Kansas Ethanol Production and its Effect on Crops, Livestock, Trucking, and a Community

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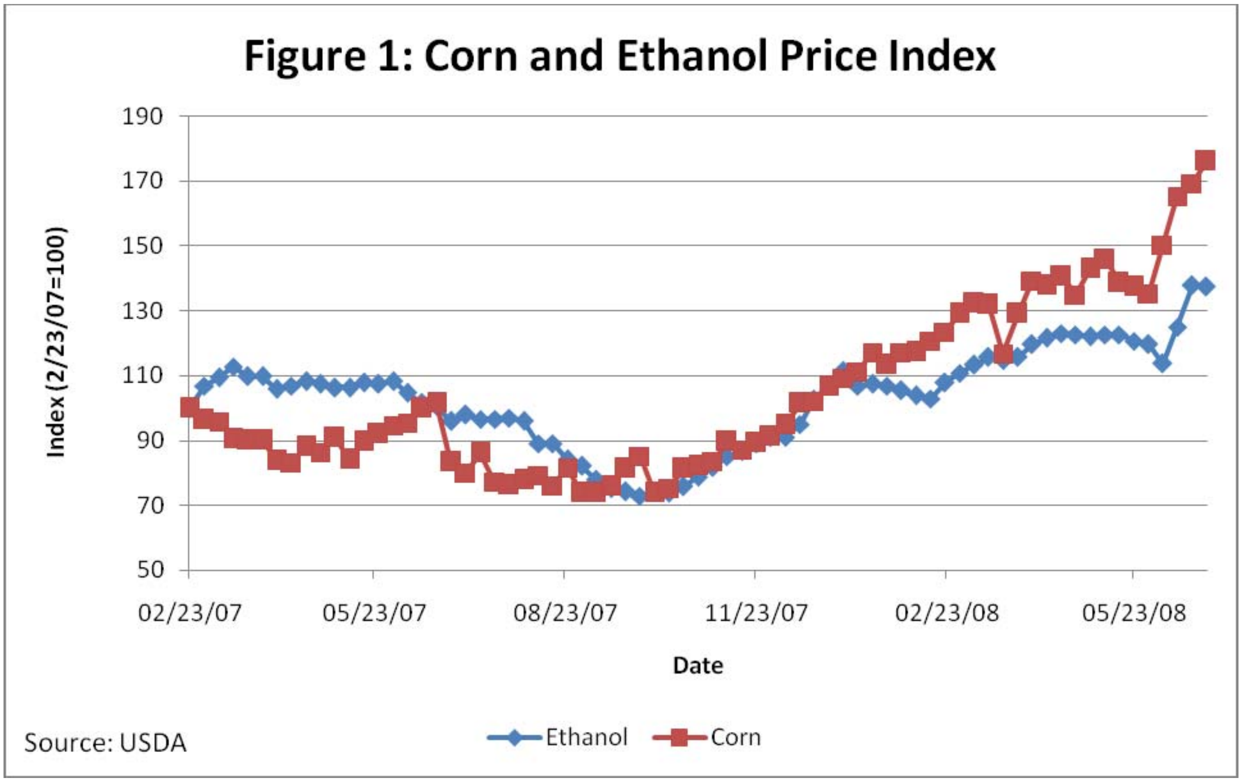
Introduction

Despite record high ethanol prices and demand, Kansas ethanol plants find themselves on a slippery slope. This is largely due to commodity prices many thought that we would never see again. Figure 1 illustrates a weekly corn and ethanol price index for the period of February 23, 2007 to June 27, 2008. Over the 18 month time-period ethanol and corn prices increase by 37% and 76%, respectively. As shown below, these prices track relatively well from October through January, but a large divergence is apparent from January-June, with corn prices increasing at a 53% higher rate.



Models estimating ethanol profitability show that over the past twelve months, ethanol profits have teetered between positive and negative. In 2005-2006, tracking bio-fuel production was almost impossible due to the fact that new ethanol plants were being announced at the rate of several per month. Recently, the hardest piece of the industry to track is how many projects are cancelled. Nationwide, recent reports have as many as 20 existing ethanol plants currently in some form of bankruptcy or not in operation. Hence, it is difficult, and very time sensitive to keep an accurate record of current ethanol production nationwide. In fact, in completing this project, merely keeping track of the relatively few ethanol plants in Kansas proved difficult.

At the time of this paper, we settled on analyzing ten ethanol plants in Kansas, they are shown in table one. Recently, we heard that the Colwich plant is no longer in operation, and at basically the same time, the Lyons plant came online. We chose to leave out the ethanol plants in Atchison and Scandia due to their differing structures and we place little emphasis on the plant in Leoti due to its relatively small production. As the table indicates, at this point in time the plants in operation are scheduled to produce approximately 466.5 million gallons of denatured ethyl-alcohol. These numbers are based off actual, trended production, not nameplate capacity.

Table 1: Kansas Ethanol Plants and Current Production

Plant	Location	Production (MGY)
Western Plains Energy, LLC	Campus (Oakley)	48
Bonanza Bioenergy, LLC	Garden City	55
Reeve Agri-Energy	Garden City	15
East Kansas Agri-Energy	Garnett	35
Kansas Ethanol	Lyons	55
ESE Alcohol,Inc.	Leoti	1.5
Arkalon Energy	Hayne (Liberal)	110
Prairie Horizon Agri-Energy	Phillipsburg	40
Gateway Ethanol	Pratt	55
White Energy	Russell	52
	Total	**466.5**

Source: RFA and Various News Sources

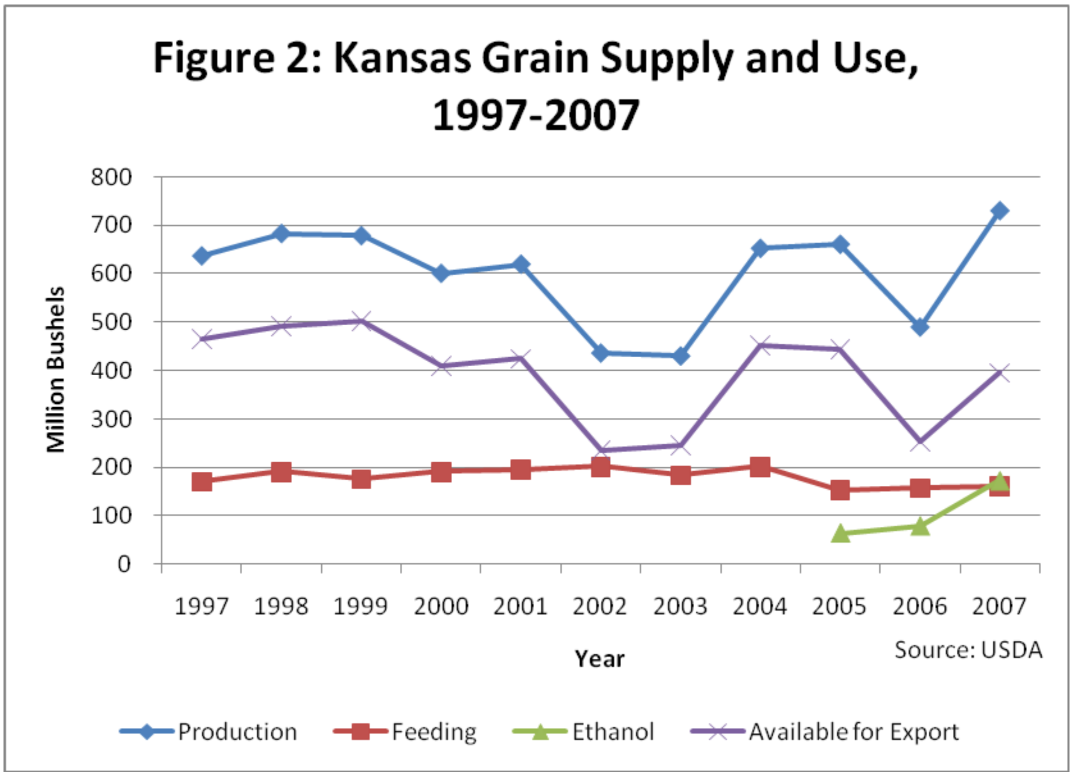
In the following sections of this paper we will discuss grain use in Kansas ethanol plants and their demand from local markets and commercial storage, ethanol plants and the livestock industry, and share estimates of how the ethanol industry has boosted the trucking industry within the state. In the final section of this paper we will take an in-depth look at White Energy in Russell and its total economic impact on Russell County and the surrounding areas.

Grain use in Kansas Ethanol Plants

Kansas ethanol plants differ in many aspects compared to what the general public thinks of “traditional” corn-belt ethanol production. One basic difference is that grain sorghum is often utilized in ethanol production. In this section we will discuss corn and grain sorghum supply and use, individual plant grain usage, implications for the grain supply on short crop years, and the availability of commercial and on-farm storage adjacent to ethanol plants.

Corn and grain sorghum have very similar starch and protein structures, allowing them to be almost perfect substitutes in ethanol production. Hence, we will be referring to the summation of corn and grain sorghum production in the remainder of this paper when grain production, feeding, usage, and/or export availability is mentioned.

Figure 2 illustrates Kansas grain production, feeding, usage in ethanol plants, and the balance available for export outside the state for 199-2007. Despite a great deal of irrigated grain acreage, Kansas's grain production can be very volatile, with production ranging from 430 to 730 million bushels, which accounts for a difference of roughly 70%. On the other hand, livestock feeding throughout this time period was much less volatile, only varying 30% between its highest and lowest years. In 2005, grain use in ethanol plants became measurable in terms of significance, and as the graph shows and the reader would imagine, has climbed sharply in subsequent years. In 2007, grain use in ethanol plants slightly exceeded grain use in livestock feeding. With current trends in the ethanol production cost structure, the authors find it unlikely that 2008 will bring increased grain usage in ethanol plants anything similar to the increases seen in 2005 and 2006. Grain available for export outside the state is obviously very closely tied to grain production and is trending slightly downward during the time-period, especially during 2005-2007 when ethanol plant grain use was climbing.



Statewide in 2007 grain use in ethanol production in Kansas represented 162 million of 730 million bushels produced. However, the amount of grain that an ethanol plant demands can have a significant effect on the grain markets adjacent to the ethanol plant. Table 2 displays grain use in individual ethanol plants and the average percent of local grain production that the ethanol plant's grain usage represents given the counties that are listed for 2005-2007. The Campus (Oakley) plant demands 17.5 million bushels of grain annually given their current capacity; this represents an average of 41% of the total grain production in Gove, Sheridan, Logan, and Thomas counties in 2005-2007.

Ethanol plants in the western third, and even more specifically in the SW quadrant of the state represent the lowest percentage of local grain use. However, some plants account for a significant amount of local grain production, Garnett's plant accounts for more than 60% of grain production for the surrounding nine counties. Statewide figures indicate that grain usage in ethanol plants amounts to 27.3% of total corn and grain sorghum production, on average, for 2005-2007.

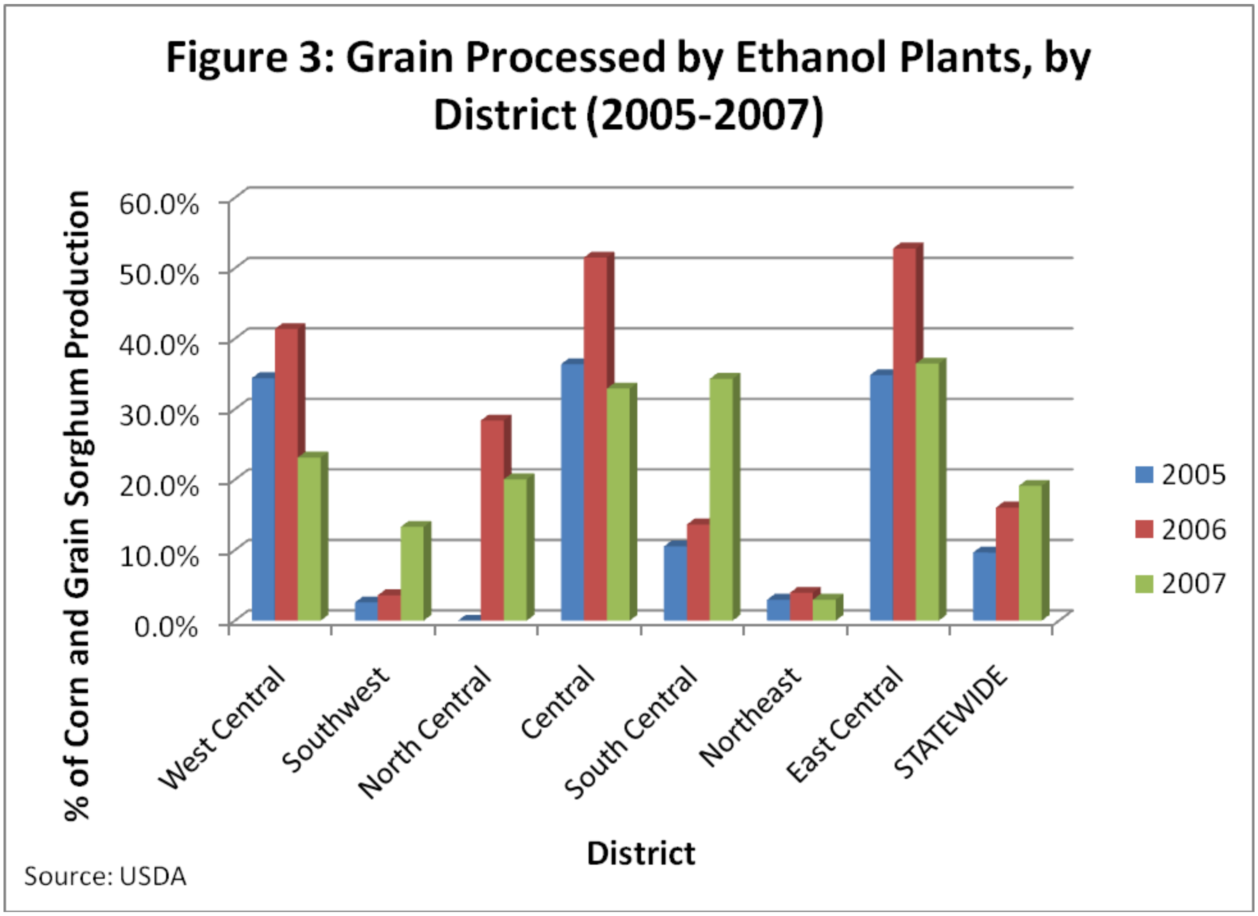
Figure 3 breaks down the grain processed in ethanol plants as a percentage of overall crop production for 2005-2007. What becomes alarmingly evident in this picture is how much the percentage of grain production demanded by ethanol plants fluctuates with crop production patterns. Grain production statewide was relatively low, and the percent of total grain production demanded by ethanol plants does not fluctuate much on a statewide level, but the individual crop reporting districts of east-central, central, and west-central saw large fluctuations.

Table 2: Grain Usage, Surrounding Counties, and % of Total Grain Production for Individual Plants and Statewide

Plant Location	Campus	Garnett	Garden City(2)	Hayne	Lyons	Pratt	Phillipsburg	Russell	Statewide
Grain Usage (Mil Bu.)	17.5	12.7	25.5	40.0	19.6	20.0	14.5	13.0	**162.8**
Counties	Gove Logan Sheridan Thomas	Allen Anderson Bourbon Coffey Franklin Linn Miami Osage Woodson	Finney Gray Haskell Hodgeman Kearny Lane Scott	Grant Haskell Meade Seward Stevens	Barton McPherson Rice Reno Stafford	Barber Edwards Kingman Kiowa Pratt Reno	Graham Norton Osborne Phillips Rooks Smith	Barton Ellis Ellsworth Lincoln Mitchell Osborne Rooks Russell	All
% of Total Grain Production*	**41.0%**	**62.4%**	**32.3%**	**53.1%**	**51.0%**	**40.5%**	**46.8%**	**44.3%**	**27.3%**

Source: USDA/NASS

***Average (2005-2007) Percentage of total corn and sorghum production accounted by the ethanol plants in counties listed.**



The availability of nearby grain storage is vital to an ethanol plant since they rarely have enough on-site storage for more than two or three days of production. Information from the Kansas Official Grain and Feed Elevator Directory was compiled and all grain elevators within a 100 mile driving distance were identified for each plant (KS Grain Directory 2008). Summing the storage capacity of these plants yields the total storage capacity within pre-defined distances from each respective ethanol plant. Using the latest data available from the US Census of Agriculture conducted by the USDA we calculated the ratio of on-farm and commercial storage capacity for the state. According to the census of agriculture in 2002 and the latest USDA stock reports, on-farm storage in Kansas equals 40.471% of commercial storage. Hence, on average if within a 20 mile radius around an ethanol plant there is 1 million bushels of commercial grain storage capacity we would expect there to be 404,717 bushels of on-farm storage capacity for a total of 1,404,717 bushels of storage capacity.

Table 3 lists commercial and on farm storage capacity for each plant broken down into 20, 40, 60, 80, and 100 mile radii. Also shown is what percent of the grain storage capacity the ethanol plant would demand if 100% of the storage were available to the ethanol plant. This is a strong assumption, so percentages of between 10-25% are probably the best estimate of how far an ethanol plant must purchase grain.

Given a 20 mile radius, Oakley/Campus is the only plant that could potentially have all of its storage requirements met, in theory. Hayne/Liberal has the lowest percent of potential grain storage in a 20 mile radius, but this is obvious given that their grain demand is double most of the other plants and their far south location. Even at a distance of 100 miles, the Hayne/Liberal plant demands 20% of all grain storage. Because of their proximity to Hutchison, Wichita, and Salina, the plant in Lyons has the lowest demand for available storage within the storage radii. Even though Garnett needs the largest area of any plant for crop production, their demand for available storage capacity is lower than most plants because of their proximity to Topeka.

Table 4 presents similar market share numbers in a different way. It shows how many miles away a plant must go for potential storage capacity given a specified market share. These numbers tell a similar story/their discussion is contained within the table. If on farm storage is unaccounted for, most require at least 10% of all commercial storage within a 100 miles radius of the plant.

Table 3: Storage Capacity Adjacent to Ethanol Plants (1,000 Bu)

	Campus	Garnett	Garden City (2)	Hayne	Lyons	Phillipsburg	Pratt	Russell
Ethanol Plant Grain Use	**17,454**	**12,727**	**25,454**	**40,000**	**19,600**	**14,545**	**20,000**	**13,000**
20 Mile Radius								
Commercial	14,911	3,308	10,086	1,986	9,910	4,437	10,214	5,630
On-Farm*	6,035	1,339	4,082	804	4,011	1,796	4,134	2,279
Total	**20,946**	**4,647**	**14,168**	**2,790**	**13,921**	**6,233**	**14,348**	**7,909**
Grain Use/Total Storage	*83.33%*	*273.89%*	*179.66%*	*1433.81%*	*140.80%*	*233.36%*	*139.39%*	*164.38%*
40 Mile Radius								
Commercial	33,365	13,724	55,276	33,338	69,554	16,822	30,042	26,037
On-Farm*	13,503	5,554	22,371	13,492	28,150	6,808	12,159	10,538
Total	**46,868**	**19,278**	**77,647**	**46,830**	**97,704**	**23,630**	**42,201**	**36,575**
Grain Use/Total Storage	*37.24%*	*66.02%*	*32.78%*	*85.41%*	*20.06%*	*61.55%*	*47.39%*	*35.54%*
60 Mile Radius								
Commercial	79,500	23,391	121,355	75,954	104,450	33,669	118,470	59,914
On-Farm*	32,175	9,467	49,114	30,740	42,273	13,626	47,947	24,248
Total	**111,675**	**32,858**	**170,469**	**106,694**	**146,723**	**47,295**	**166,417**	**84,162**
Grain Use/Total Storage	*15.63%*	*38.73%*	*14.93%*	*37.49%*	*13.36%*	*30.75%*	*12.02%*	*15.45%*
80 Mile Radius								
Commercial	108,997	107,151	161,064	106,483	202,809	65,600	165,036	208,783
On-Farm*	44,113	43,366	65,185	43,095	82,080	26,549	66,793	84,498
Total	**153,110**	**150,517**	**226,249**	**149,578**	**284,889**	**92,149**	**231,829**	**293,281**
Grain Use/Total Storage	*11.40%*	*8.46%*	*11.25%*	*26.74%*	*6.88%*	*15.78%*	*8.63%*	*4.43%*
100 Mile Radius								
Commercial	137,914	128,838	217,715	136,950	273,377	106,586	218,496	286,306
On-Farm*	55,816	52,143	88,113	55,426	110,640	43,137	88,429	115,873
Total	**193,730**	**180,981**	**305,828**	**192,376**	**384,017**	**149,723**	**306,925**	**402,179**
Grain Use/Total Storage	*9.01%*	*7.03%*	*8.32%*	*20.79%*	*5.10%*	*9.71%*	*6.52%*	*3.23%*

Table 4: Distance From Specified Market Share

Minimum distance traveled to Commercial Storage

	(Miles Away Given Market Share*)			
Plant	**100%**	**50%**	**25%**	**10%**
Campus/Oakley	24	44	56	>100
Garnett	39	62	62	97
Garden City (2)	34	39	52	>100
Hayne/Liberal	44	62	>100	>100
Lyons	29	31	49	80
Phillipsburg	38	58	75	>100
Pratt	31	45	55	93
Russell	31	40	60	70

Example: The Campus/Oakley plant demands all commercial grain storage capacity for a distance of 24 miles. 44 miles away they demand 50% of all commercial grain storage capacity. 56 Miles away they demand 25% of all commercial storage capacity. They demand 10% of all commercial grain storage capacity for greater than 100 miles.

Minimum distance traveled to Commercial and On-Farm Storage

	(Miles Away Given Market Share*)			
Plant	**100%**	**50%**	**25%**	**10%**
Campus/Oakley	18	30	51	92
Garnett	31	53	62	76
Garden City (2)	28	35	47	87
Hayne/Liberal	31	52	88	>100
Lyons	27	31	31	70
Phillipsburg	29	45	65	97
Pratt	25	39	51	71
Russell	25	37	50	64

**Market Share=(Grain Use by Ethanol Plant/Grain Storage Capacity)*

Source: Kansas Grain Elevator Survey

Statewide, grain usage in ethanol plants is relatively small compared to most of the traditional corn-belt states. However, these plants have a large effect on their surrounding area, with many plants having to pull in grain from a distance of 60 miles or greater. Plants are also dependent on commercial and on-farm storage to ensure they receive grain in a timely manner.

Distiller's Grain and Kansas Livestock

Kansas ethanol plants enjoy the opportunity to forgo significant natural gas costs through marketing their distiller's grain as wet (WDGS or Wet-Cake). In its wet form, each bushel of grain put through the distillation process yields a slightly modified product that is 30% dry matter, or a total weight of approximately 43.75 pounds. In its 90% dry-matter form, the same bushel of grain weighs approximately 17.5 pounds. The drying process in which plants extract the 26.25 pounds of water is very natural gas intensive, requiring approximately 11,000 BTUs (ICM). Given a natural gas price of $11.01 (2007 average price in Kansas) each ton of dried distiller's grain with soluble (DDGS) requires $37.62 of natural gas costs to dry.

Wet-cake substitutes easily into feeder, beef, and dairy cattle rations, cattle in feedlots are potentially the most stable demand. (Relatively small dairy presences in Kansas and beef cows are traditionally put out to grass each Spring/Summer, eliminating the need for WDGS in their ration.) Therefore, in order to determine the size of the potential WDGS market in Kansas, cattle on feed numbers were acquired for each district in Kansas and calculated for the Oklahoma Panhandle. Using the rations in the *Iowa State University Ag Decision Maker, Livestock Budgets* it was determined that each animal in a feedlot will consume 1.05 tons of WDGS each year. Given this information, we can easily convert the cattle on feed numbers by district to potential WDGS usage.

Table 5 contains each plant's WDGS production and the potential WDGS usage in their region. All plants except Campus/Oakley, Hayne/Liberal and the two plants in Garden City have potential WDGS surpluses in their area, or they produce more WDGS than the potential demand by feedlots in their area. Statewide there is a surplus of 409,500 tons, or 13.3% of total WDGS production. Cattle on feed in the Oklahoma panhandle can be considered as a potential WDGS market due to their close location to the Hayne/Liberal and Garden City plants. When this potential is factored in, the statewide surplus falls to 92,663 tons or 3.01% of total WDGS production.

Again, it is worth noting that these surpluses were calculated solely based off cattle on feed numbers. Similar to potential WDGS consumption per cattle on feed, a reasonable assumption is 1.05 tons of WDGS per beef cow. Given the approximately 1.5 million beef cattle in the state, this potential WDGS surplus can easily be absorbed (NASS). The purpose of this discussion was merely to indicate that cattle on feed alone in the state cannot potentially consume the state's entire WDGS production. Another issue is timing, during the spring/summer months when beef cattle are traditionally pastured; they are unavailable as a potential WDGS market. Hence ethanol plants may be forced to dry their bi-product to service markets outside the Midwest.

Table 5: Kansas WDGS Production and Potential Cattle on Feed Usage, by Ethanol Plant (2005-2007 Average)

Variable (Tons)	Campus	Garden City(2)	Garnett	Hayne	Lyons	Phillipsburg	Pratt	Russell	Statewide
Destination District(s)	NW WC	SW	EC SE	SW OK Panhandle	SC C	NW NC	SC	C	Statewide
WDGS Production	343,636	523,011	111,364	831,250	415,625	318,182	218,750	318,182	**3,080,000**
Potential Cattle on Feed Usage	647,500	1,454,950	101,850	1,771,788	370,650	240,660	218,400	152,250	**2,670,500**
WDGS Surplus	(303,864)	(931,939)	9,514	(940,538)	44,975	77,522	350	165,932	**409,500**
Surplus (Shortage)	**-88.43%**	**-178.19%**	**8.54%**	**-113.15%**	**10.82%**	**24.36%**	**0.16%**	**52.15%**	**13.30%**

State Surplus	**409,500**
Potential Oklahoma Panhandle Usage	**316,838**
Adjusted Surplus	**92,663**
Surplus (Shortage)	**3.01%**

Source: Iowa State University Ag Manager, Livetstock Enterprise Budgets and USDA/NASS

Effect on the Trucking Industry

Because of the amount of distiller's grain marketed as wet, Kansas ethanol plants have a greater demand for trucking relative to traditional corn-belt ethanol plants. Also, since plants need a pretty constant stream of grain because of their lack of on-site storage and their relatively close proximity to gasoline blenders, plants require a steady stream of truck traffic in order to stay in operation.

Assuming that each plant markets 90% of their distiller's grain as WDGS and that they haul 50% of their ethanol via truck (With the balance shipped via rail.) and KDOT regulations of 950 bushels of grain, 9,000 gallons of fuel, and 25 tons of WDGS per load, the number of truckloads for each plant on a daily and annual basis was calculated for grain, ethanol, and WDGS. These figures are contained in Table 6.

Table 6: Demand for Trucking by Kansas Ethanol Plants.

	Truckloads of Grain		Truckloads of Ethanol		Truckloads of WDGS	
Location	**Daily**	**Annually**	**Daily**	**Annually**	**Daily**	**Annually**
Campus	50.3	18,373	7.3	2,667	37.7	13,745
Garden City (1)	57.7	21,053	8.4	3,056	45.5	16,625
Garden City (2)	15.7	5,742	2.3	833	11.8	4,295
Garnett	36.7	13,397	5.3	1,944	12.2	4,455
Leoti	1.6	574	0.2	83	1.3	477
Hayne	115.4	42,105	16.7	6,111	91.1	33,250
Lyons	57.7	21,053	8.4	3,056	45.5	16,625
Phillipsburg	41.9	15,311	6.1	2,222	34.9	12,727
Pratt	57.7	21,053	8.4	3,056	24.0	8,750
Russell	50.3	18,373	7.3	2,667	26.9	9,822
Totals	**485**	**177,033**	**70**	**25,694**	**331**	**120,772**

Grand Totals	
Daily	**886**
Annually	**323,500**

After further examination of an ethanol plant's location and the market areas defined in the previous sections of this paper we determined the average haul for grain and WDGS to calculate the average load duration. Assuming that each truck operates for 2,000 hours annually, the number of trucks that need to be devoted to the plant was then calculated. Using average 2007 prices for fuel and oil, tires, trucks, trailers, insurance, and labor; the total cost of operating a truck for 2,000 hours was calculated in order to quantify the total payments that Kansas ethanol production makes to the trucking industry. Table 7 contains the average load durations and the number of trucks that need to be devoted to each plant given the constraints listed above.

Table 8 combines the above calculations and estimates the total payments to the trucking sector given average 2007 prices. As indicated, total payments to the trucking sector arising from ethanol production would be approximately \$52.9 million and require the full-time use of 475 trucks. This number differs relative to traditional corn-belt plants that dry a vast majority of their distiller's grain and ship it via rail. These corn-belt plants also ship 100% of their ethanol production via rail. Notice that these calculations are very sensitive to the percent of ethanol hauled via truck, with payments fluctuating ±\$10.97 million. Also, these payments to the trucking industry are highly sensitive to fuel prices. Since these numbers were calculated for 2007 prices, payments to the trucking industry given 2008 fuel prices would be significantly higher.

Table 7: Average Load Duration and Total Trucks Required for Kansas Ethanol Plants

	Grain			WDGS			Ethanol		
Plant Location	**Truckloads Per Year**	**Load Duration**	**Total Trucks Required**	**Truckloads Per Year**	**Load Duration**	**Total Trucks Required**	**Truckloads Per Year**	**Load Duration**	**Total Trucks Required**
Campus	18,373	2	18.4	13,745	3	20.6	2,667	6	8.0
Garden City (1)	21,053	2.5	26.3	16,625	3	24.9	3,056	6	9.2
Garden City (2)	5,742	2.5	7.2	4,295	3	6.4	833	6	2.5
Garnett	13,397	2.5	16.7	4,455	3	6.7	1,944	6	5.8
Leoti	574	2	0.6	477	3	0.7	83	6	0.3
Lyons	42,105	2.5	52.6	33,250	3	49.9	6,111	6	18.3
Hayne	21,053	2.5	26.3	16,625	3	24.9	3,056	6	9.2
Phillipsburg	15,311	2.5	19.1	12,727	3	19.1	2,222	6	6.7
Pratt	21,053	2.5	26.3	8,750	3	13.1	3,056	6	9.2
Russell	18,373	2.5	23.0	9,822	3	14.7	2,667	6	8.0
Total	**177,033**		**217**	**120,772**		**181**	**25,694**		**77**

Total Loads/Year	**323,500**
Total Trucks Required	**475**

Table 8: Total Payments to the Trucking Sector

Material	Loads	Trucks Required*	Operating Cost Per Truck	Total Payments
Grain	177,033	217	$105,329	**$23,308,551**
WDGS	120,772	181	$103,071	**$18,672,130**
Ethanol	25,694	77	$131,439	**$10,976,097**
Total	**323,500**	**475**		**$52,956,778**

**FTE=2,000 Hours*

Impact of an ethanol plant on a local economy.

The ethanol plant in Russell, Kansas has been in operation since October of 2001. It is situated adjacent to a wheat gluten plant. White Energy acquired both operations in early 2006. White is currently operating at 116% of its production capacity or 52 MGY (million gallons per year) of denatured ethyl-alcohol. The wheat gluten plant produces approximately 40 million pounds of high-protein wheat gluten annually and pipes the starch stream from this process into the ethanol plant. This starch stream is the equivalent of about five million bushels of wheat. The balance of starch needed for ethanol production is provided by 13 million bushels of grain sorghum from within a 60 mile radius of the plant.

This grain sorghum produces approximately 285,000 tons of distillers grain with soluble. Because the wheat starch stream from the gluten plant does not yield WDGS, White Energy's total WDGS output is small relative to other plants with the same ethanol production capacity. An overwhelming majority (≈98%) of this WDGS is marketed as wet to feedlots mainly within a 60 mile radius.

Another factor that makes White Energy unique compared to other ethanol plants is that it is also located near a combined heat and power (CHP) plant owned and operated by the city of Russell. This plant uses a natural gas turbine that creates both electricity and steam. Pipelines between the CHP and ethanol plants allow White Energy to purchase steam at a discounted rate from the city of Russell. When the CHP plant is operating up to 30,000 lbs. of steam can be transferred each hour, providing up to 65% of the needed heat for ethanol production. However, due to the recent increase in natural gas costs, the city of Russell can purchase power off of the grid cheaper than it can generate it, so Russell's CHP plant has not been in operation on a regular basis since 2006.

White Energy employs around 70 full-time workers and makes it a point to buy as many inputs locally as possible. Besides its full-time staff, they regularly employ local welders, manufacturers, and maintenance workers to perform repairs, maintenance, and upgrades on their facilities. White Energy and its employees also donate a significant amount of time and money to local institutions such as the school system and organizations such as 4-H, FFA, and the Russell County Fair Board.

Given the large amount of inputs purchased locally and jobs provided in a relatively small population it is probably safe to conclude that White Energy has a significant impact on local employment, output, and value creation. In order to quantify this, we collected data on production and employment to estimate White Energy's total output and profitability. Since the main concentration of this study is ethanol production, we collected data and analyzed numbers only for the ethanol side of White Energy; we assumed that the wheat starch stream was purchased as an outside input.

Employees within the Office of Local Government at KSU then used these numbers to estimate an IMPLAN model that determines the total output, employment, and value creation effects that White Energy has on the local economy. The three dimensions of economic activity that IMPLAN measures are defined below:

Three dimensions of economic activity (Swenson 2006):

1. Direct Activity-This is the increased regional output and labor demand by the direct operations of White Energy.
2. Indirect Activity-For White energy to manufacture its products, it must purchase inputs from local suppliers.
3. Induced Activity-Workers in the ethanol plant (direct activity) and workers in the supplying industries (indirect activity) convert their paychecks into household spending. Consequently, this induces another round of economic activity in the region

The above definitions can also be applied to employment. Direct employment is defined as jobs created within the ethanol plant. Indirect employment arises from the plant purchasing inputs from local suppliers. To meet this need, the suppliers must hire additional employees. The third type is induced employment; this is the jobs created when workers from direct and indirect sectors contribute their earnings to the local economy, hence creating additional, seemingly unrelated employment within the area. Induced employment is the hardest to quantify, hence an IMPLAN model must be estimated.

Another assumption that must be addressed in the IMPLAN model is the issue of wheat and grain sorghum production. Since wheat and grain sorghum are already produced in surplus in the region the IMPLAN model must not allow additional crop production in the area. This assumption has a major impact on job creation because if all of the grain utilized by White Energy needed to come from additional or new crop production, then a significant amount of additional output would have to occur within the crop production sector.

Table 9 shows the estimated impact of employment and value creation that White Energy has on Russell County. Since some of the production coefficients and net margin numbers are proprietary budget information, the full list of inputs and outputs are not included in this paper.

Table 9: Total Economic Impacts of Ethanol Production

	Direct	Indirect	Induced	Total	Multiplier
Jobs	35	173	27.1	235.1	6.72
Value Added	$14,652,000	$2,756,369	$867,922	$18,276,291	1.25

As noted above, the total employment impact assuming no additional grain production is 235.1 jobs with a multiplier of 6.72. This multiplier tells us that for every job created in the ethanol plant, 6.72 jobs are created within Russell County. The value creation can be interpreted similarly; with a multiplier of 1.25 every $1 of value added by the ethanol plant creates $1.25 of value within the county. This particular plant is owned by an outside corporation, so the amount of value distributed throughout the community is small relative to if this plant was owned by a local cooperative or a group of local investors (Swenson 2006).

Compared to other studies (Urbanchuk 2002) the total employment impact seems small. This is due to the issue of not allowing local grain production to increase. If we allow local grain production to increase, the employment numbers increase significantly.

Table 10 shows increased employment if local grain production had to expand in order to supply any of the needed wheat and grain sorghum. Although we know that these jobs were not created in reality, that local grain production is sufficient to supply the plant, they are interesting to examine because they show the number of people that it takes to keep this ethanol plant in operation.

Table 10: Total Employment Impacts With Increased Local Grain Production

	Direct	Indirect	Induced	Total	Multiplier
Jobs	35	537.2	37.7	609.9	17.43

The employment and value added effects for White Energy in Russell, Kansas were calculated. The results show that the plant creates approximately 235 jobs and adds an additional

$18.27 million worth of value added output. These numbers are very sensitive to the assumption of crop production. If we assume that additional crop production must occur in order to supply the ethanol plant, then the plant's effects are significantly greater. Since this area produces grain sorghum in surplus and data from the area fails to show a substantial increase in grain sorghum acreage, we assumed that no additional production is occurring.

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