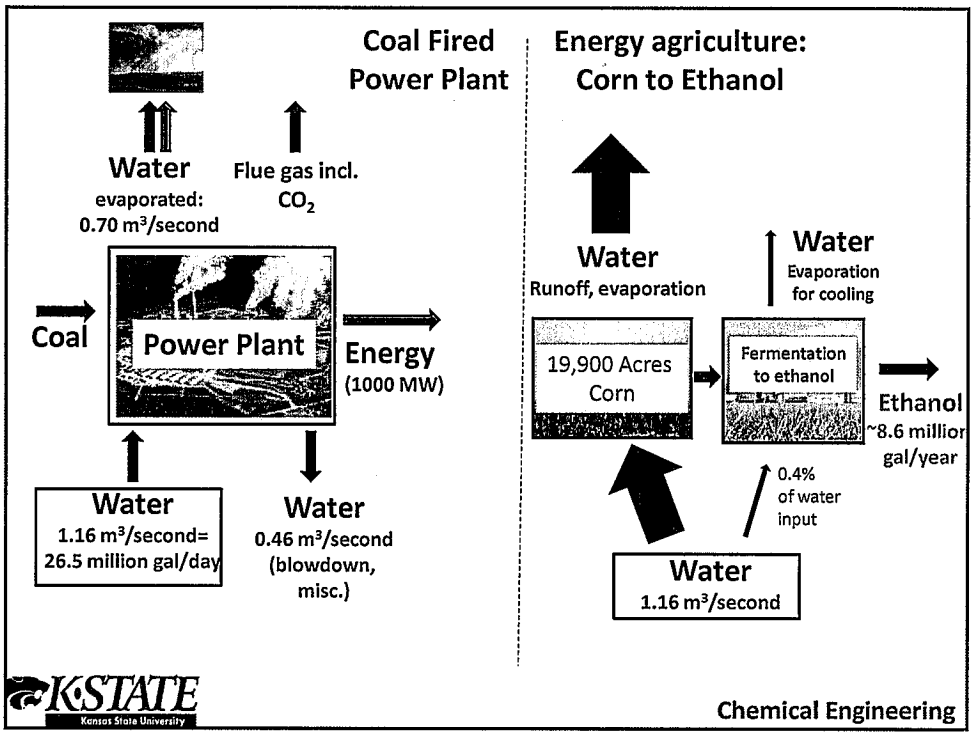
K-STATE
Kansas State University
Chemical Engineering


Note: Kansas River at Lecompton:
85 m³ water/second
1000 MW power plant:
1.16 m³ water /second
Coal Fired Power Plant Water Demand
Water
evaporated:
0.70 m³/second
Flue gas incl. CO_2
Materials Energy
Coal
Coal
Power Plant
Energy
(1000 MW)
Energy
(as heat, ~1000 MW)
End Use
Water Energy
(fuel, electrical)
Water
1.16 m³/second
=26.5 million gal/day
(evaporate for cooling+ blowdown+ misc.)
Air
Water
0.46 m³/second
(blowdown, misc.)
Source: Power Plant Water Usage and Loss Study, DOE NETL, 2005, p. XV, Table ES-1, PC, Subcrit.: 1220 gal/MWh


Coal Fired Power Plant
Water
evaporated:
0.70 m³/second
Flue gas incl. CO_2
Coal
Power Plant
Energy
(1000 MW)
Water
1.16 m³/second
(evaporate for cooling, blowdown, misc.)
Water
0.46 m³/second
(blowdown, misc.)
Agriculture
Note: burning the corn and 60wt% of the stover gives on the order of ~50 MW
Water
Evaporation
Water
(with biomass)
~20,000 acres corn
Water
1.16 m³/second
Water
Runoff
Corn, Garden City area:
18 inches of water (conventional irrigation).
Source: Lamm, Freddie, Res. Engineer,
Kansas State Biological and Agricultural Engineering



Concluding Remarks

- Mass and energy balances (conservation of mass, 1st law of thermodynamics) are an unassailable tool to compare processes, including resources, conversion, and end use, in a transparent and visual manner.
- Information presented based on *quantitative* mass and energy balances is clear and can be easily used for what-if scenarios.
- **Evaluation of any benefits of water use and the complex decisions in this regard always rest with policymakers.**

Chemical Engineering

K-STATE
Kansas State University

Questions?

Calculations and quantities shown above rely on assumptions.
Detailed assumptions, copies of slides, references used, calculations:
please e-mail pfromm@ksu.edu

KANSAS WATER ENERGY NEXUS

Nancy Jackson, Climate & Energy Project

Joint Committee on Energy & Environmental Policy

29 September 2009

WHAT DOES THIS MAN KNOW?

WATER IS THE NEW OIL

- Pickens owns water rights to over 65 billion gallons of water/year
- Plans to pump over 250 miles, 11 counties, and 650 tracts of private property to thirsty Dallas
- Has invested $100 million and 9 years
- Pickens is not alone:
  - Nestle, Dutch Shell, Bass Brothers

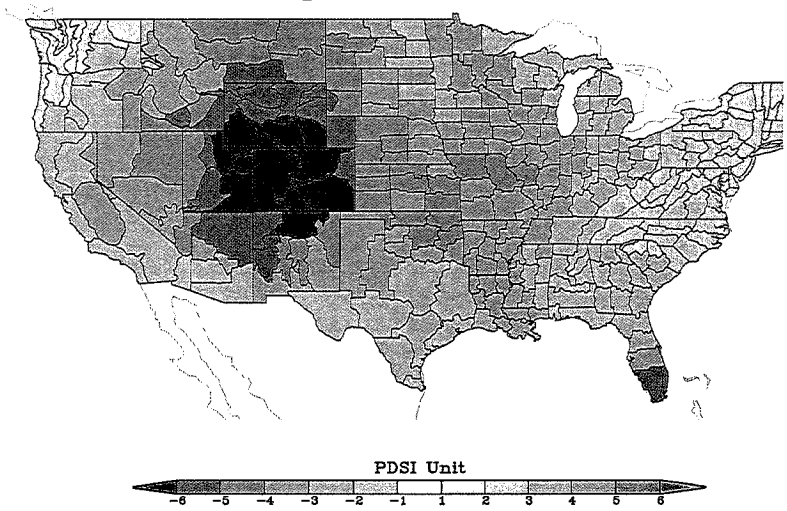
WHY?

47%

Portion of the world's population that will face severe water shortages by 2030.

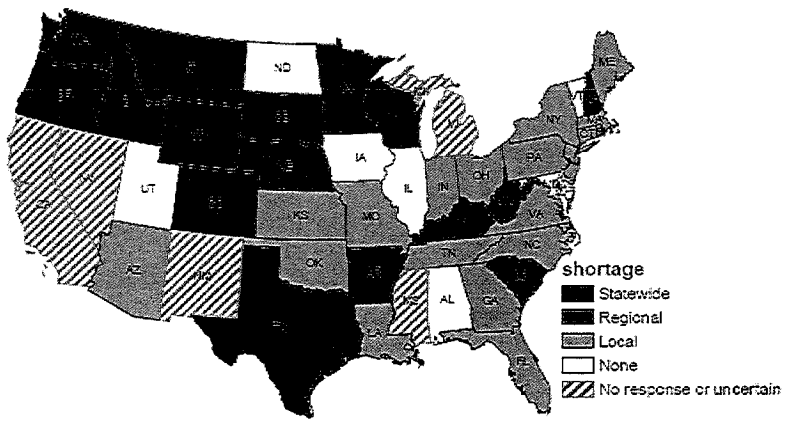
Organization for Economic Cooperation & Development

Palmer Drought Index 2035-2060



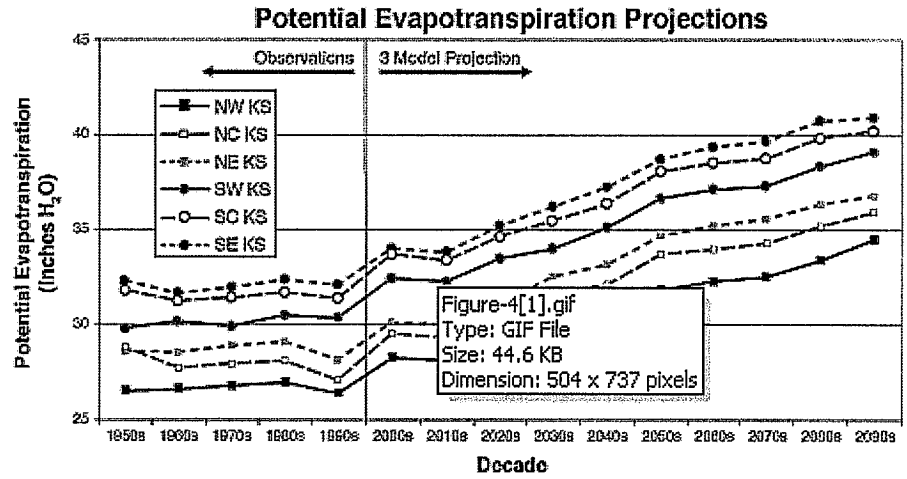
NOAA 2003

Likely Shortages Next Decade

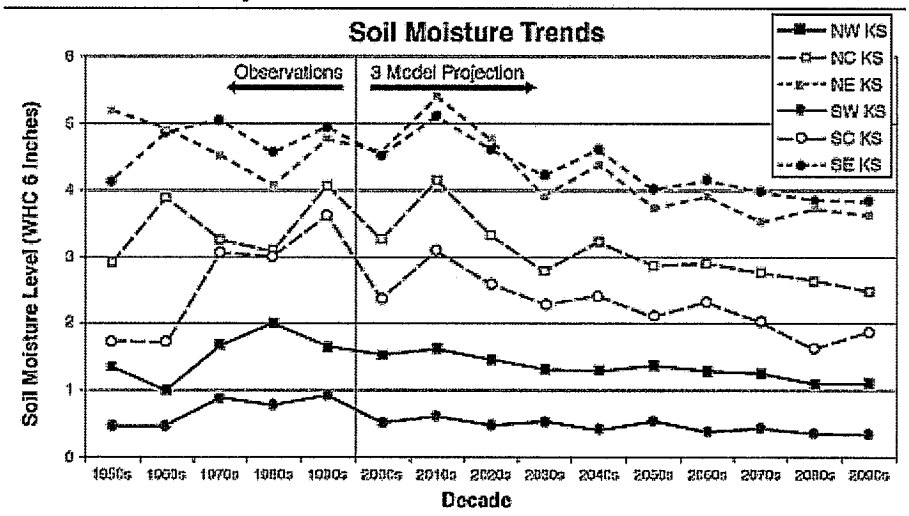


GAO, 2003

KU Study 2008



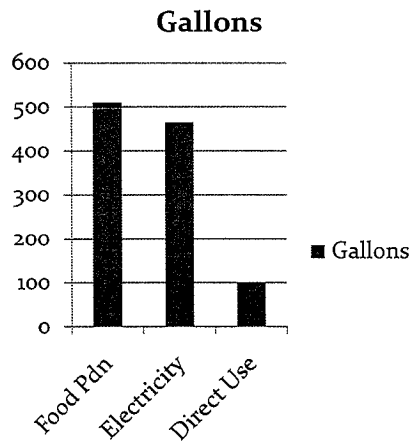
KU Study 2008



A Few Words on Western Water

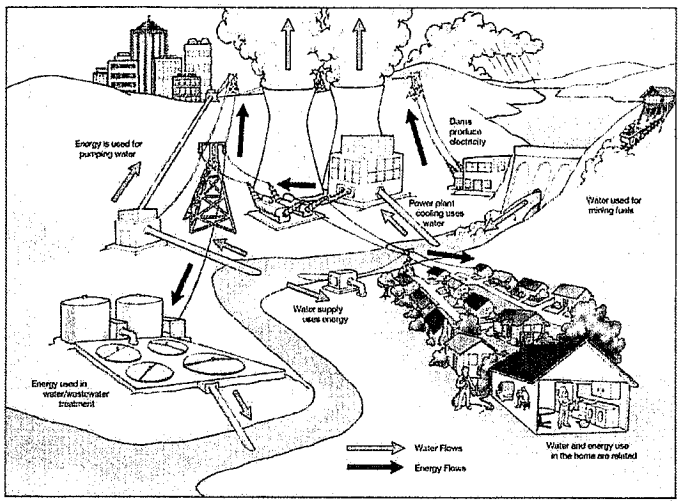
- "A man from the west will fight over three things: water, women and gold, and usually in that order." Senator Barry Goldwater
- "In the Western United States, water flows uphill to money." Glen Sanders
- "The solution to our water problems is more rain." Attributed to Mark Twain
- "Anyone who can solve the problems of water will be worthy of two Nobel prizes - one for peace and one for science." John F. Kennedy

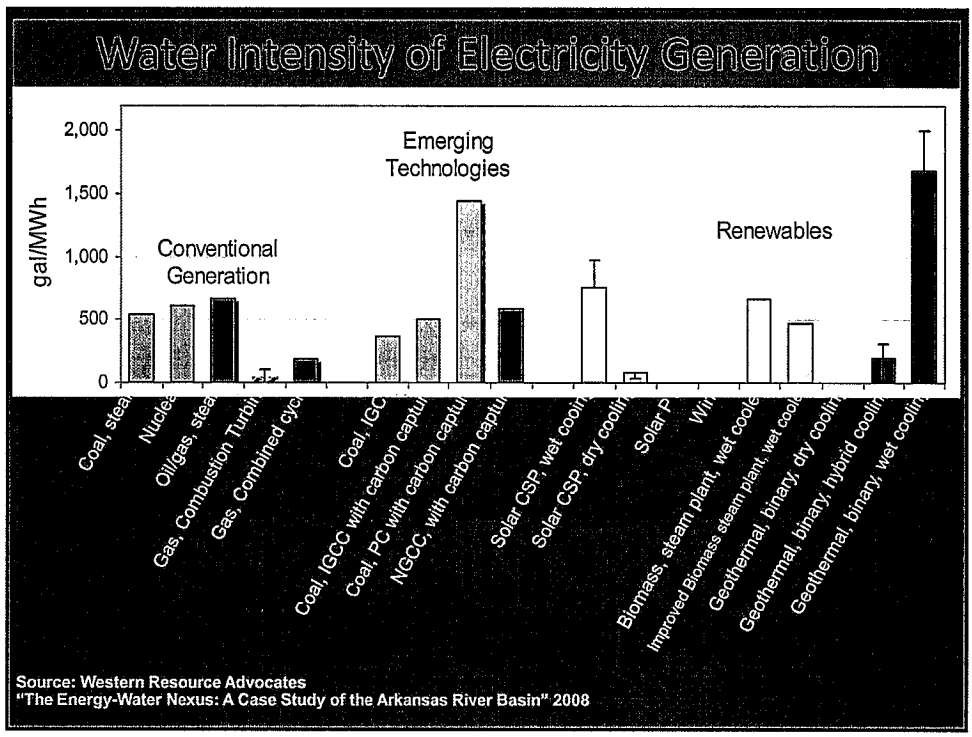
Energy Requires Water



- 510 for food production
  - Irrigation & livestock
- 465 to produce household electricity
  - Range is 30-600 depending on technology
- 100 for direct household use
  - Includes bathing, laundry, lawn watering

Energy-Water Nexus – U.S.DOE





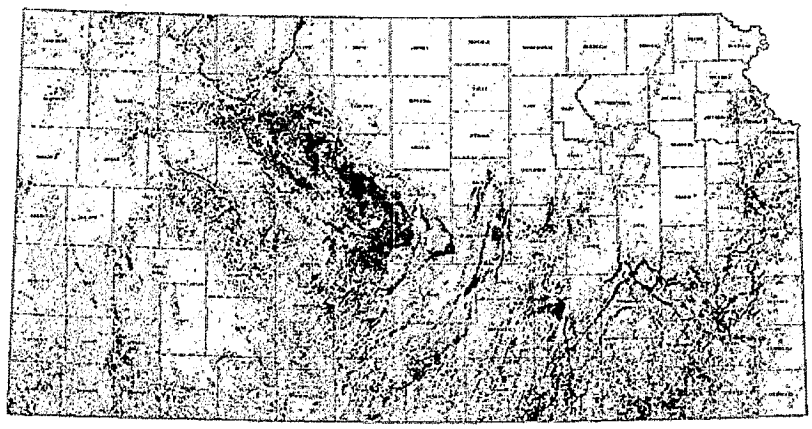
Energy Element	Connection to Water Quantity	Connection to Water Quality
Energy Extraction and Production		
Oil and Gas Exploration	Water for drilling, completion, and fracturing	Impact on shallow groundwater quality
Oil and Gas Production	Large volume of produced, impaired water*	Produced water can impact surface and groundwater
Coal and Uranium Mining	Mining operations can generate large quantities of water	Tailings and drainage can impact surface water and ground-water
Electric Power Generation		
Thermo-electric (fossil, biomass, nuclear)	Surface water and groundwater for cooling** and scrubbing	Thermal and air emissions impact surface waters and ecology
Hydro-electric	Reservoirs lose large quantities to evaporation	Can impact water temperatures, quality, ecology
Solar PV and Wind	None during operation; minimal water use for panel and blade washing	

*Impaired water may be saline or contain contaminants

Energy Element	Connection to Water Quantity	Connection to Water Quality
Refining and Processing		
Traditional Oil and Gas Refining	Water needed to refine oil and gas	End use can impact water quality
Biofuels and Ethanol	Water for growing and refining	Refinery waste-water treatment
Synfuels and Hydrogen	Water for synthesis or steam reforming	Wastewater treatment
Energy Transportation and Storage		
Energy Pipelines	Water for hydrostatic testing	Wastewater requires treatment
Coal Slurry Pipelines	Water for slurry transport; water not returned	Final water is poor quality; requires treatment
Barge Transport of Energy	River flows and stages impact fuel delivery	Spills or accidents can impact water quality
Oil and Gas Storage Caverns	Slurry mining of caverns requires large quantities of water	Slurry disposal impacts water quality and ecology

**Includes solar and geothermal steam-electric plants

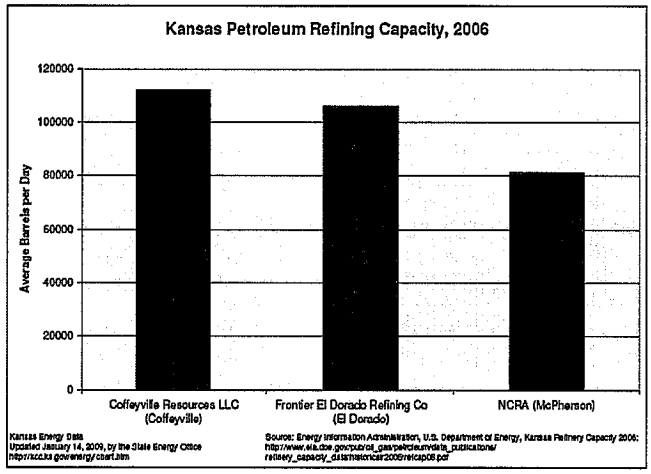
Oil & Gas Well Locations Across Kansas



This map shows the distribution of over 240,000 oil and gas wells in Kansas. Well locations include active, abandoned and all other wells that are in the Conservation Division KGS/KID. This data is still under development and subject to change.

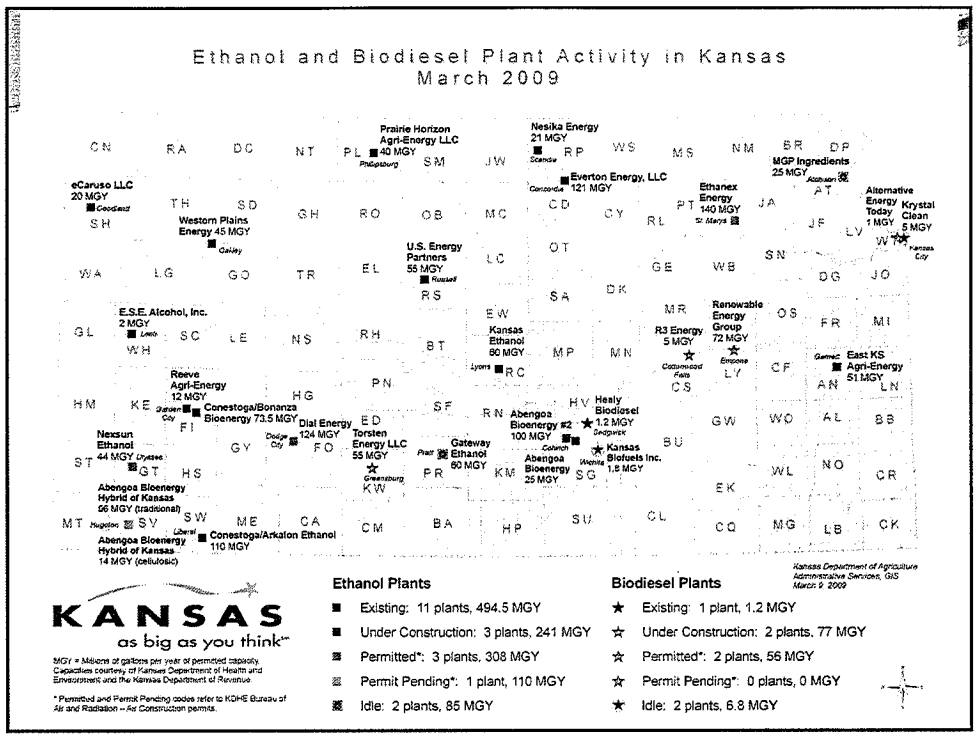
Kansas Corporation Commission
Utilities Division, GIS Section
13 June 2008

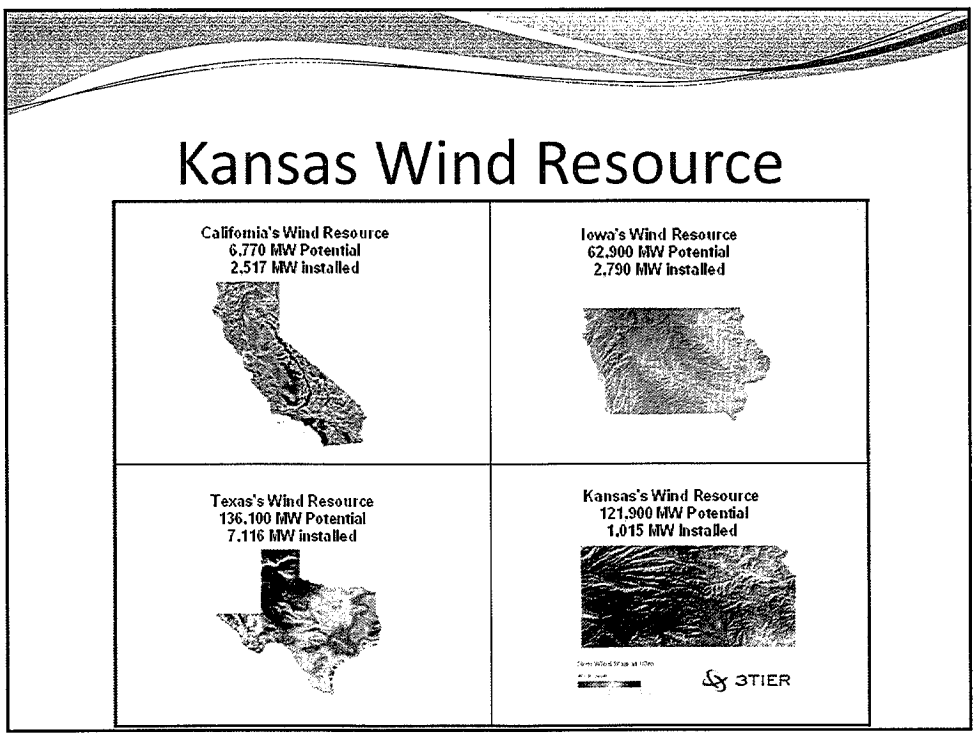
Kansas Petroleum Refining Capacity, 2006



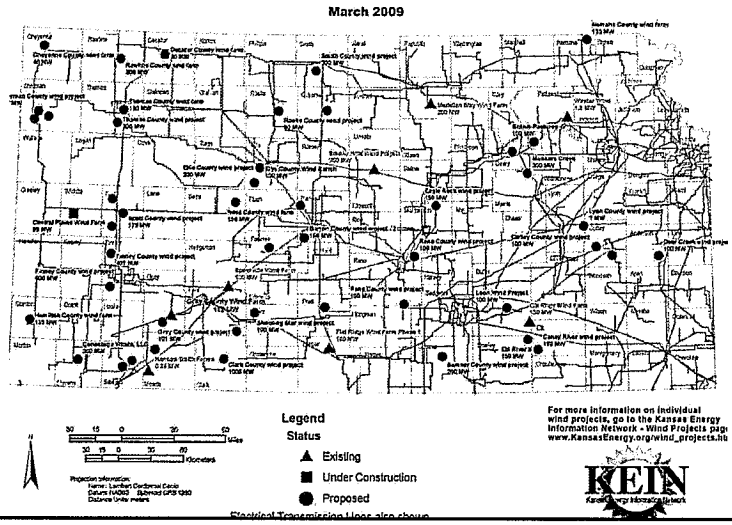
Kansas Energy Data
Updated January 14, 2009, by the State Energy Office
http://access.gov/energy/chart.htm

Source: Energy Information Administration, U.S. Department of Energy, Kansas Refinery Capacity 2006: http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/refinery_capacity_data/statecap2006/ks/capks.pdf

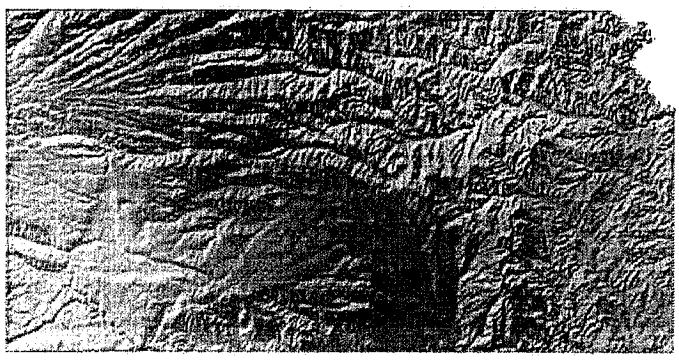

Ethanol and Biodiesel Plant Activity in Kansas
March 2009
Prairie Horizon Agri-Energy LLC 40 MGY
Nesika Energy 21 MGY
Everton Energy, LLC 121 MGY
MGP Ingredients 25 MGY
eCaruso LLC 20 MGY
Western Plains Energy 45 MGY
Ethanex Energy 140 MGY
Alternative Energy Today 1 MGY
Krystal Clean 5 MGY
U.S. Energy Partners 55 MGY
E.S.E. Alcohol, Inc. 2 MGY
Renewable Energy Group 72 MGY
R3 Energy 5 MGY
Kansas Ethanol 80 MGY
East KS Agri-Energy 51 MGY
Reeve Agri-Energy 12 MGY
Conestoga/Bonanza Bioenergy 73.5 MGY
Dial Energy 124 MGY
Nexsun Ethanol 44 MGY
Torsten Energy LLC 55 MGY
Gateway Ethanol 80 MGY
Abengoa Bioenergy 100 MGY
Healy Biodiesel 1.2 MGY
Kansas Biofuels Inc. 1.8 MGY
Abengoa Bioenergy 25 MGY
Abengoa Bioenergy Hybrid of Kansas 66 MGY (traditional)
Abengoa Bioenergy Hybrid of Kansas 14 MGY (cellulosic)
Conestoga/Arkalon Ethanol 110 MGY
Kansas Department of Agriculture Administrative Services, GIS March 9, 2009
KANSAS
as big as you think
MGY = Millions of gallons per year of permitted capacity.
Capacities courtesy of Kansas Department of Health and Environment and the Kansas Department of Revenue.
* Permitted and Permit Pending codes refer to KDHE Bureau of Air and Radiation – Air Construction permits.
Ethanol Plants
Existing: 11 plants, 494.5 MGY
Under Construction: 3 plants, 241 MGY
Permitted*: 3 plants, 308 MGY
Permit Pending*: 1 plant, 110 MGY
Idle: 2 plants, 85 MGY
Biodiesel Plants
Existing: 1 plant, 1.2 MGY
Under Construction: 2 plants, 77 MGY
Permitted*: 2 plants, 56 MGY
Permit Pending*: 0 plants, 0 MGY
Idle: 2 plants, 6.8 MGY

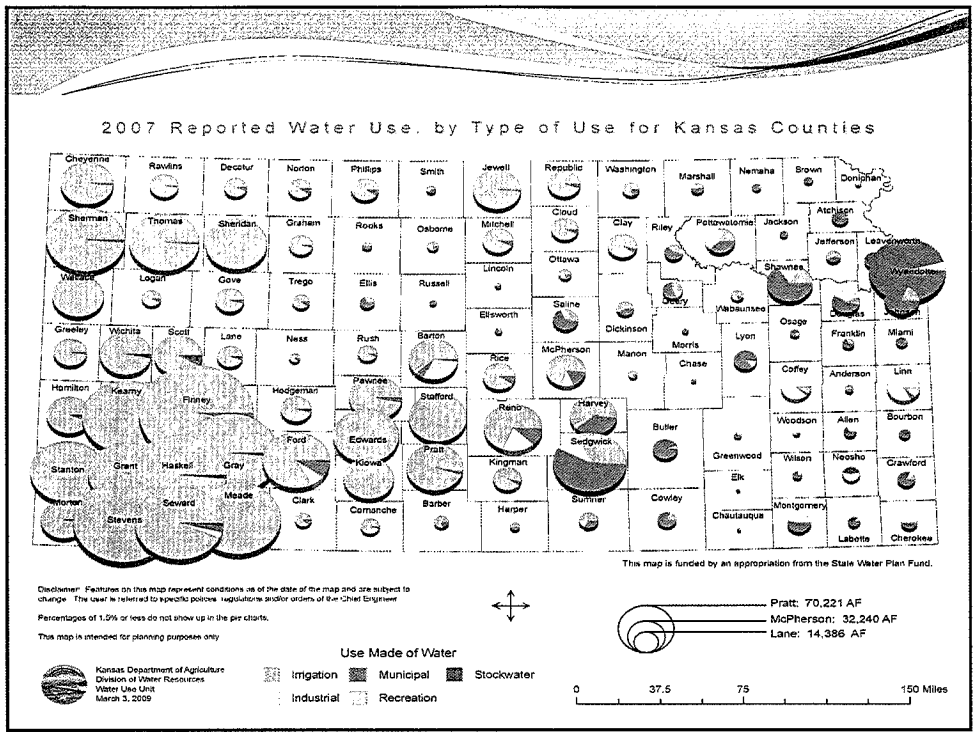

Kansas Wind Resource
California's Wind Resource
6,770 MW Potential
2,517 MW installed
Iowa's Wind Resource
62,900 MW Potential
2,790 MW installed
Texas's Wind Resource
136,100 MW Potential
7,116 MW installed
Kansas's Wind Resource
121,900 MW Potential
1,015 MW Installed
3TIER

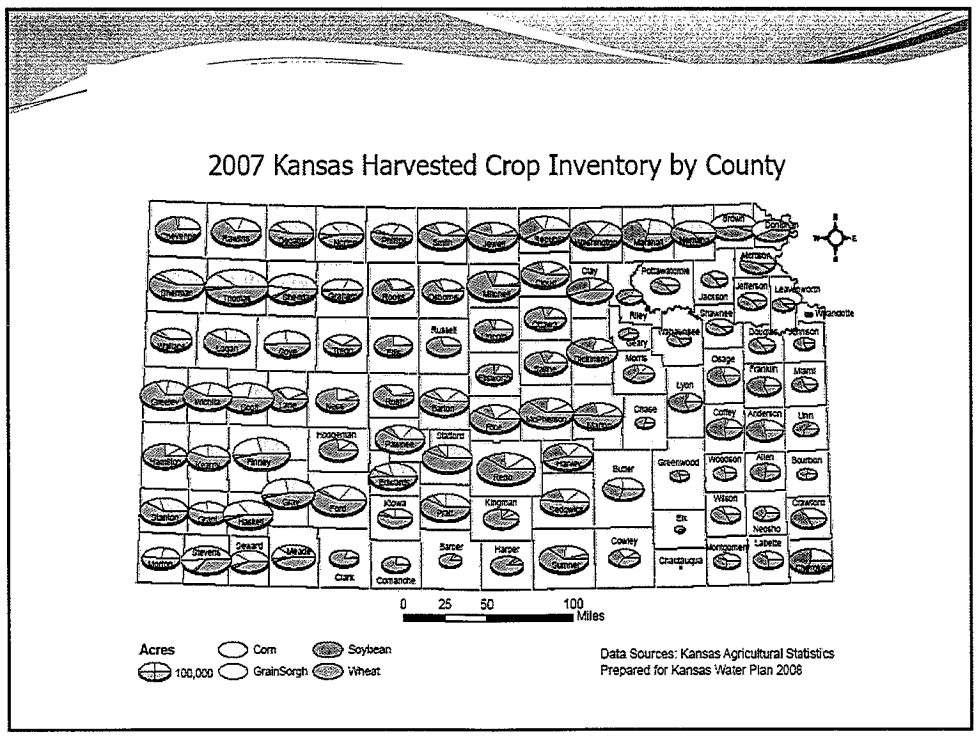
Proposed & Existing Wind Farms



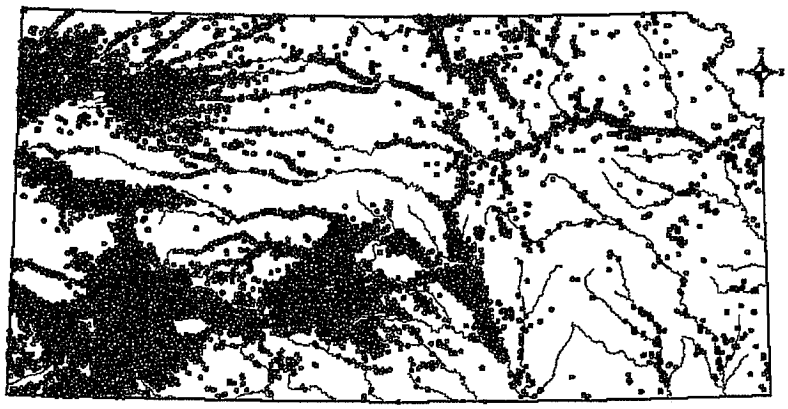
Kansas Solar Resource




2007 Reported Water Use, by Type of Use for Kansas Counties
This map is funded by an appropriation from the State Water Plan Fund.
Disclaimer: Features on this map represent conditions as of the date of the map and are subject to change. The user is referred to specific policies, regulations and/or orders of the Chief Engineer.
Percentages of 1.0% or less do not show up in the pie charts.
This map is intended for planning purposes only.
Kansas Department of Agriculture
Division of Water Resources
Water Use Unit
March 3, 2009
Use Made of Water
Irrigation
Municipal
Stockwater
Industrial
Recreation
Pratt: 70,221 AF
McPherson: 32,240 AF
Lane: 14,386 AF
0
37.5
75
150 Miles


2007 Kansas Harvested Crop Inventory by County
0
25
50
100
Miles
Acres
100,000
Corn
GrainSorgh
Soybean
Wheat
Data Sources: Kansas Agricultural Statistics
Prepared for Kansas Water Plan 2008

Kansas
Irrigation Points of Diversion



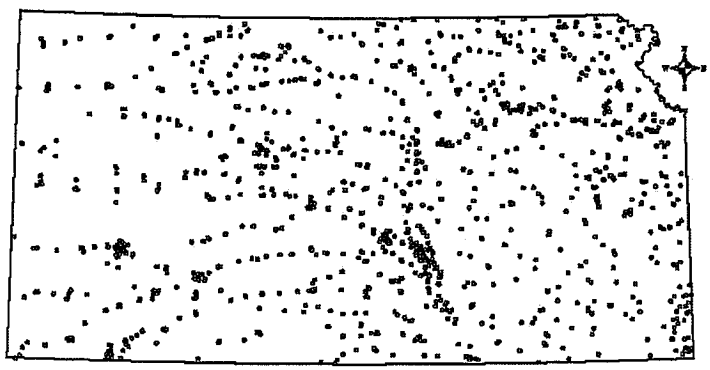
▪ Surface Water ▪ Ground Water

100 50 0 100 Miles

Data Source: Kansas Department of Agriculture, November 2008

Prepared for Kansas Water Plan 2008

Kansas
Municipal Points of Diversion

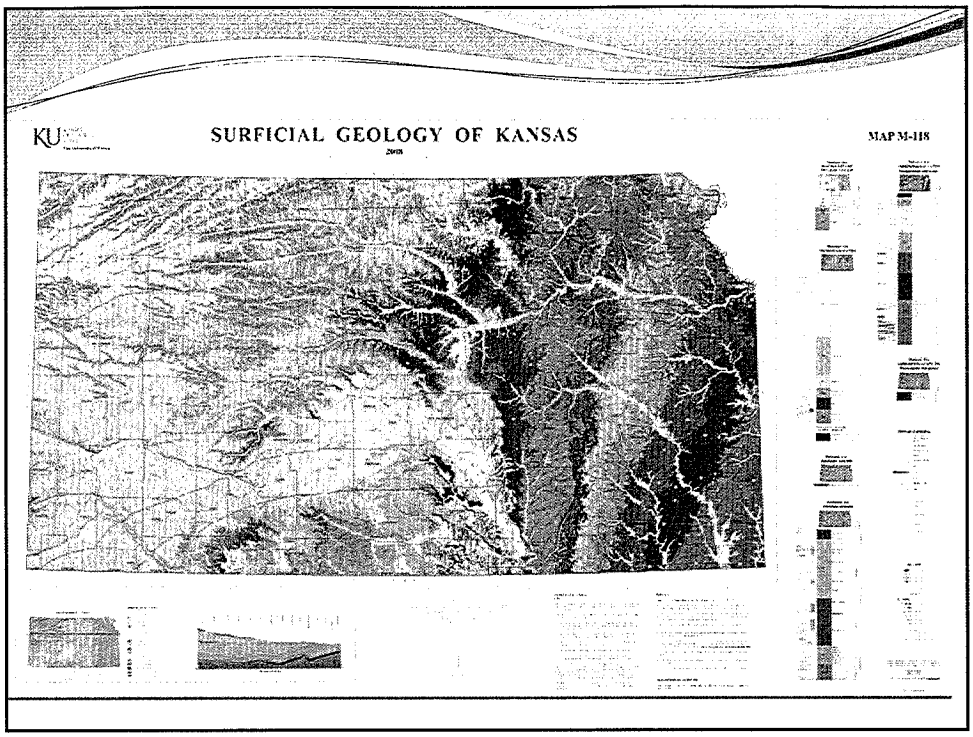


▪ Surface Water ▪ Ground Water

100 50 0 100 Miles

Data Source: Kansas Department of Agriculture, November 2008

Prepared for Kansas Water Plan 2008



THINKING ENTREPRENEURIALLY

- Sir Edmund Burke, an 18th century father of modern conservatism: "Society is a compact between the living, the dead, and the yet unborn."
- T. Boone Pickens proposes selling water – the very foundation of organic life – to the highest bidder.
- Water in the West *does* flow uphill to money.
- How does Kansas – a famously conservative state with an enviable water plan – approach the future?

ENERGY DEMANDS ON WATER RESOURCES: *The Federal Perspective*

***Betsy Woodhouse** – Southwest Hydrology, University of Arizona*

In response to a 2004 congressional directive, the U.S. Department of Energy (DOE) prepared a report to Congress on the interdependency of energy and water in the United States. As illustrated in the table at right, water is an integral element of energy resource and development.

The report, released earlier this year, has a national to regional focus and notes that much of the growth in electricity demand over the next 25 years is projected to occur in areas such as the Southwest where water supplies are already limited. Technologies are available that can reduce water use, such as wind and solar power, but economics, among other factors, have limited their deployment so far.

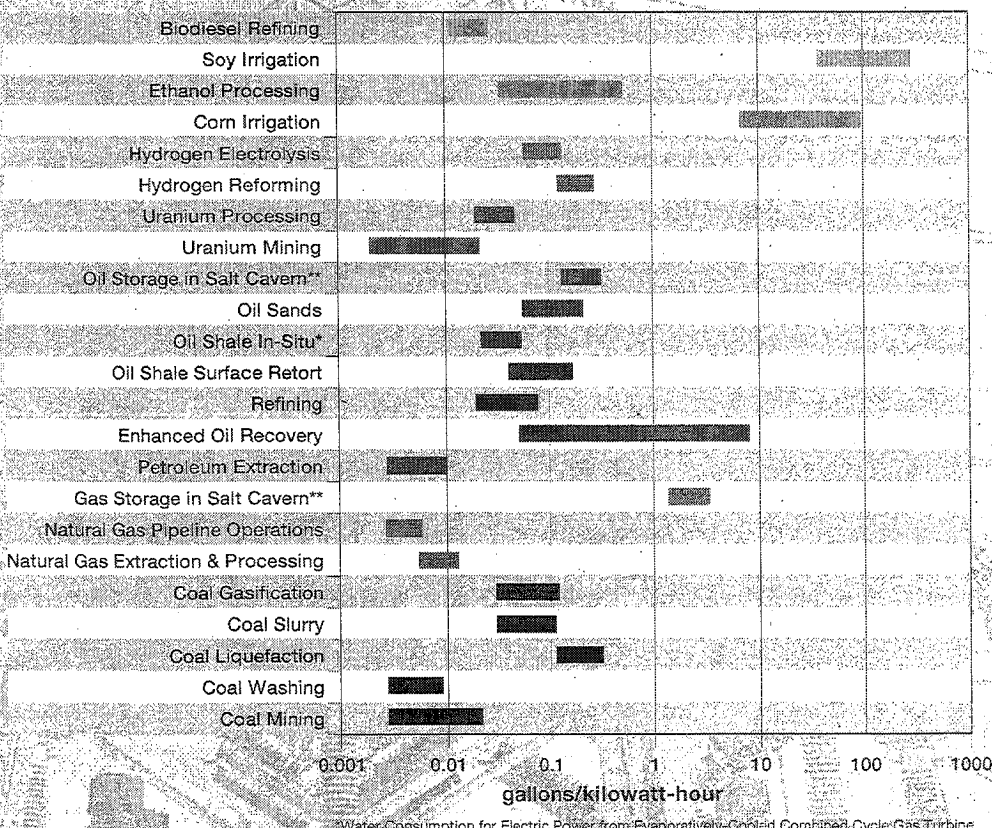
Managers and policy makers must now consider energy and water development so that each resource is used according to its full value. The chart at right shows water consumption for various stages of energy production, a consideration that will become increasingly important as new energy sources are developed.

What is the federal role in this issue? According to the report, federal agencies need to foster greater collaboration among federal, regional, and state agencies and with industry and other stakeholders. Science- and system-based policies are needed to ensure that regulations developed to support one area, such as greater domestic energy supplies, do not have unintended negative impacts on water resources or water quality. Finally, infrastructure synergies should be maximized to promote conservation of both energy and water.

The 80-page report, "Energy Demands on Water Resources: Report to Congress on the Interdependency of Energy and Water," prepared by Sandia National Laboratory with support from the National Energy Technology Laboratory and Los Alamos National Laboratory, is available at www.sandia.gov/energy-water/docs/121-RptToCongress-EWwEIAcomments-FINAL.pdf.

	Energy Element	Water Quantity Connection	Water Quality Connection
Energy Extraction & Production	Oil and gas exploration	Water used for drilling, completion, and fracturing	Shallow groundwater quality impacted
	Oil and gas production	Large volume of impaired water produced	Produced water can impact surface and groundwater quality
	Coal and uranium mining	Large quantities of water may be produced	Tailings and drainage can impact surface water and groundwater
Electric Power Generation	Thermoelectric (fossil, biomass, nuclear)	Surface water and groundwater used for cooling and scrubbing	Thermal and air emissions impact surface waters and ecology
	Hydroelectric	Reservoirs lose large quantities of water to evaporation	Water temperatures, quality, ecology can be impacted
	Solar photovoltaic and wind	Only minimal water used for panel and blade washing	None
Refining & Processing	Traditional oil and gas refining	Water used to refine oil and gas	End use can impact water quality
	Biofuels and ethanol	Water used in growing and refining	Wastewater requires treatment
	Synfuels and hydrogen	Water for synthesis or steam reforming	Wastewater requires treatment
Energy Transportation & Storage	Energy pipelines	Water used in hydrostatic testing	Wastewater requires treatment
	Coal slurry pipelines	Water used for slurry transport and not returned	Final water is of poor quality and requires treatment
	Barge transport of energy	Fuel delivery is impacted by river flows and stages	Spills or accidents can impact water qualty
	Oil and gas storage caverns	Large quantities of water required for slurry mining of caverns	Slurry disposal impacts water quality and ecology

Connections between the energy sector and water availability and quantity (from the Report to Congress on the Interdependency of Energy and Water).



Water consumption for various types of energy extraction, processing, storage, and transport (modified from the Report to Congress on the Interdependency of Energy and Water).

4-14

Joint Committee on Energy and Environmental Policy
9/29-30/09
Attachment 5

Nuclear Power Expansion in Kansas

Joint Committee on Energy and Environmental Policy

Presented by Mark Schreiber
Director Government Affairs

September 29, 2009

Westar Energy

Current Status

5-2

- Wolf Creek Generating Station began commercial operation in September 1985 with a 40 year operating license. Westar and KCPL each own 47%, with KEPCo owning 6%.
- In 2008, the operating license was extended 20 years to 2045.
- Current output equals 1160 MW.
- 28% improvement in MWh production since startup.
- Wolf Creek's average capacity factor over the last 3 years is 92%.

Current status (cont.)

5-3

- In 2008, Wolf Creek used 775 gal/MWh. This figure refers to water removed from the Neosho River below John Redmond Reservoir.
- The site was designed for two units of similar size and technology.
- With plant capacity improvements and uncertain water usage for the next generation of nukes, current cooling lake capacity may not support a second unit of similar or greater size.
- Contract water availability is uncertain.

Next Generation Nukes

5-4

- The next generation of nuclear power plants is called Generation III.
  - Currently about 30 new nuclear units are proposed. Most are proposed for existing sites along the east coast and in Texas.
  - From application to commercial operation = ~10 years
  - Cost is $6B to $9B based on estimates of proposed plants in Florida.
  - Market cap of Westar Energy today is $2.2B. Great Plains has a market cap of $2.4B.

Generation IV Nukes

5-5

- Generation IV nukes are being proposed for the 2030+ timeframe.
- These models will incorporate new cooling technologies, operate at higher temperatures and pressures using elements, such as helium, lead and sodium as reactor coolants, rather than water.
- Less nuclear waste
- Water usage may decline, but still uncertain.

Outlook

5-6

"We believe the appropriate place in our supply plan for nuclear energy is to maintain, and where possible, expand Wolf Creek's productive capability, and to remain vigilant and flexible with regard to potential interest in another station — some day. Wolf Creek is on a site originally designed for two units. It is possible that another unit might some day be developed along side of it. It is also possible that the current owners of Wolf Creek might seek to own some or all of such a unit. Until some important questions are answered, however, we believe it is more prudent for us and our customers to be in a position of being a "fast follower" rather than an "early adopter" with regard to new nuclear plants."

From Westar Energy's Comprehensive Energy Plan, 2008

Westar Energy

AVAILABILITY OF WATER FOR A WOLF CREEK EXPANSION

Joint Committee on Energy and Environmental Policy

September 29, 2009

David Barfield, Chief Engineer

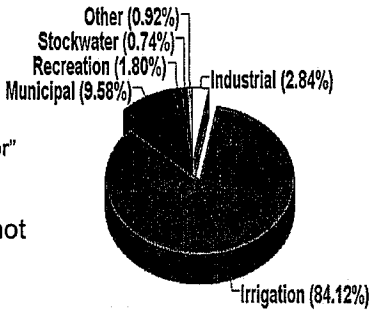
Outline

- Overview of water use for energy production statewide
- Water resources in the region
- Wolf Creek water rights and marketing contract
- Wolf Creek water use
- Options for securing additional water
- KWO will discuss regional supplies

KANSAS DEPARTMENT OF AGRICULTURE

Water Use and Energy Production

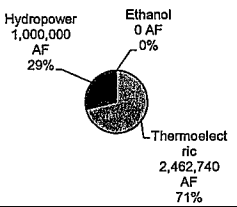
- Thermoelectric power generation and ethanol production are reported as "industrial" water use
- The "industrial" use indicated on the pie chart does not indicate the total water used for these purposes because:
  - Some water provided by municipal systems
  - Some water provided through water marketing contracts
  - Many power plants apply a "consumptive use factor" in their annual reports
  - There are other types of industrial uses
- "Water power" is a separate use category, not represented on the pie chart



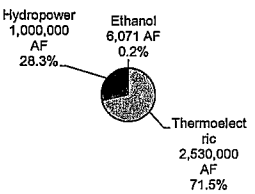
KANSAS DEPARTMENT OF AGRICULTURE

Summary of Water Use for Energy* Production in Kansas

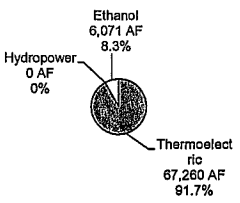
Annual Non-Consumptive Use



Annual Total Use (C + NC)



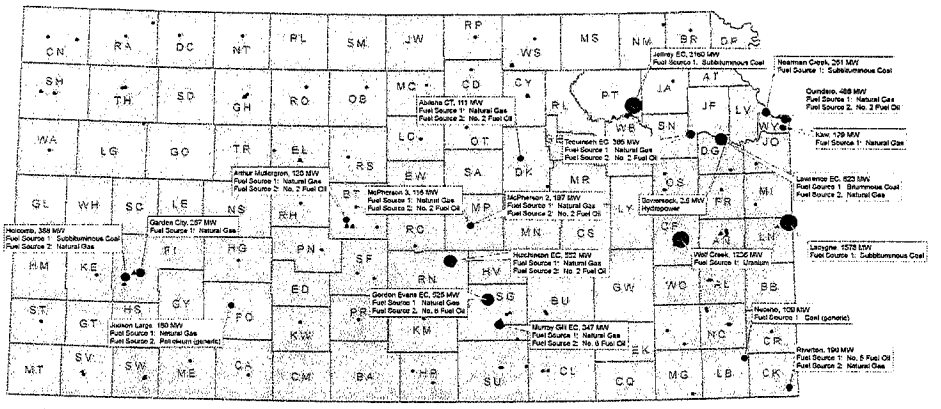
Annual Consumptive Use



*Note: This presentation focuses on electrical power generation and ethanol production. It does not address other activities that might be considered energy production – such as mining fossil fuels, growing ethanol feedstocks, producing biomass, producing biodiesel, etc.

KANSAS DEPARTMENT OF AGRICULTURE

Power Plants in Kansas



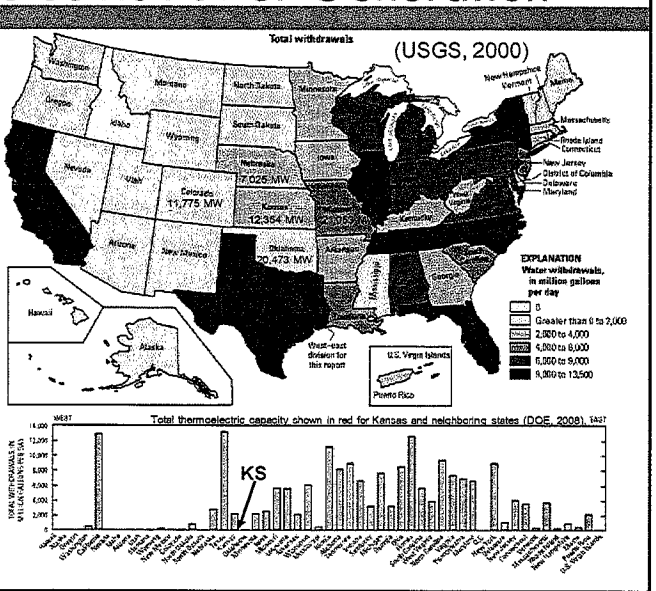
Some power plants do not have a water right, and instead are served by municipal water systems. In addition, some power plants are served through water marketing contracts (reservoir releases) that are not part of the water rights held by the power plants.

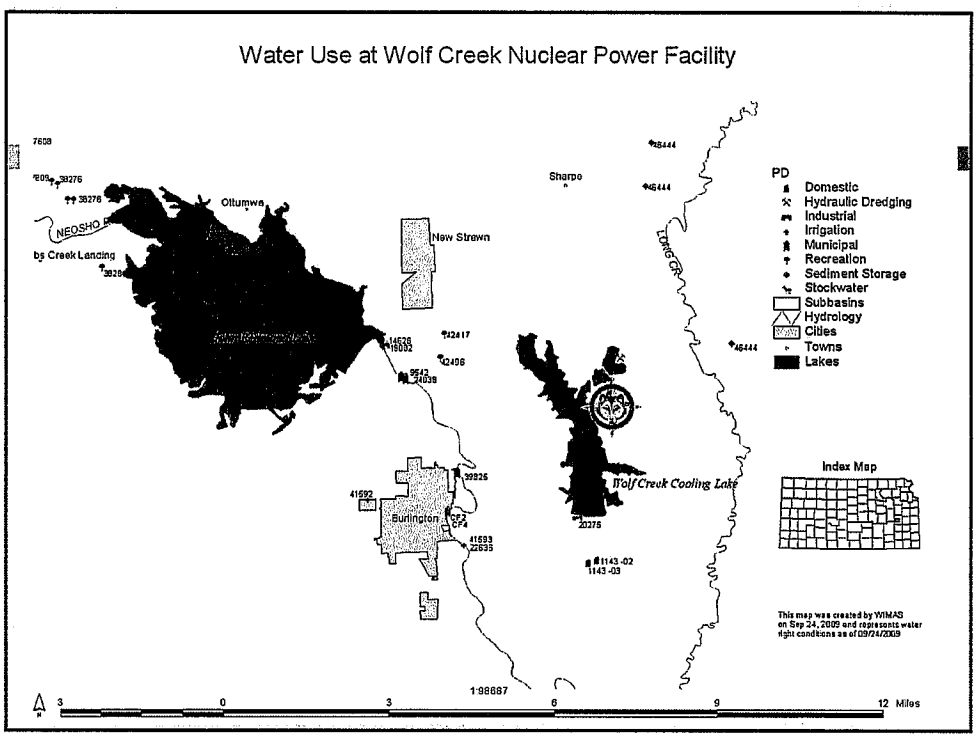
Water use and Thermoelectric Power Generation

Thermoelectric power may include coal, natural gas, oil, and biomass combustion plants as well as nuclear facilities.

Kansas thermoelectric power plants divert about 2,260 MGD (or 2,530,000 acre-feet/year) for cooling. A small fraction of this, about 60 MGD (or 67,000 acre-feet/year), the rest is returned to the source.

In this map, Kansas appears to use more water for thermoelectric power plants than some neighboring states due to the way USGS estimates use, and due to differences in cooling systems. USGS counts the amount of cooling water pumped rather than the amount evaporated. Kansas has more once-through cooling systems than Colorado and Oklahoma.





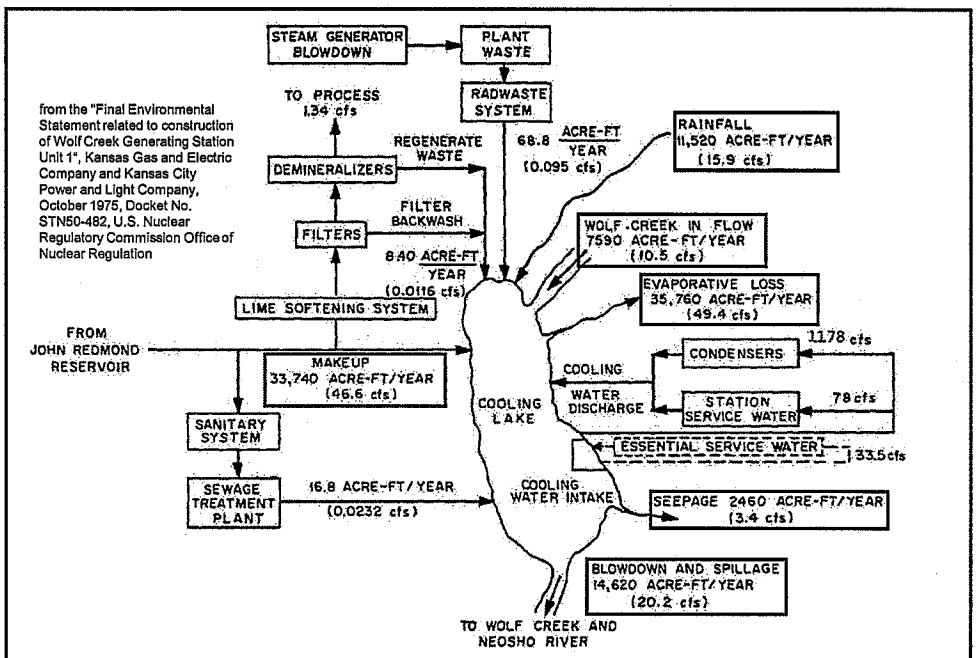


Fig. 3.2. Predicted average water budget for Wolf Creek Generating Station. (Note: 1 cfs = 450 gpm = 725 acre-ft/year.)

Wolf Creek Water Rights & Water Marketing Contract

Water Right No.	Authorized Quantity (Mgal/yr)	Authorized Quantity (AF/yr)	Limitations
14,626	6,125	18,796.4	Natural flow from Neosho River when flow exceeds 250 cfs
19,882	11,444	35,120.24	Natural flow from Neosho River when flow exceeds 250 cfs
20,275	7,460	22,894	69,480 AF/yr from cooling lake combined with Water Rights 14,626 & 19,882
Maximum under water rights	22,640	69,480	See above
Water Marketing Contract 76-2	8,249	25,315	NA
Total (rights plus marketing)	30,889	94,795	See above

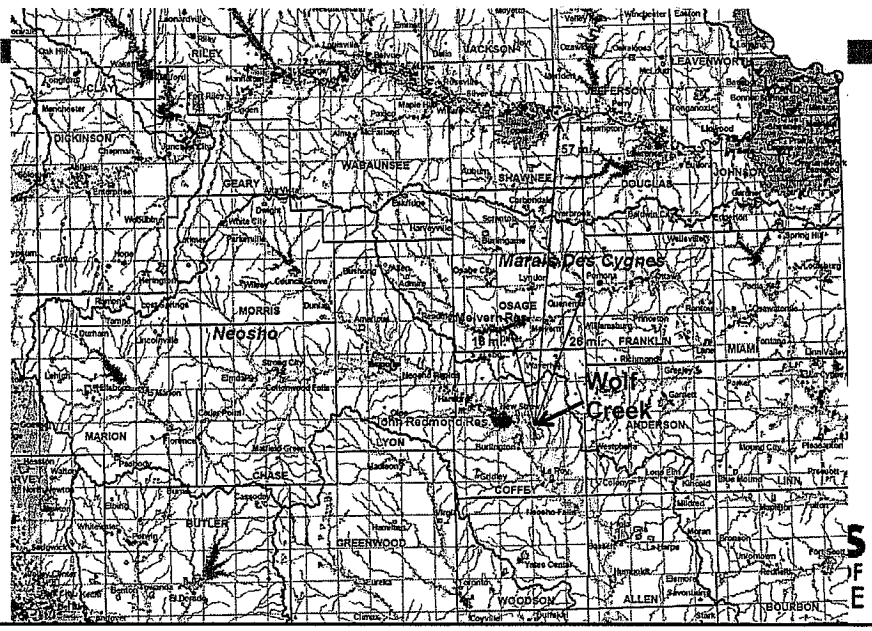
Wolf Creek Water Use/Diversion

Year	Rights (AF)	Contract (AF)	Total (AF)	Total (Mgal)
2003	25,849	5,249	31,098	10,133
2004	20,786	10,571	31,357	10,218
2005	21,851	7,237	29,088	9,478
2006	9,604	11,981	21,585	7,033
2007	17,322	37	17,359	5,656
5-year average	19,082	7,015	26,097	8,504
Record use (1981)	69,480	NA	69,480	22,640

Prior to 1989 the reported use was the amount diverted (pumped) from the river and lake. Since 1989, in order to ascertain the proper quantity subject to the water protection fee (K.S.A. 82a-954), the reported use is the computed consumptive use, that is, the amount of inflow to the cooling lake necessary to make-up losses due to forced evaporation (elevated water temperatures).

KANSAS DEPARTMENT OF AGRICULTURE

Water Resources in the Region



Options for Securing Additional Water

- Water rights
  - Apply for new water rights; and/or
  - Acquire existing rights and apply for changes
- Water marketing contract
- Sources
  - Construct additional storage; and/or
  - Construct new storage; and/or
  - Construct pipeline

KANSAS DEPARTMENT OF AGRICULTURE

Considerations for New Water

- Water assurance district backup
  - Not available in Neosho River WAD
  - Not enough in Marais des Cygnes River WAD
  - Plenty in Kansas River WAD
- Safe yield
- Minimum desirable streamflow
- Seniority
- Drought risk
- Transfer Act

KANSAS DEPARTMENT OF AGRICULTURE

Questions?

KANSAS DEPARTMENT OF AGRICULTURE

QUESTIONS ?

AVAILABILITY OF WATER
FOR A WOLF CREEK EXPANSION

Joint Committee on Energy and Environmental Policy

September 29, 2009

David Barfield, Chief Engineer

Kansas Water Office

Water Availability for a potential expansion of Wolf Creek

September 29, 2009

Tracy Streeter, Director

Kansas Water Office

Current Water Supply for Wolf Creek

- Coffey County State Lake
- Water Marketing Contract – John Redmond Reservoir
- Neosho River
- 22 MGD

Joint Committee on Energy and Environmental Policy
Date 29 SEPT 2009
Attachment # 7

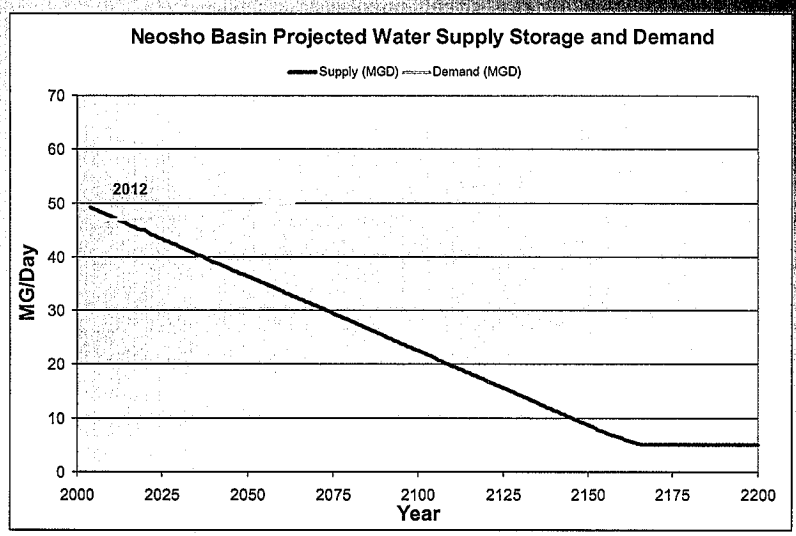
Kansas Water Office

Water Needs for Additional Reactor

- Nuclear power generation water consumption:
  - 400 gallons/MWh with once-through cooling
  - 720 gallons/MWh with wet cooling towers
  - Source: Nuclear Energy Institute
- Assuming a 2nd reactor generating 1200 MW with cooling tower:
  - 7.5 Billion gallons/year in water supply needs
  - 23,230 af/year
  - 20.7 million gallons per day

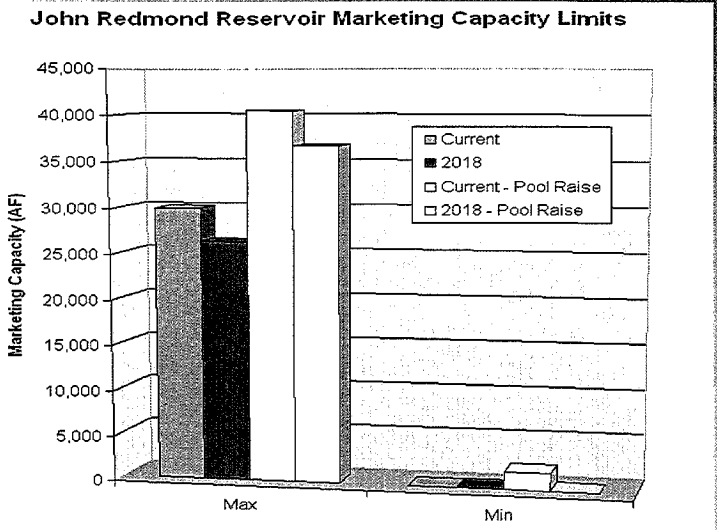
Kansas Water Office

Neosho Water Supply



Kansas Water Office

Neosho Water Supply



Kansas Water Office

John Redmond Pool Raise

- Study Initiated in 1996
- Sedimentation main issue
- Corps agrees pool rise appropriate
- Mitigation requirement
- Corps believes state should pay full price

Kansas Water Office

John Redmond Pool Raise

- Hartford levee does not meet standards
- Corps must fix levee before pool rise can proceed
- Another 5 to 10 years before levee can be fixed

Kansas Water Office

Water Supply Options

- 2nd cooling lake east of Wolf Creek
- Dredge John Redmond
- Build new regional reservoir
- Import water from another basin

Kansas Water Office

Water Supply Options

- Second cooling lake
  - Assumed Capacity 100,000 AF
  - Similar watershed and hydrology to Marion Reservoir
  - Marion Reservoir yield 5.4 MGD
- Will be needed for on site capacity

Kansas Water Office

John Redmond Dredging

- Target of an additional 13 mgd in 2050
- Dredge 52,000 AF
- Assume Mission Lake costs $6.60/cubic yard
- Total life cycle cost $553 million
- 5-10 years of project prep work

Kansas Water Office

John Redmond Dredging

- Pros –
  - Existing infrastructure
  - Avoids majority of land rights issues
  - Potential federal funding
- Cons –
  - Cost
  - Federal involvement
  - Where to put spoils
  - High sedimentation rate

Kansas Water Office

Build new regional reservoir

- Target of an additional 13 mgd in 2050
- Cedar Point as an example
  - Storage 102,000 af
  - Approx 6,000 acres
- 40 year life cycle cost $450 million
- 15 – 20 years of prep work

Kansas Water Office

Build new regional reservoir

- Pros –
  - Lower sedimentation rate
  - Can serve other needs as well
  - Other economic development opportunities
- Cons
  - Cost
  - Land rights issues
  - Environmental Issues

Kansas Water Office

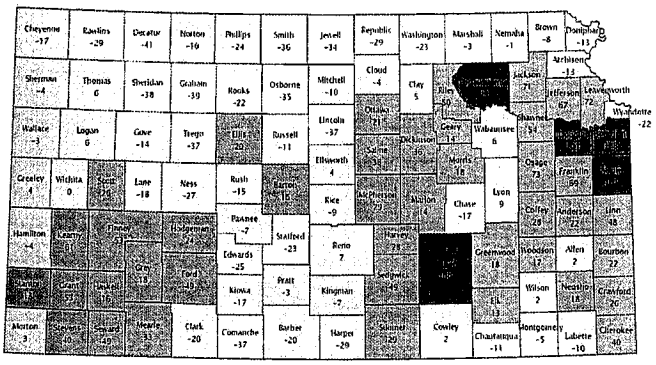
Import Water

- Marais des Cygnes option
  - Approximately 4 mgd available in Melvern or Assurance District
  - Needed for growth south of KC to Ottawa
- Kansas River Option
  - Adequate water available
  - Fast growing region

Kansas Water Office

Kansas River Basin

Percent Change in Population By County Kansas, 1990 - 2040



Source: Kansas Water Office, 1998

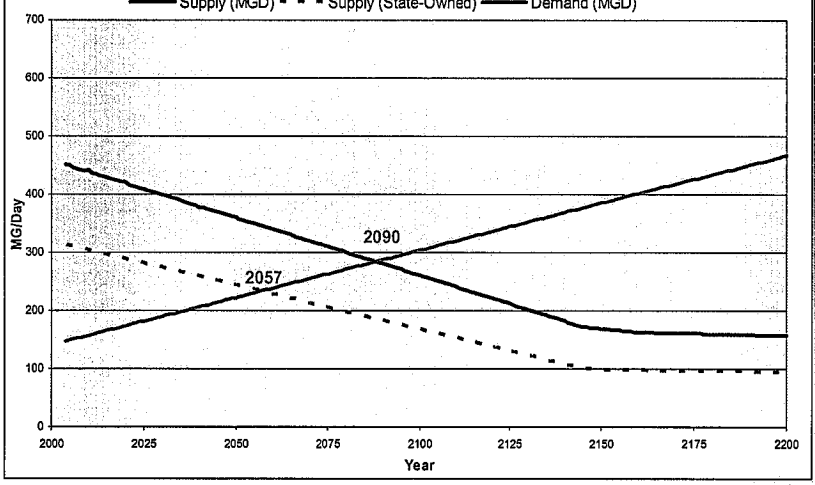
Percent Change

30% or more decrease | 11% to 29% decrease | 10% decrease to 10% increase | 11% to 74% increase | 75% or more increase

Kansas Water Office

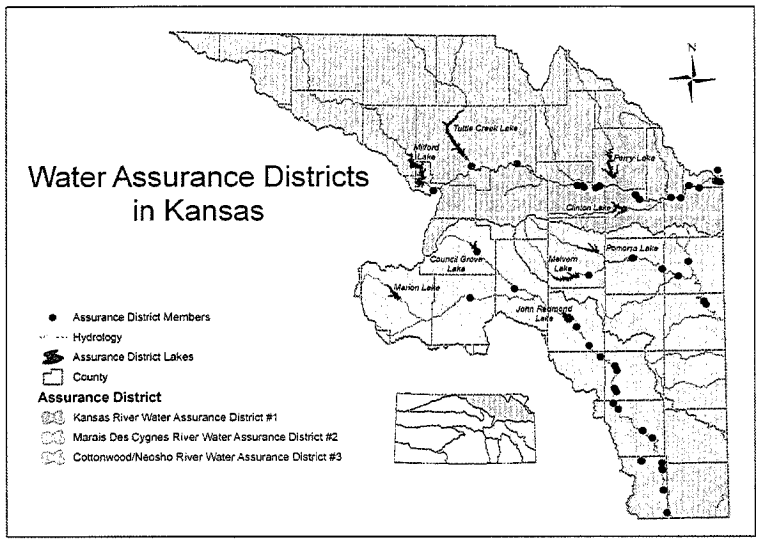
Kansas River Basin

Kansas Basin Projected Water Supply Storage and Demand



Kansas Water Office

Assurance Districts



Kansas Water Office

Kansas River Water Transfer

- Water supply line
  - Assume 40 miles of 30 inch pipe and associate pumping facilities
  - Water rights backed by assurance district storage in Milford/Tuttle Creek
  - Total Cost $95-100 Million
  - 5 – 10 years of prep work

Kansas Water Office

Kansas River Water Transfer

- Pros –
  - Existing Supply
  - Lower Cost
- Cons –
  - Water transfer
  - Growth in Kansas River Basin
  - Does not increase overall water supply

Kansas Water Office

Questions?

Joint Committee on Energy & Environmental Policy
9/29-30/09
Attachment 8

Water Usage and Energy Production

Joint Committee on Energy and Environmental Policy

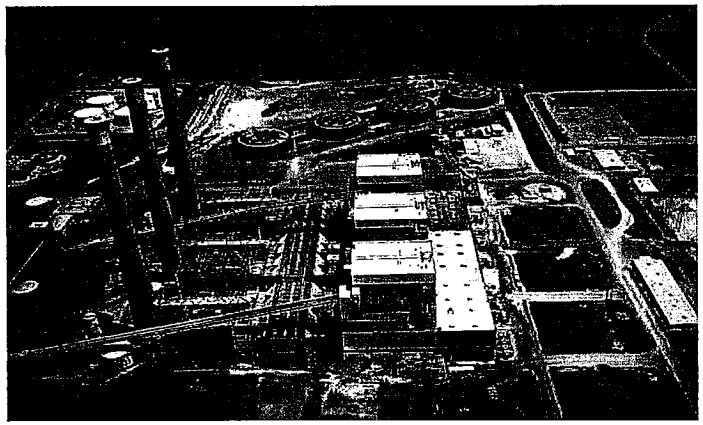
Presented by Mark Schreiber
Director Government Affairs

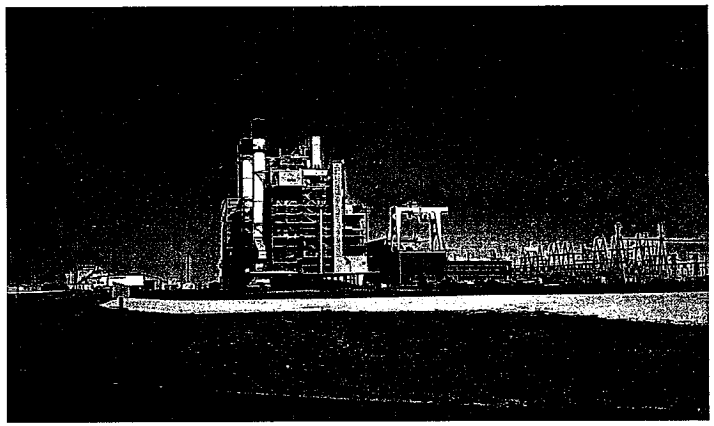
September 29, 2009

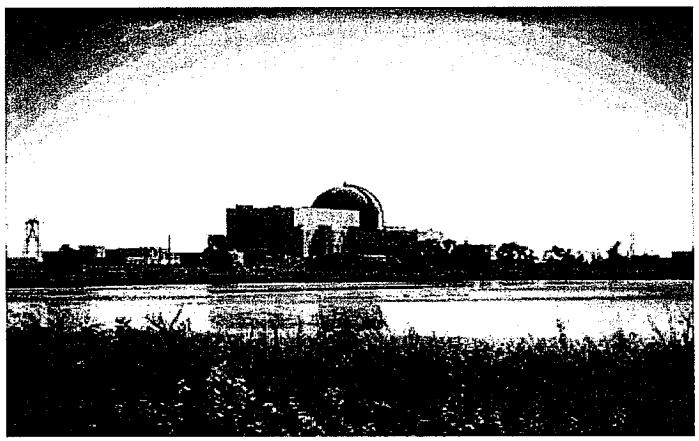
Westar Energy

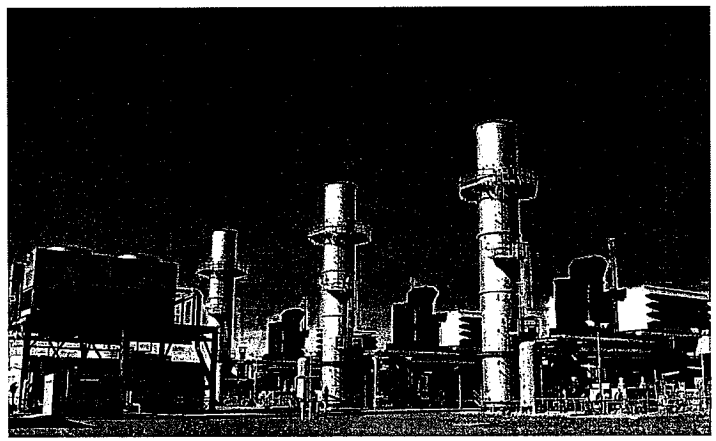
Westar Generation

8-7



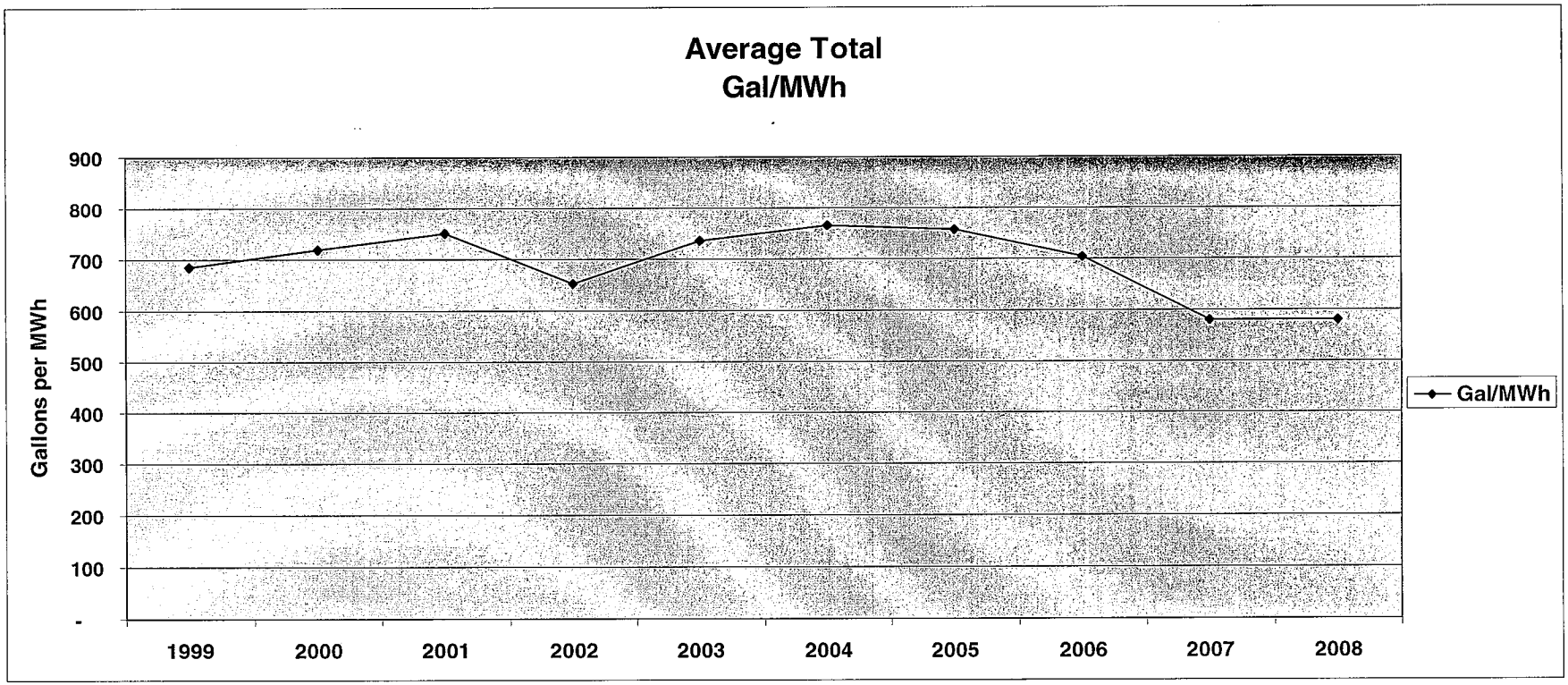






Westar Energy.

Annual Water Use



Westar Energy

Future Use of Water

4-8

- Westar's capacity growth will be relatively stable for the next several years.
- Water use related to expanded generation should also continue to be stable. Average over last ten years is 22.1B gal/yr.
- New requirements for emission reductions may emerge that affect water usage. For instance, in 2007, Sandia National Laboratories estimated carbon sequestration could increase water withdrawal and consumption by approx. 20%.

Examples of Water Conservation Practices

8-5

- Reuse of bottom ash water for a large portion of the scrubber make-up water.
- Circulating water (cools the condensing steam) is re-used several times.
- Scrubber water is recycled continuously.
- Auxiliary cooling water to cool equipment, such as coal mills, generator and turbine lube oil, is recycled in a closed loop system.

Water Conservation Options

8-6

- Advanced alternative cooling technologies
  - Once-through cooling may not be cost-effective. Cooling towers will become the norm.
- Recirculating cooling systems
  - Water recovery from cooling tower plumes
  - Use of degraded water in cooling towers
- Dry cooling systems
  - Improved fin designs
  - Forced fan design modifications

Future Water Issues

8-7

- Senate Bill 787 "Clean Water Restoration Act" could re-define "waters of the United States".
  - Added restrictions on water withdrawals and releases.
- In 2003, state water managers in thirty-six states expected water shortages in their states under normal water conditions over the next 10 years.
- Demand for electricity continues to grow nationally.
  - New generation will need water. Availability of water will drive type of generation.

Future Challenges

8-8

- Electricity generation (particularly baseload) competes with other uses for available water.
- Water availability and quality affect siting of future generation.
- Increased premium on water use technologies for new generation.

KCP&L Water Use in Energy Production

Presented to

Joint Committee on Energy and Environmental Policy

Paul Ling – KCP&L
Manager, Environmental Services

September 28, 2009

KCP&L

KCP&L's Customers, Generating Capacity and Fuel Mix

Customers

KCP&L, an electric utility, serves over 820,000 customers located in western Missouri and eastern Kansas. Customers include approximately 722,000 residences, 96,000 commercial firms, and 2,800 industrials, municipalities and other electric utilities.

Missouri and Kansas jurisdictional retail revenues averaged approximately 70% and 30%, respectively, of electric utility's total retail revenues since the July 14, 2008, acquisition of GMO.

Generating Capacity

Electric utility has over 6,000 MWs of generating capacity. As part of KCP&L's Comprehensive Energy Plan, electric utility expects to have Iatan No. 2, a coal-fired plant, in service in 2010, which will add approximately 620 MW (electric utility's share) to electric utility's generating capacity.

Fuel Mix based on generation

- Coal - 76%
- Nuclear - 18%
- Coal and natural gas - 1%
- Natural gas and oil - 3%
- Wind - 2%

KCP&L

DRA

KCP&L's Electric Utility Generation Resources

Base Load

Wolf Creek	KS	Nuclear	(Jointly Owned Unit)
Iatan No. 1	MO	Coal	(Jointly Owned Unit)
La Cygne Nos. 1&2	KS	Coal	(Jointly Owned Unit)
Hawthorn No. 5	MO	Coal	
Montrose Nos. 1,2&3	MO	Coal	

Peak Load

West Gardner Nos. 1 to 4	KS	Natural Gas
Osawatomie	KS	Natural Gas
Hawthorn Nos. 6 to 9	MO	Natural Gas
Northeast Nos. 11 to 18	MO	Oil

Wind

Spearville	KS	Wind

KCP&L

KCP&L GMO's Electric Utility Generation Resources

Base Load

Iatan No. 1	MO	Coal	(Jointly Owned Unit)
Jeffrey Energy Center Nos. 1, 2 & 3	KS	Coal	(Jointly Owned Unit)
Sibley Nos. 1, 2 & 3	MO	Coal	
Lake Road Nos. 2 & 4	MO	Coal and Natural Gas	

Peak Load

Crossroads Energy Center	MS	Natural Gas
Ralph Green No. 3	MO	Natural Gas
Greenwood Nos. 1, 2, 3 & 4	MO	Natural Gas/Oil
Lake Road No. 1 to 7	MO	Natural Gas/Oil
Nevada	MO	Oil

KCP&L

KCP&L's La Cygne Station Existing Water Usage

Breakdown of Existing Station Water Use

Service Water:

- Wet Scrubber
- Non-Potable and Sanitary

Process Water:

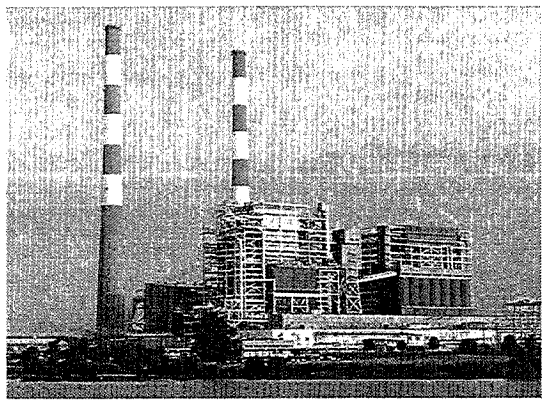
- Boiler Condensate Makeup

Material Handling:

- Dust Suppression
- Conveyance

Cooling Water:

- Large Pumps
- Boiler Condenser



KCP&L

KCP&L's La Cygne Station Future Water Usage

Additional Station Water Use

Service Water:

- Potential Wet Scrubber Replacement on Unit 1 and addition on Unit 2

Cooling Water:

- Replacement of once through cooling with closed cycle cooling with cooling towers

KCP&L

KCP&L's La Cygne Station Water Rights

Additional Station Water Use

File No. 15,181 – Natural flows of North Sugar Creek for industrial use at the La Cygne Station with an annual storage quantity in La Cygne Lake

File No. 15,179 – Natural flows of the Marais des Cygne River for industrial use at the La Cygne Station with an annual diversion quantity

Water Conservation Plan

- Required as holder of water right
- Objective to insure both high quality water and adequate quantities
- Efficient use of water during times of plentiful supply will be best preparation for times of scarcity
- Maintain amounts during time water is plentiful to assure that water will be available during drought

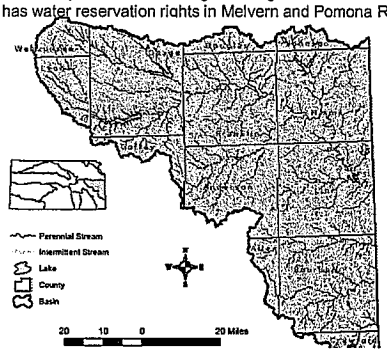
- Methods employed to conserve water:
  - Holding back lake discharge
  - Keeping tainer gates closed at certain elevations
  - Allowing lake to recede only to an elevation one foot below the design pool levels
  - Using Marais des Cygne River as make up water

KCP&L

KCP&L's La Cygne Station Water Assurance District

Additional Station Water Assurance

- Water assurance district created to provide municipal and industrial users downstream from federal reservoirs another way to obtain water supplies.
- Water assurance district enhances municipal and industrial water rights by enabling river water to be stored for later use pursuant to existing water rights.
- KCP&L has water reservation rights in Melvern and Pomona Reservoirs.



KCP&L

KCP&L's Peaking Units Future Water Usage

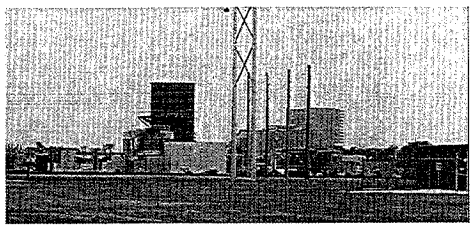
Additional Peaking Water Use

Potential Inlet Cooling on Combustion Turbines:

- Service Water

Potential Conversion of Simple Cycle Peaking Units to Combined Cycle:

- Cooling Water
- Process Water

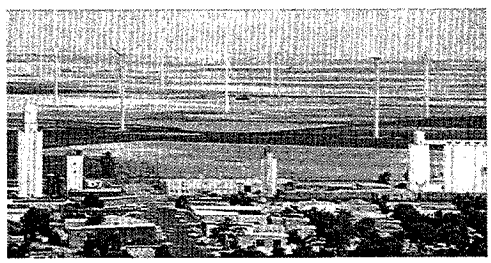


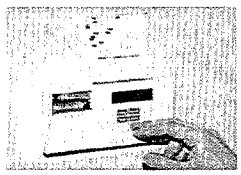
KCP&L

KCP&L's Renewable Energy and Energy Efficiency

Additional Energy from Renewable and More Efficient Use of Existing Energy

- Wind
- Energy Efficiency





KCP&L

Questions

Thank You

Paul.Ling@KCPL.com
Scott.Jones@KCPL.com

Kansas City
Board of Public Utilities 540 MINNESOTA AVENUE • KANSAS CITY, KANSAS 66101 • (913) 573-9000

Kansas City Board of Public Utilities

Missouri River Risk Mitigation, Horizontal Collector Wells, and Conservation

Introduction
- Joe Dick – Regulatory Specialist
- James E. Epp – Manager Water Operations and Acting Chief Administrative Officer

Missouri River Risks
- Degradation
- Competing Interests
- Droughts
- Floods
- Spill Risk

Horizontal Collector Wells
- Two 40 Million Gallon per Day (MGD) Wells
- Largest in the Country
- Mitigates Missouri River Risk
- Improved Water Quality

Nearman Power Cooling Tower
- Mitigates Missouri River Risk

BPU Water Treatment Plant Filter Capacity
- Filter Capacity 54 MGD
- In 2004, Approaching 50 MGD Max Day
- Filter Expansion Expensive

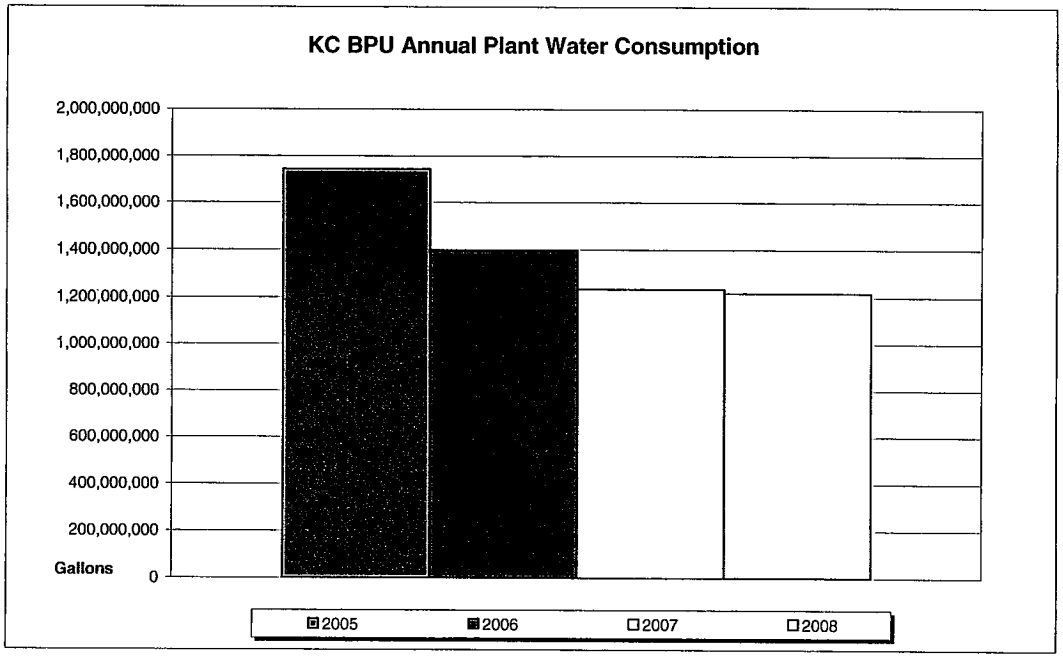
Conservation through Power Plant Water Usage Reductions
- Avoiding Expansion and Water Rate Increase
- Reduce Power Plant Water Usage
- Delayed Filter Expansion
- Avoided Rate Increase
- Saved over 500 Million Gallons

Future – More Storage for Electric Demand Side Management

10-8

Monthly annual plant consumptions less NWTP

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec.	Yearly Total	Reduction/increase
2004	82,295,215	123,583,537	86,268,060	123,203,102	90,100,828	103,359,966	168,404,916	161,936,480	169,539,751	165,532,688	119,239,227	144,832,049	1,538,295,819	
2005	141,660,473	173,053,887	185,000,994	145,019,965	109,789,802	207,816,519	186,604,813	133,111,757	139,190,412	99,423,326	104,695,582	117,678,738	1,743,046,266	204,750,447
2006	101,440,816	79,070,381	91,621,912	76,921,982	96,972,714	185,586,717	159,407,959	186,056,492	131,380,022	93,860,078	104,811,530	86,793,997	1,393,924,599	-349,121,667
2007	86,144,690	130,370,902	70,020,472	149,883,786	127,594,140	96,979,446	135,075,388	154,229,957	137,925,459	66,871,930	39,572,593	38,789,385	1,233,458,149	-160,466,450
2008	38,330,082	49,183,539	41,223,539	114,910,205	140,460,600	152,187,780	165,521,024	205,778,082	137,748,919	70,335,401	44,728,154	57,804,068	1,218,211,394	-15,246,755
2009	45,156,786	45,510,614	53,299,311	108,019,916	125,451,725	133,344,401	114,641,655	70,344,061					695,768,468	



Sunflower Electric Power Corporation

A Touchstone Energy® Cooperative

Power Plant 101

When building a generating facility, there are numerous complex factors to evaluate:

- Fuel
- Water
- Transmission
- Construction costs
- Operating and maintenance costs
- System needs
- Fit with existing system assets
- Regulatory requirements
- Market rules

Joint Committee on Energy and Environmental Policy
Date 29 SEPT 2009
Attachment # 11

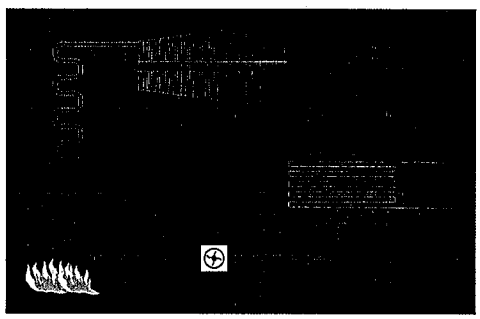
Power Configurations

- Traditional Rankine Power Cycles
  - Heat → Steam → Spins turbine-generator
  - Nuclear pressurized and boiling water reactors, solar concentrators, and carbon burning furnaces (coal, gas, oil, garbage, biomass, etc.) are some examples.
- Other Indirect Power Cycles
  - Combustion gases → Move driving device (turbines or pistons) → Generator
  - Gas turbines, jet engines, and internal combustion engines are some examples.
- Direct Power Cycles
  - Working fluids absent combustion → Directly spins generating device
  - Hydroelectric, wind turbines, and tidal energy are some examples.
- Exotic Power Cycles
  - Fuel cells and photovoltaic cells are examples of systems that can generate voltages without a mechanical power cycle.

The Rankine Cycle

The Rankine cycle is a thermodynamic cycle where heat is converted into work.

Heat is supplied externally to a closed loop that usually uses **water** as the working fluid.



Why Use Water?

- Water in a Rankine Cycle
  - Closed loop
  - Re-cycled constantly
  - Small losses
- Cooling Systems
  - Generates most of the visible vapor from a power plant
  - Result of waste heat that could not be converted to useful work
  - Largest water consumption in the power cycle
- Water is the Fluid of Choice
  - Non-toxic and relative unreactive chemistry
  - Relative abundance
  - Low cost
  - Attractive thermodynamic properties

Sunflower Experience

- Natural gas fleet entered service in 1960s and 1970s
  - Four steam units ranging in size from 58 MW to 145 MW
  - Typically require approximately 1,000 gallons per MWh of net electric production
  - All four units have discharging water systems
  - Consumption directly influenced by initial water quality
- Coal-fired unit entered service in 1983
  - 360 MW unit with a dry scrubber and fabric filter
  - Typically requires 500 gallons per MWh of net electric production
  - Zero-discharge designed water systems
  - Wastewater is captured in basins and processed for reuse

Water Considerations

- Once constructed, it is difficult to change a unit's water consumption rate significantly.
- Water Supplies
  - Lower quality water sources may be used in power cycles with careful consideration.
  - Legal complexities can be considerable.
- Technology Evolution
  - Discharging designs to zero-discharge designs to dry cooling.
- Design Choice and Tradeoffs
  - Low water designs such as dry cooling may result in lower thermal efficiency requiring greater fuel consumption for the same electric output.
  - This net effect results in greater emissions including increases in carbon emissions.

NATIONAL COOPERATIVE REFINERY ASSOCIATION

Testimony re: NCRA Water Conservation Efforts

Special Committee on Energy and Environmental Policy

Presented by Jim Loving
On behalf of
National Cooperative Refinery Association
September 29, 2009

Madam Chairman, Members of the Committee:

My Name is Jim Loving and I am President of National Cooperative Refinery Association (NCRA). NCRA, a petroleum refinery based in McPherson, Kansas is a cooperative organized under the Cooperative Marketing Act. We are owned by three regional farm cooperatives that each take their ownership share of the fuels production at the refinery gate for shipment into common carrier pipelines or at one of our two refined product terminals.

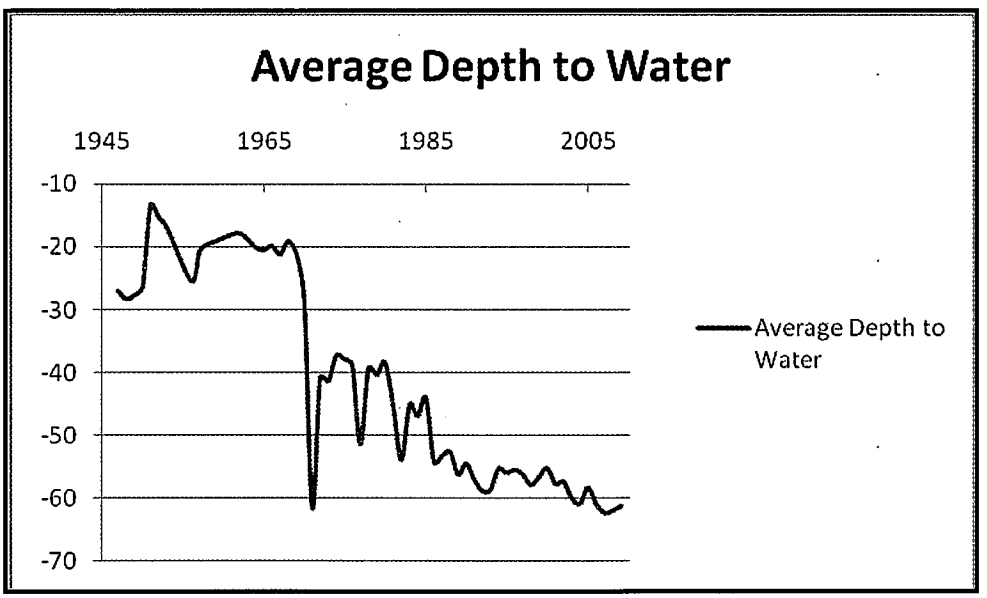
First of all, NCRA wants to express appreciation to Madam Chairman and the Committee for allowing us to share our views with you today regarding water conservation efforts at our petroleum refinery.

Oil production and oil refining have been a major piece of the Kansas economy for many years. In 1990, there were eight operating petroleum refineries in Kansas. Today there are three operating refineries. NCRA is typical of the three remaining refineries in Kansas. We employ about 600 people and have an annual payroll in excess of $44 million. We process about 100,000 input barrels per day and sell the petroleum products both locally and regionally. We produce approximately 48,000 barrels per day of gasoline and 38,000 barrels per day of diesel fuel.

Water Issues

NCRA utilizes groundwater for 100% of its water supply needs. The groundwater source for NCRA is the Equus Beds aquifer, which falls within the Lower Arkansas River Basin. The Equus Beds is a roughly 200 feet thick aquifer consisting of sands and gravels that stretch from McPherson county south through Harvey, Reno, and Sedgwick counties. As a whole, users of the Equus Beds pump on average 157,000 Acre-Feet of groundwater per year. Of the yearly totals, industry uses 15%, municipal uses 35%, and agriculture uses 50%.

Locally within McPherson County, users pump approximately 12,000 Acre-Feet of water per year with industry, municipal, and agriculture accounting for a third each of the total amount. Due to locally declining water levels in the aquifer, the McPherson county Equus Beds aquifer was designated as an Intensive Groundwater Use Control Area in 1980. The regulation of use was an attempt to stop the rapid decline of water levels in the area and allow the aquifer to stabilize for future water supply needs. Water level measurements since 1980 in the area continue to show declining aquifer levels.



Source: Kansas Geological Survey
http://www.kgs.ku.edu/Magellan/WaterLevels/index.html

In the last 30 years, NCRA has continuously increased its efforts to conserve our water resources. Here is a summary of some of these efforts.

Air Coolers

One very effective water conservation measure involves the use of air coolers. Prior to the last 30 years, NCRA used cooling water exclusively to cool process streams within the refinery. This water is circulated through heat exchangers where the water absorbs heat. The heat is then rejected to the atmosphere by the partial evaporation of the water in cooling towers. The loss of water to the atmosphere by evaporation is proportional to the amount of heat removed from the refining process. About 30 years ago, NCRA began shifting its preferred cooling method to

more expensive air coolers that require no water to operate. This trend has continuously increased the use of air coolers in our refinery. In NCRA's recent "Clean Fuels" project NCRA installed many new air coolers with a total heat removal capacity of about 265 million BTU's per hour. In our current benzene reduction project required by MSAT II, we are installing ten additional air coolers with a capacity of about 85 million BTU's per hour. This 350 million BTU per hour capacity is enough energy to cool almost 10,000 homes in our Kansas summers. This reduction of cooling tower load reduces our ground water use by approximately 560 gallons of water per minute. That's over 900 acre feet per year. NCRA plans to continue the use of air coolers whenever practical.

Coker unit Cool down and Drill out water

Another significant water savings involves NCRA's delayed coker. This unit is a batch process that requires large drums full of solid petroleum coke be cooled from about 900 degrees farenheight to safe temperatures before high pressure water jets "drill out" the coke from the drum for disposal. The quench process involves slowly adding water to the drums to cool the water and the "drill out" process uses high pressure and high volume water jets to dislodge the coke from the drum. NCRA originally used well water for both the cool down and drill out process. Provisions were made in the late 1980's to recycle waste water for this use saving an average of 180 gallons per minute or about 290 acre feet per year.

Water Treatment Improvements

Improvements in water treatment have also reduced NCRA's water requirements. In the past three decades, NCRA has made many improvements to its water treating systems including a "Hot Lime" treating system in the 1980's. This process significantly improved the quality of the makeup boiler feed water thus reducing the amount of water required to purge the impurities from the steam system in the form of blowdown. This resulted in a significant water and energy savings, until other water quality issues arose. No data is readily available to quantify this reduction of water demand at NCRA.

Water Well Relocation

Water well location also contributes to water quality. The poorer the quality of water used in the process units results in more consumption. To reduce water use, NCRA redeveloped a new water well, #12 to a location which resulted in much better quality. This relocation resulted in an approximate water savings of about 200 gallons per minute; this was completed in May of 2007. A second water well relocation is currently underway and expected to be completed by mid 2010. The expected water savings of this relocation effort is expected to be about 100 gallon per minute. This 300 gallon per minute total savings is equivalent to approximately 480 acre feet per year.

In addition to the efforts that NCRA has made in the past to conserve our water resources, we are considering significant additional projects to reduce our demand in the future.

12-3

Recovered Waste Water Reclamation

NCRA has commissioned a prominent engineering firm to develop the process design of a water treatment system to allow the recycling of up to 85% of all of the refinery wastewater resulting in the savings of approximately 700 gallons per minute of ground water. The first phase of this project was a $20.1 million dollar project to improve the quality of the wastewater so that it could be reused. Phase 1 consisted of an engineering design and project construction to install equipment to remove contaminants prior to the biological wastewater plant. The construction was completed in August 2009 and the system was in full operation by mid September. Phase 2 is a $29 million dollar installation that includes equipment which will remove water contaminants to allow for the water to meet quality specifications for boiler feed water and cooling tower makeup. Once completed, the water savings is expected to reduce water consumption from the aquifer by one million gallons per day or about 1,130 acre feet per year.

City Water Reuse

Another significant measure that NCRA is considering for the future is the reuse of water from the city of McPherson. NCRA is negotiating with the City of McPherson to secure the rights to collect the effluent from the city wastewater plant. The city wastewater would go through various treatment steps to remove contaminants prior to being used for boiler feed water and cooling tower makeup. Up to 700 gallon per minute is available for reuse. The result of this project would reduce the aquifer consumption by another 700 gallon per minute or approximately 1 million gallon per day. This is another 1,130 acre feet per year.

In addition to treatment improvements and water conservation, efforts have been made to improve the groundwater quality at our location and in the aquifer.

Chloride Recovery Wells

In 2002 NCRA implemented chloride recovery wells approximately ¼ mile east of our facility to intercept a chloride "plume" that was affecting the water quality of the refinery wells. This chloride intrusion is understood to be a result of oil field brine intrusion from many years ago. These water wells are still being operated and maintained to remove the salt contaminants. By removing the contaminants from the aquifer the water quality of the aquifer improves resulting in less water usage by its industrial users.

Additional Items under consideration

NCRA has also considered collecting rainwater in a dedicated retention pond. The large area of our west side tank farm could be diverted to a pond with pumps to pump it into our treatment systems. Our 32.1 inch average annual rainfall over approximately 125 acres could be a savings of about 330 acre feet per year or 200 gallons per minute. This land area may also be expanded after further study to increase this potential.

Conclusion

NCRA shares concern about the long term sustainability of water supplies in central Kansas. We are devoted to being part of the solution to maintain adequate water supplies for the future.

We have and continue to devote significant amounts of money and resources to studying and implementing water saving projects at NCRA. Additionally, we continue to participate with the City of McPherson and Ground Water Management District 2 to further identify current water supply issues impacting long term viability.

We support the legislature's efforts to learn more about water use and conservation efforts by its energy producers. Water is a finite natural resource and significant economic asset that continues to sustain and grow energy production to support Kansas economic growth.

Kansas has supported the three refineries that operate in the state. These facilities provide energy, jobs and pay taxes to help make our state strong. We very much appreciate the support that the legislature has provided to the Kansas refineries. It has made us economically viable and has helped maintain our competitiveness. Thank you for your support.

Thank you very much for permitting me to testify and I will be happy to yield to your questions.

the energy of innovation™

Water Use in the Fuel Ethanol Industry

Greg Krissek, Director, Government Affairs

Kansas Legislature
Joint Committee on Energy and Environmental Policy
September 29, 2009

ethanol

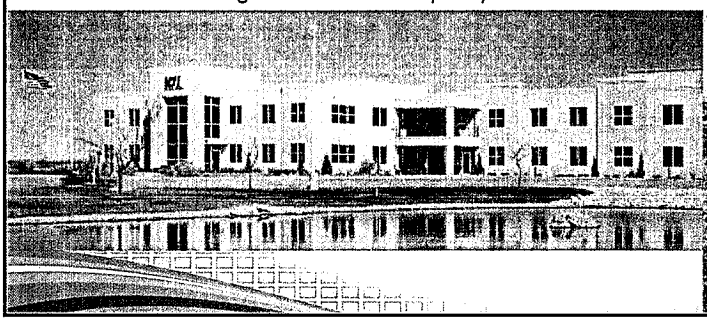
Overview of Discussion

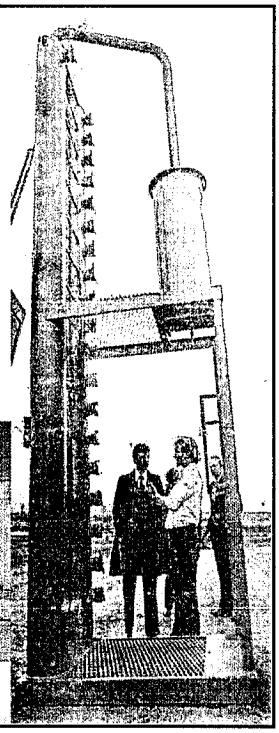
- Fuel Grade Ethanol Industry Overview
- Ethanol Production Process Description
- Water Perspective and Ethanol Specifics
- Moving Forward

Joint Committee on Energy and Environmental Policy
Date 29 SEPT 2009
Attachment # 13

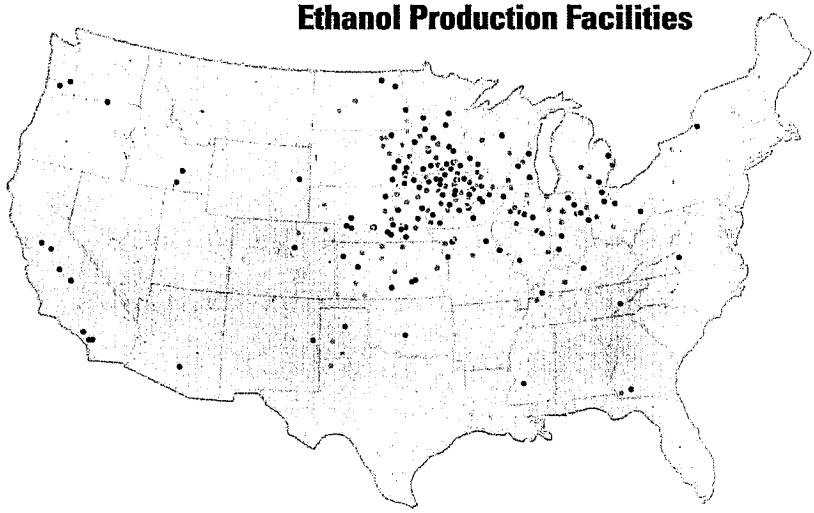
ICM History

- Founded in 1995; History Dating to the 1970's
- Based in Colwich, KS with 300 Employees
- Design, Construction, and Support of Ethanol Plants; Manufacturing
- R&D, Engineering, Energy, Controls, and Environmental
- 102 US ethanol plant customers – technology responsible for over 6.6 billion gallons of annual capacity





United States
Ethanol Production Facilities



ICM
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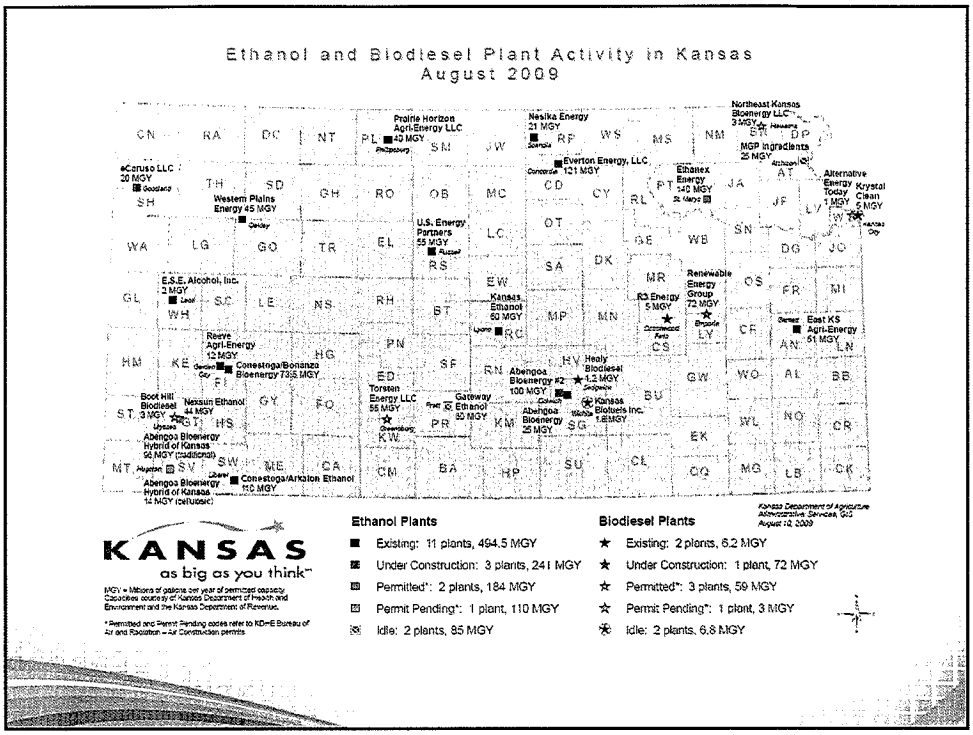
○ ICM Process Technology
● Other Technology


Ethanol and Biodiesel Plant Activity in Kansas
August 2009
Prairie Horizon Agri-Energy LLC 40 MGY
Nesika Energy 21 MGY
Northeast Kansas Bioenergy LLC 3 MGY
MGP Ingredients 25 MGY
eCenuo LLC 30 MGY
Everton Energy, LLC 121 MGY
Ethanex Energy 140 MGY
Alternative Energy Today 1 MGY
Krystal Clean 5 MGY
Western Plains Energy 45 MGY
U.S. Energy Partners 55 MGY
E.S.E. Alcohol, Inc. 3 MGY
Kansas Ethanol 60 MGY
Renewable Energy Group 72 MGY
R3 Energy 5 MGY
East KS Agri-Energy 51 MGY
Reeve Agri-Energy 12 MGY
Conestoga/Bonanza Bioenergy 73.5 MGY
Abengoa Bioenergy #2 100 MGY
Healy Biodiesel 1.2 MGY
Boot Hill Biodiesel 3 MGY
Nessun Ethanol 44 MGY
Torsten Energy LLC 55 MGY
Gateway Ethanol 55 MGY
Kansas Biofuels Inc. 1.8 MGY
Abengoa Bioenergy 25 MGY
Abengoa Bioenergy Hybrid of Kansas 96 MGY (traditional)
Abengoa Bioenergy Hybrid of Kansas 14 MGY (cellulosic)
Conestoga/Arkalon Ethanol 110 MGY
Kansas Department of Agriculture Administrative Services, GIS August 10, 2009
KANSAS
as big as you think
MGY = Millions of gallons per year of permitted capacity. Capacities source is of Kansas Department of Health and Environment and the Kansas Department of Revenue.
* Permitted and Permit Pending codes refer to KDHE Bureau of Air and Radiation – Air Construction permits
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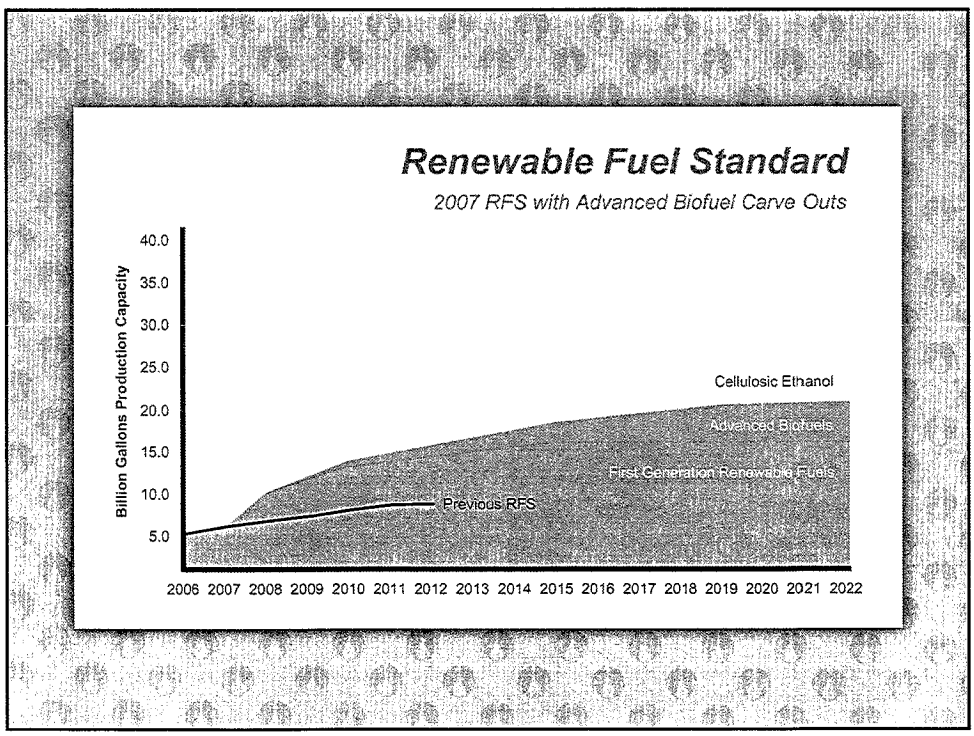
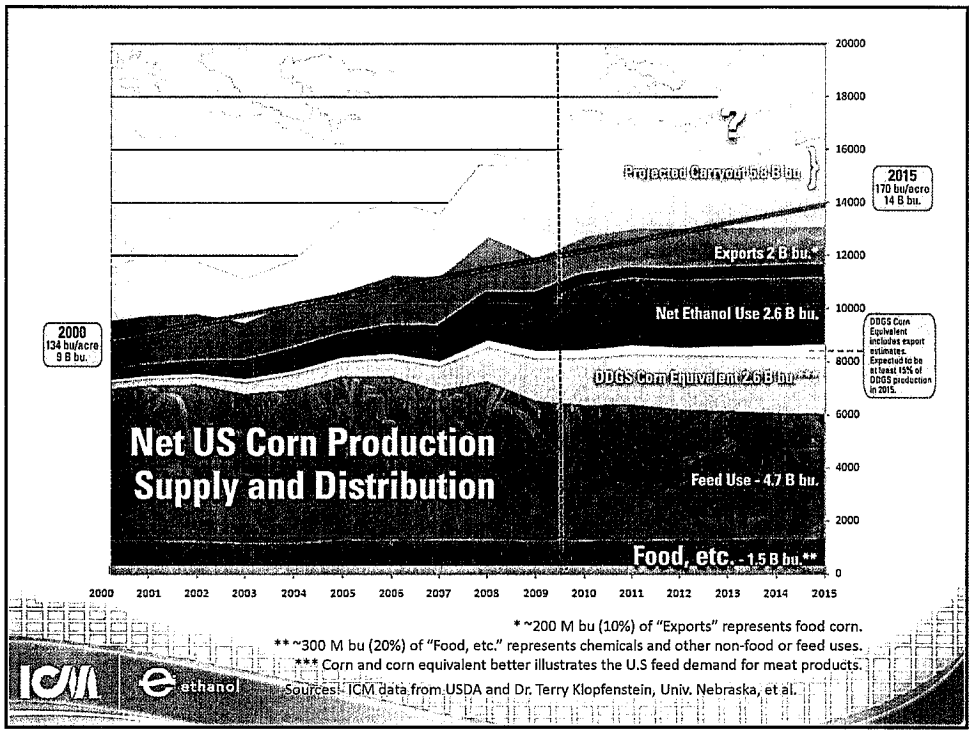
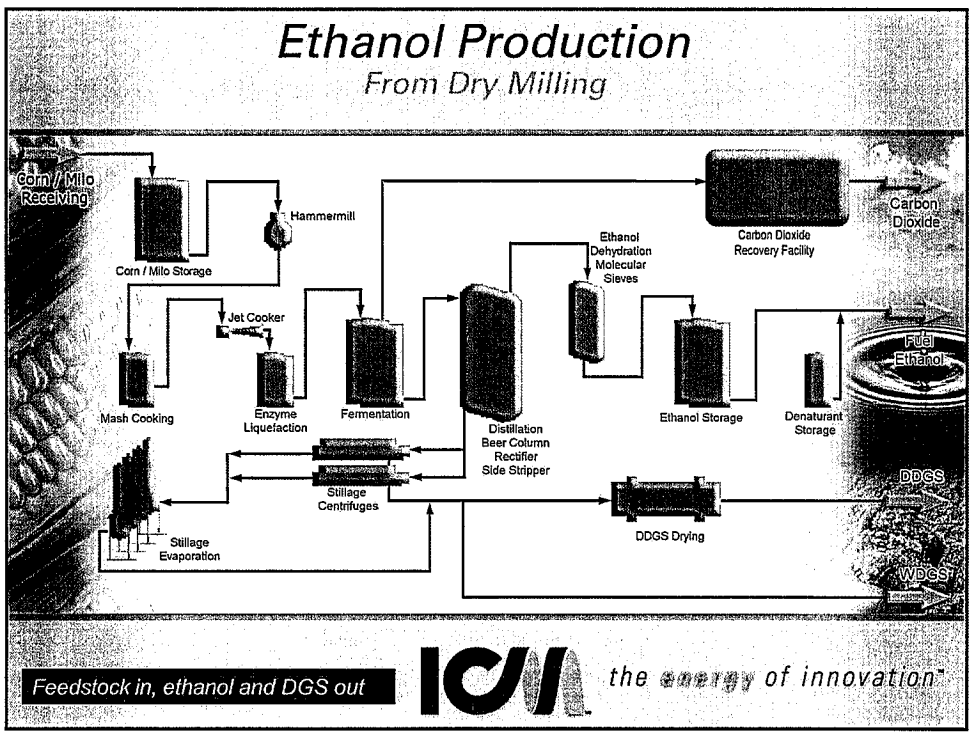

Renewable Fuel Standard
2007 RFS with Advanced Biofuel Carve Outs
Billion Gallons Production Capacity
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
Cellulosic Ethanol
Advanced Biofuels
First Generation Renewable Fuels
Previous RFS
2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022


Net US Corn Production
Supply and Distribution
2000
134 bu/acre
9 B bu.
2015
170 bu/acre
14 B bu.
Projected Carryout 1.8 B bu.
Exports 2 B bu.
Net Ethanol Use 2.6 B bu.
DDGS Corn Equivalent 2.6 B bu.
Feed Use - 4.7 B bu.
Food, etc. - 1.5 B bu.**
DDGS Corn Equivalent includes export estimates. Expected to be at least 15% of DDGS production in 2015.
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015
* ~200 M bu (10%) of "Exports" represents food corn.
** ~300 M bu (20%) of "Food, etc." represents chemicals and other non-food or feed uses.
*** Corn and corn equivalent better illustrates the U.S feed demand for meat products.
ethanol
Sources: ICM data from USDA and Dr. Terry Klopfenstein, Univ. Nebraska, et al.

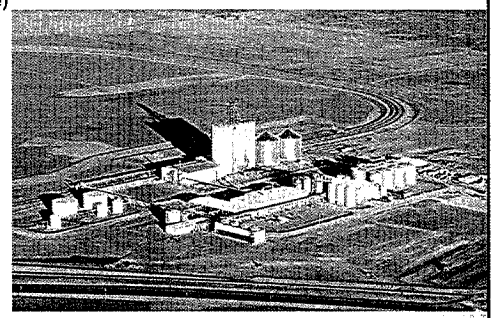

Ethanol Production
From Dry Milling
Corn / Milo Receiving
Corn / Milo Storage
Hammermill
Jet Cooker
Mash Cooking
Enzyme Liquefaction
Fermentation
Distillation
Beer Column
Rectifier
Side Stripper
Stillage Centrifuges
Stillage Evaporation
Ethanol Dehydration Molecular Sieves
Carbon Dioxide Recovery Facility
Carbon Dioxide
Ethanol Storage
Denaturant Storage
Fuel Ethanol
DDGS
DDGS Drying
WDGS
Feedstock in, ethanol and DGS out
the energy of innovation

Grain Based Fermentation

Maize based (corn kernel)
- ~95% of US industry ferments corn kernels
- Other potentials
  - **Grain sorghum (milo)**
  - **Small grains (wheat, barley, rye, triticale)**

"Typical" new dry grind plant today
- Ethanol: 2.8 gal/bushel corn
  - 96 gallons per dry ton
- DDGS: 18 lbs/bushel corn
- CO2 capture where economics allow
- > 98%+ up time
- Emissions below 100 tpy
  - **(NOx, VOC, PM, CO, SOx)**
- Higher focus on DDG quality

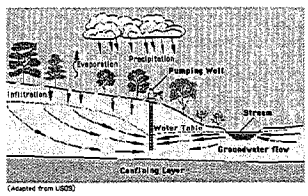
Fuel ethanol produced exclusively by fermentation
- Plant consumption per gallon ethanol
  - **30,000 BTU**
  - **0.75 kW electrical input**
  - **3 to 4 gallons water**
    - **Majority of water needed for cooling**



ICM | ethanol

Overview of Primary Water Needs

- Water Supply
  - Must provide sustainable quantity and quality of water
  - Sources include wells, surface water, grey water (municipal wastewater)
- Wastewater Permitting
- Capital & Operating Costs For Water Treatment



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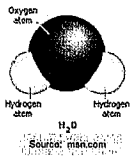
Water statistics

- Ethanol industry as a whole



  - 3-5 gallons of water required per gallon of ethanol produced
    - Average water use declined from 5.8:1 in 1998 to 4.2:1 in 2005 (Institute for Ag & Trade Policy-October 2006)
  - ~1/3 of water is used for process water
  - Remaining 2/3 used in utility systems with ~ 90% of that used in the cooling tower

Largest water usage occurs in the cooling tower

Water Supply-Quality

Supply water must protect assets and performance

- Performance Related Issues:
  - Ethanol production
    - High concentrations of sulfates, chlorides, silica, and/or hardness will have negative impact on production efficiency (heat transfer) through corrosion and scaling in ***boiler and cooling tower***

The better the water quality in the cooling tower, the less water required

Water Supply-Quality (cont'd)

Supply water will affect wastewater discharge permitting

- Permitting related issues
  - Poor source water quality results in poor wastewater quality and therefore poses difficulty with respect to wastewater permitting
  - Quality of water coming into plant may exceed wastewater permit limits straight from the source

Poor water quality equates to permitting difficulty and higher project costs

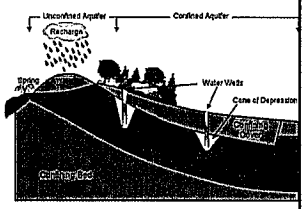
Water Supply-Quantity

- Sufficient water supply needed over the plant's operating life
  - Quantity needs to be sustainable
  - Quantities needed 24 hours/day, 7 days/week, 52 weeks/year
    - A 50 MMgal/yr plant at 3-5 gallons water per gallon of ethanol produced
      - Equates to ~150 – 250 MMgal/yr water

Water Supply MUST BE sustainable

Water Supply-Quantity (cont'd)

- Tapping into a limited resource
  - Pumping water must be properly managed to minimize impact to existing uses.
  - A long-term aquifer sustainability evaluation and groundwater chemistry assessment should be completed to limit impacts.
- Balancing act - in some locales the ethanol plant is the largest user of water
  - 100 MGY ethanol plant uses 2x-3x water quantity of town with population of 700
  - Town with population of 10,000 uses 2x-3x water quantity of 100 MGY ethanol plant



Improper water management is a costly mistake both environmentally and economically

Wastewater Permitting

Process Wastewater is NOT Discharged at ICM Designed Plants

All water (at ICM designed plants) used within the process is either recycled or leaves the plant as moisture content in distiller's grains and solubles (DGS) or evaporated.

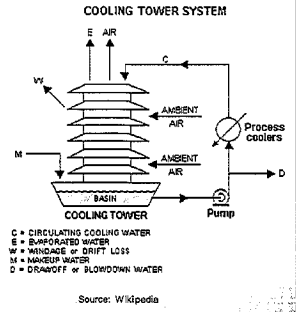
All wastewater at ICM plants is non-process wastewater

ICM | ethanol

Wastewater Permitting (cont'd)

Typical Wastewater Streams (cont'd)
(ICM Design)

- Cooling Tower Blowdown
  - Water lost to evaporation
    - Evaporation = more highly concentrated water
  - Concentration cycles of water in the cooling tower is heavily dependent on wastewater permit limits



All wastewater at ICM plants is non-process wastewater

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Capital and Operating Costs

- Dependent on water quality
- Varies depending on proposed discharge point (surface water, irrigation, or municipal treatment)
- Some treatment technologies exist that could improve water quality, but treatment options are often not economically viable to the plant

  Examples: Cold lime softening, Zero Liquid Discharge

Water quality has a large impact on a project's viability and costs

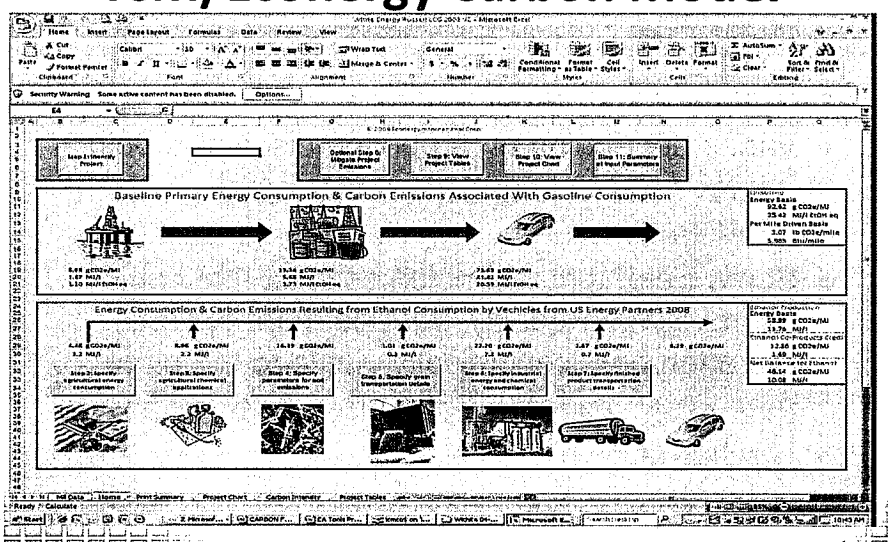
ICM | ethanol

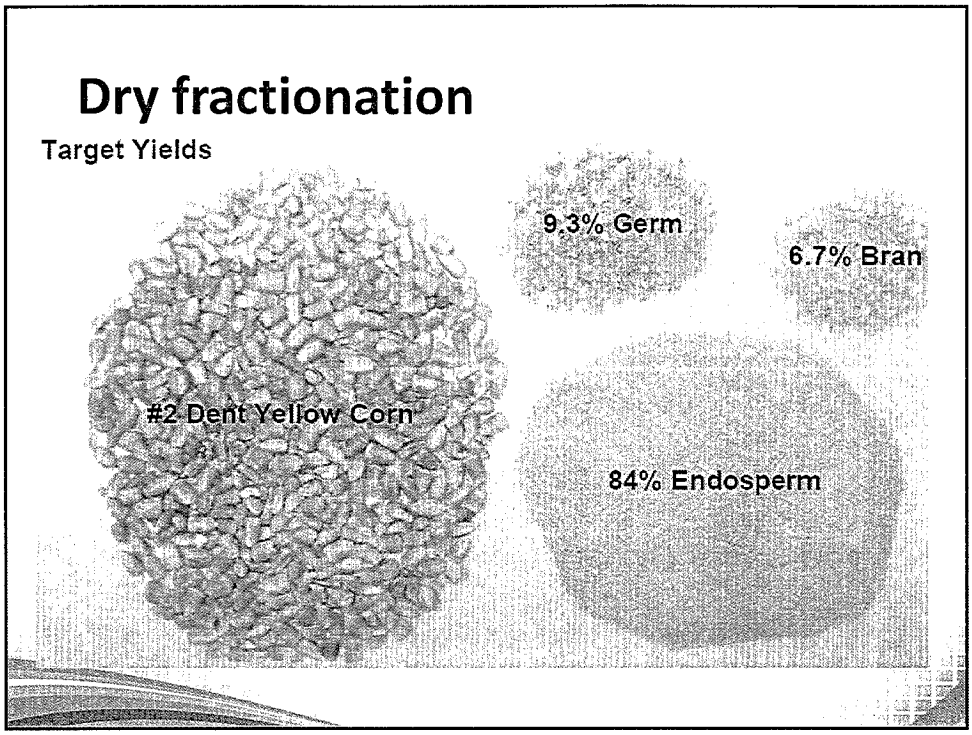
Moving Forward

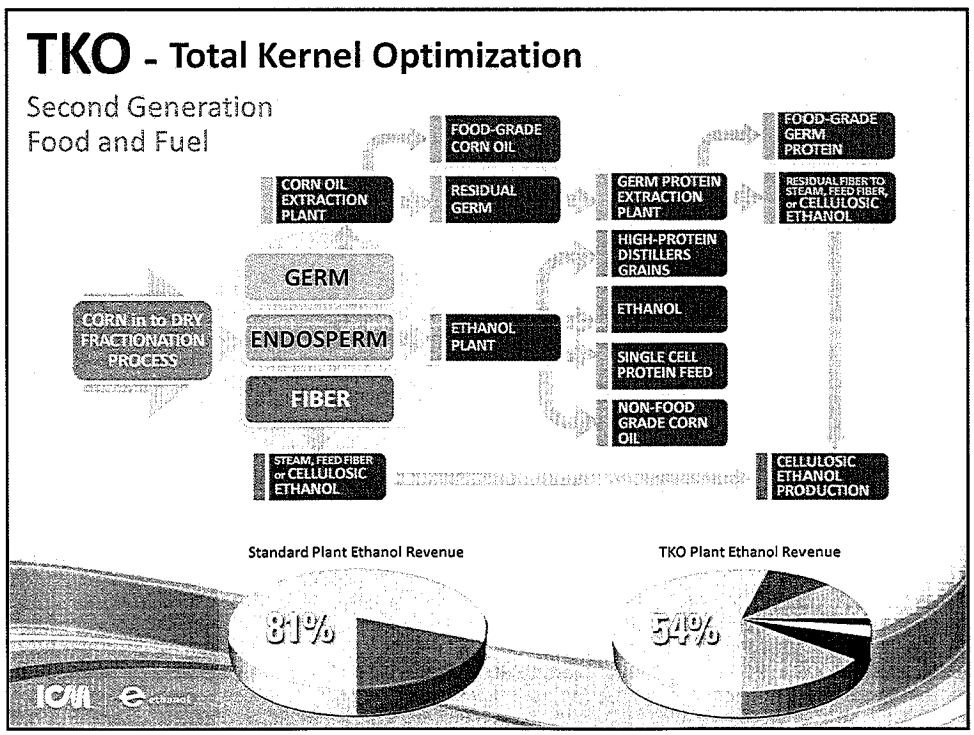
- Research and Development
  - Ongoing research to increase process and energy efficiency for reduced water usage
  - New technologies and product streams
  - Intertwined with focus on carbon reduction and capture and sequestration

ICM | e ethanol

ICM/Econergy Carbon Model




Dry fractionation
Target Yields
9.3% Germ
6.7% Bran
#2 Dent Yellow Corn
84% Endosperm


TKO - Total Kernel Optimization
Second Generation
Food and Fuel
CORN in to DRY FRACTIONATION PROCESS
GERM
ENDOSPERM
FIBER
CORN OIL EXTRACTION PLANT
FOOD-GRADE CORN OIL
RESIDUAL GERM
GERM PROTEIN EXTRACTION PLANT
FOOD-GRADE GERM PROTEIN
RESIDUAL FIBER TO STEAM, FEED FIBER, or CELLULOSIC ETHANOL
ETHANOL PLANT
HIGH-PROTEIN DISTILLERS GRAINS
ETHANOL
SINGLE CELL PROTEIN FEED
NON-FOOD GRADE CORN OIL
STEAM, FEED FIBER or CELLULOSIC ETHANOL
CELLULOSIC ETHANOL PRODUCTION
Standard Plant Ethanol Revenue
81%
TKO Plant Ethanol Revenue
54%

Dry Fractionation Ethanol Plant

- Food-grade Corn Oil
- Food-grade Protein
- Food-grade Snack Grits & Flour
- High-protein Distillers' Grains
- Single-cell Protein for Feed
- Bran for Dietary Fiber
- ...Ethanol

Ethanol - ***Made in Kansas***

Association Of Ethanol Processors

Testimony Before the Joint Energy and Environment Committee

Steve McNinch, CEO of Western Plains Energy LLC

Tuesday, September 29, 2009

Good afternoon, Chairwoman McGinn and members of the Joint Energy and Environment Committee. I am Steve McNinch, CEO of Western Plains Energy LLC, which is an ethanol plant near Oakley, Kansas. The Western Plains plant began operating in 2004, as a 30 million gallon per year plant but expanded to its current capacity of 48 million gallons per year. I am also the Chairman of the Kansas Association of Ethanol Processors, which represents the ethanol plants and allied industries in Kansas.

Chairwoman McGinn has asked me to review the water usage by ethanol plants. My plant uses approximately 500 acre feet per year. It is common practice for a plant to buy water rights from an irrigator to have water to operate the plant. Once a plant purchases the water right, the Division of Water Resources within the Kansas Department of Agriculture, automatically reduced the water right by 40% because the law requires any water right that goes from agricultural use to either commercial or industrial be reduced by 40%. Thus from the initial stage there is a reduction in the amount of water we can use versus what the farmer would have been able to use.

Another way the ethanol plants help with the reduction of water consumption is by selling the wet distillers grain to a feedlot. The wet distillers grain contains enough water that the feedlot can reduce the amount of water given to the animals by at least 10%. Therefore, even though the water is initially used by the ethanol plant, this usage is overset by the reduction needed to be used by the feedlot.

KAEP, 816 SW Tyler, Topeka, KS 66612, 785-234-0461, Fax 785-234-2

Water at an ethanol plant is primarily used to cool the ethanol plants. The estimate is 2/3 of the total water use goes to cooling the plant and 1/3 goes to the ethanol process. This water that is used for cooling is recycled but some is lost to evaporation. However, the end result is that ethanol contains only 1% water. Therefore, almost all of the water used by an ethanol plant is being consumed and used in the state of Kansas.

You may wonder how the water usage of an ethanol plant compares to other water usage. Here are some interesting comparisons:

- To produce 50 million gallons of oil, it would take approximately 6700 acre feet of water
- The 500 acre feet used by my plant would only be enough water to grow 250 acres of corn.
- An average golf course uses 314 acre feet of water per year
- 30,000 head of dairy cattle consume approximately 1200 acre feet a year
- Kansans use approximately 4.6 million acre feet of water a year. Ethanol plants use only 4049 acre feet of this usage, or only .09% of the total water usage in the state.

We recognize that water is an important and finite resource. That is why the ethanol industry is working hard to ensure that through better and newer technology we can improve the water efficiency of the ethanol plants. Currently ethanol plants are running at lower cooking temperature and are eliminating direct steam injection as ways to reduce the amount of energy and water needed to cool the plant.

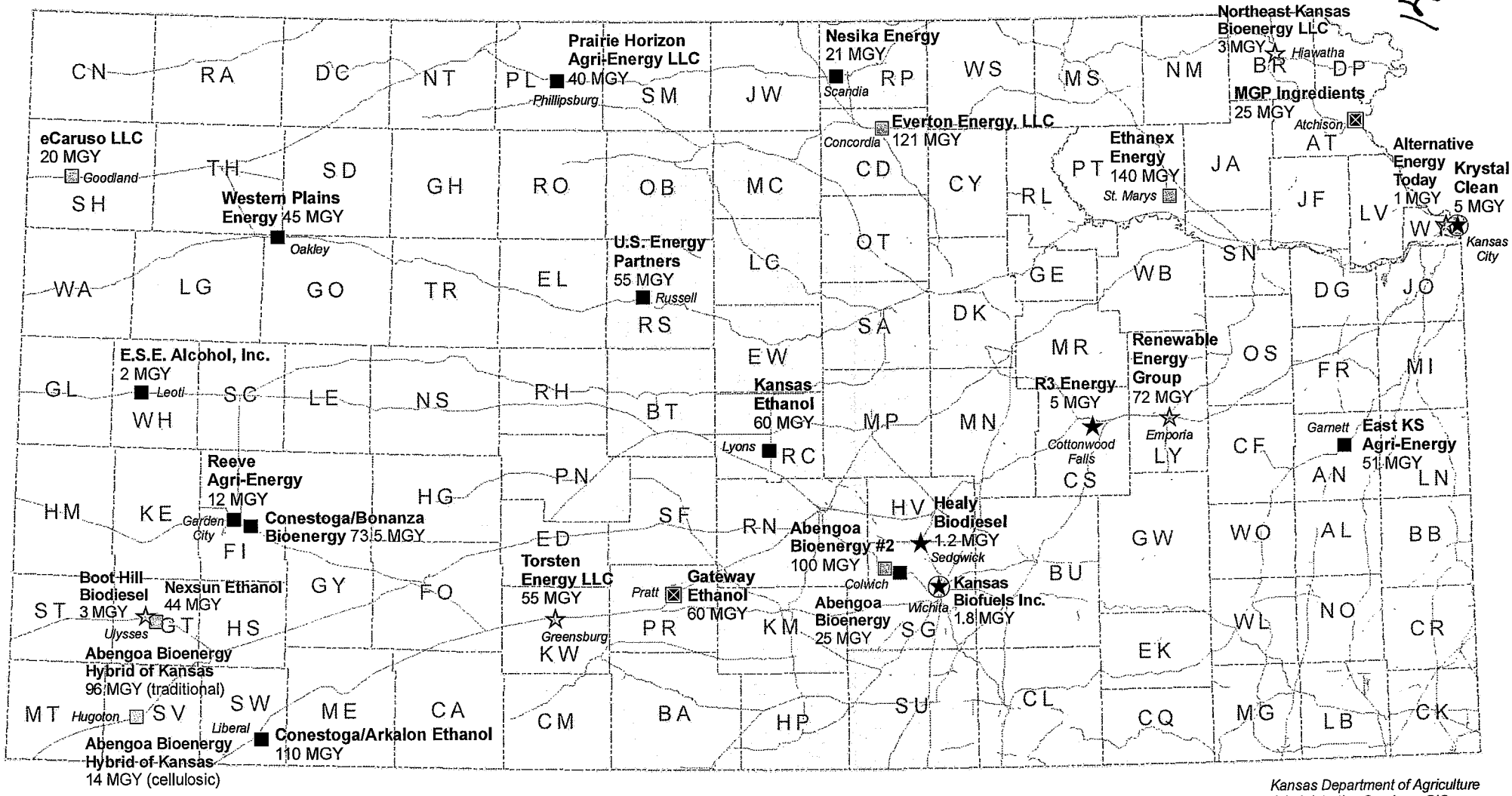
Ethanol plants in Kansas have generated local economic growth through their presence in those communities. A Nebraska study found that a 100 million gallon plant results in:

- $150m in capital construction
- $70 m to the economy during construction
- Expansion of the local economic base by $233 million each year
- 45 direct jobs plus 101 indirect jobs
- Raised grain prices by $.10 a bushel

- Tax revenues of $3.2m per year
- Western Plains employs 37 people and has an annual payroll of $2,500,000.

I appreciate the ability to present this information to the committee today. I hope I have given you an understanding of the water used by an ethanol plant in Kansas and the benefits that the small, rural communities receive from having one of these plants in their area. I would be happy to answer any questions you may have at the appropriate time.

Ethanol and Biodiesel Plant Activity in Kansas
August 2009



Kansas Department of Agriculture
Administrative Services, GIS
August 10, 2009

KANSAS
as big as you think℠

' = Millions of gallons per year of permitted capacity.
pacities courtesy of Kansas Department of Health and Environment and the Kansas Department of Revenue.

* Permitted and Permit Pending codes refer to KDHE Bureau of Air and Radiation – Air Construction permits.

Ethanol Plants

- ■ Existing: 11 plants, 494.5 MGY
- ▣ Under Construction: 3 plants, 241 MGY
- ▣ Permitted*: 2 plants, 184 MGY
- ▣ Permit Pending*: 1 plant, 110 MGY
- ⊠ Idle: 2 plants, 85 MGY

Biodiesel Plants

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- ⊛ Idle: 2 plants, 6.8 MGY

KANSAS FARM BUREAU
The Voice of Agriculture

2627 KFB Plaza, Manhattan, Kansas 66503-8508 • 785-587-6000 • Fax 785-587-6914 • www.kfb.org
800 SW Jackson St., Suite 1300, Topeka, Kansas 66612-1219 • 785-234-4535 • Fax 785-234-0278

PUBLIC POLICY STATEMENT

JOINT COMMITTEE ON ENERGY and ENVIRONMENTAL POLICY

RE: Agriculture and the Water-Energy Nexus

September 29, 2009
Topeka, Kansas

Testimony provided by:
Brad Harrelson
State Policy Director
KFB Governmental Relations

Chairperson McGinn, and members of the Committee, thank you for the opportunity to appear today in support of SCR 1610. I am Brad Harrelson, State Policy Director—Governmental Relations for Kansas Farm Bureau. KFB is the state's largest general farm organization representing more than 40,000 farm and ranch families through our 105 county Farm Bureau Associations.

On behalf of Kansas Farm Bureau (KFB) I would like to extend our appreciation to the Kansas Legislature for its interest in water and energy issues which are vital components of modern production agriculture. We at KFB stand ready to assist you in your mission to consider these important issues.

Field to Market

Keystone Alliance for Sustainable Agriculture

Background Presentation
Date: September 2009
By: Michael Doane, Monsanto

Premise

- Agricultural productivity will need to at least double in the next 40 years to meet demand
- Competition emerging for land, water and energy available for farming
- Externalities such as GHG emissions, water quality, biodiversity loss, soil health in the view
- We will need to meet these challenges in a manner that works for farmers, our food and fiber supply, our communities and our environment

15-2

Population and Income Drives the Demand for Corn and Soybean

+13% The growth in world **population** over the last 10 years	+36% The growth in global **income** over the last 10 years	+21% The growth in **meat** consumption (Beef +14%, Pork +11%, Chicken +45%) over the last decade
+34% The growth in world **corn** consumption over the last decade	+52% The growth in world **soybean** consumption over the last decade	+6% The growth in world **crop area** harvested over the last decade

Agricultural productivity gains mean more food, feed and fuel from the same land area.

Population and historic data from Global Insights Crop and livestock historic data from USDA "Last 10 years/decade" = 1998 - 2008

Background: Field to Market

- **Field to Market is a collaborative stakeholder group** of producers, agribusinesses, food and retail companies, and conservation organizations that are working together to develop a supply-chain system for agricultural sustainability.
- **We are developing outcomes-based metrics**
  - We will measure the environmental, health, and socioeconomic impacts of agriculture first in the United States
  - We are beginning with national scale environmental indicators for corn, soy, wheat, and cotton production in the U.S.
- The group was convened and is facilitated by **The Keystone Center**, a neutral, non-profit organization founded in 1975 to ensure that present and future generations approach environmental and scientific dilemmas and disagreements creatively and proactively.

4

15-3

Steering Committee Members and Participants

- American Farm Bureau Federation
- American Soybean Association
- Bayer CropScience
- Bunge
- Cargill
- Conservation International
- Conservation Technology Information Center
- Cotton Incorporated
- CropLife America
- CropLife International
- Darden Restaurants
- DuPont
- Fleishman-Hillard
- General Mills
- Grocery Manufacturers of America
- John Deere
- Kellogg Company
- Land O'Lakes
- Manomet Center for Conservation Science
- Mars, Incorporated
- Monsanto Company
- National Association of Conservation Districts
- National Association of Wheat Growers
- National Corn Growers Association
- National Cotton Council of America
- National Potato Council
- Syngenta
- The Coca-Cola Company
- The Fertilizer Institute
- The Nature Conservancy
- United Soybean Board
- World Resources Institute
- World Wildlife Fund
- University of Arkansas Division of Agriculture
- University of Wisconsin-Madison College of Agricultural and Life Sciences

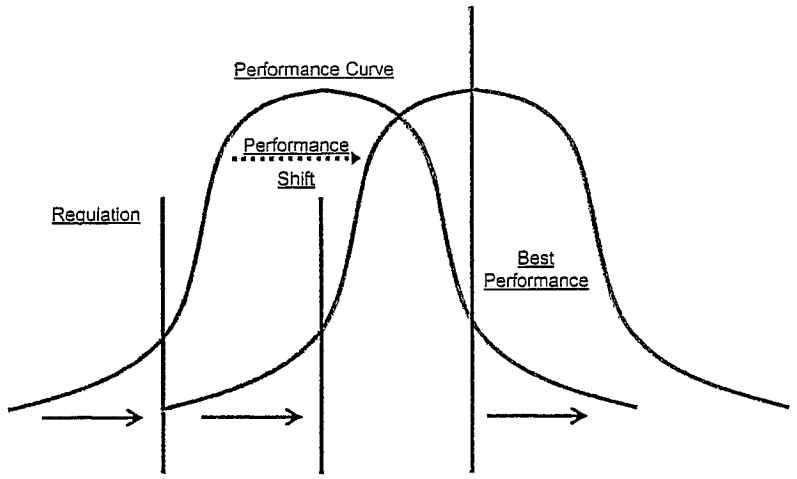
5

Working Definition of Sustainable Agriculture

- Meeting the needs of the present while improving the ability of future generations to meet their own needs
  - Increasing productivity to meet future food demands
  - Decreasing impacts on the environment
  - Improving human health
  - Improving the social and economic well-being of agricultural communities

15-4

Accelerating better practice adoption



Source: World Wildlife Fund - US

7

Environmental Indicator Report Data and Methods

- **Data & Methods Overview**
  - National scale outcomes (US only)
  - Land use, soil loss, irrigated water use, energy use, and climate impact (greenhouse gas emissions)
  - On farm-production of corn, cotton, soybeans, and wheat – 230 million acres
  - Results normalized to units of output (bushel or pound) and as absolute values
  - Utilizes mostly publicly available data (USDA-NASS, NRI, USGS, CTIC)
- **Process Overview**
  - Compiled by IHS Global Insight with committee oversight Nov 2007-May 2008
  - Peer Review process conducted in May 2008
  - Public Comment Period initiated in August 2008
  - Final Report released in January 2009

15-5

Field to Market: Environmental Resource Indicators Report Summary

Percent Reduction of Inputs per Unit of Output (1987-2007)[1]

Indicator	Corn	Cotton	Soybeans	Wheat
Land Use	-37%	-25%	-26%	nil
Soil Loss	-69%	-34%	-49%	-50%
Irrigated Water Use	-27%	-49%	-20%	nil
Energy Use	-37%	-66%	-65%	-9%
GHG Emissions	-30%	-33%	-38%	+15%

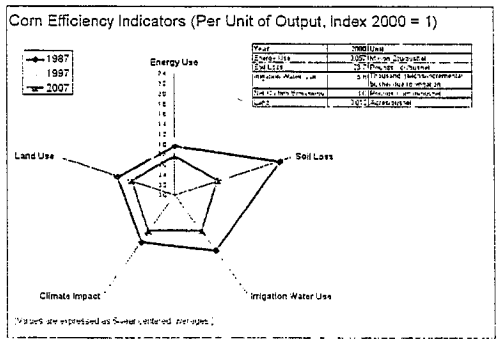
1/ Indexed to actual values in year 2000

9

Environmental Indicator Report Corn: Summary of Results

Over the study period (1987-2007),

- **Productivity** (yield per acre) has increased 41 percent.
- **Land use** increased 21 percent. Land use per bushel decreased 37 percent.
- **Soil loss** above T has decreased 43 percent per acre and 69 percent per bushel.
- **Irrigation water use** per acre decreased four percent. Water use per bushel has been variable, with an average 27 percent decrease over the study period.
- **Energy use** per acre increased three percent. Energy use per bushel decreased 37 percent.
- **Greenhouse gas emissions** per acre increased eight percent. Emissions per bushel decreased 30 percent.



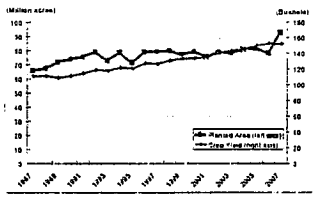
• **Total annual trends** over this time period indicate increases in total annual energy use (28 percent), water use (17 percent), and greenhouse gas emissions (34 percent). Total annual soil loss has decreased 33 percent.

15-6

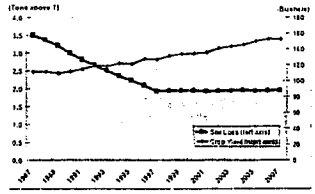
Field to Market

Corn: Land Use and Soil Loss

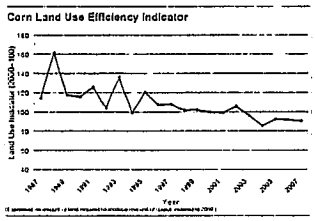
Corn Land Use and Yield per Acre



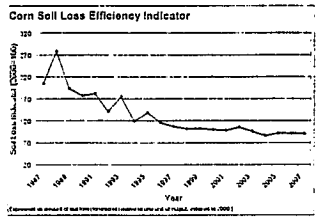
Corn Soil Loss per Acre and Yield per Acre



Corn Land Use Efficiency Indicator



Corn Soil Loss Efficiency Indicator

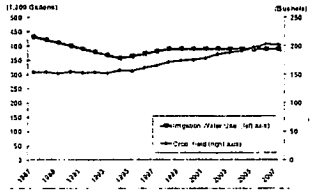


11

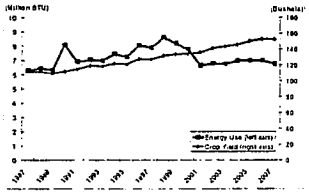
Field to Market

Corn: Water Use, Energy Use, and Climate Impact

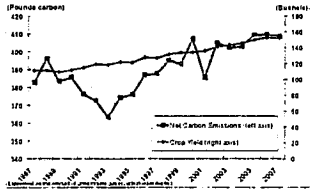
Corn Irrigation Water Use per Acre and Yield per Irrigated Acre



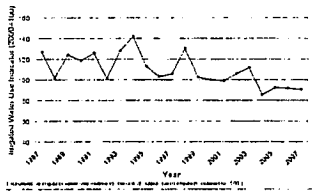
Corn Energy Use per Acre and Yield per Acre



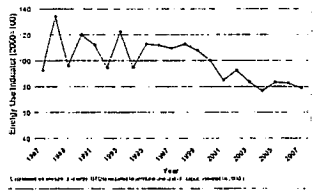
Corn Net Carbon Balance per Acre and Yield per Acre



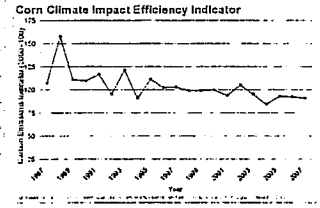
Corn Irrigation Water Use Efficiency Indicator



Corn Energy Use Efficiency Indicator



Corn Climate Impact Efficiency Indicator



12

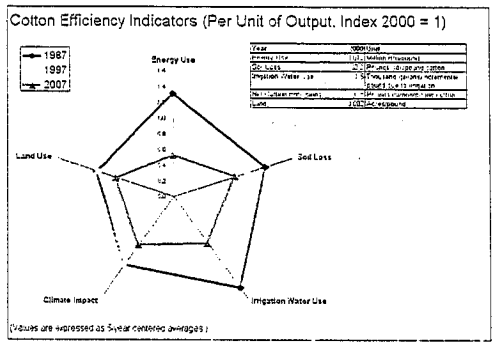
15-7

Field to Market

Environmental Indicator Report
Cotton: Summary of Results

Over the study period (1987-2007),

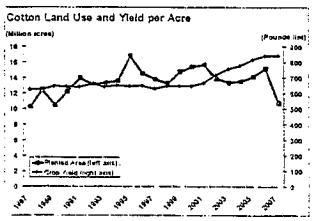
- **Productivity** (yield per acre) increased 31 percent, with most improvement occurring in the second half of the study period.
- **Land use** has fluctuated over time, with an overall increase of 19 percent. Land use per pound produced has decreased 25 percent.
- **Soil loss** per acre decreased 11 percent while soil loss per pound decreased 34 percent.
- **Irrigation water use** per acre decreased 32 percent, while water use per incremental pound of cotton produced (above that expected without irrigation) decreased by 49 percent.
- **Energy use** per acre decreased 47 percent while energy use per pound decreased 66 percent.
- **Greenhouse gas emissions** per acre decreased nine percent while emissions per pound fluctuated, with more recent improvements resulting in a 33 percent average decrease over the study period.

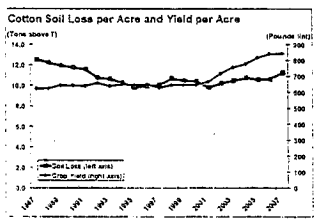


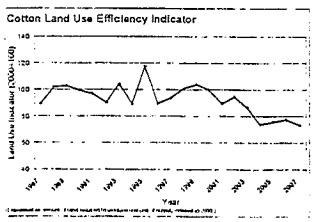
• **Total annual trends** over the time period indicate soil loss and climate impact in 2007 are similar to the impact in 1987, with average trends over the study period remaining relatively flat. Total energy use decreased 45 percent and total water use decreased 26 percent.

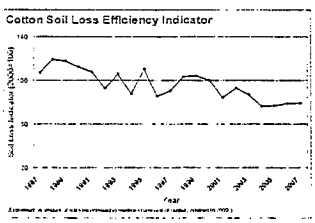
Field to Market

Cotton: Land Use and Soil Loss









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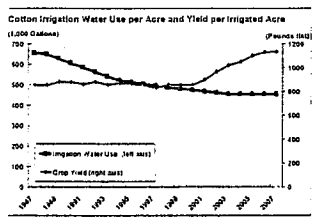
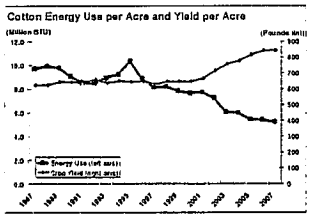
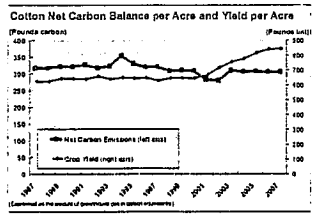
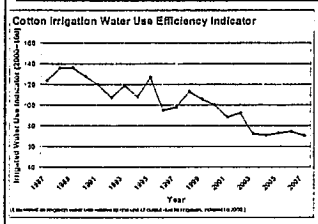
15-8

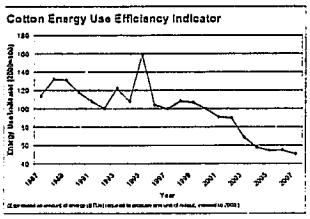
Cotton: Water Use, Energy Use, and Climate Impact

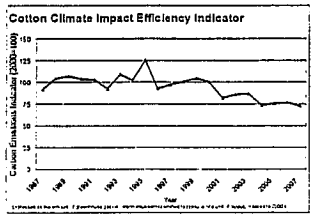












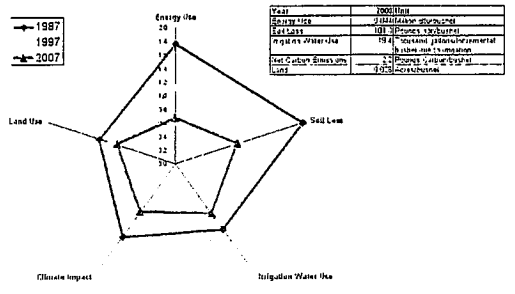
15

Environmental Indicator Report Soybeans: Summary of Results

Over the study period (1987-2007),

- **Productivity** (yield per acre) increased steadily by 29 percent.
- **Land use** increased in absolute terms and by 31 percent while land use efficiency per bushel improved by 26 percent.
- **Soil loss** per acre decreased roughly 31 percent while soil loss per bushel decreased 49 percent. These trends coincide with significant changes in farming practices in states that grow the bulk of all soybeans.
- **Irrigation water use** per acre has changed little over time and water use per bushel improved 20 percent. However, only four to seven percent of the crop utilizes supplemental water.
- **Energy use** per acre has decreased 48 percent while per bushel energy use decreased 65 percent. Soybeans have seen the most dramatic shift in inputs used, particularly herbicides and fuel for tillage, enabling per-unit energy requirements to decline substantially over time.
- **Greenhouse gas emissions** per acre declined 14 percent and emissions per bushel decreased 38 percent.

Soybean Efficiency Indicators (Per Unit of Output, Index 2000 = 1)



(Values are expressed as 5-year centered averages.)

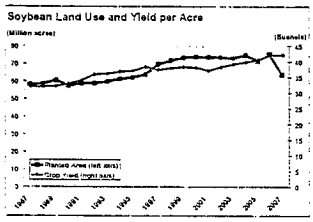
• Total annual trends over this time period indicate soybean production's total energy use decreased 29 percent, total soil loss decreased 11 percent, total irrigation water use increased 39 percent, and climate impact increased 15 percent.

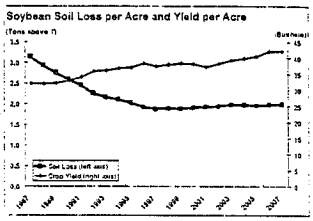
16

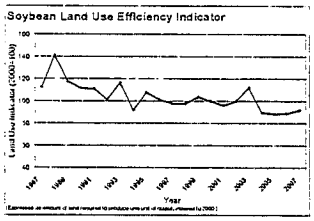
15-9

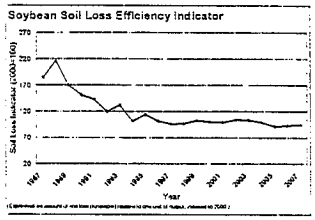
Field to Market

Soybeans: Land Use and Soil Loss









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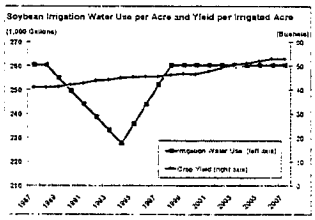
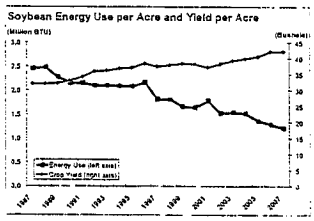
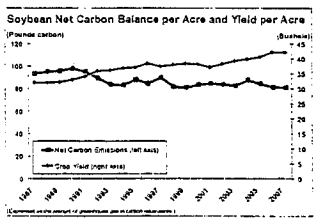
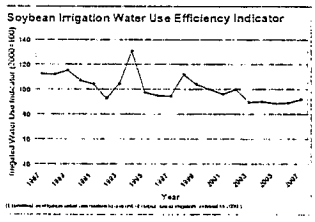
Field to Market

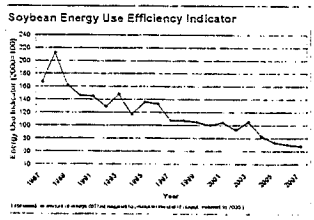
Soybeans: Water Use, Energy Use, and Climate Impact

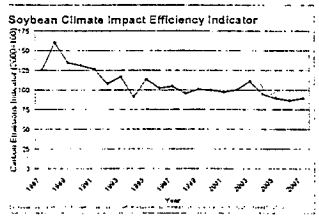












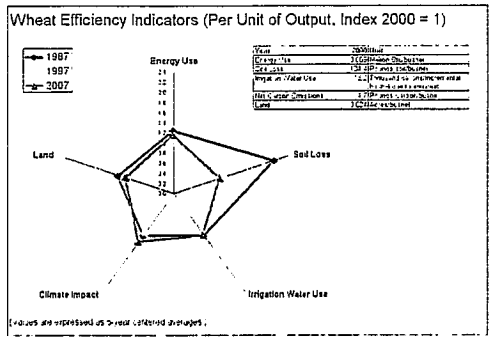
18

15-10

Environmental Indicator Report
Wheat: Summary of Results

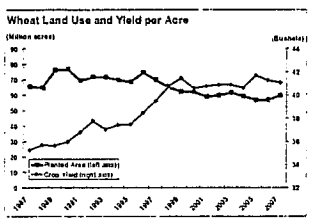
Over the study period (1987-2007),

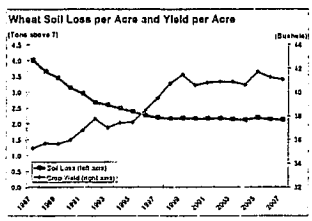
- **Productivity** (yield per acre) increased by 19 percent.
- **Land use** decreased 24 percent. Land use per bushel was variable, with an average overall decrease of 17 percent.
- **Soil loss** per acre and per bushel improved 39 percent and 50 percent, respectively, with most improvements over the first half of the study period.
- **Irrigation water use** per acre increased 17 percent while water use per bushel produced due to irrigation showed an average flat trend.
- **Energy use** per acre increased eight percent and energy use per bushel decreased nine percent.
- **Greenhouse gas emissions** per acre increased 34 percent and emissions per bushel increased 15 percent, with a larger increase in the latter half of the study period.

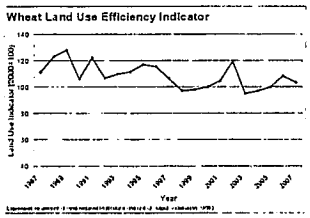


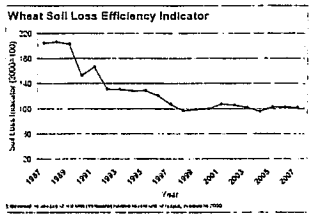
- **Total annual trends** over this time period indicate wheat's total energy use and total irrigation water use were similar in 1987 and 2007, with average trends over the twenty year study period showing an 18 percent decrease in total energy use and an 11 percent decrease in total water use. Total soil loss has decreased 54 percent. Total climate impact has increased an average of five percent over the study period, with a more significant increase over the past decade.

Wheat: Land Use and Soil Loss









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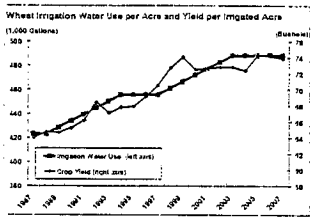
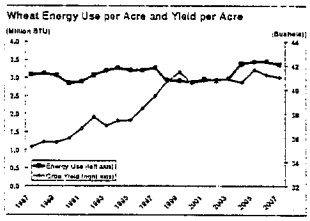
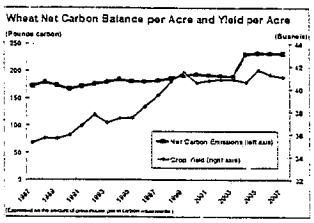
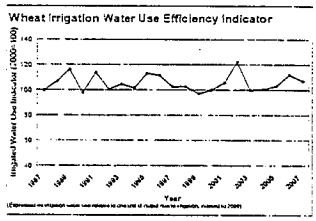
15-11

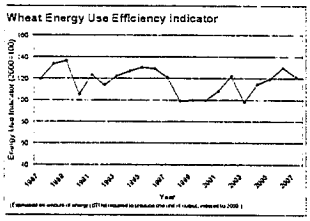
Wheat: Water Use, Energy Use, and Climate Impact

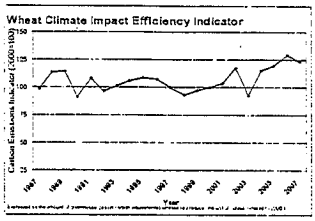












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Key Learnings

- Steady gains across corn, soy and cotton on all indicators, less so on wheat
- Productivity improvement (yield) is the driver for resource use efficiency
- Significant gains are possible when policy & innovation come together – see Soil Loss
- Nitrogen use and application is the largest part of the energy and climate footprint, the exception is soybeans
- Accurate outcomes-based data forms the basis for our value chain discussions on sustainability
- Reliable and current data sources ex-US are limited

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15-12

Environmental Indicator Report Discussion and Conclusions

- Resource Indicators DO:
  - Describe progress or lack of progress for resource use or impact per acre, and resource efficiency per unit of output
  - Provide context for focusing on specific challenges and regions
  - Provide starting points for developing outcomes metrics at other scales, for a variety of technology choices, and a variety of crops.
- Resource Indicators DO NOT:
  - Define a benchmark level for sustainability.
  - Represent all dimensions of sustainability. We will continue to develop other environmental, social, and economic indicators.

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Next Steps

- Outreach with policymakers & food channel
- Calculator for field level decision support analysis by individual farmers
- Development of other indicators in 2nd Report:
  - Water quality
  - Habitat/biodiversity
  - Economic health
  - Occupational safety
- Early efforts on supply chain incentives & signals
  - Pilot project with DMI on low carbon feeds

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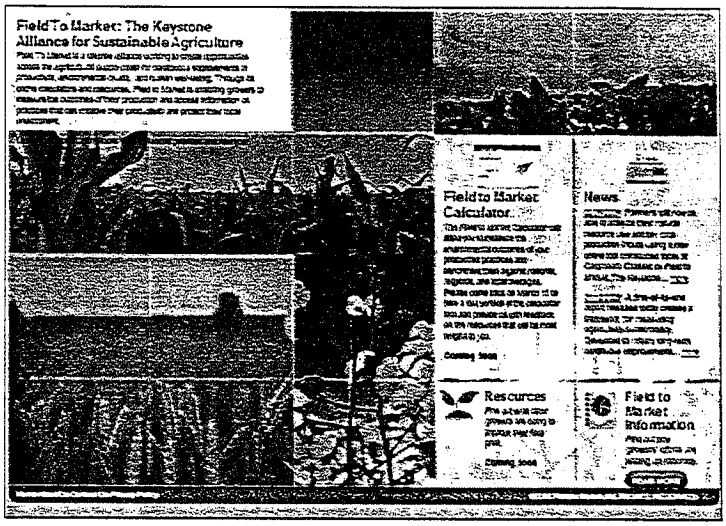
15-13

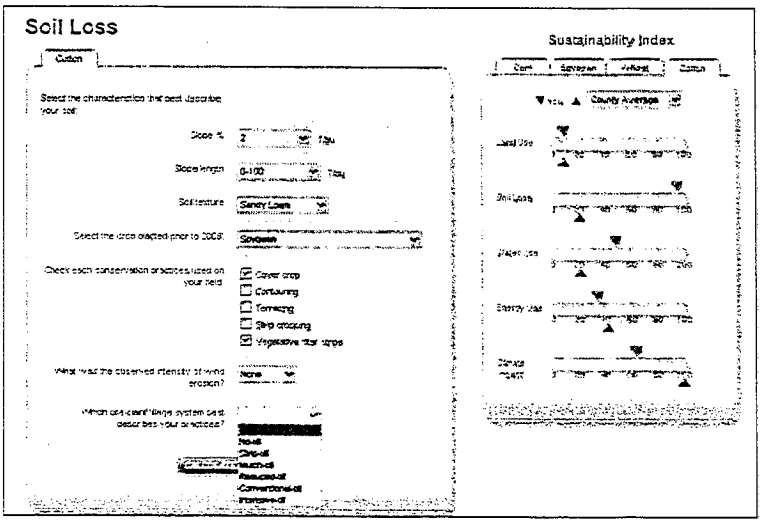
Field to Market

Field to Market Homepage
http://www.fieldtomarket.org



Field to Market

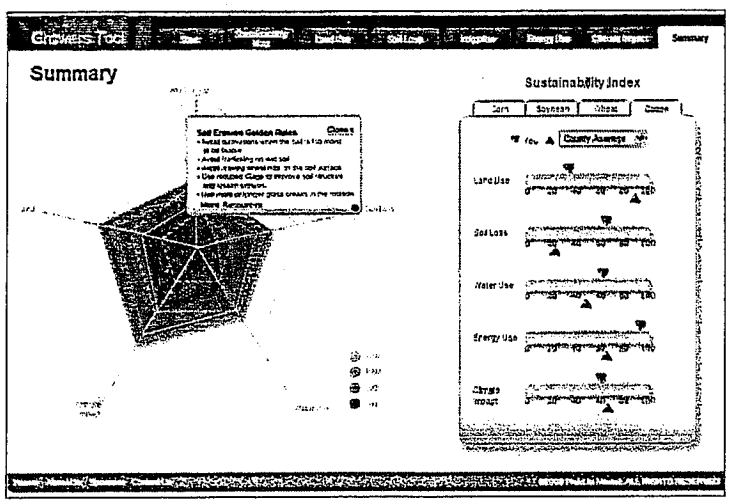
Soil Loss Calculator



15-14

Field to Market

Results Summary



Field to Market

Questions/Contact Information

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  - 970-513-5846; salexander@keystone.org
- Julie Shapiro, Associate
  - 970-513-5830; jshapiro@keystone.org
- *Field to Market* Website hosted at Keystone Center
  - http://keystone.org/spp/environment/sustainability/field-to-market
- *Field to Market* Website (includes background information and grower tool updates)
  - http://www.fieldtomarket.org

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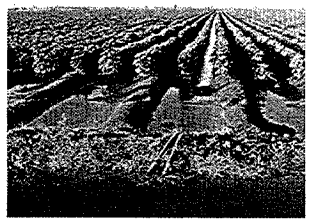
15-15

Research on Water Use Efficiency and Drought Stress Tolerance at K-State



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Center for SORGHUM Improvement

Impact of Drought and/or Heat on Kansas Crops

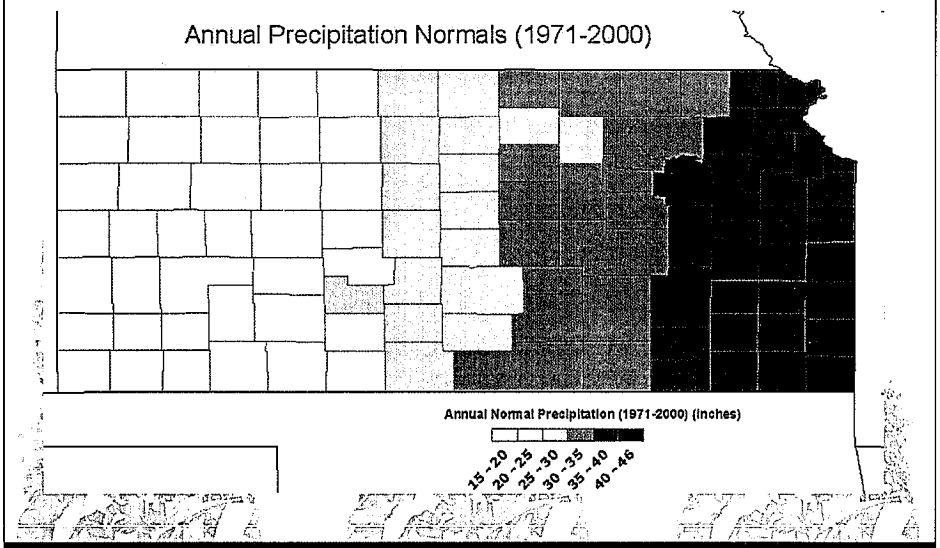
Drought Impact on Crop Production and Revenue.

Crop	Revenue Loss (Million Dollars)
1. Wheat	387
2. Sorghum	272
3. Corn	261
4. Soybean	97
5. Alfalfa	68

Source: Economic impact of 2001-2002 drought: Income and financial condition of Kansas farmers. Kansas Farm Management Association.

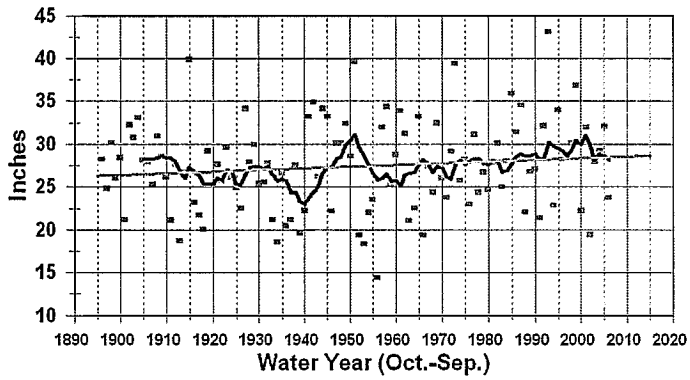
Drought related revenue losses in 2002 and 2004 were about $ 250 million in sorghum and total of about $ 1.1 billion.

Kansas –Environment - Precipitation



Gets drier as we travel from East to West
Average annual rainfall is approximately 25.52 inches

Kansas –Environment - Precipitation

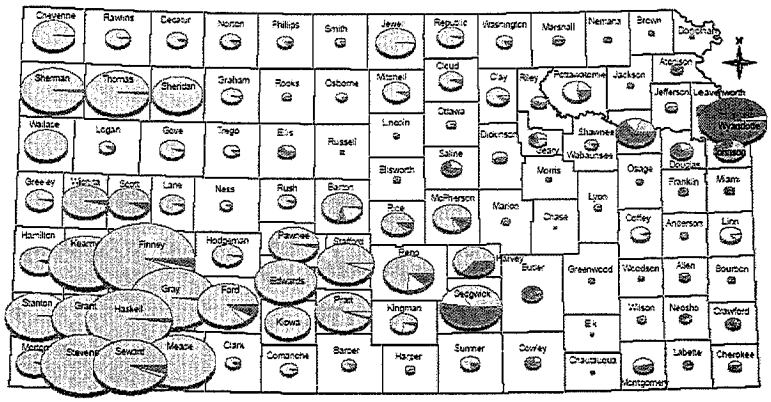


Source: Dr. S.A. Staggenborg
Kansas State University

High year to year variation in rainfall.

Water Use in Kansas

2006 Water Use By County



Data Sources:
Division of Water Resources, Water Use Program
Kansas Water Office, Water Marketing Program

50 25 0 50 Miles

Kansas Water Office December 2007

Water Use by Type of Use

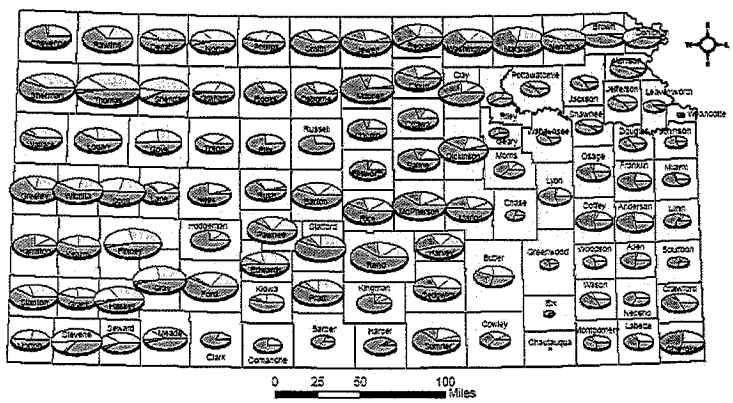
Acre Feet
33,000

Irrigation
Industry
Municipal
Recreation
Stock Water

Most of the water is used for irrigation of field crops.

Crop Inventory in Kansas

2007 Kansas Harvested Crop Inventory by County



Acres
100,000

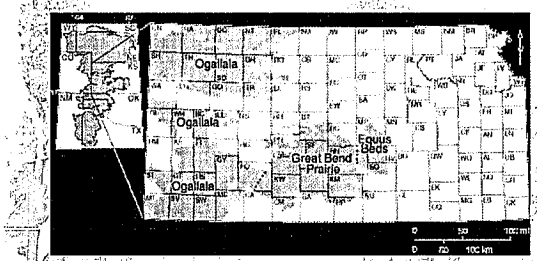
Corn
GrainSorgh
Soybean
Wheat

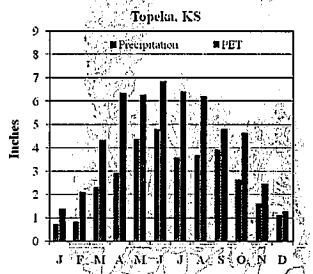
Data Sources: Kansas Agricultural Statistics
Prepared for Kansas Water Plan 2008

Selection of drought tolerant and water use efficient crop is important.

Precipitation and Water Resources in Kansas

- Great Plains and adjoining area have evaporative demands that exceed precipitation.
- Irrigation water supplies are limited and depleting fast (Ogallala aquifer)
- Understanding and managing crop water supplies and use is essential to successful cropping systems, yield and profits to producers.
  - Crop intensity, crop selection, variety selection, tillage practices, irrigation management (number, timing and intensity), weed management and fertilizer management

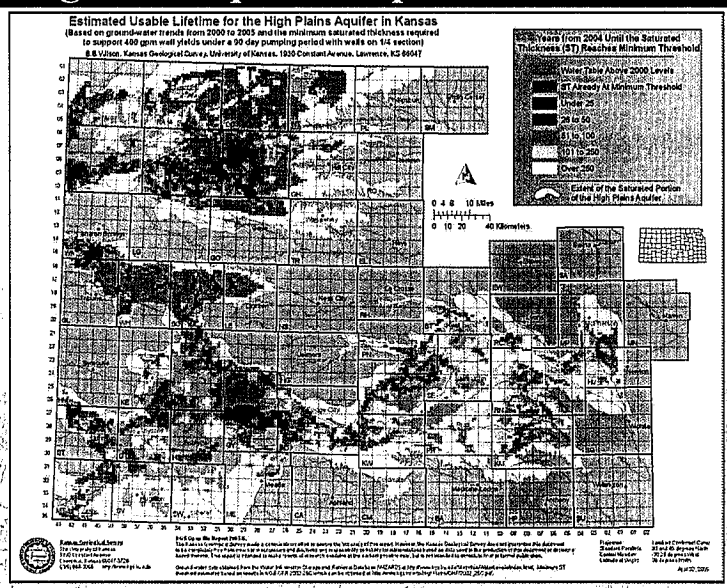




A water supply in a cropping system context is the amount of water available to the plant for growth during growing season.

Most irrigation supply is from Ogallala aquifer in Western Kansas.

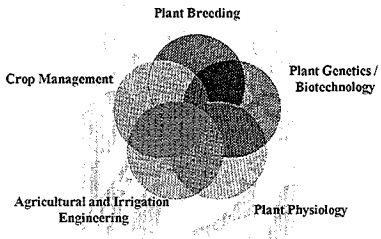
Ogallala Aquifer Depletion in Kansas



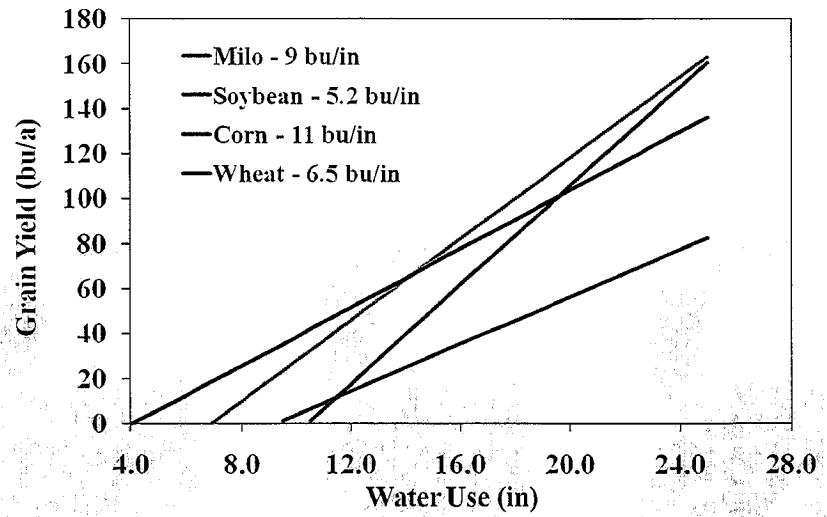
Water in Ogallala aquifer is limited and declining at a rapid rate.

K-State Research Areas

1. Identify best crop species under dry land conditions.
2. Determine the best timing of irrigations to avoid stress during critical periods.
3. Identify best plant population and planting geometry for efficient resource use.
4. Develop new efficient methods of irrigations to decreases losses.
5. Determine best crop systems to improve water use efficiency.
6. Evaluate germplasm collections for drought and heat tolerant traits.
7. Understand physiological and genetic basis for drought and heat tolerance.
8. Identify genes associated with drought and heat tolerance.
9. Develop drought and heat tolerant cultivars using traditional and molecular breeding tools.



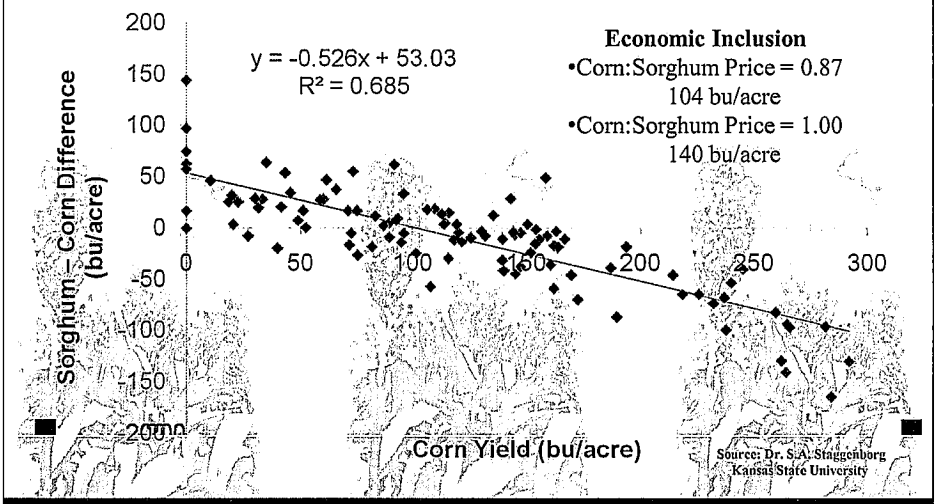
Crop Water Use of Kansas Crops



Source: Dr. L.R. Stone
Kansas State University

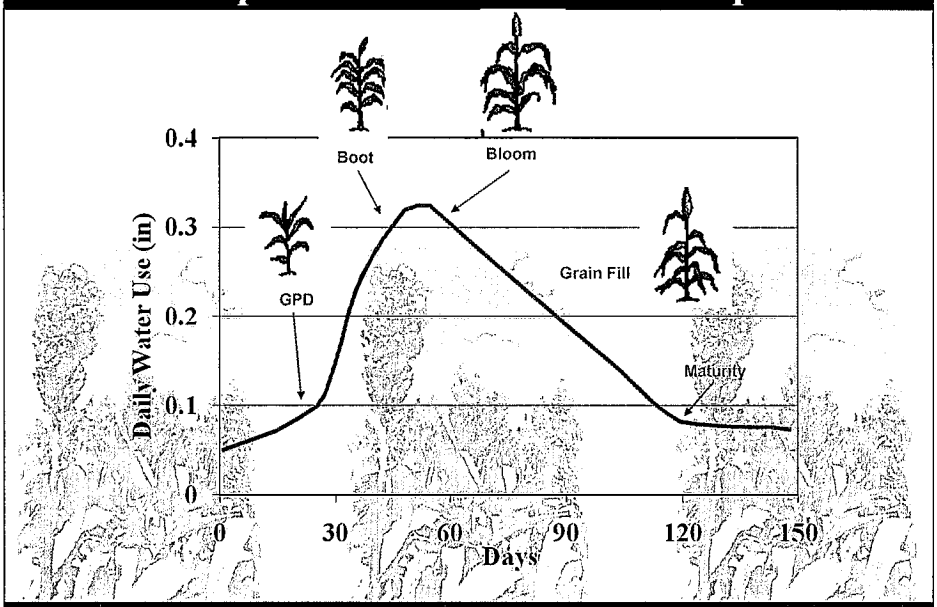
Among Summer Crops Sorghum is More Efficient.

Sorghum – Dry land Crop of the Plains



Sorghum is a better crop in in dry lands where productivity is low.

Crop Water Use of Kansas Crops



Maximum water use occurs during early reproductive stages for all crops.

Susceptible Stages to Drought / Heat Stress: Cereals

Western Kansas

Eastern Kansas

Pre-Flowering

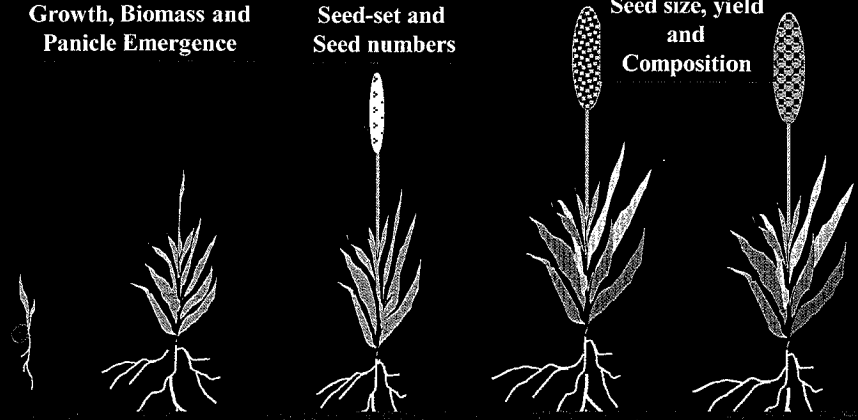
Growth, Biomass and Panicle Emergence

At Flowering

Seed-set and Seed numbers

Post-Flowering

Seed size, yield and Composition



Reproductive stages of flowering and seed-set are most sensitive to drought and heat stress.

Susceptible Stages to Drought / Heat Stress: Soybean

Pre-Flowering

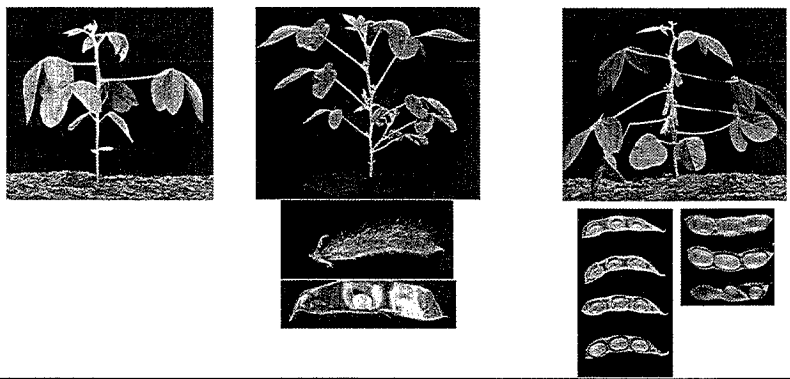
Growth, Biomass and Flowering

At Flowering

Seed-set and Seed numbers

Post-Flowering

Seed size, yield and Composition



Reproductive stages of flowering and seed-set are most sensitive to drought and heat stress.

Irrigation Timing is Very Important

Time of Irrigation	Sorghum Yield
	bushels/acre
Pre-plant only	65
Pre + Boot Stage	125
Pre + Half-Bloom	115
Pre + Soft-Dough	114
Full Season Irrigation	126

Source: Tribune, Kansas
Kansas State University

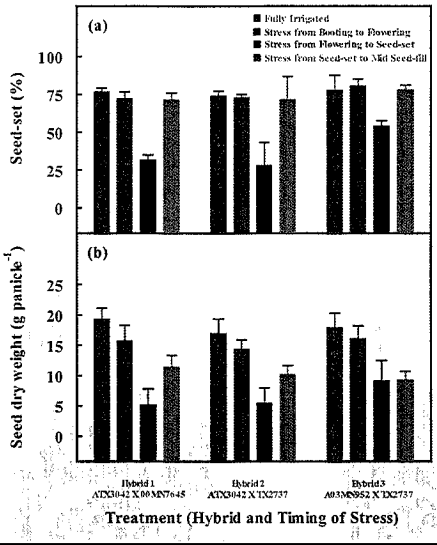
Irrigations at critical stages only will help efficient water use and improving crop yields.

Irrigation / Stress Timing is Very Important

- Plant stage of development at which plant stress can irreversibly reduce grain yield.
  - In determinant grain crops this stage is normally early reproductive stages
    - Corn – tassel silk
    - Grain sorghum – head exertion through pollination
    - Soybeans – early pod through early pod fill
- Mistakes at this time result in a conversion from a grain production system to a forage production system.

Avoiding stress during critical stages will improve crop yields.

Impact of Drought Stress on Yield Components



Control

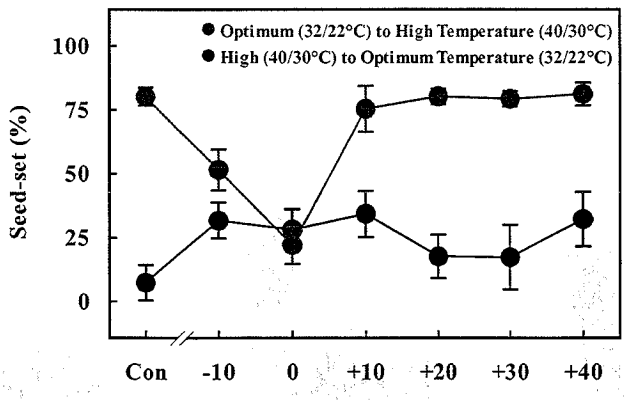
Drought at flowering

Seed dry weights were decreased by 14, 63 and 43% when drought was imposed during panicle emergence, flowering or early seed-filling period, respectively.

Source: Dr. P.V.V. Prasad
Kansas State University

Drought from flowering to seed-set decreased seed-set.
Drought during flowering and post flowering decreased seed yield.

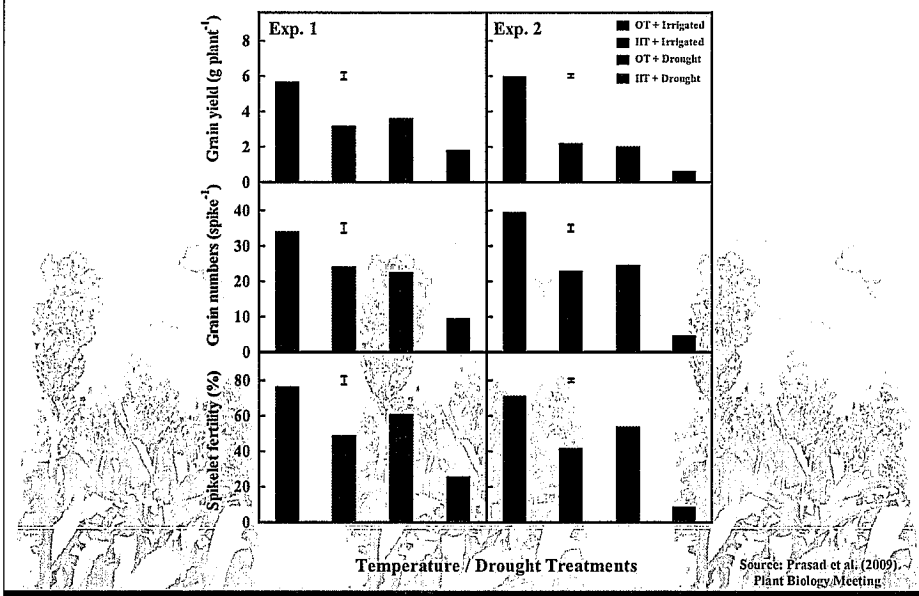
Heat Stress – Sensitive Stages – Seed-set



Source: Prasad et al. (2008)
Crop Science 48: 1911-1948.

Heat stress at 10 d prior to flowering and at flowering decreased seed-set.
Most sensitive stage was at flowering.

Drought and Heat Stress – Wheat

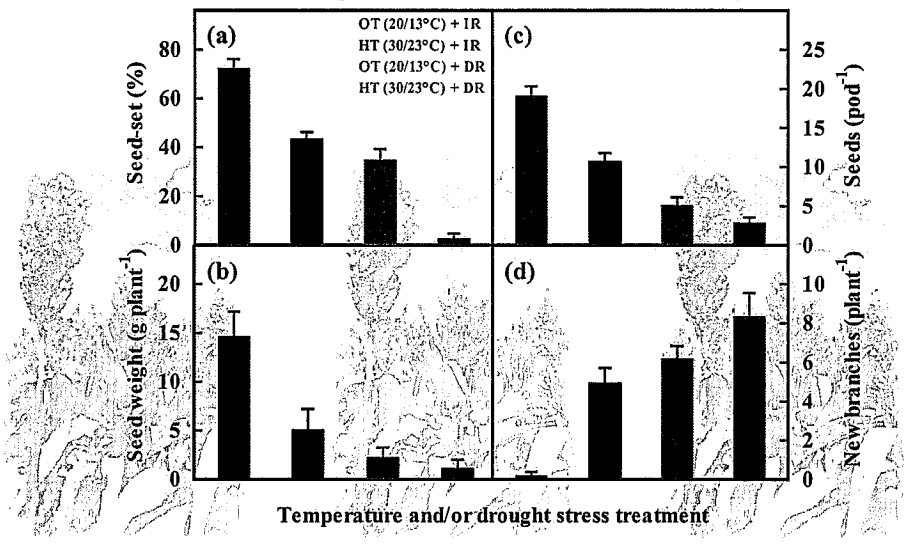


Source: Prasad et al. (2009). Plant Biology Meeting

Heat stress can decrease yields even under fully irrigated conditions.

Drought and Heat Effects: Canola

Fig. 3: Influence of temperature (optimum temperature, OT; high temperature, HT), drought (irrigated, IR; drought, DR) on (a) seed-set; (b) seeds per pod; (c) seed weight; and (d) number of new branches after recovery.

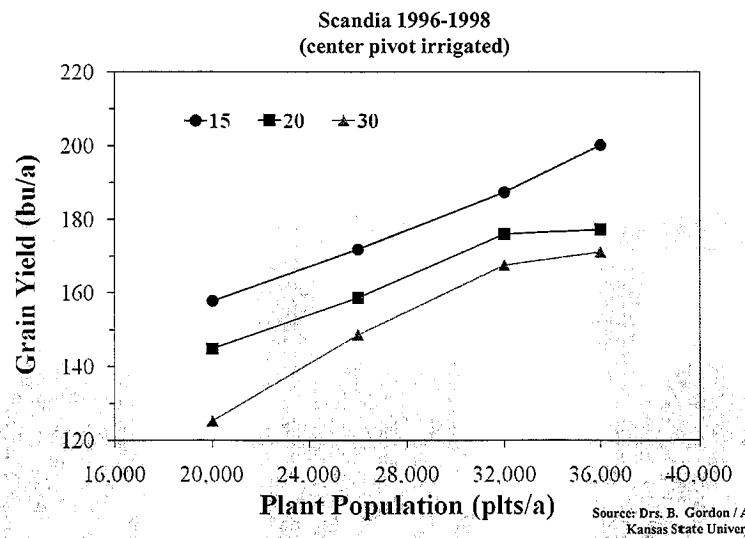


Irrigation Timing - KanSched

- KanSched is an irrigation scheduling computer software program developed and released by KSU.
- It was developed for scheduling corn irrigation events, but can be used as irrigation scheduling tool for most summer annual crops in Kansas.
- It allows the user to select soil type plus plant phenology dates and requires reference ET, irrigation, and rainfall as inputs.
- It is also being used in other states.

Source: Dr. D. Rogers and G. Clark
Kansas State University

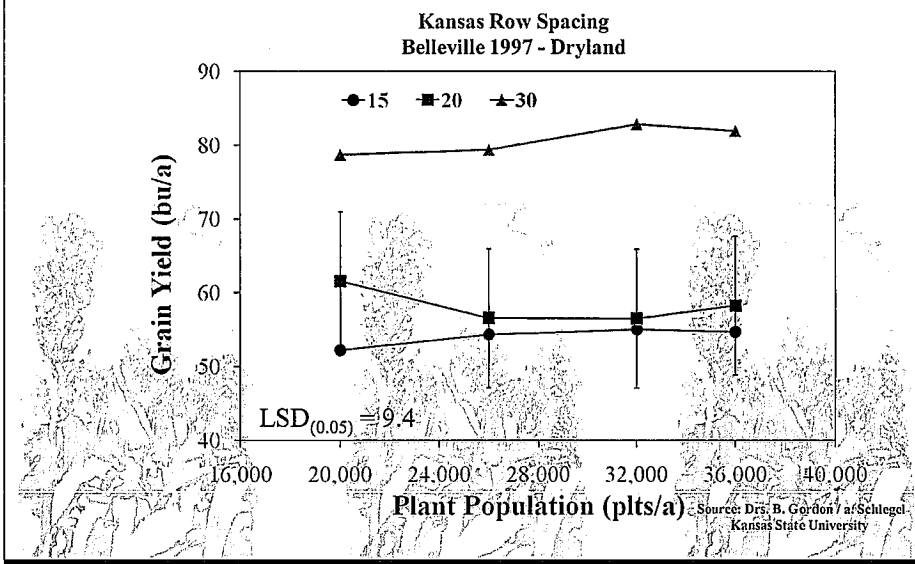
Plant Population Under Irrigation



Source: Drs. B. Gordon / A. Schlegel
Kansas State University

Narrow row spacing produces higher yields compared to wider rows under irrigation.

Plant Population Under Dryland



Source: Drs. B. Gordon / A. Schlegel
Kansas State University

Wider row spacing produces higher yields compared to narrow rows under dryland.

Planting Geometry - Dryland – Clumps

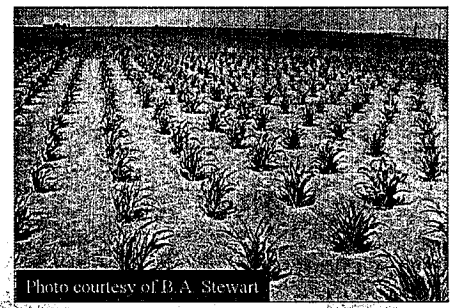
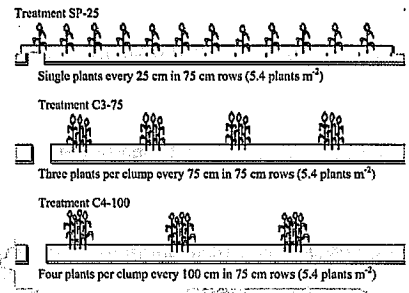


Photo courtesy of B.A. Stewart



Variable	Uniform Planted Rows	Clump Planting
Number of Tillers	2.8	1.3
Grain yield (kg ha^{-1})	1289	2226
Harvest index	0.24	0.44

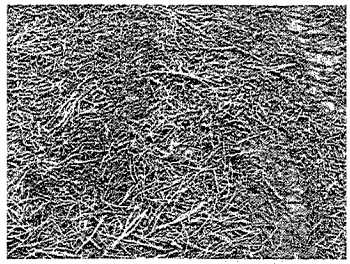
Recent work in the Texas panhandle and western Kansas has shown that clump planting of sorghum has promise in dryland environments. The three-year average yield advantage for clump vs. uniform planting has been 9 bushels per acre (18%) at Tribune. This yield advantage was likely related to clump-planted sorghum forming fewer tiller per plant than uniformly planted sorghum, 1 vs. 3.7 respectively in 2008.

Source: Dr. A. Schlegel
Kansas State University

Planting geometry can improve water use efficiency and increased yield in dryland conditions.

Reduced Tillage – Crop Residues

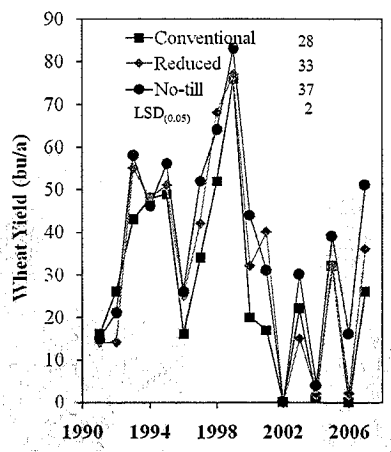
- Save water
  - Increase residue
    - Cool soil
    - Reduce soil evaporation
    - Increase infiltration
    - Reduce soil erosion

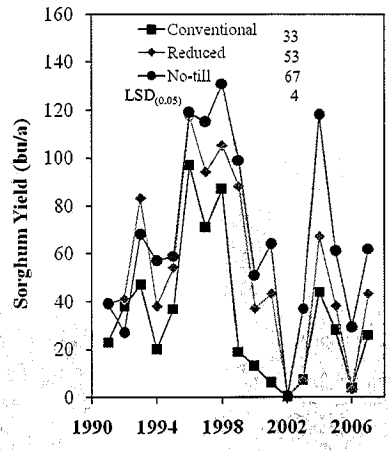


Tillage Implement	Moisture Lost (in)
Disc	0.52
Chisel	0.50
Sweep Plow	0.14
Rod Weeder	0.22

Reduced tillage systems increases infiltration of rain water and decreases moisture loss.

Tillage System – Crop Residue





No till systems can improves crop productivity under dry land conditions.

Irrigation Delivery Methods

Irrigation System	Efficiency (%)	Net Return/a† ($)
Gravity Feed	70	65
Center Pivot		
Overhead Sprinkler	85	71
In-Canopy Sprinkler	92	
LEPA (1' above ground)	98	77
Subsurface Drip	99-100	

Source: Dr. F. Lamm Kansas State University

†based on 600 gpm on 125 acres; LEPA - Low Energy Precision Application

Irrigations method can help improve water use efficiency.

Crop Management Under Irrigation

- Irrigation efficiency can be reduced if mistakes are made managing the crop.
  - Cultural practices – planting dates and planting rates?
  - Fertility – influences growth and develop
  - Tillage systems – soil residue and reduced tillage passes reduces water losses
  - Hybrid – proper selection critical for handling stress
  - Crop Selection – water use efficiencies and critical growth stage differences

Improving Water Use Efficiency and Drought Tolerance of Kansas Crops

Presentation to Joint Committee on Energy and Environmental Policy
September 29, 2009, Topeka, Kansas

Limited ground water, drought and heat stresses are among the important factors limiting crop production in Kansas. Comprehensive understanding of the impact of drought and heat stress will be critical in evaluating the impact of climate change and climate variability on crop production. In Kansas, both winter (wheat and canola) and summer (corn, sorghum, soybean, sunflower and cotton) crops are highly susceptible to drought and high temperatures particularly during reproductive stages of crop development. In years, 2002 and 2004 considerable yield losses (> 30%) across the state occurred due to drought/heat stress, causing revenue loss of about $1 billion. Therefore, drought and heat tolerance are vital traits which will benefit producers and the agriculture industry in Kansas. Development of efficient irrigation, precipitation and crop management practices are also important due to limited availability of irrigation water from the Ogallala aquifer and limited and variable rainfall. The main goal is to minimize stress during critical stages (flowering) of crop development.

In recent years, energy security, climate change and sustaining rural economies has become an important priority for researchers. It has increased awareness and interest in alternative energy resources, particularly towards bioenergy. While minimizing our carbon foot print, bioenergy production can have strong influence of water resources (water foot print). Bioenergy and crop production will interact strongly with water resources and environmental stresses. Crop production in the agriculture sector (irrigation) is a major consumer of fresh water in Kansas, particularly from Ogallala aquifer. Water in this aquifer is being used at faster rate than it is being replenished, and it is predicted to cause serious economic pressure on the area in near future. Knowledge about water consumption and water use efficiency are of prime importance to select suitable crop species and also to breed for cultivars with greater tolerant to stress (drought and heat). This research area is essential to sustain agriculture, irrigation water and future of bio-economy of Kansas.

K-State is home to the Great Plains Sorghum Improvement and Utilization Center (GPSIUC), Wheat Genetic Resource Center and K-State Kansas Water Resources Institute (water conservation in Ogallala region of Kansas). Several researchers associated with these Centers and also at other Departments at K-State are addressing the issues related to water use efficiency, drought tolerance and crop and irrigation water management. We are taking a multi-disciplinary approach to address this concern. Some of ongoing research activities / objectives include:

- Improve yield potential, drought tolerance of Kansas crops through plant breeding and genetics.
- Identify most suitable crop species with high yield potential under dry land conditions.
- Determine best timing of irrigation to avoid stress during critical stages of crop development.
- Develop improved and efficient methods of irrigation to decreases losses.
- Identify best crop management practices (tillage, population, fertilization and weed control) for efficient use of water and other inputs (fertilizer).
- Determine best crop rotations and cropping systems to improve overall water use efficiency.
- Evaluate germplasm of crop (e.g. sorghum, wheat, soybean and corn) for traits associated with drought and heat tolerance and increased water use efficiency (WUE).
- Understand physiological and genetic basis for drought and heat tolerance.
- Identify genes associated with increased drought and heat tolerance and improved WUE.
- Develop drought and heat tolerant cultivars using traditional and molecular breeding techniques
- Expand research on bioenergy crop uniquely adapted (e.g. sorghum) to drier regions of the US.

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16-15

Breeding for improved water use efficiency/drought tolerance

Presentation by Allan Fritz to the Joint Committee on Energy and Environmental Policy

September 29, 2009

General comments

- Breeding is generally responsible for about half of yield increase. The other half comes from improved management practices.
- Breeding for drought tolerance is one of the most difficult and complex breeding objectives.
- Drought is a complex phenomena in itself as timing and intensity vary greatly and plant response can be very different depending on these factors. One implication is that advances for dryland agriculture are not necessarily directly applicable to irrigated agriculture.
- Genetics of drought tolerance are complex. Mechanisms include avoidance as well as physiological mechanisms. Some mechanisms of tolerance can actually be detrimental to yield. Plant root systems are probably the most important plant structure to study for drought tolerance. Larger/deeper root systems are correlated with yield under limited moisture conditions by allowing the plant to more effectively mine water from the soil.

Genetic approaches to improvement of drought tolerance/water use efficiency

- Traditional genetic mapping of a bi-parental population. In this approach, the progeny of a defined cross (generally tolerant x susceptible) are evaluated for appropriate traits. A DNA marker map is constructed and statistical methods are applied to identify regions of chromosomes associated with the trait. One limitation is that genetic background can have significant influence meaning that the result may be true for the specific cross, but not apply all crosses in a breeding program. Other limitation are that the effects on the trait are almost always overestimated and verification research must be performed after the initial analysis. While this method can be very useful, it is not a quick fix.
- More recent strategies are based on a "map as you go" approach. A very large number of DNA markers are assayed on lines under evaluation. Performance data from environments that are representative of the breeding goal are used in conjunction with the markers to identify chromosomal regions controlling the trait. This can be a very powerful technique, but it requires a very large number of DNA markers as well as a large number of testing locations. This strategy is currently employed in many private corn breeding programs and allows "real-time" application of DNA marker technology.

Activities at K-State

- Dr. Prasad's presentation includes an excellent summary of research activities at K-State in this area. The integration of breeding, genetics, plant physiology, cropping systems and engineering is essential.

The role of biotechnology

- More efficient use of water is a prime target for biotech companies. Monsanto anticipates releasing GM drought tolerant corn in 2012 and many other public and private entities are working on this issue. While these technologies are promising, it is not reasonable to expect

them to be a magic bullet. Monsanto has estimated a 10% yield increase in the western corn belt. It is not clear from the information currently available whether this product will be able to support higher yield with reduced irrigation or if it will be of primary benefit to dryland corn production.

- Research of this nature is extremely expensive. Private industry has invested vast resources targeting this area though there is significant and important research at public institutions. Due t cost of bringing GM traits to market, the out turns of public research would almost certainly have to be commercialized through public-private partnerships.
- While it is clear that GM corn and, perhaps to a lesser extent, soybeans will be delivered by private industry, the picture is more muddled for other crops. For instance, the wheat industry is highly fluid at the moment. The commercialization of GM traits in wheat seems to be inevitable, but will not likely happen much before 2020. At the moment, it appears that the major industry players are amenable to partnering with public institutions to deliver GM wheat varieties

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cell: (785 (410-2096

KANSAS
CORPORATION COMMISSION

MEMORANDUM

To: Kansas Legislature Joint Committee on Energy and Environment

From: Thomas Wright, KCC Chairman

Date: Wednesday, September 30, 2009

Re: American Recovery and Reinvestment Act (ARRA) Programs

The Kansas Corporation Commission has received more than $50 million from the Department of Energy as part of the American Recovery and Reinvestment Act of 2009. The following describes the programs designed by the Commission.

Efficiency Kansas ($37.2 million): Efficiency Kansas is loan program that finances cost-effective energy-efficiency improvements in existing homes and small businesses.

- Revolving Loan Program: Provides long-term, sustainable source of financing.
- Public-Private Partnership**:** Kansans can access financing through partner banks and partner utilities.
- Energy Audit: All financed projects must be based on the findings of an energy audit that will prioritize recommended improvements based on cost-effectiveness.

Comprehensive Rate Design ($1 million): The KCC will employ the services of a consultant to assist in developing and guiding a comprehensive, collaborative planning process to redesign utility rate structures to achieve new goals of energy efficiency and environmental protection.

Energy Efficiency and Conservation Block Grant ($9.5 million):

- **Renewable Energy Grants ($3.8 million):** This program will provide grants to local units of government—including school districts, community colleges, vocational schools, universities—that did not receive direct block grant allocations. The grants will be for renewable electrical generation projects and may include wind, solar, biomass, or fuel cells and will be for 25% of approved project costs (up to $250,000).
- **Facility Conservation Improvement Program Rebates & Grants ($3.2 million):** The FCIP enables public agencies (state, municipalities, counties, and schools) to use energy

savings performance contracting to access financing for energy efficiency and conservation projects.

  - Start Up Cost Rebates: Rebates up to $40,000 will be available to participants to offset start-up costs.
  - Project Buy Down: Participants will be eligible for grants up to $150,000 to fund projects that don't meet the statutory 30-year payback period but have significant, long-term benefits.
  - Small Projects: Participants will be eligible for grants up to $150,000 to help fund projects that are considered too small by energy service companies and are thus not eligible for the current FCIP.

- **Energy Managers for Local Units of Government ($2.5 million):** This new program will provide a stipend to local units of government to enable them to hire energy managers for up to three years.

Energy Efficiency Building Codes Working Group ($n/a): As a requirement for receiving energy-related ARRA funding through the U.S. Department of Energy, Kansas and other states provided assurances that the State would make progress on several initiatives, including adoption of statewide building codes for energy efficiency. The KCC has established a working group that will develop recommendations for the Kansas legislature and outline a plan to achieve compliance with the ARRA requirements.

Staffing Grant ($821,422): The National Energy Technology Laboratory within the Department of Energy has provided funding to ensure that regulatory agencies will be able to meet the increased demands caused by the ARRA. With this grant, the KCC intends to hire two engineers and an attorney with specialized knowledge and skill sets to address emerging energy issues.

Appliance Rebates ($2.68 million): By mutual agreement between KCC and Kansas Housing Resources Corporation (KHRC), this funding was transferred to the KHRC to be used in a low-income appliance rebate program.

KCC ARRA Statistics, as of September 29, 2009

Efficiency Kansas

Outreach Activities

- 24 informational meetings statewide
  - 468 attendees (primarily lenders and contractors)
  - Strong interest from both lenders and contractors and overall positive response to program as vehicle for economic activity and improvement of housing stock
- Meeting with energy auditors in Wichita to discuss audit specifications
- Meeting with How$mart contractors in Hays to discuss Davis-Bacon requirements
  - 30 contractors attended
- Exhibitor at Lawrence Energy Conservation Fair
- Passed out postcards at State Fair
- Will host booth during Kansas Wind & Renewable Energy Conference, Oct. 6 – 7.
- ***Public launch on November 17.***

Partner Banks

- 6 Banks have signed Participation Agreement: (1) Sunflower Bank, (2) Mid America Bank, (3) First National Bank and Trust Company of Junction City, (4) Baldwin State Bank, (5) Capitol Federal Savings, (6) Tampa State Bank
  - 66 locations statewide
- Based on our initial follow-up, 18 lenders say they plan to participate right away (others are "maybe" and some are waiting to see how the program goes).

Partner Utilities

- Several regulated utilities and at least one non-jurisdictional utility planning to participate
  - Midwest Energy has signed up as the first Partner Bank
- KCC Utilities Division staff anticipates it will be early 2010 before utility programs are ready.

Efficiency Kansas Qualified Energy Auditors

- 23 energy auditors on current list (17 individual businesses)

Efficiency Kansas Training Institutions

- **Kansas Building Science Institute**
  200 Zeandale Road, Manhattan, KS 66505
  www.kansasbuildingscience.com

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- **Metropolitan Energy Center**
  3808 Paseo, Kansas City, MO 64109
  www.kcenergy.org
- **Neosho County Community College**
  800 West 14th Street, Chanute, KS 66720
  www.neosho.edu

Scholarships for Energy Auditor Training

- 62 scholarships awarded
- 1 scholarship awardee on our current list of qualified auditors

Renewable Energy Grants

- Program has bee approved by DOE.
- SEO will announce first round of awards in October.
  - First 3 for $1 million worth of projects; the fourth for $800,000).
  - Applications will be scored by the Energy Office.
- The first round is planned to be announced at the Wind and Renewable Energy Conference (October 6 & 7).

FCIP Rebates & Incentives

- Programs have been approved by U.S. DOE.
- SEO plans to begin offering by the end of the year.
- SEO is working with Energy Service Company partners to effectively roll out the program.

Energy Manager Grants

- Program has been approved by DOE.
- SEO will begin operating by the end of the year.
- SEO is working with the Association of Energy Engineers to provide training for energy managers.

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Kansas Corporation Commission
American Recovery and Reinvestment Act Funding
$50,566,500 from Department of Energy

State Energy Program
$38,284,000

- Efficiency Kansas
  $37,284,000
- Rate Design
  $1,000,000
- Administration
  $1,427,357
- Marketing
  $500,000
- Loan Fee Rebates
  $481,000
- Energy Audit Rebates
  $350,000
- Energy Audit Equipment
  $250,000
- Energy Audit Scholarships
  $150,000
- Energy Audit Training Grants
  $100,000
- Loan Fund
  $34,025,643

Energy Efficiency and Conservation Block Grant, $9,593,500

- Renewable Energy Grant
  $3,837,400
- Facility Conservation Improvement Program
  $3,200,000
  - FCIP Rebates
    $1,000,000
  - FCIP Grants
    $2,200,000
- Energy Manager Stipends
  $2,556,100

Appliance Rebate
$2,689,000

- Kansas Housing Resources Corporation
  $2,689,000

State Energy Office

*A Division of the Kansas Corporation Commission, funded through the federal **State Energy Program (SEP)**.*

Efficiency Kansas Energy Auditor List

Listed below, in alphabetical order based on business name, are the energy auditors that have been qualified to work with the **Efficiency Kansas Loan Program**.

The State Energy Office is coordinating with the Efficiency Kansas **qualified training institutions** to identify additional qualified energy auditors who wish to be on the list. **Click here for more information about becoming an auditor**.

AEA, LLC
Rob Laquet, Jeff Laubach, Jesse Krivolavek, Jason Laubach
16935 Auburn Drive
Bonner Springs, KS 66012
913-543-3572
www.aeauditors.com

Airtight Home Energy Audits
Robert Coffman
1217 Pennsylvania St.
Lawrence, KS 66044
785-727-0209
www.airtightenergyaudits.com

Brookside Building Performance
Brian Rotert
6320 Brookside Plaza, Suite 528
Kansas City, MO 64113
816-419-3438

Building Performance Co.
Chad Robinson
5990 E. Mentor Rd.
Gypsum, KS 67448
785-787-0180
www.buildingperform.com

Clean Efficient Energy Company, LLC
Richard Patrick Jenkins
11616 W. 100th St
Overland Park, KS 66214
913-579-3638
www.cleanefficientenergy.com

The Demby Group, LLC
J.R. Demby
PO Box 4222
Lawrence, KS 66046-1222
785-979-1950
www.NoAirLeaks.com

Energy Loss Consultants
Dwight Hawkinson
4110 Connecticut Rd

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Elsmore, KS 66732
620-363-4950

Energy Plus
Dave Paddock
6817 Northwind Circle
Wichita, KS 67205
316-260-8416

Essential Inspections, LLC
Ryan Grimm
1404 E 345 Rd
Berryton, KS 66409
785-550-8104
www.essentialinspections.com

Green CAT Services
Robert Jones
7351 Springfield Street
Prairie Village, KS 66208
913-375-4842
www.greencatservices.com

IAQ Solutions
Von Kopfman
3365 SW Gage Blvd
Topeka, KS 66614
785-256-5348
www.bluedotkansas.com

Kansas Weatherization Services, Inc.
Jon Vogel
2900 NW Button Rd.
Topeka, KS 66618
785-217-5686
www.kansasweatherization.org

Northstar Comfort Services, Inc.
Paul Miller
12727 E. Kellogg
Wichita, KS 67207
316-685-2368
www.northstarcomfort.com

Scott Jackson Construction, Inc.
Scott Jackson
1964 N 1550th Road
Eudora, KS 66025
785-331-6561

Sustainable Energy Systems
Rocky Huffman, Andrew Huffman, Dan Masterson, Stephen Self
11435 SW Thunder Rd
Augusta, KS 67010
316-775-5576
www.sustainingkansas.com

Tom Chavey, Inc.
Tom Chavey

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3436 Treesmill
Manhattan, KS 66503
785-565-1498

Verifica, Inc.
Todd Rogers
1734 Georgia Road
Humboldt, KS 66748
620-212-1088
www.verificainc.com

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TESTIMONY BEFORE JOINT COMMITTEE ON
ENERGY AND ENVIRONMENT
September 30, 2009
Stephen R. Weatherford, President Kansas Housing Resources Corporation

SUMMARY OF PROGRAM ACTIVITY UNDER AMERICAN RECOVERY AND REINVESTMENT ACT

Kansas Housing Resources Corporation (KHRC) administers five programs that were either impacted or created by the American Recovery and Reinvestment Act of 2009 (ARRA). However, today our purpose is to discuss the Weatherization Assistance Program.

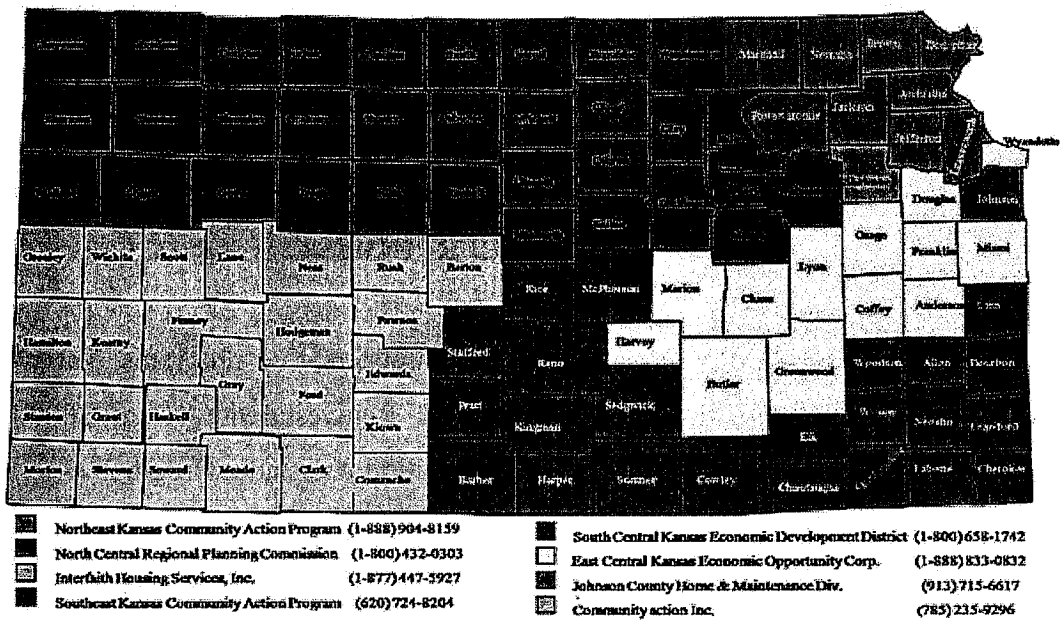
Kansas Weatherization Assistance Program (K-WAP)

Program Summary: K-WAP is a U.S. Department of Energy (DOE) funded program that KHRC initially began administering in 1974. The purpose of the program is to make low-income households in income-eligible, single or multi-family dwellings more energy efficient, thereby reducing the utility bills of these families. Funds may be used for leakage reduction, incidental repairs, health and safety measures, furnace and cooling system repair/replacement, insulation, and replacement of inefficient refrigerators. DOE regulations limit the eligibility to those with incomes at or below 200% of the poverty level ($20,800 annually for a single person or $42,400 annually for a family of 4 in Kansas). The new regulations also include an increase in the per-home average cost of repair and improvements from $2,500 to $6,500.

The weatherization program is operated through a network of eight local service providers. Each agency provides weatherization for their region of the state. The following map identifies each service provider and the region in which they operate.

2009 Service Provider Map

Counties Served by Kansas Weatherization Assistance Program



The following chart shows a five year history of funding for the Weatherization Program. Funding is based on a program year which begins each April 1 and ends the following March 31.

Year	DOE	LIEAP	Total
2008	$ 2,518,837	$ 2,497,970	$ 5,016,807
2007	$ 2,264,099	$ 2,501,390	$ 4,765,489
2006	$ 2,706,214	$ 4,415,873	$ 7,122,087
2005	$ 2,262,771	$ 2,149,146	$ 4,411,917
2004	$ 2,390,904	$ 2,548,024	$ 4,938,928
Average	**$ 2,428,565**	**$ 2,822,481**	**$ 5,251,046**

Status of 2009 DOE and LIEAP Expenditures:

Kansas received $7,858,574 funding for the 2009 plan year, an increase of nearly 60% over 2008. Weatherization providers are currently expending 2009 funding from both the Department of Energy and Federal Low Income Energy Assistance Program (LIEAP) and as of September 29th have weatherized 523 homes at a cost of $4,062,988. Additionally, 471 homes are in progress and an additional 1,329 homes are on a waiting list for services. Funds remaining from the 2009 allocation will not be sufficient to complete all 1329 homes on the waiting list. Therefore, the remaining homes will be transferred to the ARRA waiting list as 2009 funding is exhausted.

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Impact of ARRA: In addition to the nearly 60% increase in DOE funds for FY 2009, the K-WAP program also received $56 million in ARRA funds for a three-year period. In view of the substantially increased funds as well as the existing sub grantee agencies' ability to ramp up operations to the extent necessary, for the short term, KHRC set aside $16 million and established a multi-family program to be managed by KHRC staff, focusing on weatherizing Tax Credit properties, USDA Rural Development properties, and project-based Section 8 properties that had no direct HUD funds for energy-efficiency improvements. The $40 million balance is expected to be used by the network of providers for single-family dwellings.

ARRA Issues: Section 1606 of ARRA provides that all contracts and services performed using ARRA funds must pay Davis-Bacon prevailing wages. Under this requirement, all ARRA weatherization grantees and contractors must determine the prevailing wage in their area, ensure that the salary and fringe benefits meet or exceed that wage, and keep detailed recordkeeping of their compliance with Davis-Bacon. Historically, DOE has waived Davis-Bacon requirements for the Weatherization programs. In early September, DOE and the Department of Labor issued prevailing wage classifications for weatherization workers in Kansas. This step was vital for KHRC's weatherization program to begin spending ARRA weatherization funds.

ARRA Activity: Since receiving the go-ahead to start weatherization activities this past September 1, the weatherization network has completed 8 homes using ARRA funds. Together the network has an additional 542 homes in progress and 1,030 on waiting lists (in addition to any homes that may be transferred from the 2009 DOE waiting list). To date KHRC has released reimbursement totaling $1,584,857 in ARRA funds. The expenditure includes actual weatherization, ramp-up activities such as new employees, new employee training, technical assistance and equipment. Ramp-up activities have been held to less than 2% of the allocation. KHRC expects the network to weatherize 3,709 single family homes over three years with the ARRA funding.

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Multi-family Weatherization Program: KHRC weatherization staff began their first pilot project on a multifamily property in Topeka on September 4, 2009. This pilot project will serve as an excellent training opportunity and provide valuable experience for KHRC's multifamily program, which will go statewide after this project is complete. The property is located at 13th and SW Van Buren which has 18 units. The scope of work will include new heat pumps, refrigerators, air sealing and two window replacements. KHRC expects to weatherize 2,111 multi-family units over three years utilizing ARRA funds.

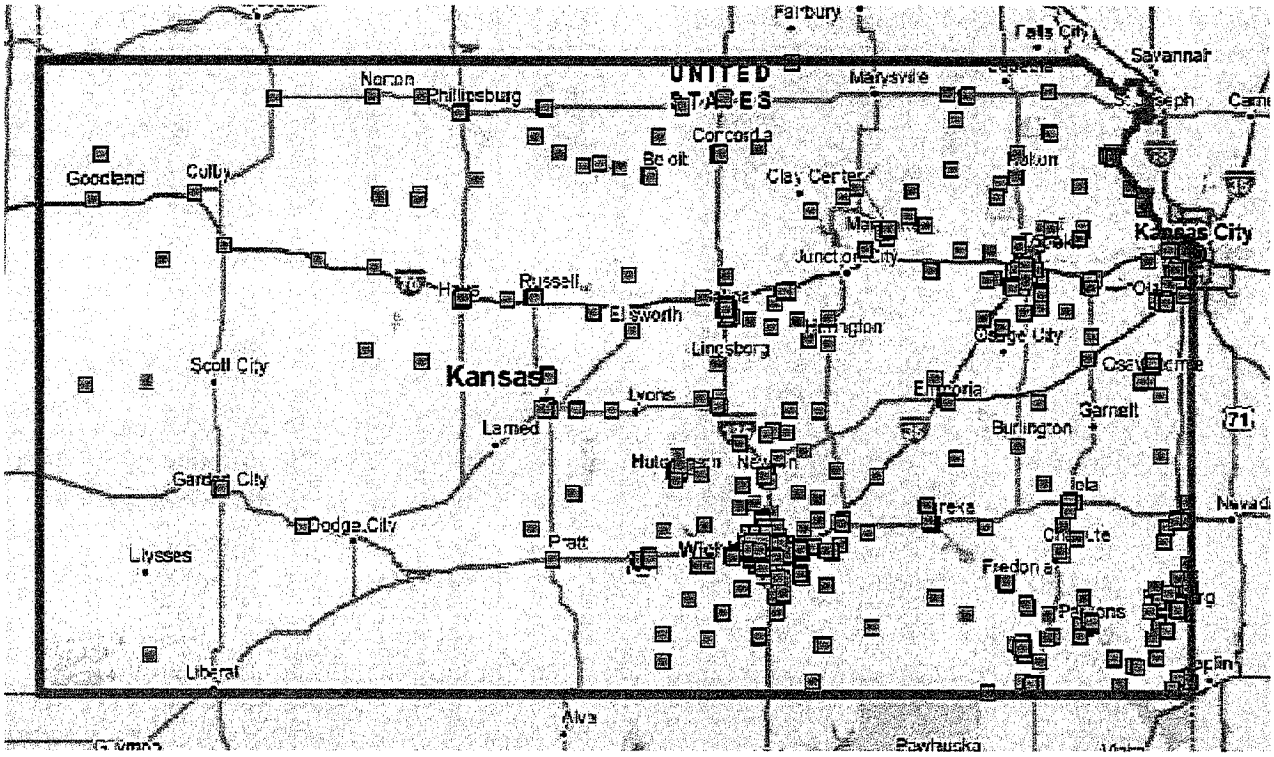
Residential Appliance Replacement Program:

While not technically an ARRA program, the large increase in 2009 provided an opportunity to utilize $4 million in funding from the Low Income Energy Assistance Program for a new statewide initiative called the Residential Appliance Replacement Program. The Appliance Replacement Program allows income-eligible homeowners and renters to replace old, energy-hungry and unsafe appliances with new, energy-efficient and environmentally-friendly models. Appliances eligible for replacement include refrigerators, water heaters, heating and cooling systems and window air units.

Demonstrating the exceptional popularity of this program, KHRC had to close the application process after only two weeks. In addition to the $4 million expended in the program, additional applications totaling $7 million remain unfunded.

Across the state, 1021 homes have been served and $3,989,842.50 in program funds has been expended. The following map demonstrates the distribution of homes served across the state.

19-4



Appliances Replaced:

Furnaces		573
Air Conditioning Units		660
Window A/C	*127*	
Central A/C	*533*	
Tankless Water Heaters		155
Refrigerators		712

Residential Appliance Replacement Program II

Recently the Department of Energy awarded $2.7 million to the State Energy Office to sponsor a residential appliance rebate program. KHRC and the Energy Office entered into an agreement for KHRC to develop and administer the program. KHRC submitted a summary application in July which DOE approved. KHRC submitted a detailed application on September 10th. Included in our detailed application is a preference for those who submitted an application under the first RAR program but were unsuccessful due to exhaustion of those funds. While we have not received official approval, DOE comments have been favorable.

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KANSAS
DEPARTMENT OF ADMINISTRATION

Mark Parkinson, Governor
Marilyn Jacobson, Director
http://da.ks.gov/fm

MEMORANDUM

TO: Marilyn Jacobson

FROM: Richard Gaito

DATE: May 14, 2009

SUBJECT: Review of Recovery Act Funding of Vehicles

I have reviewed the Recovery Act Program as managed by the Department of Energy and administrated by the Clean Cities Program. This program encompasses grant funding, utilizing fuel efficient vehicles. While the program has four separate funding sections totaling $300 million dollars, only the fourth section of the program involves the purchase of fuel efficient vehicles. This fourth section has $15 million dollars of federal grant monies available. The requirements and qualifications include submittal of application to the Clean Cities Program by May 20, 2009. A second application submission period, which is dependent upon demand and availability of funds, is scheduled to end on September 30, 2009. The program schedule is for four years, with the first half for vehicle deployment and the final half for data collection. In addition to other requirements, the main qualification for acceptance includes the ability to rapidly initiate the project, the expected number of vehicles to be included in the project and the ability of the applicant to sustain the project without future Federal assistance.

The program allows for the purchase of light duty hybrid vehicles and light duty diesel vehicles. The maximum amount of funds available per vehicle is $2,000 dollars. In determining the cost feasibility of the program, I used the State of Kansas vehicle contract as the basis for comparison of midsize gasoline vehicles to midsize hybrid vehicles. With the hybrid cost at $7,732 more than an equivalent gasoline vehicle, and taking into account the potential savings of fuel based on a 5 year period, at $4,196, the initial cost is reduced to $3,536 per vehicle. If the program was utilized subtracting the $2,000 credit from the $3,536, over a five year period, I estimate the State of Kansas would need an additional $1,536 per vehicle purchased, just to break even.

In the application we would need to provide the number of vehicles that would be replaced with the more fuel efficient hybrid vehicle. Additionally, the application requires the formation of a team which would manage and oversee the program and to insure that all provisions of the application are met.

DIVISION OF FINANCE AND FACILITIES MANAG
900 SW Jackson, Room 600-N, Topeka, KS 66612-1220 • (785) 296-211
e-mail: marilyn.jacobson@da.ks.gov

In the event that the State of Kansas submitted an application and was awarded funding, the projected start date would be February, 2010. Reports generated on a quarterly and annual basis would be required in the fields of management, financial information and scientific/technical data.

In conclusion, research has led to my recommendation that the State of Kansas not participate in the program. This recommendation is based on two negatives. 1) The additional cost per vehicle over the five year period and 2) The additional cost of personnel to manage the program.

As always, I am available for questions or discussion at your convenience.