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Ethanol: Salvation or Damnation?

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ethanol: salvation or damnation?



What is ethanol?

Ethanol is a clear, colorless, flammable, high-octane liquid fuel produced by the fermentation of plant sugars – such as those found in corn. Ethanol, also known as ethyl alcohol, is oxygenated. When added to ordinary, unleaded gasoline, ethanol increases the oxygen content of the fuel –helping it to burn more cleanly. Although ethanol is considered an alternative fuel, pure ethanol isn't generally used as a motor fuel. Instead, it's typically blended with gasoline at a rate of 10 percent (E10) or 85 percent (E85).

*—Nebraska Ethanol Board,
American Coalition for Ethanol and
Clean Fuels Development Coalition*



FALL 2008

DEEP is a periodic publication of the depth-reporting classes at the University of Nebraska–Lincoln's College of Journalism and Mass Communications.

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PHOTOGRAPH BY TERESA PRINCE

Lincoln businessman and college alumnus Lowell Vestal (left) visits with Dean Will Norton Jr. at a college event in fall 2007.

It was 1961.

The first depth-reporting class produced a report on the Nebraska State Legislature that was thorough, provocative, insightful and informative.


Those University of Nebraska journalism students began a tradition of excellence that has continued through the years.

Today, the Depth-Reporting and Documentaries program is a source of pride for students, faculty and alumni. It is the program that defines the College of Journalism and Mass Communications.

Depth-Reporting and Documentaries is rooted in good fundamental journalism that aims to inform, explain and empower.

It inspires passion, professionalism and a sense of possibility in the next generation of journalism leaders.

Lowell Vestal, an alumnus of the college and a Lincoln businessman, has contributed to this tradition of excellence. The students and faculty of this college are grateful for his support and encouragement.



In recent years, a constellation of buzzwords has rumbled throughout the land, echoing up and down the halls of Congress, across big-city boulevards and out onto the open plains, penetrating deep within Nebraska's farm country. By now, everyone — politicians, scientists, researchers and all manner of everyday citizens — has become well-acquainted with the buzzwords: fossil fuels, carbon footprints, global warming, biofuels, alternative energy, energy independence.

And with a vital presidential race heating up, oil topping out at more than \$140 a barrel and a gallon of gas now hovering near \$4, questioning exactly what those phrases mean has become more critical than ever.

Can a nation that constitutes 3 percent of the global population but consumes 25 percent of its oil dramatically reduce its reliance on fossil fuels? Can we come up with an alternative fuel that keeps more

money in our collective wallets, cleans up the environment and helps free us from the clutches of Mideast despots?

In his 2007 State of the Union address, President George W. Bush declared that ethanol offered Americans the best hope for a stable energy supply. Among other things, Bush said, the corn-based gasoline additive would help liberate the U.S. from hostile foreign regimes and put money in the pockets of American farmers. To help achieve his goal, the president decreed that 16 billion gallons of corn-based ethanol be available to American consumers by 2017.

But in short order, the presidential directive spawned as many questions as answers: Would a network of ethanol plants in Corn Country really revitalize rural communities? Does corn-based ethanol require more energy to create than it yields? Are there health risks and environmental issues to contend with? Has using corn for fuel helped drive

up the cost of food, sparking riots in some parts of the world? In the end, do alternative biofuel sources — switchgrass, sweet sorghum, algae — offer better results than corn?

For nine months, a team of UNL student journalists — six print and four broadcasting — went looking for the answers to these questions. The students read hundreds of pages of background material, interviewed scores of scientists, researchers, professors and energy experts by phone and e-mail, grilled a number of ethanol advocates in person, participated in an energy symposium at Stanford University, traveled to Berkeley, Chicago and Kansas City, and visited ethanol plants, rural communities and cattle country to try to get to the bottom of this elusive, complex issue.

The results of their months-long research can be found in the following stories, graphics and photographs.

— JOE STARITA

RUNNING ON EMPTY FOOD VS. FUEL

The recent boom in the ethanol industry has resulted in a greater demand for corn, which, in turn, has led to a strain on the supply, triggering higher prices.

BY MIMI ABEBE

PHOTOGRAPH BY AARON E. PRICE

A pile of corn sits at the Cargill storage plant in Ord, Neb., about two miles from the US BioEnergy ethanol plant. Some of the corn will be moved to US BioEnergy where it will be processed into ethanol. The size of the pile varies each season but can average 1 million bushels. With corn prices in constant fluctuation, worth is difficult to determine, but a pile of corn this size could be worth more than \$5 million.

On a Sunday evening, Anabel Ostiguin bustled about her small kitchen making dinner for her hungry family.

The 37-year-old mother of six, who moved from Chicago to Lincoln in 1993, carefully placed a stack of chicken-and-cheese quesadillas on a serving plate. With the sticker shock that greets her on each trip to the grocery store, Ostiguin struggles to provide even basic food for her family of eight.

So every few months, the Ostiguins make a nine-hour drive from Lincoln to Chicago in their copper-colored '98 Chevy Suburban to stock up on tortillas, bought directly from El Milagro, a tortilla manufacturer that offers prices lower than the family can find in Lincoln. At \$15 for a pack of 36 tortillas, they buy a box with 16 packs — enough to last the Ostiguins three or four months.

“We can save more if we buy in bulk,” Anabel said. “With higher prices in everything, we have to limit ourselves.”

Like many other families, the Ostiguins struggle to live on an increasingly tight budget. Cutting corners can go only so far, however, when the price of one of the most basic needs, food, continues to shoot up.

According to the U.S. Department of Agriculture, in 2007, the price of meat, poultry and fish went up by 3.9 percent, dairy products by 7.4 percent and eggs skyrocketed 28 percent. In the first quarter of 2008, the price of eggs was up 40 percent from a year earlier.

The dramatic rise in food prices is a trend that won't level off anytime soon. According to the USDA, all food prices are expected to increase another 4 percent in 2008.

This increase in price has been attributed to several factors, but one has become somewhat of a lightning rod: ethanol. Specifically, corn-based ethanol.

The recent boom in the ethanol industry has resulted in a far greater demand for corn, which, in turn, has led to a strain on the supply, triggering higher prices. In spring 2008, the price of corn hovered around \$6 a bushel. And as the price increases, consumers feel its aftershocks on their wallets.

A 2007 Iowa State study on the long-term effects of biofuels in the U.S. was clear in its conclusion: "In response to increased demand for corn by the ethanol sector, feed prices increase and stay high for several years."

In 2008, ethanol plants were projected to gobble up one-fourth of the nation's corn supply, leaving less to feed poultry and livestock — and less for the many foods that contain corn. Forced to pay steeper and steeper corn prices, many middlemen are inclined to pass those costs on to consumers.

As much as Americans feel the pain of higher food prices, the global impact is even greater. The world's poor, who spend most of their income on food, have no means to ease the financial burden of higher food prices. Consequently, food riots have occurred in several countries.

"The prices of basic staple foods are likely to increase, threatening economic access to sufficient food, particularly for the poorest who already spend a high proportion of their incomes on food," said Jean Zeigler, the U.N. Special Rapporteur on the right to food. "The sudden, ill-conceived rush to convert food, such as maize, wheat, sugar and palm oil, into fuels is a recipe for disaster."

In the increasingly contentious food vs. fuel debate, a close look at numerous studies, interviews and government documents reveals a number of key issues.

"As oil prices go up, that creates more incentive

for producing biofuels which puts pressure on food prices," said Richard Heinberg, a senior fellow at Post Carbon Institute, a think tank devoted to environmental and energy issues. Using corn for fuel and other products, he said, inevitably puts pressure on food prices.

Still, not everyone is convinced that ethanol is the source of higher food prices.

"The 'rest of the story' is that energy prices are a far larger culprit in higher food prices," Keith Olsen, president of the Nebraska Farm Bureau Federation, wrote in a July 2007 editorial in the Lincoln Journal Star. "The use of energy adds significant costs to foods as they move through growing, processing, packaging and shipping.

"The bottom line is that the corn-food price link is grossly overstated. The reality is that higher corn prices have had very little impact on food prices. Food prices in general do not rise as much as the media portray."

Rick Tolman, president of the National Corn Growers Association, put it even more bluntly, speaking to the National Press Club in April, 2008.

"While we do have some role in higher corn prices, we're closer to Little Bo Peep than an ax murderer," Tolman said.



PHOTOGRAPH BY AARON E. PRICE

The Ostiguin family drives to Chicago, Ill., every few months to buy tortillas in bulk directly from a manufacturer that offers lower prices than Lincoln stores.



PHOTOGRAPHS BY KATE VEIK

ABOVE: Corn and corn derivatives have nearly 600 uses. Corn is found in obvious places like cereal, potato chips and tortillas and in some less obvious places like glue, deodorizers and peanut butter. **ABOVE RIGHT:** Mexican consumers get 60 percent of their daily calories from tortillas, so tortillas have huge nutritional importance.

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This sentiment doesn't resonate with the Ostiguin family, who now spends more than \$800 each month on basic food.

"As the kids get older, we consume more and more," Anabel Ostiguin said. "We have to plan ahead."

Corn has long been a key staple in the U.S. food supply. It is consumed not only by people, but also by cows, hogs and chickens. Beef, milk and eggs are among the most vital items in U.S. meals. The dramatic increase in prices for these and other foods has put pressure squarely on the budgets of American consumers.

Some researchers link those price increases to a number of causes, including weather and energy costs. Others have looked at a broad range of possible impacts.

In November 2007, Stanford University pub-

The Ostiguin family spends more than \$800 each month on basic food.

lished a study titled "The Ripple Effect: Biofuels, Food Security, and the Environment." Among other things, the study's seven authors considered the impact on food availability and cost if a large percentage of five key food crops, including maize, cassava, sugar cane, soy and palm oil, were redirected to produce biofuels.

According to the study, the use of these commodities to create fuel rather than food could trigger a strain on the supply that leads to higher food prices throughout the world.

Urging more careful analysis of the causes and effects of this trend, the authors wrote, "... biofuels are causing an abrupt increase in demand for agricultural commodities traditionally used for fuel and feed, which is placing upward pressure on crop

prices. Whether future price increases and subsequent adjustments in demand and supply occur at local, regional, or global scales has yet to be determined.”

Ken Cassman, University of Nebraska–Lincoln professor of agronomy and agriculture and a co-author of “The Ripple Effect,” echoed the cautious analysis of the Stanford study. Cassman is highly critical of studies linking corn-based ethanol to higher food prices. He said those studies create a false relationship between the inflation of food prices and rising corn prices.

“There is going to be a higher impact on food prices than these backwards studies suggest,” Cassman said.

Much of that impact may come from scarcity. A March 2008 article in the Lincoln (Neb.) Journal Star said ethanol is having a significant impact on wheat prices because the demand for ethanol is causing farmers to plant corn instead of wheat.

“Our grain stocks are at a 30-year low,” Heinberg said, adding that, in the next 50 years, population growth and increases in per capita consumption mean people will have to produce as much food as has been produced in the last 10,000 years. With skyrocketing wheat and corn prices, that task will be a considerable challenge.

“This is why I think that we’re facing what could be the greatest agricultural crisis in the history of our species,” Heinberg said.

Ethanol Across America, an education campaign of the Clean Fuels Foundation, said higher energy, transportation and labor costs may be to blame for higher food costs. The industry group said weather can also be involved. Blizzards and ice storms, for example, can cause ranchers to lose cattle and farmers to lose grain, fruit and vegetable crops.

“Weather didn’t have any effect during the last few years, so that can’t explain what’s going on right now,” said Richard Perrin, a UNL agricultural economics professor.

He said current food prices are partially due to higher corn prices, but energy and transportation costs also play a critical role.

“Meat, poultry, eggs and dairy products — the

foods where corn is a major input and are most affected by rising corn prices — accounted for about 0.2 percent of the 1.2 percent acceleration in food price inflation between September 2006 and April 2007. Rising energy prices had a more significant impact on food prices than did corn,” Perrin said.

Higher corn prices will likely affect the prices of more items than food. Add it all up, and there are nearly 600 uses for corn and corn derivatives.

Corn is found in obvious places like cereals, potato chips and tortillas. According to the Kentucky Corn Growers Association, it is also a primary ingredient in Johnson & Johnson baby powders, Duracell Procell Batteries, Febreze Deodorizing Spray, Kingsford Charcoal and Vagisil Feminine Powder.

And, more and more, corn is being used to make ethanol.

A study published in February 2008 by the Economic Research Service Department of the U.S. Department of Agriculture concluded that the price increase per bushel of corn from \$2 in 2005 to \$3.40 in 2007 was due partly to extra demands from ethanol.

The study reported that, by the end of the 2006-2007 crop year, more than two billion bushels of corn, or 19 percent of the harvested crop, was used to produce ethanol, a 30 percent increase from the previous year.

Less than 10 percent of the U.S. corn crop is used for domestic human consumption; the rest goes for things like animal feed and ethanol production, the study said, adding, “Ethanol’s impact on retail food prices depends on how long the increased demand for corn drives up farm corn prices and the extent to which higher corn prices are passed through to retail.”

Increased costs for corn could be passed on to the consumer.

For example, an 18-ounce box of corn flakes contains about 12.9 ounces of milled corn. The average price of corn for the past 20 years has been \$2.28 per bushel, which makes the value of corn in a box of corn flakes about 3.3 cents. The rest of the

cost comes from packaging, processing, advertising, transportation and other things. But when the price of corn hits \$3.40 per bushel — the average in 2007 — the value of the corn in that same box is 4.9 cents.

“The 49-percent increase in corn prices would be expected to raise the price of a box of corn flakes by about 1.6 cents ... assuming no other cost increases,” the USDA study said.

While consumers are concerned about rising food costs, corn farmers are pleased with the trend.

In November 2007, the Lincoln Journal Star ran a pro-ethanol advertisement titled “Food & Fuel Facts.”

“It’s great that Nebraska corn farmers are finally getting a good price for their product,” the ad said. “If we spend a few cents more at the grocery store, that’s a small price for having the safest, most abundant and most affordable food supply in the world.

“Ethanol is helping solve our nation’s energy challenges. And it’s helping today. The money we spend on ethanol stays right here in America. In Nebraska. And that’s worth every penny. Even a couple of cents extra for our box of corn flakes.”

FACTS CORN

☞ Baby powder, contact lens solution, toothpaste and corn flakes are among more than 600 products containing corn used in daily life. — *Kentucky Corn Growers Association*

☞ A February 2008 study concluded that the price increase of corn from \$2 a bushel in 2005 to \$3.40 a bushel in 2007 was partly because of extra demands from ethanol. — *U.S. Department of Agriculture*

☞ A November 2007 Stanford University study says the United States and Brazil account for more than 90 percent of global bioethanol production. — *“The Ripple Effect”*

☞ The price of meat, poultry and fish all increased 3.9 percent, dairy products by 7.4 percent and eggs by 28 percent in 2007. — *U.S. Department of Agriculture*

☞ The five key commodities in ethanol production are maize, cassava, sugar cane, soy and palm oil.

— *“The Ripple Effect”*

☞ The overall effect of food-price increases is much more detrimental to the world’s poor than to Americans.



WHAT'S IN A BUSHEL?

1.6 pounds of corn oil

In addition to foods such as cooking oil, salad dressing, mayonnaise, margarine and shortening, corn oil is also an ingredient in soaps, inks and leather-tanning supplies.

13.5 pounds of 21 percent gluten feed

High gluten feed is used to raise both livestock and poultry, and it's also an ingredient in pet foods.

2.6 pounds of 60 percent gluten meal

Gluten meal is an ingredient in some poultry feeds and is also used in fur cleaners.

2.7 gallons of ethanol at a wet-milling plant

or 32 pounds of starch
Not simply a food ingredient, corn starch is used in adhesives, batteries, cardboard, crayons, dyes, plywood, paper, antibiotics and eco-friendly plastics.

or 33 pounds of sweetener
Corn syrup and high fructose corn syrup are used in lots of foods, particularly in the U.S. where corn syrup can be a cheaper alternative to sugar. One bushel of corn yields enough corn syrup to make nearly 370 cans of Coca-Cola Classic.

SOURCE IOWA CORN PROMOTION BOARD



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However, many American families struggle with even moderate price increases.

Big families have to be on a budget, said Anabel Ostiguin. Her family goes through five gallons of milk a week and, at most, consumes meat only three times a week because of higher prices.

Among the pro-ethanol arguments, one of the strongest is that increased corn prices can rejuvenate rural communities by bringing revenue to local farms and farms around the world.

“As a senator from the Cornhusker state, I am acutely aware of the needs of our cattle and pork producers as well as our grain farmers,” wrote Nebraska U.S. Sen. Ben Nelson in the summer 2007 Ethanol Across America Issues Brief. “It is important to remember that the better corn prices received by farmers help revitalize rural communities while, as this brief shows, having very little effect on the prices consumers pay for food.”

According to others, the international reality is not so simple.

For example, 50 percent or more of the population of Africa derives most of its income from agriculture, Cassman said.

Zambia is a prime example.

About 70 percent of Zambians subsist on agriculture, and the number is even higher in rural populations, said Adam Norikane, CCF Zambia Food Security Specialist. Maize (corn) comprises the highest percentage of rural Zambian farmers’ crop lands and yields.

Maize is sold to the Federal Reserve Agency, which is a government organization, said Norikane, under a policy designed to keep prices steady and offer a sellers’ market, regardless of global price fluctuation. This is the government’s attempt at stabilizing staple-crop production.

“But if the government can’t sell it on the world market, then they can’t pay the farmers, and the

PHOTOGRAPH BY KOSUKE KOIWA

According to the Nebraska Corn Board, in 2007 Nebraska farmers produced 1.4 billion bushels of corn. In the 2007-2008 marketing year, nearly 70 percent of Nebraska’s corn production will be used in the state, with 30 percent shipped out of the state, according to ProExporter Network projections.

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farmers have to ask someone they know for money to buy seed for next season,” Norikane said.

Mexican farmers face similar problems.

Poor subsistence farmers don’t usually produce enough to cover all of their household needs, wrote Alder Keleman, Congressional Hunger Fellow and author of “The Mexican ‘Tortilla Crisis’ of 2007,” in which she discusses the future of small-scale, Mexican farmers. They end up purchasing maize or maize substitutes. This situation leads to price increases in other food products.

Some experts say the misconception that higher crop prices help farmers is widespread.

“Although increasing food prices should theoretically benefit millions of people working as peasant farmers in developing countries, this is not always the case,” said Jean Zeigler, the U.N. Special Rapporteur. “Many farming families are net buyers of staple foods, as they do not have enough land to be self-sufficient, and will therefore be affected by rising consumer prices.”

On average, Americans spend about 10 percent of their income on food — less in proportion to their disposable income than do people in any other country in the world, Cassman said.

Globally, the picture is much different.

“The figures I’ve seen suggest that the poorest Mexican consumers get something like 60 percent of their daily calories from tortillas, so they have huge nutritional importance,” Keleman said.

In Mexico, the daily minimum wage around the time food prices spiked in 2007 was about 50 pesos, or about \$5, Keleman said. So a price increase of 10-15 pesos per kilo of tortillas could have a huge impact on the food security of a family living off a minimum-wage-level salary.

Ziegler’s U.N. report summed it up this way: “The consequences of such a rapid increase in food prices would be grave. The International Food Policy Research Institute projects that the number of people suffering from undernourishment would increase by 16 million people for each percentage point increase in the real price of staple food.

“This could mean that 1.2 billion people would be suffering from hunger by 2025.” 🌾





PHOTOGRAPH COURTESY
LINCOLN JOURNAL STAR

E. BEN NELSON

“It is important to remember the better corn prices received by farmers help revitalize rural communities, while ... having very little effect on the prices consumers pay for food.”

U.S. Sen. Ben Nelson

D-Neb.

PHOTOGRAPH BY KOSUKE KOIWAI

Alan Songster of Exeter, Neb., harvests corn. Less than 10 percent of the United States corn crop is used for domestic consumption.

NIGHTMARES in the ETHANOL DREAM

Although President George W. Bush, Congress and Midwest politicians all champion corn ethanol, some economists, scientists and even a few farmers benefiting from the grain-alcohol nudge say that view is an intoxicated, rose-tinted illusion.

BY CASSIE FLEMING

Facing cameras, microphones and rows of well-heeled lawmakers, the son of an oil man and a former oil man himself told the nation once again that it had been dependent on oil, particularly foreign oil, for far too long.

In his 2007 State of the Union address, President George W. Bush said hope and opportunity for Americans ultimately depended on a stable energy supply. Through bursts of machine-gun-like applause, the president rattled off a grocery list of reasons why ethanol makes more and more sense, why it is vital if the U.S. is to curb its oil addiction.

“This dependence leaves us more vulnerable to hostile regimes and to terrorists — who could cause huge disruptions of oil shipments, raise the price of oil and do great harm to our economy,” said Bush, who did not know then that the price for a barrel of oil would jump from about \$55 in January 2007 to more than \$130 by spring 2008.

To achieve the ambitious vision laid out in his address, Bush mandated 35 billion gallons of renewable and alternative fuels to be available to Americans by 2017. Of this amount, 16 billion gal-

lons was to arrive in the form of corn-based ethanol — an amount that would require about five times Nebraska’s 2006 corn production.

Congress later changed the mandate to 36 billion gallons of ethanol by 2022 with a maximum of 15 billion gallons from corn.

Although the president, Congress and Midwest politicians all champion corn ethanol, some economists, scientists and even a few farmers benefiting from the grain-alcohol nudge say that view is an intoxicated, rose-tinted illusion.

“I don’t use ethanol in my car, and I know that sounds stupid for a farmer to say,” said Merlin Stuhr, an eastern Nebraska corn and soybean farmer. “It just costs too much money to use because my car doesn’t go as far on ethanol as it can on oil.”

Amory Lovins, a veteran U.S. energy adviser and cofounder of the Rocky Mountain Institute, a think tank, said if he could have the ear of a mayor in an ethanol town right now, he would say, “Enjoy it while it lasts.”

When all is said and done, the ethanol debate

raises several important questions:

What underscores the fierce political allegiance to ethanol?

Is ethanol a valid alternative outside the Corn Belt? In the end, is ethanol a boon or bane?

“It all boils down to economics,” said Ernie Goss, a Creighton University economist. “This area benefits from it right now, so the political support will follow.”

In fact, agribusiness coughed up \$250 million to federal candidates from 2000 to 2008, according to the campaign finance Web site, Open Secrets, <<http://opensecrets.org>>.

“High oil prices — and a high oil proportion that comes from outside countries — was the motivation to find ethanol,” Goss said. “It motivated Congress to support the industry. This bred a situation where companies see the ability to gain profit from ethanol. Then the states chimed in with their own support because state politicians are looking to help their local constituencies.

“Ethanol is just bad decisions by the government,” Goss said.

But to ethanol’s many political supporters, the alternative fuel is the cure for a number of problems: It breathes life into dying rural communities, they argue, and puts money into the hands of the heartland’s hardworking farmers, allowing them to create a more sustainable world.

All in all, the politics of ethanol and the potential mileage to be gained by supporting it have not been lost on those who would one day like to call the White House home.

“We can harness the ingenuity of farmers and scientists, citizens and entrepreneurs, to free this nation from the tyranny of oil and save our planet from a point of no return,” Illinois Sen. Barack Obama, Democratic presidential candidate, told New Hampshire voters on the day of their January 2008 primary.

“We’ve got to get serious about ending our dependence on foreign oil,” New York Sen. Hillary Clinton, another Democrat seeking the White House, said in a television commercial that played in Iowa and New Hampshire during the early primary season.



ILLUSTRATION BY ALEX HAUETER



PHOTOGRAPH COURTESY LINCOLN JOURNAL STAR

Nebraska Gov. Dave Heineman attends a groundbreaking ceremony for an ethanol plant near Adams, Neb., in fall 2007. Nebraska has 22 ethanol production plants, producing nearly 2 billion gallons of ethanol each year — and requiring almost 600 million bushels of grain, according to the Nebraska Ethanol Board.

“Our rural communities already benefit from the \$37 million in annual pay linked to the operation of Nebraska ethanol plants. State and local economies benefit whenever a new plant is built.”

Gov. Dave Heineman

R-Neb.

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Although Arizona Sen. John McCain, a Republican presidential hopeful, had once been a harsh critic of the corn-based product, he was whistling a different tune before the January Iowa caucus.

“I had my glass of ethanol this morning, and I’m feeling good,” McCain told a 2007 Des Moines crowd.

For Jordan Lieberman, publisher of Campaigns and Elections magazine, the political connection to ethanol is a fundamental one.

“People understand you don’t get through the Iowa caucus without supporting ethanol,” he said. Iowa leads the nation in ethanol production.

Stuhr, the Nebraska corn farmer, said political backing in contested areas like Iowa is basically wallet padding.

“It’s all about who can give the candidates the most money to get into office,” he said.

Iowa agricultural services and products lined politicians’ pockets with \$250,000 in 2008, according to Open Secrets.

However, money is not the only resource that agricultural interests provide.

“I would usually just say ‘follow the money,’” Lieberman said. “But in this case I would say follow the voter, too. Because the whole Iowa economy is based on corn, the corn contribution is linked with every voter.”

Still, ethanol remains rich in inconsistencies. Some farmers, political scientists, economists and politicians continue to see nightmares in the ethanol dream.

One such nightmare is a cruel irony within the industry: While the higher corn price is a boost to farmers, it also increases the cost of ethanol production.

“My cousin is a state senator, and I tell her ethanol is no salvation for the farmer,” Stuhr, the farmer, said, adding that if the price of corn gets too high or if the price of oil gets lower, the ethanol industry will collapse.

Midwest residents are beginning to see an industry unable to sustain itself, leaving local plants to either close or be gobbled up by large corporations, said Goss, the Creighton economist.

The vast majority of politicians do not know ethanol specifics, publisher Lieberman said. For example, he said nine of 10 politicians are unaware that the amount of energy used to create a gallon of ethanol is more energy than the gallon of ethanol will eventually supply.

Outside the Midwest, a different reality exists.

“No one is talking about ethanol outside the corn-growing states,” Lieberman said. “And truthfully, people in the Northeast and West don’t necessarily care about supporting ag families.”

Nevertheless, whether coming from the lips of Midwest politicians or from charismatic presidential hopefuls, the reasons to support ethanol remain clear to many politicians.

“Our rural communities already benefit from the \$37 million in annual pay linked to the operation of Nebraska ethanol plants. State and local economies benefit whenever a new plant is built,” Nebraska Gov. Dave Heineman said in 2005.

Scott Kleeb, vying to become Nebraska’s Democratic nominee in the 2008 U.S. Senate race, said ethanol is “Nebraska’s chance to rejuvenate the pioneer spirit.”

Rejuvenation comes from increased jobs and the pride farmers gain from being on the frontier for alternative energy sources, Kleeb said.

William Morgan, executive director of the Midwest Political Science Association, said politicians support ethanol because it is good for their districts, or “because it is a ‘new’ issue and they can manage to put themselves on the cutting edge and be innovators.”

Annette Dubas, a Nebraska state senator and a corn and soybean farmer, vigorously supports ethanol legislation.

“I understand farmers and agriculture and the struggles they go through,” she said. “I ask, ‘How can we be part of a broader solution?’”

Energy independence may be the broader solution, she said.

“Every dollar sent out is one less spent here,” Dubas said. “Keep the dollars in the hands of the farmers. Do it so we can be less dependent on foreign oil.”

David Redlawsk, a campaigns and voting strategy professor at the University of Iowa, said this presidential election cycle was unusual with both sides being wide open coming into Iowa. Each candidate was so engaged, he said, that candidates who once opposed ethanol switched their stances.

Hillary Clinton, for instance, voted against ethanol subsidies in 2001 as a New York senator. But on Nov. 7, 2007, the then presidential candidate said, “I will happily support corn ethanol and all forms of ethanol.”

Eventually, they all fall in line, Goss, the economist, said.

“You’d be a nut to run against agriculture,” he said.

In October 2006, for example, Heineman posed in front of a row of upright shovels at the groundbreaking ceremony of the Altra Nebraska Ethanol Plant in Carleton. Pictures show him digging up the first pile of soil from the ground and shaking hands with the ethanol board members.

“It’s good the governor is working to open more ethanol plants in the state,” said Derek Jagels, a University of Nebraska–Lincoln junior ag-economics major.

As for why he supported the governor’s ethanol push, he cited more revenue for communities and the state, a cleaner environment and a way to wean the U.S. off foreign oil.

This scene is not unique. Politicians often scurry about the Midwest to visit and endorse ethanol plants.

Elected officials benefit from supporting ethanol because of the organizational support they receive from those connected to agricultural interests. To those running for office, supporting ethanol is comparable to supporting Midwest families’ values and way of life.

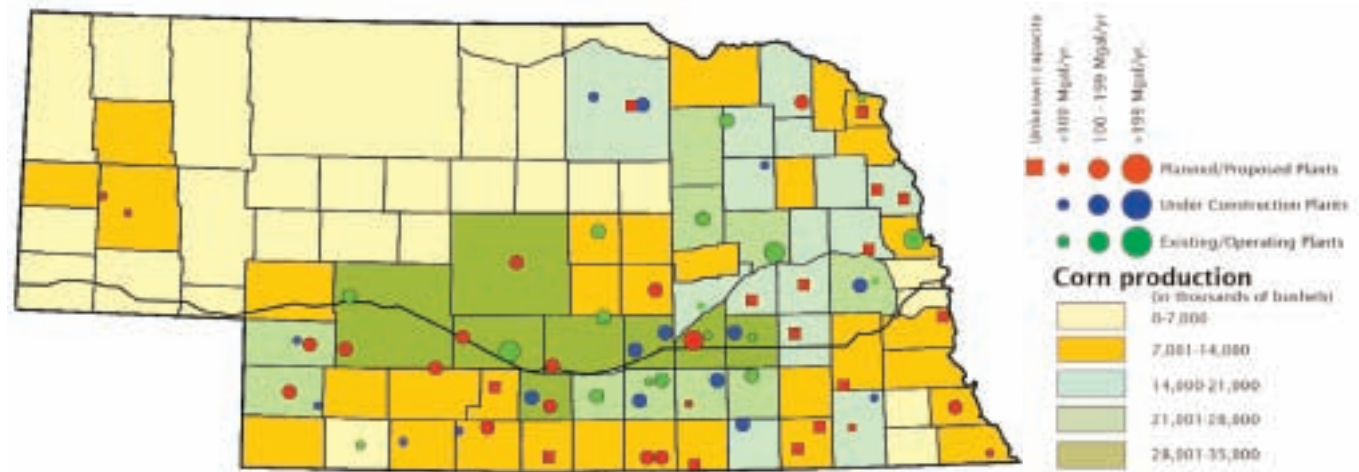
“Ethanol is political football for votes,” said M.E. “Bus” Whitehead, founder of Lincoln’s Whitehead Oil. “If I were campaigning in Nebraska like Clinton or Obama, I would love ethanol.”

Jagels, who comes from a farm family, said bio-fuel is going to be something he “definitely thinks about when he votes.”

From a rural-development standpoint, politicians realize they need to support ethanol, said Rick

NEBRASKA PLANTS

As of July 2008, Nebraska had 22 operating ethanol plants and 16 more already under construction. Thirty-five more plants have been planned and proposed, mostly in large corn-producing counties.



GRAPHIC BY ALEX HAUTER

SOURCE NEBRASKA DEPARTMENT OF ENVIRONMENTAL QUALITY

Leonard, research analyst for the Nebraska legislature’s agriculture committee.

Nebraska Gov. Heineman understands why.

“Agriculture is the backbone of Nebraska’s economy,” he states on the agriculture page of his Web site.

One thing to understand about ag issues, Stuhr said, is that to predict grain prices, only the fluidity of the market can be trusted.

“Let me tell you something,” Stuhr said, sitting in a truck-stop diner along Nebraska Interstate 80. “A guy called me the other day to tell me how to market my grain, and the last thing he said to me was, ‘This price is going to be good forever.’”

Stuhr laughed.

“You can’t say something like that to a farmer who has seen the price of corn go up and down for

as long as he has lived,” he said. “That guy must have just stepped off the graduation floor.”

Shawn Greiner, a hog farmer from southeast Iowa, has seen the number of ethanol plants in his state reach a peak. Last year, he said, ethanol companies were promising a plant on every corner, but now the companies are not making much money, if any.

“No new plants are being built,” he said. “They wanted to have one in my town next to the biodiesel plant. But they can’t get enough money. And I even heard they are thinking about shutting down the biodiesel plant.”

He said input cost — the price of corn — was too high.

Stuhr has also seen three proposed ethanol plants in his area never get off the drawing board.



PHOTOGRAPH BY KATE VEIK

Cargill owns the ethanol plant in Blair, Neb. The plant, which went online in 2005, has a capacity of 85 million gallons a year.

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He said the government's own regulations damage the industry.

"I trucked my corn down to the ethanol plant, and some kid told me I had to tarp my truck," he said. "I only haul from two miles away and don't go over 30 miles per hour. I was not tarping my truck."

He called the plant to ask about the tarp rule. The U.S. Environmental Protection Agency said the dust drifting from trucks was harmful.

"Well now, they are going to have to build a vacuum system, and that is just going to be another expense," he said. "It is so political."

Goss, the Creighton economist, said the ethanol industry is no different than any other infant industry: "It's experiencing a shakeout. Some companies are doing well. Some are not."

The less efficient ones, he said, will be closed down or bought out by the likes of Archer Daniels Midland, one of the world's largest corn and soybean processors.

"That's got to be a big rub for politicians," Goss said. "The profit isn't going to the farmers."

Two years ago, Linda and Lloyd Eichenberger watched Global Ethanol, an Australian company, buy the locally owned ethanol plant near their northern Iowa town, Lakota. They had invested in the plant four years earlier.

"There was opposition," Linda Eichenberger said. "People wanted to keep it local. They didn't trust Australia."

She said profits were supposed to double or triple when Global purchased it, but they have not. The couple probably won't invest any more in the plant.

"Politicians have not seen the research saying that ethanol may not be improving rural communities," Goss said. "They don't know it is not owned by farmers."

Another challenge created by ethanol relates to land value. Because the price of corn has increased, the value of Midwest farmland has increased, making farming more costly for people renting or buying farmland.

In fact, by Jan. 1, 2008, the average value of Nebraska agricultural real estate had reached a record high: \$1,460 an acre, according to statistics announced by the U.S. Department of Agriculture

and reported by the Grand Island (Neb.) Independent. The value of cropland rose even more — by 20 percent over the previous year — to \$2,270 an acre.

The increased land value has encouraged out-of-state companies to buy land.

"When I was younger and rented from someone I knew," Stuhr said, "he would come to me at the end of the year and ask if I had made any money. If not, he would help me with expenses. Do you think an out-of-state guy would ask if I made any money or not? Farming is a social experience."

Some fault ethanol for another reason: They say it is a short-lived solution to the energy independence issue.

Brian Donahue works for the political consulting group, Jamestown Associates, in Washington, D.C. "We're not addressing it much over here," he said. "It is a niche subject in the whole alternative energy circle."

As they look to the future, some Midwesterners see an end to corn ethanol's time in office.

"It's a way to stall before we find a permanent solution to energy independence," said Jagels, the college student, whose father invested in the ethanol plant endorsed by Nebraska's governor.

State Sen. Dubas said she, too, is looking at other forms of alternative energy.

But national politicians resist discussing corn ethanol's faults, said Lieberman, the magazine publisher.

"They can be excellent on the stump and speak intelligently without communicating anything they don't want to," Lieberman said. "So, to avoid a corn ethanol confrontation, they will just go right back to national security."

Because of the money intertwined in the relationship between ethanol and national security, Goss said he could see a storybook ending.

"If I were to write a great book," Goss said, "it would be about an ethanol plant going up in a rural community. And a guy in town starts cooking up something in his cellar that would make corn-based ethanol obsolete. Then the ethanol, big-corn guys come and bump him off." 🍷

POLITICS OIL & ETHANOL

🍷 "America's dependence on oil not only leaves families vulnerable to rising prices, but it compromises our national security and contributes to the crisis of global warming." — *John Edwards, Democrat*

🍷 "Our military and economic strength depend on our becoming energy independent, moving past symbolic measures to actually produce as much energy as we use." — *Mitt Romney, Republican*

🍷 "One of the ways to win the Islamic terrorist war against us is for us to be energy independent." — *Rudy Giuliani, Republican*

🍷 "Our rural communities already benefit from the \$37 million in annual pay linked to the operation of Nebraska ethanol plants." — *Gov. Dave Heineman, R-Neb.*

🍷 "We've got to get serious about ending our dependence on foreign oil." — *Hillary Clinton, Democrat*

🍷 "We can harness the ingenuity of farmers and scientists, citizens and entrepreneurs, to free this nation from the tyranny of oil and save our planet from a point of no return." — *Barack Obama, Democrat*

🍷 "Both climate change and reduction of our dependence on foreign oil are now national security issues." — *John McCain, Republican*

🍷 "It's time to say that we're not going to allow dictators, whether it's the Middle East or from Venezuela, to continue to, in essence, enslave the American people." — *Mike Huckabee, Republican*



FOLLOW THE MAIZE

From kernel to car fuel: the step-by-step stages of ethanol production.

BY MIMI ABEBE

In the spring of 2008, Nebraska was home to 21 ethanol plants; seven more were under construction.

These plants process corn — a staple in the world's food supply — into fuel for cars, which some believe will be the key to solving our national energy crisis.

The corn, a staple item in the world's food supply, is being transformed into fuel for cars. According to the Nebraska Ethanol Board, "ethanol production has become the third largest use of Nebraska corn — consuming more than 300 million bushels of Nebraska corn harvest annually."

Typically, ethanol plants sit very near their raw material — corn.

York County, in southeast Nebraska, is one of the top corn-producing counties in the state. Each year, 20 million bushels of corn comes into the Abengoa Bioenergy ethanol plant near the city of York. This plant produces 55 million gallons of ethanol a year, said Mitch Stuhr, the plant's manager. But by today's standards, this plant is only middle-sized. The majority of plants being built today can produce 100 million gallons a year.

Long lines of semitrucks pause at the entrance to Abengoa Bioenergy, each truck containing 1,000 bushels of corn from local farmers. To become ethanol, the corn at this dry-milling plant is put through three stages: cooking, fermentation and distillation.

PHOTOGRAPH BY AARON E. PRICE

North Loup, Neb., fields are planted with ear corn.

PROCESS



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COOKING

First, hammer mills grind the corn to reveal the starch within the kernels. Water is mixed with the ground grain to create a mash. The mash is run through a hydroheater and heated to 250 degrees until it explodes.

After the mash is cooled, alpha amylase, an enzyme, is added to break down the bonds of the starch and create a complex sugar.

The mixture is cooled again to 90 degrees Fahrenheit, a temperature that allows yeast to work best during fermentation.

FERMENTATION

Fermentation is the process by which yeast converts sugar into alcohol. Four tanks at the Abengoa Plant ferment mash into alcohol.

To start the process, another enzyme, gluco amylase, is added to the mash. This enzyme changes the complex sugar into a simple one that is easier to process. Yeast is then added.

The products of this process are alcohol, CO₂ — which is released in bubbles — and heat. Beer for drinking has about 6 percent alcohol. After cooling, ethanol beer has about 19 percent alcohol.

DISTILLATION

The next step is distillation, the process of purifying liquid through evaporation and subsequent condensation of the liquid.

First, the alcohol is separated from the ethanol beer. The beer is sent through a series of heated trays to evaporate the water, leaving the alcohol to sink to the bottom of the distillation column.

That alcohol is then run through a molecular sieve that removes the remaining five percent of water.

The water that comes out of this process is distilled water. The alcohol is 190 proof, the highest

FOLLOW THE MAIZE

DRY MILLING

In the dry-milling process, corn kernels are ground into flour, and enzymes convert the flour starch into sugars, which are fermented into ethanol. Other products are carbon dioxide (used in the carbonated beverage industry) and an animal feed called distillers grain. Most ethanol plants in the U.S. use this process.
— *National Corn-to-Ethanol Research Center*

1 Hammer mills grind the grain into flour to release the starch

1

2 The flour is mixed with water to create a liquid mixture called mash, which is heated

2

3 Enzymes are added to convert the starch into sugars

3

4 Yeast is added to the mash, and the mixture ferments into "beer," which contains about 10 percent alcohol

4

5 The mash moves to distillation columns, where evaporation yields 190-proof ethanol. The ethanol exits the top of the last column, and the solid residue (stillage) is processed into distillers grain, which is used for animal feed

5

6 A molecular sieve removes the remaining water from the ethanol

6

7 A small amount of gasoline is mixed with the ethanol to "denature" it, making it undrinkable, thus avoiding the beverage alcohol tax

7

North Loup, Neb., corn field

proof alcohol possible, very similar to Everclear, a popular beverage that's notorious for its high levels of alcohol. Unlike Everclear, this alcohol contains methanol, ethanol or isopropyl, elements that can be poisonous.

Once the alcohol has passed through quality-assurance tanks, denaturants are blended in to prepare the alcohol for shipping. The Abengoa plant uses white gasoline as a denaturant to render the alcohol unfit for human consumption. Without this step, the alcohol from the Abengoa plant could be classified as a spirit that could be taxed.

Ethanol fuel is the final product of this process. It is sent to alcohol brokers, blenders, refineries and other places that use ethanol. Ninety percent of the final product is transported by rail. The remaining 10 percent goes by truck.

BYPRODUCTS

The major product of the ethanol-making process is, of course, ethanol, which makes up about one-third of the output of the Abengoa plant. Byproducts constitute another two-thirds of the plant's output: Half of that is CO₂, and the rest is made into feed called distillers grain.

Distillers grain is a high-protein, low-fiber feed. It is usually mixed into other feed such as alfalfa or corn when given to livestock.

The distillers grain can be sold wet, or it can be sold after it is dried.

Abengoa sells wet feed within a 50-mile radius of the plant because the feed has a shelf life of only a week. Dry feed, with a shelf life of up to a year, is sold all over the country for a much higher cost. The Abengoa plant produces about 50 percent dry feed and 50 percent wet feed. ♪

PHOTOGRAPH BY AARON E. PRICE

WET MILLING

In the wet-milling process, corn kernels are soaked in an aqueous medium of water and acid before being separated into starch, protein, germ and fiber. The primary products of wet milling include starch and starch-derived products (e.g., high-fructose corn syrup and ethanol), corn oil and corn gluten.
— *National Corn-to-Ethanol Research Center*

Corn soaks or "steeps" in water and acid to enable separating the grain into its parts

1

Grinders remove the germ; the oils in the germ are extracted and refined

2

The remaining fiber, gluten and starch are separated

3

Remaining starch is used for one of three things

4

Starch is fermented into ethanol, dried and sold as corn starch or processed into corn syrup. The fermenting process is similar to that used in the dry-milling process

5

The ethanol is market-ready after a denaturant – often gasoline – is added, making the ethanol undrinkable, thus avoiding the beverage alcohol tax

6

GRAPHIC BY ALEX HAUTER

History of Ethanol

Ethanol has become a hot topic today, but its controversial history actually dates back to the 1800s.

BY MIMI ABEBE

Americans listened carefully as President Franklin Delano Roosevelt gave the famous speech that marked the U.S. entry into World War II.

“With confidence in our armed forces — with the unbounded determination of our people — we will gain the inevitable triumph — so help us God.”

Loren Schmit, a future Nebraska state senator, was 12 years old and living on his family farm in Bellwood, when he heard Roosevelt speak those historic words. Schmit was one of many Americans who believed the U.S. would win the war.

“The first time I heard of ethanol was during the 1940s in World War II,” Schmit said. “The war effort never suffered for want of fuel. I don’t know how they got it done, but they did it. They kept those planes flying.”

By the time the U.S. entered the war, the Standard Oil Co. had made a deal with Germany to cut off the supply of petroleum to the U.S., a key element in making rubber. Uneasy and anxious, the country looked elsewhere for a solution to the petroleum shortage.



ILLUSTRATION COURTESY NATIONAL AGRICULTURE LIBRARY ARCHIVES

The “muse of biofuels” illustration comes from a printed program of the Congress des Applications de L’Alcool Denature, Dec. 16-23, 1902, by the Automobile Club de France. Racing cars ran on alcohol because they had less knock in high compression engines, a quality that was later called “octane.” The image is a synthesis of the harmony between agriculture and industry.

It wasn’t long before the media were turning out images of ethanol-burning cars and slogans like, “Let’s make more rubber!” said Bill Kovarik, an ethanol historian and professor of communications at Radford University in Maryland.

So American farmers quickly began to divert their energies to growing corn for ethanol-based synthetic rubber. The industry grew, and in no time, three-fourths of U.S. rubber was a product of ethanol — not petroleum, Kovarik said.

In fact, about 600 million gallons of corn-based ethanol was produced during World War II, according to a July 2006 Metro Times article in Detroit.

“It’s no exaggeration to say that without the effort that took place here in the Midwest in the 1940s, that the war effort would have been delayed by about a year,” Kovarik said.

According to Schmit, now 78, the ethanol business did more than just create a better source of synthetic rubber for the U.S. It also created a better market for farmers to sell their corn.

That’s why Schmit decided to sell his crop to the ethanol industry. When an ethanol plant opened in Columbus in the 1990s just 14 miles from Schmit’s farm, he was one of the first to start selling his corn to the plant.

World War II wasn’t the first time America saw ethanol. The ethanol industry has a foundation that goes much further back.

Because it was clean and odorless, alcohol fuel made of grain — usually corn — began to replace whale oil in lamps in the mid-1800s.

During the 1850s, the use of whale oil for lamps was declining. Before the Civil War, about 90 million gallons of grain alcohol was used as liquid fuel for lamps, Kovarik said. The best-selling lamp fuel was camphene, made of turpentine, grain-alcohol and camphor oil. It sold for 50 cents a gallon, making it cheaper than whale oil and lard oil.

PHOTOGRAPH COURTESY NEBRASKA STATE HISTORICAL SOCIETY

This photo, taken in April 1933, shows a Lincoln, Neb., gas station of the Earl Coryell Co. selling "Corn Alcohol gasoline." The test marketing of ethanol blends was common in the Midwest at this time, but didn't succeed because the market was dominated by the major oil companies.

In 1862, Congress imposed a \$2-a-gallon tax on all alcohol to help finance the Civil War.

"It was not necessarily meant to be part of the industrial alcohol tax," Kovarik said. "It was really meant to be applied to beverage alcohol."

But because of the temperance movement, said John Carter, senior research associate at the Nebraska State Historical Society, some argued that people would find a way to drink alcohol made for fuel. Moonshiners were a concern.

After the alcohol tax was passed, the alcohol lamp-fuel business disappeared, and kerosene came into the picture. Grain alcohol — usually made from corn — was the major source of lamp fuel before kerosene took over.

The future of grain alcohol — or ethanol — would lie largely in its use as a transportation fuel.

In 1826, Samuel Morey invented the first internal combustion engine that was built to run on alcohol — probably made from grain. Later, Henry Ford championed alcohol fuels made from grain, potatoes or cellulose. In the 1880s, he designed one of the earliest automobiles to burn alcohol.

Meanwhile, Germany had a thriving industry using potatoes and sugar beets to make alcohol for household appliances. Soon the U.S. followed the example of using crops for fuel. In 1906, President Teddy Roosevelt lifted the alcohol tax to give American farmers a chance at a new market.

This meant that alcohol plants could be built for the first time, Kovarik said. At this point, grain alcohol was used to power stoves, coffee roasters and irons and also to fuel cars.

In 1933, Earl Coryell, a gasoline and oil dealer, opened a corn-alcohol gasoline station in Lincoln, Neb., and enthusiasm for ethanol continued to grow.



"It's no exaggeration to say that without the effort that took place here in the Midwest in the 1940s, that the war effort would have been delayed by about a year."

Bill Kovarik

Ethanol historian

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In the 1950s and 1960s, few cars other than racing cars burned alcohol — typically, methanol derived from natural gas.

But after a serious accident in 1964, a number of racetracks switched to a mixture of alcohol and additives that had higher octane and allowed for safer performance.

“The alcohol octane is a hundred and ten, so it’s better for racing cars,” Kovarik said.

Recently, racing cars at the Indianapolis Speedway switched to pure ethanol made from corn.

In the early 1970s, rising gasoline prices, coupled with the continuing search for new markets for agricultural products, sparked a renewed interest in ethanol production for fuel.

Gasohol was the term that was coined in Nebraska in the 1970s. Used in the United States, the term refers to a blend of 10 percent corn-based alcohol (ethanol) and 90 percent gasoline.

In the 1970s, the concentration of oil power shifted from the United States and its close allies to the Middle East, Kovarik said. The Organization of Petroleum Exporting Countries, OPEC, created an oil embargo about the time of the 1973 Arab-Israeli War.

Almost immediately, the idea of blending ethanol with gasoline to boost octane caught on in a lot of places, especially in the Midwest.

“Seemed to a lot of us in Washington that to rely more on the ingenuity of ordinary Americans from the Heartland was perhaps a route that we ought to take,” Kovarik said.

In essence, the oil industry responded by grabbing the market. Overproduction was the reason for the oil glut in the 1980s and the price drop to \$10 a barrel for oil, Kovarik said. Consequently, the ethanol industry couldn’t compete.

“We were talking about a crisis situation in the Middle East, where there would be a third of the

PHOTOGRAPH BY KOSUKE KOIWAI

The Nebraska Corn Board set up a 1930s mockup ethanol or “gasohol” station at the Nebraska State Fair in Lincoln, Neb., on Aug. 29, 2007.





world's oil at least would be gone, would not be on the market anymore," Kovarik said. "And what would that do? Not just [to] the prices, but to the availability of emergency services to police and fire trucks to, you know, the lifeblood of the American economy."

Jimmy Carter called for larger quantities of alcohol fuel in 1978.

"He wasn't trying to help the farmers. He was thinking about what might happen in the Middle East. And I think we might need to remember that that still is a possibility today," Kovarik said. Throughout the 1980s, the price of oil was consistently low, hovering near \$20 a barrel. Ahmed Zaki Yamani, former oil minister of Saudi Arabia, used oil overproduction as a way to keep prices low and to keep investments away from alternatives to oil. This strategy took a toll on the Midwest. The economy and the farming community suffered.

Then came the Clean Air Act of 1990.

This act aimed to get rid of the toxins in gasoline — especially benzene, toluene and zylene — and replace them with a cleaner, safer octane booster.

The need for a better octane booster resulted in an increase of ethanol production. The ethanol industry exploded from about 500 to 700 hundred million gallons per year in the 1980s to 2 to 3 billion gallons in the 1990s. The boom was a boost for corn farmers like Loren Schmit.

"When I was a kid, we produced 400 million bushels annually," said Schmit, the former senator who is now an ethanol lobbyist. "This year (2007), we produced 1.4 billion. One billion more!" 🍯

PHOTOGRAPH BY KOSUKE KOIWAI

A tractor pulls grain on a field near Adams, Neb., in early November 2007. In the background is the E Energy Adams, LLC ethanol plant. The plant began operation in October 2007, using approximately 55,000 bushels of corn to produce 150,000 gallons of ethanol daily, according to the Nebraska Public Power District.

Precise Portions

Precision farming assists farmers in meeting government mandates for increased corn-ethanol production.

BY CASSIE FLEMING

A century ago, a farmer, with his wife and children in tow, spent long autumn days husking corn with a metal hook strapped to his hand.

Half a century later, the farmer sat in a self-propelled, diesel combine to harvest and husk his corn.

Today, the farmer can sit in a cushioned chair, enjoying air-conditioning and the local oldies station while the combine picks and husks the corn.

But a comfortable seat, cool air and choice tunes are not the only technologies a farmer can employ while in the field. New tools offer both convenience and precision to modern farmers raising crops not just for food and fiber, but for fuel.

A contemporary farmer can align with satellites orbiting the Earth by placing a box on top of the combine's cab. As part of a Global Positioning System (GPS), these satellites follow the box and produce imagery data of the field. Combines today can also be equipped with machines called yield monitors that use electrical currents to identify soil patterns and to measure the amount of grain coming into the combine at different points in the field.

The farmer can then print out detailed maps of a field with different colors representing hills, valleys, soil types and quality, water, nutrient levels and yield.

At a computer, a farmer or company can connect to the Internet and download crop-simulation models, which contain weather data for each county, and then grow crops virtually in the computer.

When merged, these technologies provide a mosaic of information that allows growers to uniquely supervise each portion of land, a process

“Grain-based ethanol is a bridge to producing cellulosic ethanol, biofuel made from the stems and leaves of plants rather than the grain.”

John Shanahan

UNL agronomy professor

called site-specific management or precision agriculture.

From what kind of crops to plant, to when and where to plant them, to how much fertilizer and water to apply to each area, the technology used to

manage this process emerged in the early 1990s. It can help farmers manage crops in a way that increases crop yields and profits while decreasing labor and the cost of inputs like chemical fertilizer and pesticides. Used properly, this technology can also help farmers use only the irrigation and fertilizer they need.

“It’s been really exciting,” said

Ken Cassman, an agronomy professor and director of the Nebraska Center for Energy Science Research at the University of Nebraska–Lincoln. “We have been able to produce corn with much less water and with much larger yields.”

Today, farmers and agribusinesses aren’t producing crops just to provide food and fiber; to cash in on the market for corn-based ethanol, they may have to alter their production philosophy to encompass energy farming while still protecting soil quality.

“We are at a paradox,” said John Shanahan, a UNL agronomy professor and research agronomist. “We are supposed to feed people first, and then clothe them, all while holding the soil together. But now we are supposed to provide cheap feed stocks for biofuels.”

Agronomists agree that the use of precision ag will help farmers meet the government’s mandates for increased corn-ethanol production. But precision ag has a place beyond its use in growing corn. Grain-based corn ethanol is seen as a bridge to producing cellulosic ethanol, biofuel made from the stems and leaves of plants rather than the grain.

“Precision ag use in producing cellulosic ethanol is definitely out there in the future,” said Jim Schepers, a UNL agronomy professor and USDA Ag Research Service soil scientist.

Cellulosic ethanol can be made from corn stover or crop residue — the material, such as stocks, husks and leaves that farmers typically leave on the field after harvest. But crop residue that may be used for cellulosic ethanol also serves a purpose on the field: It adds organic matter to the soil, improving the soil’s fertility.

“Taking the crop residue off the soil is like having a bank account and taking the interest out,” Schepers said. “Take the residue out, and you take the nutrients out.”

But if technology is developed to produce cellulosic ethanol on a large scale, farms across the Midwest will be like bank accounts without interest.

Removing crop residue, Shanahan said, is like pillaging and plundering the land.

But agronomists, farmers and agribusiness companies nationwide have established that energy farming is in their future, so they must find a way to use crop residue as both a source for cellulosic ethanol and as a way to protect their soil. Precision ag provides one key.

“We have figured out that you can remove some residue for ethanol,” Shanahan said. “This is the trick.”

Precision ag may allow farmers or companies to treat each portion of land like an individual, Shanahan said, ensuring each portion receives the exact care it needs.

“And, as the country is increasingly relying on the Midwest’s crop land as future fuel sources, cultivating each piece of land individually is crucial,” he said. ☞

CHOICES

A look at the present and future of crops used to manufacture American ethanol. However, all alternatives retain the same common negative: Ethanol is more corrosive than gasoline, making it incompatible with existing pipelines. Ethanol must be transported by truck or train.

SOURCES

ETHANOL YIELD

PROS

CONS

CORN

350-400
gallons/acre

- Displaces some oil
- Easier, less expensive than cellulosic ethanol
- Here and now: vast majority of ethanol plants use corn
- Useful byproducts

- Needs prime ag land
- Raises corn prices
- High water, fertilizer needs

SWEET SORGHUM

400-800
gallons/acre

- Grows with less water than corn
- Easier, less expensive than cellulosic ethanol
- Uses the same fermentation and distillation process as corn

- Grain sorghum (milo) is used with corn at some plants, but sweet sorghum ethanol hasn't been tried on a large scale

WOODY, FIBROUS BIOMASS SUCH AS SWITCHGRASS, CORN STALKS, WOOD CHIPS

320
gallons/acre (est.)

- Net energy gain of about 540 percent, according to UNL study
- Can convert waste crop products to energy

- Some pilot plants but not tried on a large scale
- Need expensive enzymes to break it down into sugars

SUBSIDIES SUPPORT ETHANOL

The ethanol industry receives subsidies from every level of government.

BY AARON E. PRICE AND CAROLYN JOHNSEN

PHOTOGRAPH INSTITUTE OF AGRICULTURE AND NATURAL RESOURCES

New federal mandates require gasoline refiners and blenders to use 36 billion gallons of renewable fuels by 2022, including 15 billion gallons of ethanol made from corn.

Without federal assistance in the form of subsidies, the ethanol industry would probably not exist today, according to many ethanol advocates. However, critics say these subsidies distort the energy market and don't achieve the goals for which they were designed.

Federal, state and local governments play diverse and interconnected roles in supporting the ethanol industry with a variety of subsidies, including tax credits, a protective tariff, loan guarantees and direct payment for research.

"Ethanol in my view has needed incentives to remotely get to a place where it's on a level playing field with oil. It's hard to overestimate the amount of political strength that big oil has in federal policy," said John Hansen, Nebraska Farmers Union president.

The ethanol industry also carries potent political strength, in part because of its connection to agriculture. Doug Koplow, who tracks energy subsidies at Earthtrack.net, said subsidies for liquid biofuels that were initially intended to increase the demand for surplus agricultural crops have now expanded to other goals.

“... lately they have been promoted as a way to reduce oil imports, improve the quality of urban airsheds, reduce CO₂ emissions, raise farmer incomes and promote rural development,” Koplow wrote in his 2006 report, “Biofuels — At What Cost?” The report, which was updated in 2007, was funded by the International Institute for Sustainable Development, a policy-advocacy group headquartered in Canada.

Federal funding used to create incentives for blending or producing ethanol comes from several

sources, including the U. S. Departments of Agriculture and Energy.

One of the most significant federal incentives is the Volumetric Ethanol Excise Tax Credit or “blender’s credit.” This 51-cent credit started Jan. 1, 2005, through the 2004 American Jobs Creation Act. When ethanol is mixed with gasoline to make E85 or E10 blends, the blender receives 51 cents for each gallon of ethanol used in the blend. In 2007, blenders applied for the credit on about five billion gallons of ethanol, amounting to about \$2.5 billion in VEETC credits nationwide, according to the Nebraska Ethanol Board.

“They play a very important role in helping these plants maintain their business and their prices (for ethanol),” said Randy Klein, Nebraska Corn Board director of market development.

The 2008 farm bill expanded some other ethanol

subsidies but lowered the credit to 45 cents a gallon.

A second federal policy is the 54-cent tariff on ethanol produced outside the United States. The policy discourages importation of foreign ethanol, mainly from Brazil, by taxing it. Locally made ethanol then seems cheaper and more attractive to blenders. However, under this policy small amounts of ethanol are allowed to enter from Caribbean nations, according to David Peters, extension rural economic development specialist at the University of Nebraska–Lincoln. Peters also said Brazil could likely successfully challenge the U.S. import tax on ethanol in the World Trade Organization as an unfair “barrier to trade.”

Koplow recommends “to phase-out subsidies to biofuel manufacturers during times of high oil prices,” arguing that the market will make the manufacturing and sale of ethanol profitable without





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federal help. Considering both direct and indirect sources of federal support, Koplow says the ethanol industry will have collected between \$67-\$82 billion in federal subsidies between 2006 and 2012. That estimate doesn't include state and local subsidies to the industry.

Nebraska's subsidy for ethanol plants is the Ethanol Production Incentive Credit. Steve Sorum, project manager for the Nebraska Ethanol Board, said EPIC has paid out a total of \$204.4 million to ethanol producers since the subsidy began in 1992.

In the 2007 EPIC report, the Nebraska Department of Revenue said “the EPIC Fund will no longer be able to meet its projected obligations during fiscal year 2009-2010” and anticipated a shortfall of \$18 million by 2012. But Sorum said a \$15.5 million special appropriation from the 2008 state legislature “appears to make the EPIC solvent.”

Many local communities invest in road, water and sewer infrastructure to attract ethanol plants, hoping the larger tax base will repay the funds invested in the new infrastructure.

“Ethanol is a very young industry, and it’s competing against a very well-established petroleum industry,” Klein said. “So without the renewable fuel standards or the incentives, you wouldn’t have the investments being made because the risk would be too high.”

While drafting the 2008 farm bill, congressional leaders considered the future of federal subsidies for ethanol. In April 2007, a National Journal reporter asked Democrat Collin Peterson of Minnesota, chairman of the House Agriculture

Committee, if it was time to drop the VEETC program and the import tariff.

Peterson responded, “In order for us to develop cellulosic ethanol, we need to maintain those for the foreseeable future.”

PHOTOGRAPH BY KATE VEIK

Nebraska’s crops, stored in grain storage bins such as this one, are being used to produce corn-based ethanol. The 2005 renewable-fuels mandate requires that ethanol and biodiesel be blended into the nation’s overall fuel supply.





UNLIMITED RESOURCE OR LOOMING ROADBLOCK?

Conflicting needs for water put pressure on state's water supply.

BY AARON E. PRICE

The Nebraska Sand Hills is cowboy country, where cattle thrive in a sea of grass. Because most of the sandy soil here is unsuited for growing irrigated corn, the Sand Hills is one of the few areas of the state that have not seen large decreases in groundwater levels. The water supply here seems as abundant as the prairie grasses covering the Ogallala Aquifer — one of Nebraska's most treasured resources.

Despite the absence of corn in the area, Bruce Switzer, who ranches and farms about 23 miles northwest of Burwell in Loup County, worries about the pressure that a booming ethanol industry can place on the aquifer.

"It isn't just the water they're using in the ethanol plant. It's producers putting in more wells, farming more ground that hasn't been farmed for years and pumping more groundwater," Switzer said.

Growing one bushel of corn in Nebraska can require as much as 2,000 gallons of water. But Nebraska's ethanol industry relies heavily on groundwater to supply not only the water needs of corn crops, but also of factories that use the corn to make ethanol. Meanwhile, drought, well moratoriums, growing cities, wildlife needs and disputes with Kansas over water put additional pressure on Nebraska's water supply.

PHOTOGRAPH BY KOSUKE KOIWAI

A stream runs through Bruce Switzer's Sand Hills ranch northwest of Burwell, Neb.

WATER



Because each of these competing forces stands to benefit from using the water, pressure will continue to increase. Even Switzer, who seems to be far from the conflict, has a vested interest.

In a cowboy hat, Wrangler jeans and work boots, Switzer is a real cowboy. He runs cows and calves on 12,000 acres of ranchland and farms 130 acres of grass, including sudan, rye, orchard, red-tip and timothy. Depending on the year, the grasses are grazed or cut for hay and fed to his cattle.

Although Switzer ranches, he benefits from the ethanol boom, which is typically seen as a boon to farmers. During the winter, Switzer feeds his cattle the distillers grain byproduct from the ethanol plant in Ord.

From his front porch, Switzer sees the Calamus Reservoir with 127,400 acre feet of water dammed for irrigation and not a single corn plant in any direction. According to the Nebraska Corn Board, Loup County farmers harvested only 1.2 million bushels of corn in 2007. In contrast, 60 miles to the south, Dawson County farmers produced 38.5 million bushels on heavily irrigated land.

Ten years ago, Switzer quit growing corn to conserve water and now makes water conservation a habit. He plants crops that need less water and irrigates his grass only during dry weather in spring and fall. A corn crop in Switzer's central Sand Hill location would require irrigation all summer long.

"I hope with our technology we can use something other than corn [to make ethanol] that doesn't use so much water," he said.

Yet, many farmers elsewhere in the state are planting corn to feed ethanol factories. The U.S. Department of Agriculture's statistics show that 9.4 million acres of Nebraska land was used for corn production in 2007, including 5.8 million irrigated acres.

According to "Water Implications of Biofuels Production in the United States," an October 2007 report by the National Academy of Sciences, "Growing and processing biofuel crops to meet America's energy needs will alter how the nation's water resources are used. However, the water implications of biofuels production are complex, difficult to monitor, and will vary greatly by region."

Congress mandated production of 36 billion gal-

lons of ethanol from many sources by 2022; the mandate included a cap of 15 billion gallons from corn. Will there be enough water for all this expected production?

"Do I worry about the impact on water supplies? Yes, I do," said Ann Bleed, former head of Nebraska's Department of Natural Resources, which oversees the management of the state's surface water. "And we need to be very careful, I think, that in siting these plants we get them in areas where there is a good water supply and that we do not adversely affect existing water users in the process."

Personal interviews and government documents show that the water demands of a growing ethanol industry could conflict with the demands of existing water users. Specifically:

IRRIGATION OF CORN uses vast amounts of groundwater and surface water.

ETHANOL PLANTS use water to process corn into ethanol.

GROWING METROPOLITAN areas of Lincoln and Omaha demand water.

NEBRASKA STRUGGLES to comply with interstate water obligations to Kansas.

FEDERALLY PROTECTED wildlife on the central Platte River need water.

To meet ethanol-production goals, Nebraskans must navigate existing water issues within an atmosphere complicated by economic, environmental and social issues.

"It's going to be challenging to figure out how to share it [water], and we don't have a policy or tradition of public policy that really makes sharing very easy," said Susan Seacrest, former director of the Groundwater Foundation.

In particular, ethanol production will compete with other water users in areas where the state and natural resources districts have already limited water use.

"I am certainly concerned that if these plants are going to go in water-short areas, that there is a way of making sure that the water supplies are going to



"When you add it all up, I wonder what we would rather have: would we rather be out of oil or water?"

Bruce Switzer

Nebraska rancher

continue to be available for the plant into the future as well as to the local area in general,” said Bleed. “I would be surprised if there isn’t some ethanol plant out there who didn’t do their homework as well as they should have, and is going to run out of water at sometime in the future.”

In a 2007 report titled “Biofuels and Global Water Challenges,” the Institute for Agriculture and Trade Policy — a non-profit based in Minneapolis — warned, “water could be the Achilles heel” of the United States’ ethanol industry. Minnesota alone uses two billion gallons of water a year to support its ethanol industry.

Minnesota officials were alarmed in 2007 when a Granite Falls ethanol plant had to start using water from the Minnesota River in place of the groundwater previously allotted to the plant. The alarm caused by the rapid drawdown of the aquifer in Granite Falls prompted the state’s Environmental Quality Board to review the sustainability of the state’s water resources in view of all the competing needs.

In Tampa, Fla., the state’s first ethanol plant will become a Top 10 water user in its area, requiring 400,000 gallons of water a day. The United States EnviroFuels factory in Tampa plans to double its size, though widespread drought has residents asking where the additional water will come from.

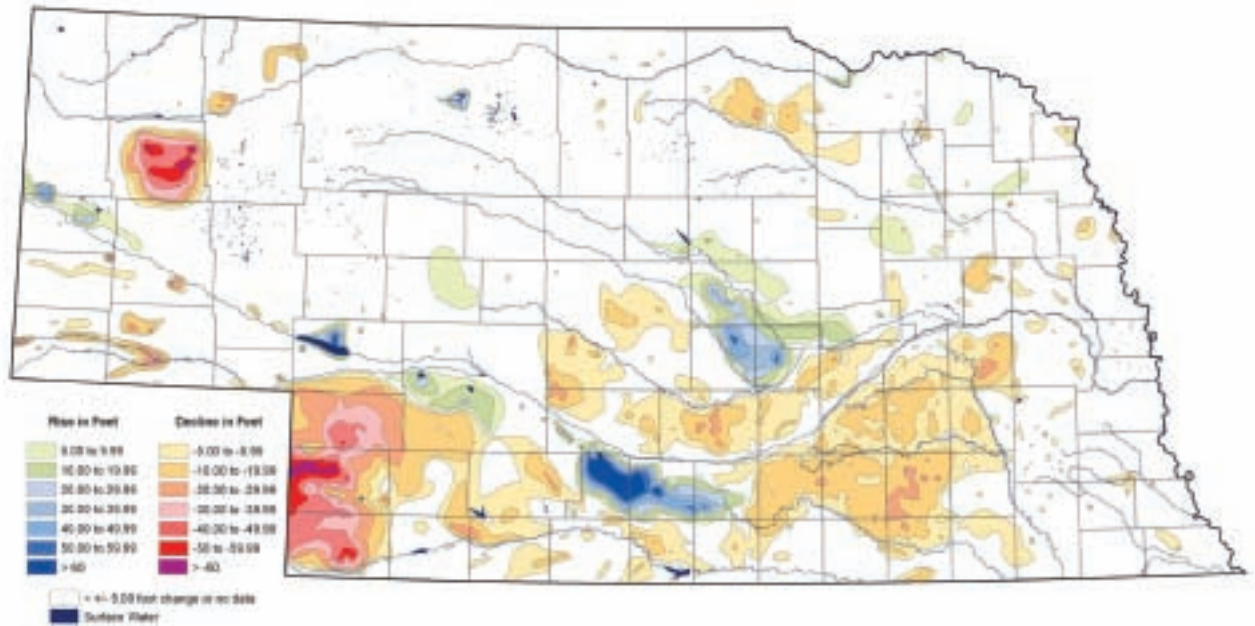
Vast water supplies have made corn king in Nebraska, and a large part of the state’s economy depends on corn and the livestock industry it supports. But corn is a thirsty plant. According to the Nebraska Corn Board, on average, 70 percent of Nebraska’s corn crop is irrigated.

“Corn is a good plant precisely because it uses a lot of water, but it uses it more efficiently at converting it into product-grain and biomass than almost any other crop plant we have,” said Ken Cassman, University of Nebraska–Lincoln agronomist.

Cassman said 1,800 to 2,000 gallons of water is required to grow a bushel of corn in Nebraska. Looking at corn production nationwide, the National Corn Growers Association came up with a much higher figure; the NCGA says 4,000 gallons of water is needed to grow each bushel of corn. In contrast, one bushel of wheat requires 11,000 gallons of

LEVELS

Since the 1950s, groundwater levels have declined in heavily irrigated areas of the state. One major exception is in south central Nebraska, where leaking irrigation canals have raised the groundwater level by more than 50 feet.



GRAPHIC BY ALEX HAUTER

SOURCE UNL CONSERVATION AND SURVEY DIVISION

water. The U. S. Geological Survey says the average household uses 107,000 gallons each year.

About 1.4 billion bushels of corn was grown in Nebraska in 2007, according to the Corn Board. Under Cassman’s most conservative estimate, 2.5 trillion gallons of water, some of it from rain, went in to growing the 2007 Nebraska corn crop.

Some of this water recharges the aquifer, and some flows back into rivers and streams. But water is also lost through evaporation from the soil surface or by transpiration from the leaf surfaces of plants.

Groundwater irrigation began in Nebraska around the end of World War II. As of May 8, 2008, the Nebraska Department of Natural Resources reported 104,903 registered irrigation wells in the state.

A U.S. Geological Survey circular titled “Estimated Use of Water in the United States in 2000” reported that 94 percent of the groundwater withdrawals in Nebraska were for irrigation in 2000; nationwide, irrigation accounted for 137 billion gallons per day, the largest use of freshwater in the U.S.

Environmental Defense, a conservation group, predicts the ethanol industry will increase demand on the Ogallala Aquifer by 900 percent, largely because of increased irrigation for corn.

“I really don’t know how many gallons of ethanol is realistic,” Bleed said. “A lot of that depends on how much other types of water uses people are willing to give up to produce ethanol.”

Processing corn into ethanol requires additional water.

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Bob Lundeen, CEO of Standard Ethanol in Madrid, Neb., said his plant pulls 175 million gallons of groundwater annually from the Republican River Basin and returns about one third of it to the river. The wells supplying water to the plant pump 350 gallons a minute while returning 100 gallons a minute to the river.

“We think our water use is on the lower end because we have newer technology and a newer plant and our technology has a record of using less water than other technologies,” Lundeen said. “Some plants use as high as 800 gallons a minute.”

The water not returned to the Republican River leaves as steam or in distillers grain.

Using water from old wells retired by the city of Cambridge, the Madrid ethanol factory produces

48 million gallons of ethanol every year.

Lundeen figured his facility uses 2.7 gallons of water for every gallon of ethanol produced.

The Renewable Fuels Association says three gallons of water is needed to produce every gallon of ethanol. The National Corn Growers Association agrees, saying a typical factory producing 40 million gallons of ethanol per year uses 330,000 gallons of water per day — equivalent to the daily water use of an 18-hole golf course.

“When you look at the geographic area, I think we’re very insignificant,” Lundeen said. “One ethanol plant is a minor water user. We’re taking over old city wells that can’t be used anymore for the city of Cambridge. We’re about as green as you can get.”

Officials at Chief Ethanol in Hastings, Nebraska’s oldest ethanol plant, declined to give information about the plant’s water use, calling it a “trade secret.” But a 2007 report from the Upper Big Blue Natural Resources District states Chief Ethanol’s two groundwater wells pump a combined total of 477.7 million gallons annually. Considering the plant’s own reported annual production of 60 million gallons of ethanol, the plant uses about eight gallons of water for every one gallon of ethanol produced.

“As recently as five years ago, it typically took about eight gallons of water to process a gallon of ethanol,” said Todd Sneller, administrator of the Nebraska Ethanol Board. “Today, it takes about three gallons of water to process a gallon of ethanol. And in the most modern plants being designed today, it takes about a gallon and a half of water.”

According to the 2008 winter issue of *Cornstalk*, a Nebraska Corn Board publication, new technologies may enable future ethanol plants to cut their water requirements by about a third.

The Nebraska Corn Board, University of Nebraska agronomists and other water professionals in the state point out the water use of ethanol factories is small compared to that of cities and corn irrigation.

Bruce Switzer, the Sand Hills rancher, also considers the water used by ethanol factories as a drop in the bucket compared to irrigation.

“When you add it all up, I wonder what we would rather have: Would we rather be out of oil or water?” Switzer said.

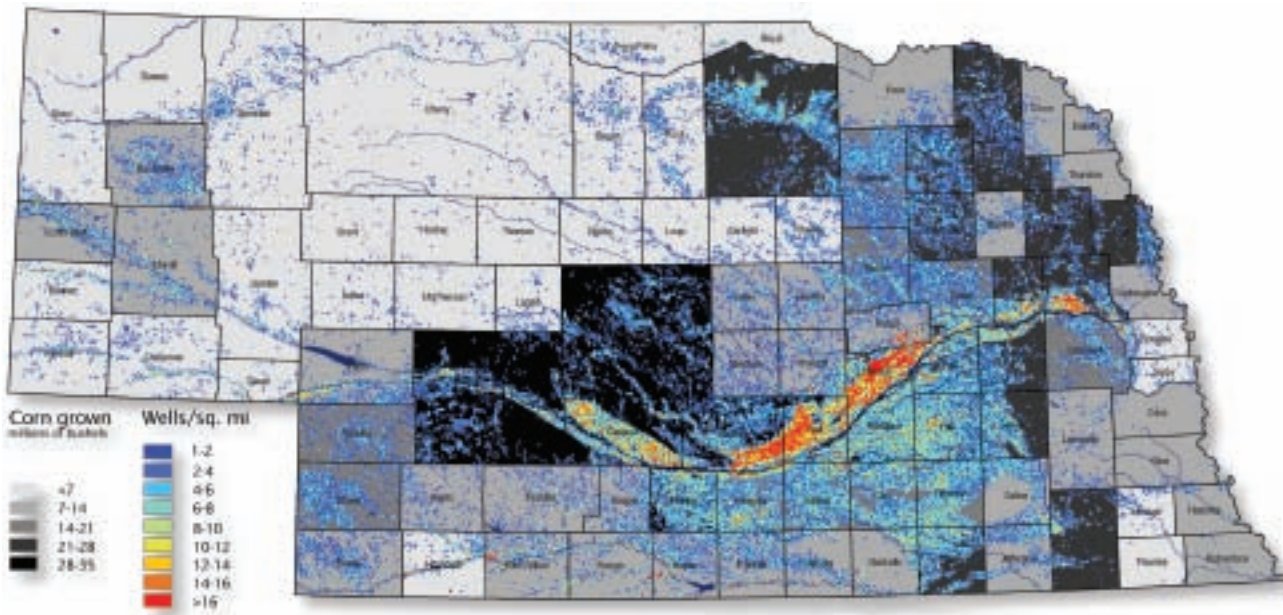
Switzer’s groundwater in the Sand Hills has a hydrologic connection to Lincoln and Omaha’s water supplies. The gradual movement of groundwater from the Sand Hills toward the east and into the Elkhorn and Lower Loup Rivers slowly provides both surface water and groundwater to the Platte River, which in time supplies water to Lincoln and Omaha.

Joel Christensen, the vice president of water operations for the Metropolitan Utilities District of Omaha, doesn’t think the ethanol boom poses a threat to water supplies in Lincoln and Omaha.

“Those river systems make Lincoln and Omaha’s

WELLS

Irrigation wells in Nebraska are most heavily concentrated along the Platte River and in the state’s major corn-growing counties.



GRAPHIC BY ALEX HAUTER

SOURCE U.S. GEOLOGICAL SURVEY

water supply very reliable,” Christensen said.

Christensen helps oversee Omaha’s annual water use of 100 million gallons per day. Half of this supply comes from the Platte; the other half comes from the Missouri River.

In contrast with Christensen, Cecil Steward, president of the Joslyn Castle Institute and a UNL architecture professor emeritus, believes the water demands of ethanol will eventually compete with Lincoln and Omaha’s water needs. Steward said that, in the 60-mile radius around Omaha, three growth conditions are developing that will challenge the use of water in ethanol production.

“One, is there water and at what expense? Another is, is it quality for domestic drinking and household use? And third, who’s competing for it on the highest order?” Steward said. “The ethanol industry and the growth characteristics of both Omaha and Lincoln and the increase in growth of acres along with this population, are all putting huge pressure in this region on a very limited and undependable resource.”

Through the Republican River Compact, Kansas, another competitor for water, claims the right to use a share of water from the Republican River, which flows from Colorado, through southern Nebraska and into Kansas. The compact, which allots a share of the river’s water to each state, essentially reduces the amount of water that Nebraska farmers can use to irrigate corn.

Tracy Zack, a Department of Natural Resources attorney representing Nebraska in the dispute with Kansas, said, “It’s up in the air. The legal side is clear. The numbers are not.”

In the years-long dispute over the numbers — that is, the acre-feet of water flowing from Nebraska to Kansas — Kansas has threatened a lawsuit to force Nebraska to allow more water to flow across the border.

Widespread drought in the Great Plains has complicated the dispute. Groundwater and surface water are hydrologically connected, so Nebraska farmers in the Republican River Valley who compensate for drought by irrigating their

crops with groundwater also decrease flows in the river. These combined factors increase the difficulty of meeting Kansas’s water requirements.

Back in the Sand Hills, Bruce Switzer watches the conflict unfold.

“I guess if they can get low on water in the Republican, why can’t we?” Switzer asked. “I just don’t think we can keep using, keep using and keep using.”

The federal Endangered Species Act requires some Platte River water to be allocated for four species of wildlife: two endangered birds (the whooping crane and interior least tern), one threatened bird (the piping plover) and one endangered fish (the pallid sturgeon). This requirement has helped to create a moratorium on new wells in much of the river valley, limiting irrigation for corn.

UNL agronomist Ken Cassman says 1,800 to 2,000 gallons of water is required to grow a bushel of corn in Nebraska. Other experts say 4,000 gallons of water is needed to grow each bushel of corn.

OGALLALA THE HIGH PLAINS AQUIFER

The High Plains – or Ogallala – Aquifer lies beneath about 175,000 square miles of land in eight states: South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, New Mexico and Texas. About 30 percent of the groundwater used for irrigation in the U.S. is pumped from the aquifer. In 2000, irrigation accounted for 17 billion gallons of withdrawal per day. The aquifer is estimated to hold about three billion acre feet of water (an acre-foot equals 326,000 gallons). Two-thirds of that amount – or two billion acre feet – lies beneath Nebraska.



UNL agronomist Ken Cassman says 1,800 to 2,000 gallons of water is required to grow a bushel of corn in Nebraska. Experts say 4,000 gallons of water is needed to grow each bushel of corn.

SOURCE U.S. GEOLOGICAL SURVEY

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Finding the right water balance for the imperiled species is a unique challenge, said Mary Bomberger Brown, program coordinator of the Tern and Plover Conservation Partnership at UNL. The fish need water, and the birds need sandbar habitat near the water.

“Anything that influences the flow for creating the proper habitat is a concern for them,” Brown said.

One concern is the heavy demand that irrigating corn and producing ethanol are making on the state’s water resources. Worries about the sustainability of those resources lead many to question the long-term sustainability of corn-ethanol production.

Nebraska’s vast groundwater resource, the Ogallala or High Plains Aquifer, is believed to hold two billion acre-feet of water, enough to cover the state to a depth of 40 feet.

“Hopefully, our underground water table will remain at a stable level and we’ll be able to pump the underground water,” said Alan Songster, who farms near York in east central Nebraska.

Yet, in much of Nebraska, the water table, which is the distance to groundwater, has fallen because of decades of heavy irrigation and more recent drought. In the southwest and the northern panhandle, for example, the water table has dropped by at least 50 feet, putting it out of reach for some irrigators and resulting in well-drilling moratoriums.

The National Academy of Sciences predicts that in the next five to 10 years, the increase in agricultural production will not alter the “national aggregate” supply of water, but will change select areas’ water supply if stress already exists on the water systems.

And yet, the drumbeat for more ethanol production continues among policymakers.

“Because the science, the technology, the efficiency of the farmer, the water management, the weed management — all of that just continues to improve year after year,” said Nebraska U.S. Senate candidate and ex-Secretary of Agriculture Mike Johanns in the fall of 2007. “And it will. That’s the one promise I can make. We’re just going to get better at this year after year.”

Increased Corn Production Can Pollute Water

As farmers raise more corn for ethanol, they’re likely to use more nitrogen fertilizer and other chemicals that can pollute water.

BY AARON E. PRICE

Record corn prices and ethanol mandates are sending signals for farmers to increase corn yields. Conventional corn production requires chemical inputs like nitrogen, phosphorus, insecticides and herbicides to help obtain high yields and maximize profits.

The push to grow more corn for ethanol may lead to water-quality problems from chemicals seeping into groundwater and running off into surface water.

“My biggest concern is water use, and if we can keep it safe during this ethanol boom,” said Bruce Switzer, who ranches in Loup County in the Nebraska Sand Hills. “I worry about polluting the groundwater along with poor usage.”

Impacts to water quality will depend on the intensity and type of cropping, on whether the corn is planted on good cropland or on marginal land and on the distance to groundwater and surface water. Planting corn in poor soils will require additional fertilizer, particularly nitrogen, which the soil cannot naturally provide. Fewer soybean-corn rotations will also increase the need for additional nitrogen.

Corn is a heavy nitrogen user; soybeans naturally replenish nitrogen in the soil, which is a major reason why farmers plant soybeans one year and corn the next in rotation on the same field. Planting corn every year can threaten water quality due to the application of additional nitrogen fertilizer.

Surface-water runoff can readily collect and move chemicals and soil into rivers, lakes and streams, creating problems for recreation, wildlife and public water supplies. Leaching, or the infiltra-

tion of chemicals into the soil, can carry chemicals into the groundwater — a primary source of drinking water.

“The quality of groundwater needs to be protected,” said Susan Seacrest, founder and former president of the Groundwater Foundation. “You really can’t let it get polluted, because once the groundwater is polluted, it is extremely costly to un-pollute it. Sometimes it’s just not even technically feasible to do that.”

Farmers are using better management practices — particularly for nitrogen fertilizer — than in the past, but even with better practices water quality problems still exist.

“Point-source” pollution typically comes from an identifiable, individual source like an effluent pipe at a factory. “Non-point source” pollution, such as runoff from farmland and city streets, can’t be linked to any one source but can affect large areas. Agricultural chemicals can contribute to non-point source pollution.

The Nebraska Department of Environmental Quality monitors water pollution in the state; Marty Link, the NDEQ’s associate director of programs for water, anticipates more problems from increased corn production.

“As more fertilizer’s applied, more of it is going to be leached down into the groundwater, and we’re going to have more of a non-point source overall over the whole state,” Link said. The agency has found nitrate pollution — particularly in groundwater that’s close to the surface, as it is along sandy areas near the Platte River. Nitrate in drinking water can cause health problems for pregnant women and

babies.

Non-point source nitrogen pollution of groundwater is a fairly localized problem; in contrast, non-point source pollution of surface water can have regional effects. For example, the dead zone in the Gulf of Mexico is an area off Texas and Louisiana where runoff from cities and farmland in the watershed of the Mississippi River has decreased oxygen in the water and created a large area with little sea life.

Non-point source pollution like this is hard to monitor because its sources are scattered. Among the chemicals used to grow corn, atrazine is the most widely used pesticide, according to the U.S. Environmental Protection Agency. Like nitrogen, atrazine concerns Link because it's difficult to track as a non-point source pollutant.

U.S. farmers use atrazine to suppress weeds in cornfields, but the chemical is banned in the European Union because its presence in drinking water concerned officials.

"Overall we haven't seen a whole lot of that showing up in the groundwater, and maybe we're not finding it cause we're not looking at it," Link said. The atrazine water-quality test is expensive to run, and funding at NDEQ is often tight, Link said.

One scientist working outside the NDEQ, Tyrone Hayes, professor of integrative biology at the University of California-Berkeley, has found atrazine in water in the Sand Hills, where little corn is raised.

"For example, Cherry County, Neb. We find atrazine that in some cases is at levels as high as in some of the corn-growing areas," Hayes said. "You don't have to necessarily be in an area where it's irrigated and where they're using it to actually find the atrazine."

Hayes has studied the impacts of atrazine on the leopard frog in Utah, Wyoming and Iowa, and has conducted "extensive studies" in Nebraska.

Hayes' research shows that one part per billion of atrazine is enough to "induce hermaphroditism and chemically castrate or demasculinize exposed amphibians." Hermaphroditism occurs when animals have both male and female parts, and can usually produce asexually or without a partner.

Leopard frogs are not naturally hermaphrodites.

"They start to produce estrogen, and that causes the males to lay eggs," Hayes said.

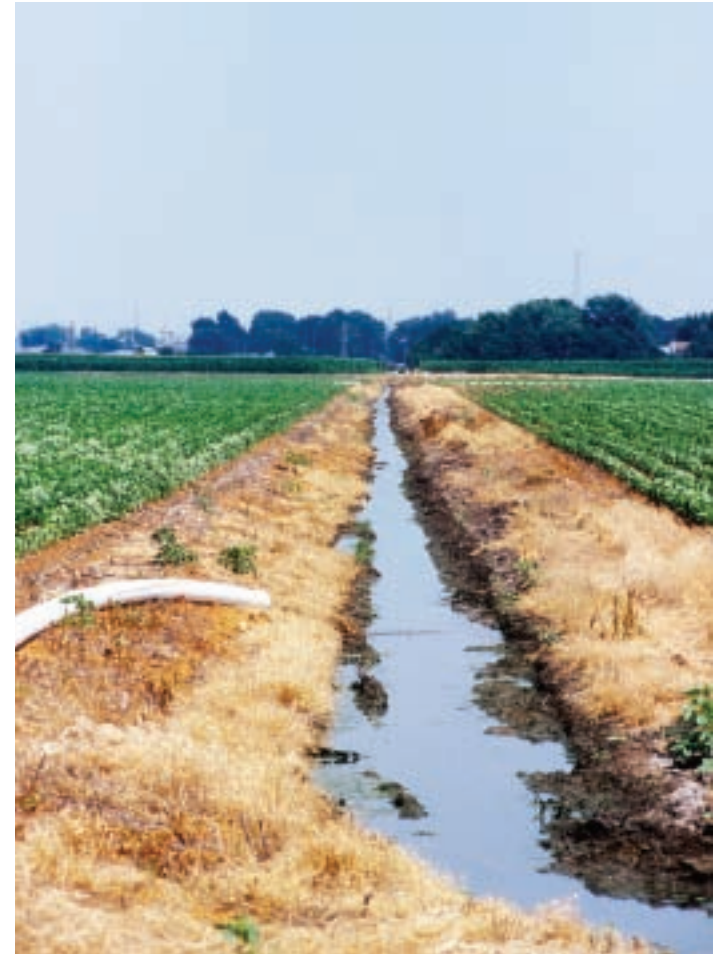
Other scientists have reached similar conclusions, but Syngenta, the company that makes atrazine, disputes these findings. On its Web site, the company says "atrazine is safe when used as directed." The EPA has identified atrazine as a hazard to human health when people are exposed to it at levels above 3 parts per billion (ppb) for even short periods of time. Nebraska is one of nine states where the EPA has found atrazine in drinking water at levels above the EPA limit of 3 ppb.

Hayes said atrazine does not collect in food, and exposure through drinking water and occupational

The use of atrazine and other pesticides is likely to become more widespread throughout the U.S. Corn Belt as farmers respond to economic incentives to plant more corn.

contact contribute to human atrazine accumulation. Speaking at a University of Nebraska-Lincoln conference in April, 2008, Frank Ackerman, the director of the research and policy program at Tufts University's Global Development and the Environment Institute, said more study needs to be done on the effects on humans of long-term exposure to low levels of atrazine.

Ackerman praised the European Union for ban-



PHOTOGRAPH INSTITUTE OF AGRICULTURE AND NATURAL RESOURCES

Groundwater and surface water are captured in irrigation canals and used to water crops. Nearly 1.4 billion bushels of corn was grown in Nebraska in 2007, according to the Corn Board, and 2.5 trillion gallons of water — some of it from rain — went into growing the 2007 Nebraska crop.

ning atrazine in line with the so-called "precautionary doctrine," that is, acting out of concern that "although the science isn't settled, it's disturbing."

Nevertheless, the use of atrazine and other pesticides along with nitrogen fertilizer is likely to become more widespread throughout the U.S. Corn Belt as farmers respond to economic incentives to plant more corn. ♪

CORN MONOCULTURE no friend of BIODIVERSITY

Federal mandates for corn ethanol, which encourage farmers to plant more corn, may threaten the biodiversity of grasslands.

BY AARON E. PRICE

PHOTOGRAPH BY AARON E. PRICE

A meadow at the Gracie Creek Ranch outside Burwell, Neb., is left untouched for the biodiversity to thrive in its natural state.

Nine-Mile Prairie near Lincoln, Neb., is a biodiversity goldmine. Big bluestem, little bluestem and sawtooth sunflowers sprinkle the landscape. Red-winged blackbirds, eastern phoebes and northern blue jays sing their unique songs. With little human disturbance, forces of nature have, for centuries, built complex interactions of wildlife, plant and soil communities in this 230-acre prairie.

In 2008, Nine-Mile Prairie provides habitat for 80 species of birds and 350 plant species, including the endangered prairie fringed orchid.

Federal mandates for corn ethanol, which encourage farmers to plant more corn, may threaten the biodiversity of grassland ecosystems like Nine-Mile Prairie.

In fact, some predict that thousands of acres of Conservation Reserve Program land — which the federal government has encouraged farmers to take out of crop production and restore to prairie habi-

tat — might be planted to corn, a crop that does little to support biodiversity.

“I think it’s a real mistake to be plowing up ground in CRP and, even worse, plowing up native prairie in the big rush for corn ethanol,” said former U.S. Secretary of the Interior Bruce Babbitt at a speech in Lincoln in April 2008.

“I think the biggest environmental threat I see is taking cropland that was in set-aside programs and moving it back into production agriculture,” said Dave Wedin, University of Nebraska – Lincoln ecologist.

Since the 1980s, the CRP has encouraged farmers to take marginal cropland out of production and to plant grasses and trees for wildlife habitat. Replacing crops with diverse native plants also reduces soil erosion and improves water quality on CRP acres.

“They’re not the reservoir of our natural biodiversity that our native prairie remnants are; but,

nonetheless, there were a lot of benefits in terms of soil carbon, soil health and habitat,” Wedin said.

The CRP recognizes the value of restoring natural ecosystems, including diverse wildlife and plants, on marginal land. Highly erodible or poor-quality soil on marginal land makes it less suited for growing crops or raising livestock.

Under a 10- to 15-year contract, the CRP pays farmers to manage marginal land for wildlife and other natural resources. If replanting or grazing occurs during the contract, the farmers must repay the money.

According to the Farm Service Agency, farmers have put about 36 million acres into the program nationwide. As of March 2008, 1.2 million acres of Nebraska farmland was under CRP contracts.

Federal regulations originally limited CRP land to a maximum of 39.2 million acres nationally, but the 2008 farm bill dropped that cap to 32 million acres.

Rob Robertson, vice president of government relations for the Nebraska Farm Bureau, expects farmers to take land out of the existing CRP acres in the next two to three years to grow crops.

“If the corn prices, bean prices, and everything is high, we don’t doubt that some of that land will go back into crop production,” Robertson said.

In particular, farmers wanting to cash in on the corn-ethanol market will plow more CRP acres and other grassland to plant corn. Robertson said any decrease in wildlife won’t be a major issue.

In contrast, Steve Chick, the state conservationist in the Nebraska office of the Natural Resources Conservation Service, was concerned about the effects of losing CRP acres to crop production. “All of this would affect diversification of wildlife habitat,” Chick said.

CRP acres supplement the few acres of native prairie that remain. According to the Wachiska Audubon, only two percent remains of the tall-grass prairie that once covered much of the Great Plains.

Little protection exists for the remaining native prairie. According to the World Wildlife Fund, only 1.5 percent of the native Great Plains is protected by any park system.

“The grasslands are one of the least protected areas out of all the protected areas on the planet,” said Dawn Montanye, a WWF manager of conservation economics. Nine-Mile Prairie is one of the few protected areas.

In a diverse ecosystem, natural predators control pest species, making application of chemicals unnecessary. Natural nutrient-cycling and nutrient-trapping in the soil can improve water quality. Natural ecosystems with a diversity of plants and animals are better able to survive extremes in the weather. For example, in biologically diverse systems, tall plants protect shorter plants from the wind and sun.

“I think we need to keep as many species as we can around in viable populations,” said Paul

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Johnsgard, University of Nebraska-Lincoln emeritus professor of biological sciences. Johnsgard is concerned about the disappearance of biodiversity as agricultural crops replace native prairie.

“Plowing up such fragile lands to raise wheat or corn for a few decades, often until the topsoil blows away and the land is abandoned, is like throwing away a treasure trove of potential biological riches to raise a single species of grass that needs so much tilling, water, herbicides, and pesticides to survive that scarcely anything else of value can survive there,” writes Johnsgard, in his book “Prairie Dog Empire.”

Monoculture crops like corn — with the same species of plant covering hundreds or thousands of acres — have few built-in defenses against pests and adverse weather.

For example, the relatively shallow roots of corn are no match for the tangled roots of prairie grasses, which stabilize nutrient-rich soil against wind and water erosion.

Though corn satisfies a demand for both livestock and human food, the expansion of corn pro-

duction for ethanol plants adds to pressures on biodiversity. On this issue, Tyler Sutton, director of the Grassland Foundation, sees parallels between current and historical federal policies.

“You go back to the Homestead Act, which required plowing of grasslands to prove up the claim, carrying it forward into the modern era, where crop subsidies clearly encourage conversion of prairies and grasslands into crop production,” Sutton said.

Ethanol production to satisfy the U.S. hunger for fuel is just the most recent step in a history of replacing naturally diverse prairie ecosystems with systems created and managed by people.

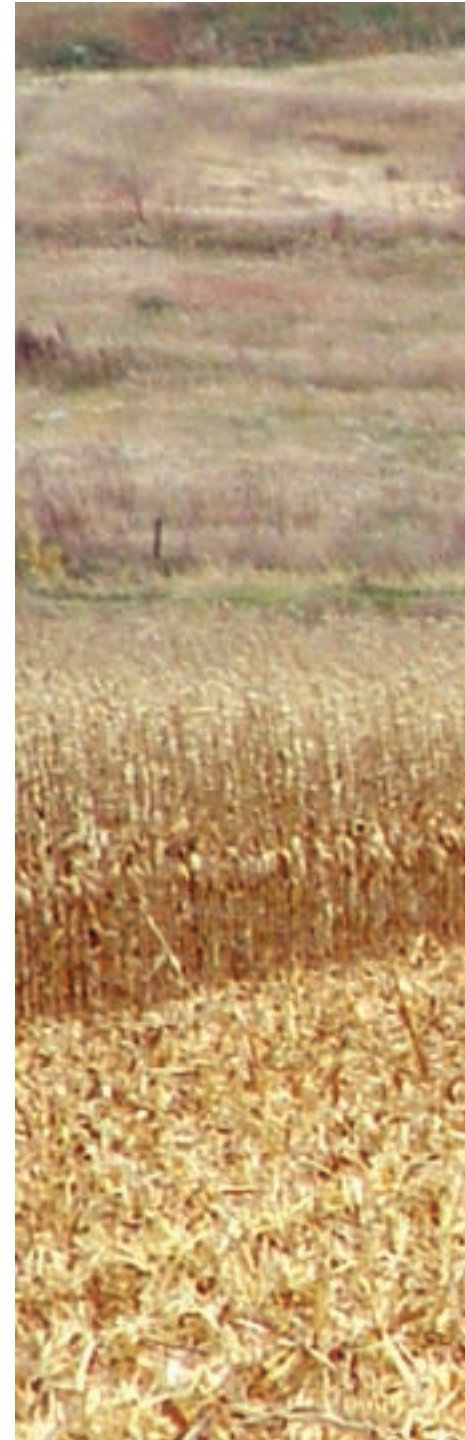
“Philosophically you can say people have always shaped the ecosystems of the Great Plains,” Wedin said. “It isn’t so much a question of what’s natural, but a question of what people as a society want with the values we hold and reflect to manage that landscape.” ¶

“Plowing up such fragile lands to raise wheat or corn for a few decades, often until the topsoil blows away and the land is abandoned, is like throwing away a treasure trove of potential biological riches.”

Paul Johnsgard

UNL emeritus professor of biological sciences

PHOTOGRAPH BY AARON E. PRICE
Farmer harvests corn in Loup County, Neb.





IMPACT



HONING IN ON THE HOMELAND

In 2006, Americans consumed 20.7 million barrels of oil a day, making the United States the world's top energy user.

BY CASSIE FLEMING

Mark Chrisp scoffs as his friend, Mike Fogerty, pumps gas into a 1965 mint-green Ford pickup at a Lincoln, Neb., gas station. Chrisp, 47 and unemployed, says he does not waste money on gas.

And if people do not stop recklessly pumping gas, he says there will be consequences because the world is running out of oil.

"We are all going to die," he says.

"Scam," interrupts Fogerty, a 47-year-old Lincoln welder. "There is no shortage of gas in the world. There's even lots in the U.S."

Chrisp doesn't buy it. "Just wait. All you oil-addicted crooks will see what it is like to live without it."

Chrisp's abstinence is unusual in a nation obsessed with using oil.

In 2006, Americans consumed 20.7 million barrels of oil a day, making the United States the world's top energy consumer, using nearly three times as much as China, the world's second-largest consumer. According to the Energy Information Agency, 70 percent of oil used in the U.S. is used to fuel vehicles.

To satisfy this craving, Americans are handcuffed to a few oil-rich nations. But as energy-ravenous



PHOTOGRAPH BY KATE VEIK

Trucks fill up at the Flying J, a major gas station and truck stop just off I-80 near Gretna, Neb.

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countries like China and India enter the global market and drink from the same oil reservoir, the supply evaporates and the price per barrel skyrockets. The high prices strain the U.S. economy and dump money into the fortresses of oil-rich foreign countries.

“None of us would write a check to Osama bin Laden, slip it in a Hallmark card and send it off to him. But that’s what we are doing every time we pull into a gas station,” said Mike Huckabee, former Arkansas governor and one-time Republican presidential candidate.

But, with alternative fuel, some believe hope is not lost. Many legislators, energy experts and Midwestern corn growers promise that farmers and their corn ethanol will usher the country into an era of energy independence. Others say the alternative fuel will be just one slice of the U.S. domestic ener-

gy pie, which includes solar, wind, coal and nuclear sources, as well as conservation efforts.

From President Bush touting ethanol as a savior to Midwest enthusiasts hailing corn as the country’s next fuel source, the ethanol industry has emerged as a partial cure for oil addiction. The message: Pump ethanol into the country’s gas tanks, and save the country from an oil-dependency crisis.

“Two years ago, ethanol was the industry that was heroically helping energy independence and environmental sanity, and they got extra props for standing up to the oil industry and the Arabs,” said Bill Kovarik, ethanol historian and professor of communication at Radford University in Maryland.

“National security is tied to the ethanol project,” said William Wolski of Energy Independence publications.

But at the Lincoln gas station, Fogerty did not

select the ethanol-blended gasoline.

“Ethanol is an even more exhaustible resource than oil,” Fogerty said. “And my car can’t even run on it.”

“It’s a joke,” Chrisp said.

Many say ethanol is a transition fuel to be used only until a better oil alternative is discovered.

Yet no one knows when this better source will surface, making today’s energy choices pivotal, said Paul Fenn, founder and CEO of Local Power, a California-based sustainable power non-profit group.

“If we wait until it is a crisis, we are dead,” Fenn said. “We will fail to find a solution, and we will die.”

“Oil was easy — easy to get and easy to use, and we got stuck on it,” Wolski said.

Sixty percent of U.S. oil comes from foreign nations — 20 percent from countries in the Persian Gulf and 40 percent from OPEC countries, according to Petroleum Supply Monthly.

“Oil-rich nations kept the price low for a while and prevented us from coming up with our own sources of energy,” Wolski said.

Oil-rich nations — including Iran, Iraq, Kuwait, Saudi Arabia and Venezuela — are expected to hold the United States on an increasingly shorter leash, supplying more and more of the country’s oil in the future, according to Ethanol Across America.

Energy independence from these countries creates an array of problems for Americans: They spend more at the pump, they are subject to an uncertain oil supply because of political turmoil in oil-producing areas, and their need for oil holds them hostage to powerful oil regimes.

“Many oil-exporting countries are located in troubled regions and are politically and economically insecure,” said Scott Kleeb, a Democrat running for Nebraska’s open Senate seat in 2008. “The oil spout could be corked anytime.”

OPEC’s 1973 oil embargo disrupted 5 percent of the U. S. oil supply. The country imported 30 percent to 40 percent of oil then. Today, it imports 60 percent.

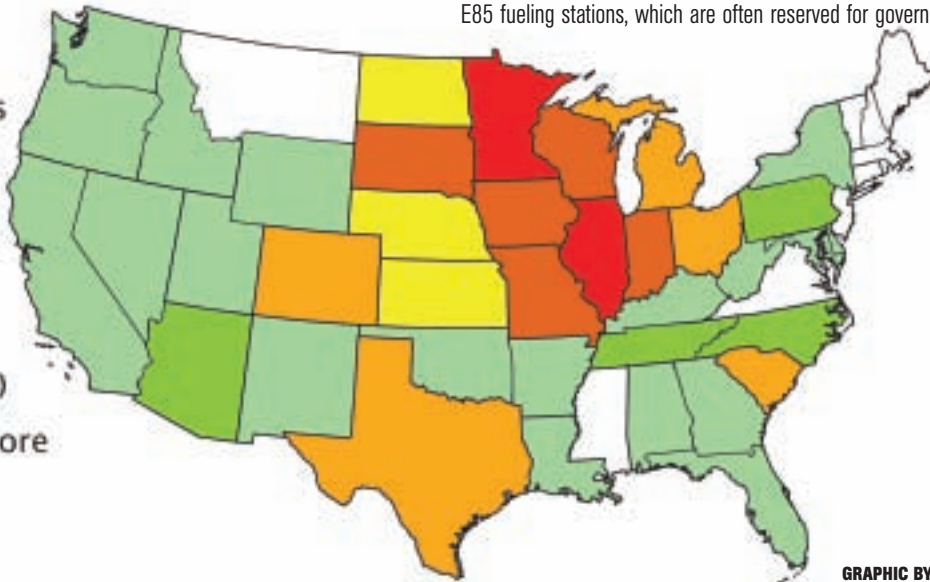
“If a conflict erupts overseas, we won’t have access to this petroleum,” Wolski said. “It will crush

PUMPING ETHANOL

As of February 2008, the U.S. Department of Energy’s online database of E85 fueling stations reported 1,219 public E85 stations in the United States. Minnesota had the most, with 314, followed by Illinois, which had 155 E85 stations. Twelve states, including Alaska and Hawaii (not pictured) had no public E85 stations. The site also keeps track of private E85 fueling stations, which are often reserved for government use.

Map key

- 0 stations
- 1 to 5
- 6 to 15
- 16 to 25
- 26 to 50
- 51 to 100
- 101 or more



GRAPHIC BY ALEX HAUTER

our entire economy.”

The U.S. spends an estimated \$39 billion to \$98.5 billion annually to secure the production and transport of oil from politically volatile regions, according to a 2005 report from the International Center for Technology Assessment.

Additionally, Wolski said, American, international and foreign oil companies are spending an increasing amount of money searching for new places to drill; they are coming up empty-handed.

Peak oil is the point where world oil production hits a maximum and begins to decline. The Cambridge Energy Research Associates puts peak oil after 2020. Others say peak oil was reached in 2005.

When demand exceeds supply, prices increase.

“You won’t see oil as low as \$40 a barrel ever again — even if that is what the Saudis, for example, want,” Wolski said. “The reality is they’ll run out of it, and they know it.”

Current defense expenditures and the fear of an energy peak frighten U.S. leaders.

In 2003 congressional testimony, former Secretary of Energy Spencer Abraham said, “Failure to meet increasing energy demand with increased energy supplies, and vulnerability to disruptions from natural or malevolent causes, could threaten our nation’s economic prosperity, alter the way we live our lives and threaten our national security.”

Enter: Ethanol.

“The price of oil kept rising, and you got ethanol,” said Ernie Goss, a Creighton University economist. “A lot of people think the idea came from Al Gore, but, no, it was the price of oil.”

Because corn-based ethanol is the easiest form of alternative energy to produce, it was seen as a way to wean the country off oil, said Fenn of California’s Local Power.

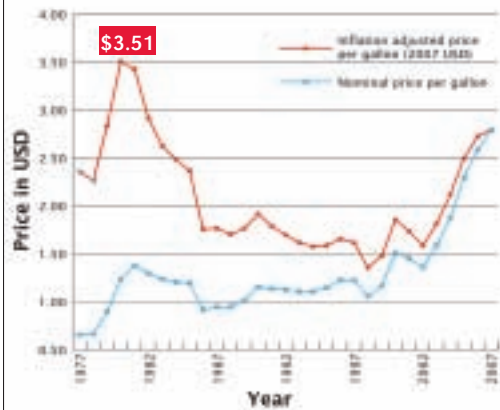
“A few years ago, it was the darling of environmentalists,” Fenn said. “Hippies were saying, ‘We’re running out of oil, and oil is bad. Let’s grow it and it put it in our car.’”

Then the government and even those in the oil



PHOTOGRAPH BY KATE VEIK
Rick Becarra fills up his pickup truck at the E85 pump on 11th and Jackson streets in Omaha, Neb. “I’ve always filled up with E85, it’s cheaper.”

PUMP IT UP



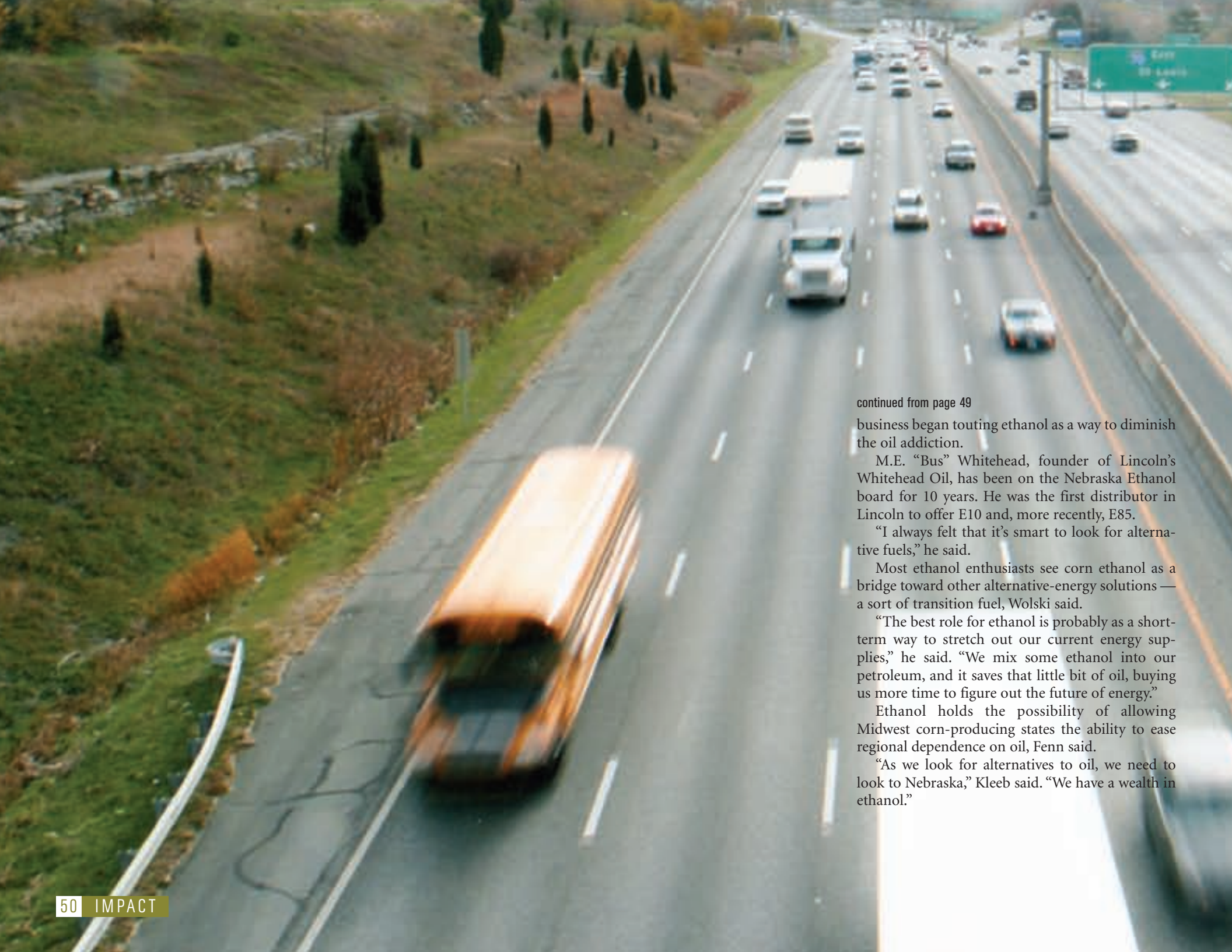
Regular unleaded gasoline cost an average of \$2.80 per gallon in the U.S. in 2007. The 2007 average is not the country’s highest when adjusted for inflation. **GRAPHIC BY ALEX HAUTER**

SOURCE ENERGY INFORMATION ADMINISTRATION, BUREAU OF LABOR STATISTICS



Ernie Goss is a Creighton University economist.

PHOTOGRAPH BY KATE VEIK



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business began touting ethanol as a way to diminish the oil addiction.

M.E. “Bus” Whitehead, founder of Lincoln’s Whitehead Oil, has been on the Nebraska Ethanol board for 10 years. He was the first distributor in Lincoln to offer E10 and, more recently, E85.

“I always felt that it’s smart to look for alternative fuels,” he said.

Most ethanol enthusiasts see corn ethanol as a bridge toward other alternative-energy solutions — a sort of transition fuel, Wolski said.

“The best role for ethanol is probably as a short-term way to stretch out our current energy supplies,” he said. “We mix some ethanol into our petroleum, and it saves that little bit of oil, buying us more time to figure out the future of energy.”

Ethanol holds the possibility of allowing Midwest corn-producing states the ability to ease regional dependence on oil, Fenn said.

“As we look for alternatives to oil, we need to look to Nebraska,” Kleeb said. “We have a wealth in ethanol.”



Because the Midwest is rich in biofuel resources, Fenn said, “it is naïve” to ignore ethanol as part of the energy-independence remedy.

“But it’s only part of the remedy,” Fenn said.

The negative consequences of energy dependence can be stalled by a variety of new discoveries and new efforts, Wolski said.

“The reality is, if we can discover alternative energies, the down slope after peak oil isn’t as steep,” he said. “But we will have to get all the sources we can get our hands on.”

Late in 2007, Nebraska State Sen. Annette Dubas of Fullerton, in east-central Nebraska, held a meeting in her district about alternative energies.

“All kinds of people were there — solar, wind, coal, nuclear, ethanol and even people talking about methane,” she said. “There are so many solutions, so many ideas. It was really good dialogue. Everyone knows it’s important to look at everything.”

Similar discussions are happening nationwide, with claims that each form of alternate energy will usher the United States into an era of energy independence. But each solution has its own limitations.

Wolski, of Energy Independence publications, said he believes electric cars will be a familiar sight in two years and 50,000 electric cars will be hitting the pavement daily by 2023.

Economist Ernie Goss is doubtful about this energy cure.

“When I was kid, everyone was talking about battery-powered cars,” Goss said. “But even today we don’t have one.”

In France, nuclear power is used for battery-powered cars, Wolski said; and some scientists say this is the best route to go.

Whitehead said because electric cars are so expensive, the gas-fueled internal-combustion engine is superior.

“It’s the best way to drive cars,” he said.

The U. S. has not scratched the surface of domestic oil, the founder of the Lincoln oil distribution

PHOTOGRAPH BY KOSUKE KOIWAI

Traffic in Kansas City, Kan. The United States is the largest emitter of carbon dioxide from the burning of fossil fuels. The U.S. consumes approximately 20.8 million barrels per day but produces only 8.3 million barrels a day according to 2005 estimates by the Central Intelligence Agency.

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company said, citing the ocean and the Arctic National Wildlife Refuge, as potential sources.

“But we can’t use this oil because the environment wackos are always stopping us,” he said. “They say getting that oil is like raping the environment. I don’t understand it.”

Whitehead also suggested producing oil shale from tar sands in Colorado and Canada.

Fenn, who founded California’s Local Power, said he could not justify this practice for the same reason he does not support coal as an energy source: Both deteriorate the environment.

“In the middle of a climate crisis?” Fenn said. “It’s mad.”

But Wolski said coal will be the long-term energy solution.

“Germans used it in World War II. South Africans used it when they couldn’t import oil during the apartheid,” Wolski said. “Coal could replace the oil in Saudi Arabia.”

Like all alternative-energy solutions, ethanol has flaws.

“The expectations for ethanol were too high,” said Goss, the Creighton University economist. “And these expectations haven’t been met.”

Two hundred new ethanol plants are planned to be under construction by 2009, but 1,000 ethanol plants will be needed to meet Congress’s energy-security goal of 36 billion gallons of ethanol from many sources by 2022, Wolski said. The Energy

Independence and Security Act of 2007, which set the goal, limits corn-ethanol’s share to 15 billion gallons.

The ethanol industry’s many problems, including a lack of retail locations, a high need for water and other environmental concerns, capital-intensive plants, decreasing amounts of financing and increasing import costs, raise questions about ethanol’s ability to alleviate dependence on foreign oil.

“Now it is more common to see ethanol supporters vilified as ‘Children of the Corn’ for spreading the gospel of gasohol,” Kovarik said. (“Gasohol” was a term coined in the 1970’s for a blend of 10 percent corn ethanol and 90 percent gasoline).

Corn ethanol is a small source on the road toward energy independence, and it is costly, said Amory Lovins, chairman and chief scientist of the Rocky Mountain Institute.

“When I talk about biofuels, I am not talking about corn-based ethanol,” he said.

Wolski said corn-based ethanol will lead to cellulosic ethanol. And this, he said, will mark the bioethanol peak.

Government may be another obstacle facing oil alternatives.

“The heart of the wild, national mood swings toward ethanol is an immature approach at scientific and technological issues of all kinds,” said Kovarik, the ethanol historian. “The immaturity becomes reflected in politics. We see energy tax and research policy waxing hot or cold toward this or that technology.”

Lovins said government’s premature support of an alternative fuel before understanding if it can successfully wean the country off oil wastes precious time and money in the search for an effective alternate energy source.

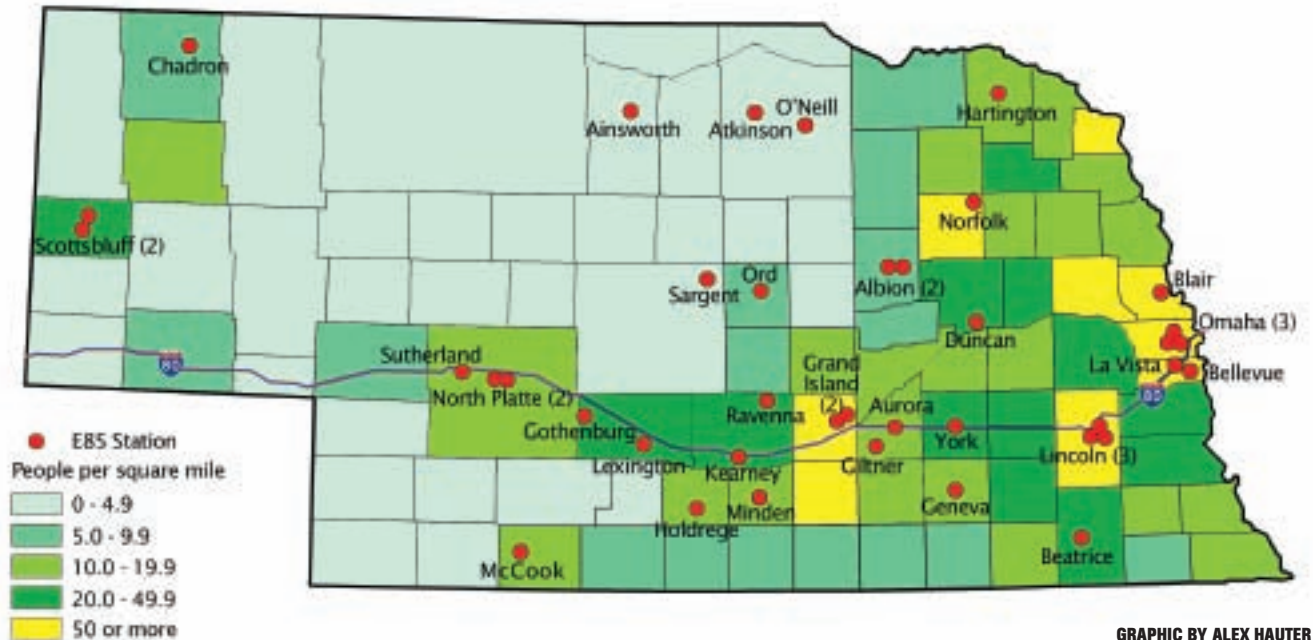
The federal government’s energy plan, including its support of ethanol, perpetuates Americans’ expanding oil dependence, Lovins said.

“The most comprehensive threat to the national energy sector is the current U.S. federal energy policy,” he said.

Goss said private industry, not the government,

FILLING UP

In May 2008, 38 Nebraska fueling stations were selling E85, a blend of 85 percent ethanol and 15 percent gasoline.



GRAPHIC BY ALEX HAUTER

SOURCE U.S. CENSUS BUREAU, NEBRASKA ETHANOL BOARD

should lead the way toward energy independence. By their investment choices, private companies will dictate the best way to end energy dependence. If ethanol ceases to receive private investment, it cannot possibly be the cure.

However, the government must have some role in reducing demand for foreign oil, others say. Specifically, the government can spearhead conservation practices.

“The government is like institutional acupuncture,” Lovins said. “It can stick a needle in where business logic isn’t working.”

Lovins’ examples of government intervention include stimulating demand for very efficient cars, scrapping old “clunkers” and designing energy-efficient military and government fleets.

Reducing demand is the cheapest solution, Fenn said, naming as key goals technologies that increase energy efficiency and conserve and store energy.

Still, the government can go only so far. Nebraska State Sen. Don Preister said the state legislature has considered bills requiring all manufacturers to use ethanol.

“But the manufacturers opposed it stringently,” the Bellevue senator said.

Wolski said he is confident that advancing alternative energy sources will always require government help.

“Taking out government is like gouging our eyes out,” said Fenn, founder of California’s Local Power. “Our eyes are the government.”

Healing the energy addiction needs to involve a comprehensive approach, with both the government and business; yet it must be done at the local level, Fenn said.

“The problem with the oil industry is that it is a colossal system,” he said. “This will be the problem with the coal, nuclear, hydrogen and ethanol industries.”

Nothing will completely replace oil, but each region should produce a portion of its own supply of fuels, he said. This means ethanol should be used where corn is already grown.

“To grow a plant and then ship it to another part of the country is insane,” Fenn said about using corn-based ethanol across the nation. “The places with lakes, use algae; the places with corn, use corn.”

In the wide-ranging debate over how to reach energy independence, many options are available.

“People want to make energy independence work,” Wolski said.

But Jerry Loos, who worked in the energy business for 30 years, said past trends show people have a poor track record for using less foreign oil.

“We’ve been wed to oil for 100 years. I would like to think we can move beyond that,” said Loos, the public information officer of the Nebraska Energy Office. “But history shows the opposite. I am not optimistic.”

“Failure to meet increasing energy demand with increased energy supplies, and vulnerability to disruptions from natural or malevolent causes, could threaten our nation’s economic prosperity, alter the way we live our lives and threaten our national security.”

Spencer Abraham

Former U.S. Secretary of Energy

FACTS OIL INDEPENDENCE

☞ Americans consumed 20.7 million barrels of oil a day in 2006, making the United States the world’s top energy consumer ahead of China,

☞ Seventy percent of oil used in the U.S. is used to fuel vehicles.

– Energy Information Agency

☞ Sixty percent of U.S. oil comes from foreign nations- 20 percent from countries in the Persian Gulf and 40 percent from OPEC countries.

– Petroleum Supply Monthly

☞ Oil-rich nations are expected to hold the U.S. by an increasingly shorter leash, supplying more and more of the country’s oil in the future, according to Ethanol Across America.

☞ The U.S. spends an estimated \$39 billion to \$98.5 billion annually to secure the production and transport of oil from politically volatile regions.

– International Center for Technology Assessment

☞ Peak oil is the point where world oil production hits a maximum and begins to decline. One report by the Cambridge Energy Association puts peak oil at 2020. Others say peak oil production was hit in 2005.

☞ Construction plans call for 200 new ethanol plants by 2009, but five times this amount will be needed to meet the energy-security goal of 36 billion gallons of ethanol by 2022.

– William Wolski, Energy Independence publications



PHOTOGRAPH BY AARON E. PRICE

The VeraSun ethanol plant is near Albion, Neb., a town of approximately 1,800. The plant was designed to be more environmentally-friendly.



ethanol and the ELEMENTS

Using ethanol in place of gasoline helps to reduce carbon dioxide emissions, but this solution may contribute to the problems.

BY MELISSA DROZDA AND CAROLYN JOHNSEN

It's mid-April in Lincoln, Neb., and Dennis Voldehnal takes his usual afternoon bike route home from work.

He knows something isn't right.

His nose tingles. He snuffles.

His eyes begin to itch, then water, then burn intensely. In a fraction of a second, lungs fill with air, eyes squint, mouth opens, neck muscles tense.

Then he sneezes. He sneezes again.

"It felt like sand hitting my eyes," said Voldehnal, a 53-year-old factory worker.

But it wasn't sand. It was pollen.

"I never had allergy problems like that before," Voldehnal said.

Allergy problems have been blossoming over the last decade. Research shows increased levels of carbon dioxide are partly responsible: More sneezing is caused by more pollen. More pollen is caused by higher levels of carbon dioxide, which warms the earth, boosting pollen production in plants like ragweed.

By burning gasoline in cars, trucks and sport utility vehicles, we contribute to higher levels of CO₂ in the atmosphere.

With about 251 million vehicles on U.S. roads — and numbers steadily increasing — CO₂ emissions are growing.

Some believe ethanol is a solution. Touted as an alternative fuel to reduce America's dependence on foreign oil, ethanol is also promoted as a way to reduce CO₂ levels and global warming. The Renewable Fuels Association says, "Using ethanol in place of gasoline helps to reduce carbon dioxide emissions by up to 29 percent given today's technology."

But this solution may contribute to the problems — both of global warming and of increased human exposure to allergens.

According to researchers at Harvard University, higher levels of carbon dioxide will boost pollen production, and allergy sufferers can expect more sneezing and itchy eyes.

"We are beginning to see some health effects of carbon dioxide build up that we couldn't have foreseen even a few years ago," Paul Epstein, Ph.D., told CBS News. Epstein is one author of the Harvard study, which was published in the June 2006 issue of *Environmental Health Perspectives*.

For the federally funded study, researchers compared concentrations of ragweed pollen under current CO₂ levels with increased levels projected for the future, if levels were to continue to increase at the current rate. Scientists assumed earlier springs caused by global warming contribute to higher pollen levels.

"The clearest sign of global climate change is the earlier onset of spring," the study's lead author, Christine Rogers, Ph.D., told CBS News. "Our goal was to examine the interaction between the lengthening of the growing season and the increase in carbon dioxide."

In fact, the study's findings led the scientists to conclude that "with elevated CO₂, we predict pollen production will be just as robust in years with late springs as in years with early springs." Higher CO₂ levels pose a public-health concern because "pollen seasons will be more intense and could start earlier than expected."

Ragweed, whose potent pollen causes allergy problems in about 10 percent of the population of

North America, was the subject of the study. The Harvard scientists were also concerned that the combination of the plant's pollen with other pollutants, such as particles of diesel fuel, might "lead to an increase in the frequency or severity of asthma and allergy symptoms."

Although CO₂ doesn't directly affect human health, it directly affects plants; it's the plants that can affect people. Epstein explained some plants grow larger and faster when exposed to higher levels of CO₂.

CO₂ is what we exhale when we breathe and what plants use, or "inhale," during photosynthesis. CO₂ is also found in carbonated soft drinks, providing the fizz and bubbles in a can of soda. It's a colorless, odorless, non-flammable gas.

But CO₂ is also a greenhouse gas, which means it's naturally part of Earth's atmosphere. In fact, greenhouse gases like CO₂ help create Earth's greenhouse effect because these gases trap energy from the sun and prevent heat from escaping back into space.

With too little greenhouse gas, our world would be a significantly colder place. Too much greenhouse gas could mean drastic changes in global climate and potentially harm our health.

About a quarter of U.S. carbon dioxide emissions come from burning gasoline in the internal-

combustion engines of our vehicles.

The U.S. Emissions Inventory, a yearly report from the Environmental Protection Agency, said vehicles with poor gas mileage contribute the most to CO₂ emissions from vehicles.

The evidence is mixed on whether ethanol can help to lower CO₂ levels.

Ethanol-fueled vehicles emit fewer greenhouse gases than gasoline-fueled vehicles, according to reports published in 2006 and 2007 from Argonne National Laboratory's Center for Transportation Research.

Michael Wang, a researcher at ANL, developed a software model that evaluates alternative fuels from "well-to-wheels." The model showed that vehicles using corn-based E85 instead of gasoline reduced their CO₂ emissions by 18 to 29 percent.

In another 2006 study, Alexander Farrell, professor of energy and resources at the University of California at Berkeley, and others concluded that a switch to corn ethanol reduces greenhouse gas emissions by only 13 percent.

The Farrell study, published in *Science* in January 2006, also assumed that the reduction in emissions varies and depends on how the ethanol is made. Does it come from a factory that's powered by coal or natural gas? The study's authors concluded that coal-powered ethanol plants produce more greenhouse gases than those fueled by natural gas. Suggesting that cellulosic ethanol would do a better job than corn-based ethanol of reducing greenhouse gases, the authors said scientists need more sophisticated methods to fully evaluate the environmental effects

of ethanol production and use. However, the authors were upbeat about the future, saying that a biofuels industry “could play a key role in meeting the nation’s energy and environmental goals.”

Two more recent studies have considered the effects on greenhouse gas emissions if forests and grassland were converted into land to grow crops for ethanol. Soil and vegetation, including trees and grass, are carbon “sinks,” in that they absorb CO₂, the primary greenhouse gas. But they release it when plowed or burned to grow crops.

These two studies, published in Science in February 2008, added the land-

use factor, more specifically, the increase in land used to grow plants, like corn, to make biofuels.

Removing natural vegetation means greater release of stored CO₂ and less CO₂ storage in the future.

One of the 2008 studies, by Joseph Fargione — regional science director at the Nature Conservancy — and collaborators, found land-use change for growing corn for ethanol produced in the central U.S. had a carbon debt of 93 years. This means nearly a century would have to pass before the CO₂ benefits of using ethanol as a vehicle fuel would be realized.

In the other study, Timothy Searchinger, a senior fellow at Georgetown’s Environmental Law and Policy Institute, looked at worldwide land-use change and concluded the carbon debt of ethanol production is 167 years. In other words, because of the large amount of CO₂ initially released from clearing land by plowing or burning, it would take 167 years to see the CO₂ reduction benefits of ethanol.

The authors of this study said previous studies did not account for “carbon emissions that occur as farmers worldwide respond to higher prices and convert forests and grassland to new cropland ...”

Whether CO₂ emissions come from burning gasoline or ethanol in our cars, trucks and SUVs or

from converting land to grow crops for biofuels, carbon dioxide is something that can’t be ignored.

If levels aren’t kept in check, CO₂ will increase global warming rates, intensify pollen levels and consequently worsen symptoms for allergy and asthma sufferers.

Yet improvements in biofuel production might ultimately reduce carbon debts, meaning the climate could receive the positive effects on global warming that supporters of ethanol have promised.

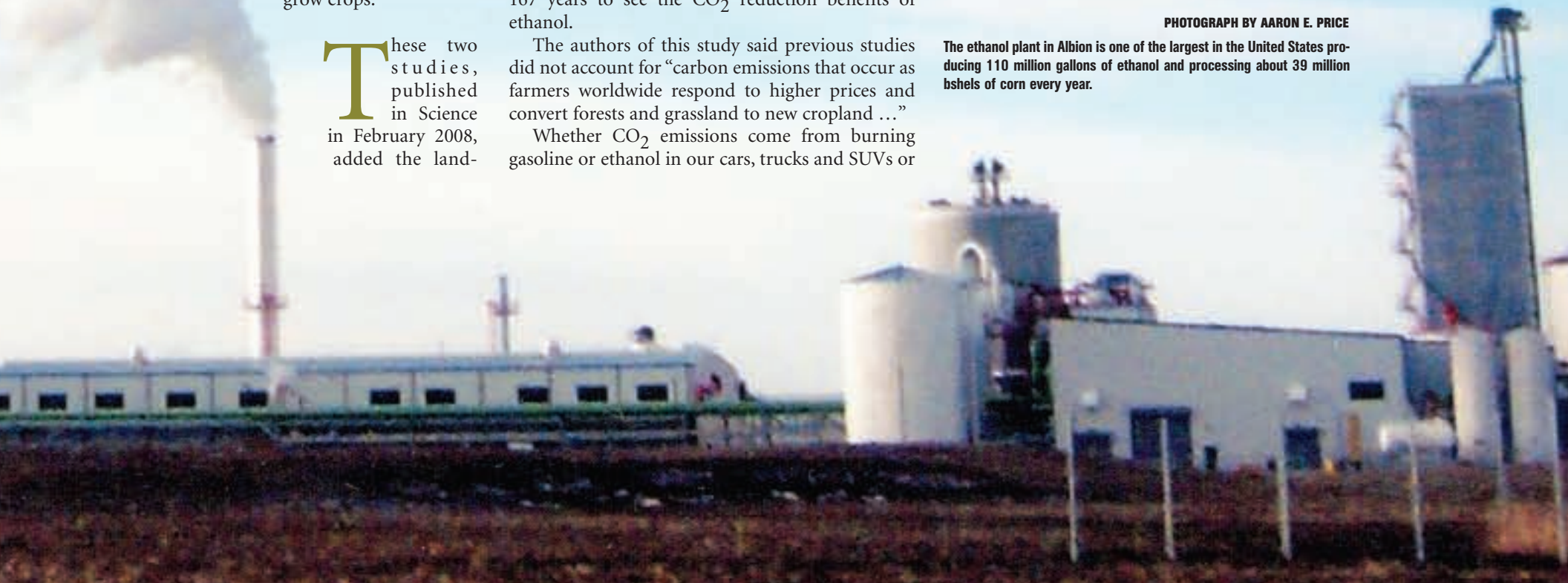
That outcome might make life easier for people like Dennis Vodehnal and his newfound allergies. Vodehnal, the bicyclist, said he’s not sure what the best solution is to combat fuel demands and climate change, but he does know about the problem.

“It’s not because of us,” he said, looking at his wife, Wanda.

“We ride bikes.” 🚲

PHOTOGRAPH BY AARON E. PRICE

The ethanol plant in Albion is one of the largest in the United States producing 110 million gallons of ethanol and processing about 39 million bushels of corn every year.





Minden's city officials hope their ethanol plant will spark long-term economic growth.

BY LUCAS JAMESON

Four years ago, Dave Cavanaugh — then a chemical salesman — was in an uncomfortable position.

“The chemical business was up and down and up and down, and I didn't know where it was going to be from month to month. That's a lot of stress on a person,” said the single, 44-year-old father of one who sold herbicide, fungicide and pesticide to local farmers.

But in 2003, he opted out of the chemical business in favor of a production job at a newly constructed ethanol plant seven miles west of Minden, Neb.

“I knew that the plant could probably offer me some stability,” Cavanaugh said. “I could see the writing on the wall that the chemical business is looking at the perspective of ‘get big or get out.’ And it's like that now with farming, cattle or anything.”

Cavanaugh is not alone. Across the Midwest, many rural communities and their citizens face similar dilemmas. Small-town residents keep leaving in droves, favoring bigger cities and bigger incomes. Meanwhile, farmers and agricultural businesspeople, like Cavanaugh, are forced to “go big” or find another career somewhere else.

The ethanol industry has been touted as an invaluable alternative. In fact, its many proponents claim that corn-based ethanol can revive rural America and that it can become an almost magical potion capable of curing much of what ails today's agricultural communities.

NEW DEAL OR NO DEAL WEM DEVT OB WO DEVT

“Producing ethanol fuel in the U.S. generates jobs and wealth by processing domestic resources into clean-burning transportation fuel. Thousands of jobs, increased farm income, and tax receipts in the hundreds of millions of dollars follow,” a report published by the Clean Fuels Development Coalition said.

Others are more concerned about the longevity of the fuel’s economic effects.

“The end of the ethanol boom is possibly in sight and may already be here,” Iowa State University economics professor Neil E. Harl warned in a September 2007 New York Times article. “This is a dangerous time for people who are making investments.”

In 2000, when KAPPA [Kearney Area Ag Producers Alliance] Ethanol proposed building an ethanol plant in Minden, most residents, farmers and government officials believed it would bring more citizens to Minden and increase enrollment for Minden Public Schools.

Chuck Woodside, the KAAPA Ethanol general manager, also offered rosy predictions.

“I think it will provide some great jobs. It will improve the entire area, as good jobs will raise everybody’s standard of living,” Woodside told The Minden Courier.

Four years later, Minden has benefited from the ethanol plant, but it has not injected new life into the city. The mixed report card, according to numerous articles, studies and interviews with residents, economists and agriculture experts, reveals a number of findings. Among them:

THE POPULATION of Minden has declined slightly since the ethanol plant was built.

PUBLIC SCHOOLS have shown no significant boost in enrollment.

PROPERTY VALUES haven’t been affected by the plant.

However, a detailed analysis of the plant’s impact also reveals that:

LOCAL BUSINESSES have received direct and indirect boosts from the plant.

PHOTOGRAPH BY KATE VEIK

AT LEFT: Four ground-water wells with a storage capacity of 2 million gallons provide most of the water for 3,000 people in Minden, Neb.



PHOTOGRAPH BY KATE VEIK

Dave Cavanaugh opted out of the chemical business in favor of a production job at the newly-constructed ethanol plant west of Minden, Neb.

MORE JOBS and job stability for local residents have been provided by the plant.

A HANDFUL OF STOCKHOLDERS have made a lot of money from the plant.

Although the plant hasn’t lived up to some expectations, it has clearly had a positive overall effect on the city, according to several local businessmen, farmers and government officials. But others remain skeptical of the plant’s impact and believe it has made only modest changes to the area’s economy. And with the possible waning of the corn-ethanol boom, no one can say for sure what lies ahead.

In 1995, a group of Kearney County farmers formed the Kearney Area Ag Producers Alliance, or KAAPA. Five years later, KAPPA proposed the idea of an ethanol plant to roughly 300 local farmers. The proposal passed, and KAAPA Ethanol became a limited liability company with its profits paid out to the owners.

Once the plant proposal went through, a committee reviewed 40 potential plant sites, which were eventually whittled down to two.

“We basically went to the cities of Minden and Gibbon and asked, ‘What will you give us?’ ” said LaMoine Smith, vice president of the KAAPA Ethanol board. “Minden added up to have the best incentive package.”

The city offered KAPPA tax-increment financing, a good location next to the Burlington railroad and the blessing of the Southern Power District; the plant offered Minden growth opportunities.

Lewis said Minden wanted the plant for economic reasons.

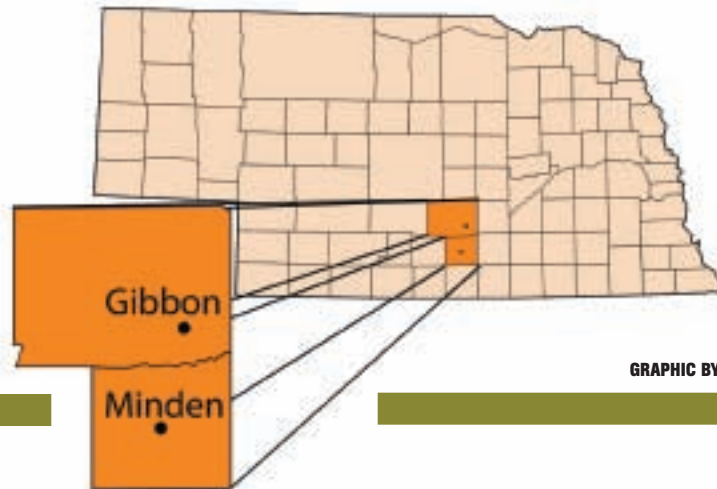
The plant initially cost about \$50 million to build, and KAPPA spent 18 months raising money from local farmers and businesses. Construction began in fall 2001 on a plot that was annexed by Minden in May 2002. The plant initially produced 40 million gallons of ethanol per year but has since expanded to produce 59 million gallons annually.

A TALE OF TWO SITES

In 2000, the Kearney Area Ag Producers Alliance had whittled its possible locations for an ethanol plant down to two possible central Nebraska communities, Minden and Gibbon. Minden offered KAAPA public financing and a location next to railroad lines. The plant was supposed to help boost Minden's population, but despite the plant, the town's demographics follow trends similar to the rest of Kearney County and its nearby competition, Gibbon.

MINDEN KEARNEY COUNTY	GIBBON BUFFALO COUNTY
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2,964	Population (2000)	1,759
2,877	Population (2006 estimate)	1,775
3.2%	Unemployment rate - County (Feb. 2002)	2.9%
2.7%	Unemployment rate - County (Feb. 2008)	2.1%
\$40,092	Median household income (2000)	\$34,955
\$41,900	Median household income (2005)	\$36,600
\$74,300	Mean home and condo value (2000)	\$72,200
\$79,200	Mean home and condo value (2005)	\$77,000



GRAPHIC BY ALEX HAUTER

During construction, there were obvious effects on Minden's economy.

"There was a noticeable boost in business during the building of the plant," said Bill Huenemann, Fifth Street IGA manager and Minden Chamber of Commerce board member. "Sometimes there's a small boost still."

But the plant has not led to a population increase. According to the U.S. Census Bureau, the population of Minden in 2000 was 2,964. In 2006, 2,877 people lived in the city. Kearney County's population shows a similar decline.

Minden Public School enrollment wasn't affected by the ethanol plant, either.

"It's hard to show any definite increase in students," Lewis said. "But some of the employees at the plant may have kids that aren't school age yet."

However, Lewis said he isn't discouraged by the numbers.

"It has still been a good thing for the city," he said.

The ethanol plant itself has certainly been successful for its 480 stockholders, about half of whom are farmers in the Kearney County area. Smith said since the plant went into production in 2003, it has paid roughly \$66 million in dividends to those owners.

Because about half of the stockholders reside in Kearney County, "That means there's about \$33 million added to the county that farmers can spend that wouldn't have been spent if the plant wouldn't have been built here," Smith said.

Stockholders are not the only ones who have seen direct benefits. The ethanol plant requires about 34 full-time employees, who make a combined \$1.8 million a year. That steady salary is appealing to many area residents who are tired of unstable farm markets.

Before the ethanol plant was constructed, Brad Carlson split his time between farming and working at the Eaton Corp. factory just outside of Kearney, about 30 miles north of Minden.

When the plant came online, Carlson applied and now works in the distillation and evaporation process department. He sold all of his farmland and equipment. He also quit the Eaton factory.

“I guess I just wanted something more stable,” he said. “I got a pretty good job out of it.” Carlson is among the roughly 50 percent of the plant’s employees who live in Kearney County. Dave Cavanaugh — the former chemical salesman — said he thinks the plant has helped Minden attract new jobs.

“I’m not going to say it supplied a lot of jobs, but it supplied a few jobs around the community,” he said. “I think, all in all, it has been very good for Kearney County.”

However, not everyone in Minden has seen benefits. Linda Larsen, the Kearney County assessor, said that although Minden’s property values have gone up in recent years, the rise has little to do with the ethanol plant.

“Some people would like to believe that people at the plant would be buying homes and cars from Kearney County,” Larsen said. “But most of the vehicles at the plant are from different counties. We haven’t seen them buying the property that we thought was going to happen.”

Larsen added that she expects both residential and commercial property values to continue to rise in the area, although she’s not sure why.

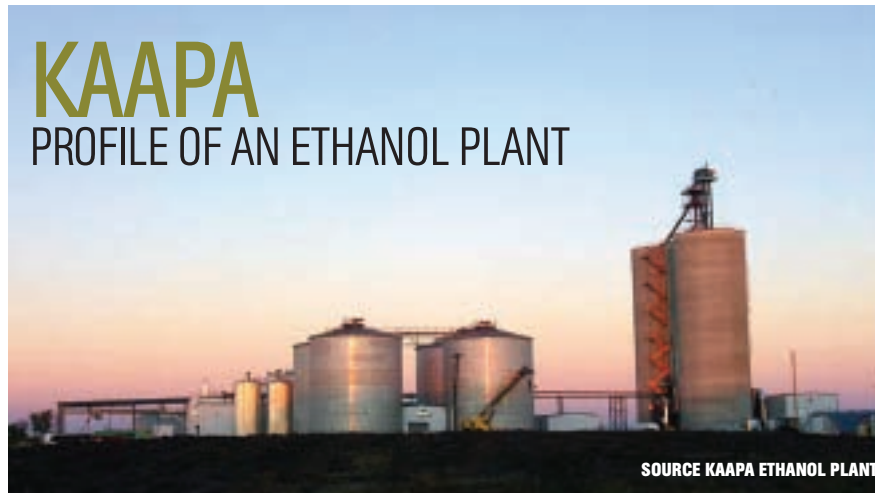
Even with healthy property values, the plant has not spurred housing sales in the city.

“I think we only sold one house to someone who worked at the ethanol plant,” said Annie Jacobsen, broker and owner of McBride Realty in Minden. “Most of the people that work there already live in this area; and if they didn’t, then they moved to Kearney instead.”

John Saathoff, who has owned Big John’s Ford dealership in Minden for 38 years, said he has not sold more vehicles because of the plant.

“The plant has helped the community, but I don’t know about us directly. I don’t think they’ve helped our sales go up,” he said.

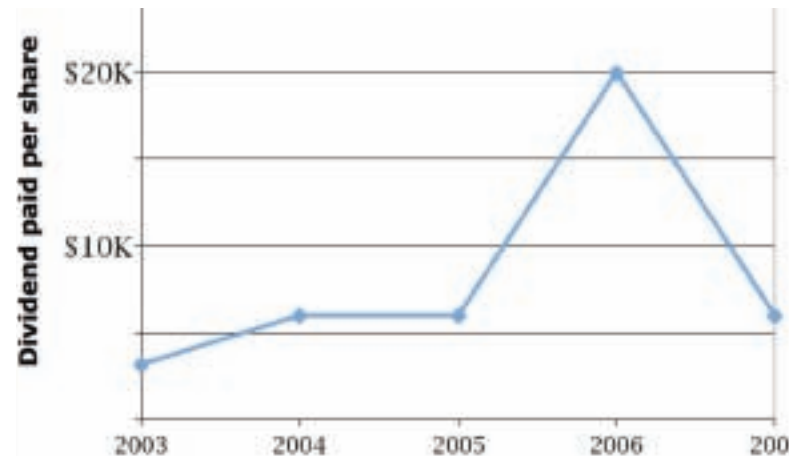
Other Minden businesspeople say the plant has had an indirect impact on the town’s economy. Local agriculture businesses have had relatively busy years since the ethanol plant opened, but business people said it’s hard to draw any direct correla-



The KAAPA Ethanol LLC plant opened in Minden in 2003. Here's a look at some statistics about the plant's inputs, outputs, comings and goings. The plant:

- 🌾 has an annual payroll of \$1.8 million
- 🌾 operates around the clock and has 34 full-time employees
- 🌾 makes 5 million gallons of ethanol per month
- 🌾 uses 96 billion BTUs of natural gas per month
- 🌾 uses 2.1 million kilowatts of electricity per month
- 🌾 uses about 1.7 gallons of water per gallon of ethanol produced or 8.5 million gallons per month
- 🌾 receives 90 truckloads of grain every day
- 🌾 ships 90 truckloads of distillers grain every day
- 🌾 produces 8,000 gallons of ethanol every day, which is shipped in 20 train cars
- 🌾 is scheduled to be completely paid off by 2018

This chart shows dividends paid by KAAPA. In 2008 shares are worth \$58,000, up from \$12,000 originally.



GRAPHIC BY ALEX HAUTER



PHOTOGRAPH BY KATE VEIK

LaMoine Smith, vice president of KAAPA Ethanol Board, said the 2006 spike was the “perfect storm” of high ethanol prices and low corn prices.

continued from page 61

tion to the plant.

Brent Stewart, manager and crop-duster with Pioneer Aerial Applicators in Minden, said he had so much land to spray in 2006 that he brought in extra pilots to help with the workload. However, Stewart said he equates most of the extra work to the fact that many area farmers are using no-till farming techniques. This type of farming can help keep soil fertile, but it also requires more chemicals to keep weeds and fungi in check, resulting in business for crop-dusters like Stewart.

Stewart did give some credit to the ethanol plant.

Genesis on

In spring 2007, when the Genesis ethanol plant at Mead, Neb., started producing, it was supposed to be the birth of a new breed for the ethanol industry. The \$77 million plant, owned by E3 BioFuels, was touted as the prototype for at least 15 similar so-called “closed-loop” systems in the U.S. Its creators championed the plant’s unique features.

“There isn’t much difference in energy efficiency between a traditional ethanol plant and a gasoline plant,” said Dennis Langley, president of E3 Biofuels. “I wanted to see something that was a dramatic step forward. This does that,” he told the Fremont Tribune in June 2007.

The closed-loop process sounded a little dirty. At the Mead site, about 27,000 cattle produced about 1.6 million pounds of manure a day, which was stored in pits adjacent to the ethanol plant. The methane gas obtained from the manure was then used to power the plant, which produced ethanol from corn.

The cattle, in turn, ate the leftover distillers grain — a protein-rich byproduct of the ethanol-production

The Genesis plant filed for bankruptcy in November 2007, leaving millions of dollars owed to companies and local farmers.

BY LUCAS JAMESON

process that makes good feed for cattle. Some of the unused manure was used to fertilize nearby cornfields, closing the loop from field, to factory, to feedlot and back to the field. The entire process created an efficient, energy-saving system.

The plant was embraced by local residents, congressmen and the Nebraska governor alike.

“It is a priority of mine to advance Nebraska’s success story in the ambitious and positive vision of energy security,” Congressman Lee Terry told Southwest Nebraska News in June 2007. “I believe the methods employed at Mead’s facility should be encouraged and expanded.”

Gov. Dave Heineman echoed Terry’s optimism.

“This plant sets a new standard for ethanol pro-

duction in Nebraska and our nation,” he told the Fremont Tribune.

But less than a year after it started producing, the Genesis plant experienced some growing pains. On Nov. 30, 2007, the plant filed for bankruptcy, leaving millions of dollars owed to companies and local farmers. Months later, the plant remains idle.

“We’re still in Chapter 11 and still working on obtaining the financing it will take to restart the facility,” said John Curran, the Genesis manager, in early March 2008.

Initial blame for the bankruptcy focused on the relatively new closed-loop technology, but plant officials insisted that the technology had nothing to do with the rocky start. Instead, they pointed to a boiler

“Commodity prices for corn are up, so indirectly it has helped. I think farmers did plant a little more corn,” he said. “Our entire community is hinged on agriculture, and the ethanol plant is bound to help the local economy.”

LandMark Implement, located just east of the city limits, sells machinery parts and combines. The company had an excellent year in 2006.

“It definitely has to do with the increase in grain prices. Especially in the last six months, it has picked up considerably,” said Jeff Pettz, a salesman at Landmark. “We sold more tractors, combines,

planters — everything really. And I think ethanol played a role in that.”

Still, it’s hard to make a definitive connection between the Minden ethanol plant and the company’s above-average sales.

“I know the ethanol plant has been paying good dividends, but I don’t know which of our specific customers have stock in the company,” general manager Jim Mach said. “I’m sure there’s been some effect, but it’s just hard to say how much.”

Other local agriculture businessmen are a little more skeptical about the plant’s effects so far. Tom

Madsen, a Pioneer seed dealer, said he does not think Kearney County has seen much change since the plant opened. Madsen said he has had a profitable year but doesn’t give much credit to the ethanol plant.

“My sales have been on a steady increase for the last 10 years, before this ethanol plant was even built,” he said.

Madsen said the market could look a lot different in a few years if five or six ethanol plants are operating within a 40-mile radius of Minden.

“I think what you’re going to see is guys who can home-store their corn — they’re the ones who are going to benefit the most,” he said. Madsen explained that the ethanol plants will want corn that can give them the most gallons of ethanol per bushel. The farmers will have the advantage to sell their corn to the highest bidder.

“As time goes along I think the farmers will have a better deal,” he said.

But Madsen isn’t the only person looking to the future. Smith said KAAPA has plans for another expansion, but is moving cautiously.

“There are a lot of plants on the drawing board; and as a lot of plants come online, that’s one thing we’ll look at before making any decisions,” he said.

KAAPA is also aware that the ethanol wave may crest soon.

“We actually expected things to slow down already, but it hasn’t happened yet,” Smith said.

With so many ethanol plants either under construction or proposed in the Corn Belt, almost every agriculturally-minded farmer or businessman agrees on one thing about the Minden plant. Brent Stewart summed it best: “They hit the perfect time.”

And although the plant hasn’t rejuvenated Minden, it definitely came along at a good time for many Kearney County residents, including Dave Cavanaugh. The plant provided him a stable, well-paying job that has helped him support his daughter. Now, instead of the uncertain months of chemical sales, Cavanaugh gets a steady paycheck from the plant.

“It’s been good for the county,” he said, “and it has been good for me, too.”

Hold

explosion that forced the plant to produce at about 50 percent capacity, according to Ethanol Producer Magazine.

Whatever the cause, the bankruptcy made many Mead-area farmers, who were listed as creditors, a little uneasy.

“We could end up with 2 cents on the dollar, or 50 cents. Nobody knows,” Ashland farmer Randy Bundy told the Omaha World-Herald in December 2007.

Meanwhile, David Hallberg, who invented the closed-loop system and patented it in 2002, did his best to reassure the locals.

“We’re going to do what we can to put together something that will keep the community intact and take care of the employees,” he said.

The only thing the people of Mead could do was wait.

“Right now (the plant is) just sitting here, cold iron, and the owners are working with various financial resources to try and put together a start-up plan,” Curran said, adding that there was no definite date for the plant to come back online.

“The owners are working with various financial resources to try and put together a start-up plan ... there is no definite date for the plant to come back online.”

John Curran

Genesis manager

INFRASTRUCTURE IMPACTS:

As federal pressure increases to meet ethanol mandates and as new ethanol plants are built across the country, how will all this ethanol be moved around – from factory to distributor to vehicle? Here's a sampling of the infrastructure issues.

BY CAROLYN JOHNSEN



PHOTOGRAPH BY KATE VEIK

Minden, Neb., grain bins help to supply the KAAPA Ethanol LLC plant



Congress mandates biofuel production

The federal renewable fuel standard in the Energy Independence and Security Act of 2007 requires the country to use 36 billion gallons of ethanol and biodiesel by 2022. Of that amount, 15 billion gallons can be ethanol made from corn. To meet this mandate, the country will have to invest in new technology to efficiently and safely transport, sell and use ethanol.

Transporting ethanol

Oil is distributed around the country in 200,000 miles of pipeline. Ethanol corrodes conventional pipelines, so it's currently moved by train and truck. But to use 15 billion gallons of ethanol by 2022, the country will need to find new ways to move the fuel from factory to consumer. Brazil has used pipelines to move ethanol; in November 2007, an Oklahoma company proposed building an ethanol pipeline as part of an ethanol hub in Nebraska, but no action has been taken on that proposal.

Congress weighs in

The energy bill passed by Congress in December 2007 includes several mandates to study how to upgrade the infrastructure to distribute ethanol. For example, the bill includes money for determining “the feasibility” of requiring gas stations to install E85 pumps and of building pipelines to transport ethanol and for studying how otherwise to improve the distribution of biofuels.

Selling ethanol

The Renewable Fuels Association said 170,000 filling stations operated in the U.S. in early 2007, but only about 1,100 of them were selling E85 — the 85 percent ethanol-15 percent gasoline

blend that flex-fuel cars typically run on. The scarcity of E85 pumps in the country made finding fuel difficult for the drivers of the six million flex-fuel vehicles on the road then — and for the million more flex-fuel vehicles that automakers expected to sell in 2007.

Driving on ethanol

Automobile manufacturers and ethanol advocacy groups alike caution against using ethanol in cars that aren't designed for it. But the Christian Science Monitor has reported that big automakers told President Bush that “by 2012, half of all their new vehicles could be flex-fuel models” — well ahead of the 2022 deadline for meeting the renewable fuel standard.

Insuring public safety

In the last three months of 2007, ethanol fires in Missouri, Ohio and Pennsylvania called attention to the special problems of fighting such fires. All three of these fires involved tanker trucks or trains carrying ethanol.

The foam that firefighters use to put out gasoline fires won't work on an ethanol fire, which just eats through the foam and continues to burn. There is a special foam to use against ethanol fires, but fire departments need to be trained to use it.

The Nebraska State Fire Marshal and Region VII of the Environmental Protection Agency offers such training. The Nebraska Ethanol Board distributes a free DVD on the topic to local fire departments. Although officials with the State Fire Marshal's office said there have been ethanol fires in Nebraska, the records were unclear on how many.

SWEET IDEAS

ALTERNATIVE BIOFUELS

Scientists and farmers alike promote research of alternative energy crops, but without necessary funds the search to find a cost-effective method continues.

BY LUCAS JAMESON

Ismail Dweikat, a sweet-sorghum researcher, is accustomed to going against the grain. He recalls a recent ethanol seminar where he opted to remove PowerPoint slides showcasing his sugary crop's environmental advantages over corn.

"I was the only sweet-sorghum guy in 2,700 people," he says with a wry smile. "I had to play it safe."

As he sits in his modest, cluttered office discussing ethanol, the smell of strong java fills the room. Nearby, a near-empty, coffee-stained pot sits atop a heater accompanied by a dozen mugs from research seminars around the country. The associate professor of agronomy and horticulture at the University of Nebraska-Lincoln gushes about the potential of his African plant, which from a distance looks like earless stalks of corn.

"You could put sweet sorghum up against anything — corn, switchgrass, stover, whatever — and nothing could beat sweet sorghum," he says.

But despite having numerous advantages over corn-based ethanol as an energy crop, sweet sorghum has been overlooked and its research under-funded, says Dweikat, a native of Palestine who has studied the crop for four years.

Other alternative feedstocks have suffered similar negligence. Advocates of these feedstocks say most of their crops require no irrigation, can be grown on marginal land, are less harmful to the environment and are more energy efficient than corn. Yet, these alternatives have long been overshadowed by the mature corn-based economy. The reason: Alternative biofuels are not yet economically viable.

One skeptic says that, in the long run, corn isn't an ideal energy crop.

"So we are going to want to see a transition to cleaner, greener versions ... where there's a higher energy content in the fuel itself," said Daniel Kammen, professor of public policy at the University of California at Berkeley.

Those cellulosic feedstocks like sweet sorghum, switchgrass, forest residue and corn stover (the plant parts remaining after the grain is harvested)

are getting some attention now. The Energy Independence and Security Act of 2007 requires cellulosic ethanol and other advanced biofuels to provide 21 billion gallons of fuel by 2022.

Ethanol made from cellulose is the same product as ethanol made from corn, but the production process is different. Instead of using enzymes to change cornstarch into sugars, the cellulosic process breaks down the cellulose of almost any biomass into sugars that can then be fermented into ethanol.

"Corn for ethanol is at least a good start," Dweikat said. "Now we've proved the concept works, so we need to move to a more productive source."

While making ethanol from alternative sources may become more efficient, several obstacles remain before ethanol made from kernels of corn takes a back seat.

According to several researchers, economists and farmers, alternative sources will require more federal and private funding, improvements in technology, a new infrastructure and support from farmers before any of those sources can supplant corn as the key ethanol feedstock.

"I look forward to the day when Texas ranchers can grow switchgrass on their country, and then

have that switchgrass be converted to fuel,” President George W. Bush said in a March 2008 speech at the Washington International Renewable Energy Conference.

For several years, the federal government has been touting switchgrass, a perennial prairie grass well-suited to Nebraska’s climate. According to Rob Mitchell, a research agronomist for the U.S. Department of Agriculture, switchgrass as a biofuel crop “makes a lot of sense from many different angles.” On paper, the advantages over corn seem overwhelming:

LAND: Switchgrass can be grown on marginal land, so farmers can save their best land for crops like corn and soybeans.

WATER: The deep, fibrous roots of the plant keep soil intact, prevent water runoff and improve water quality.

EQUIPMENT: Switchgrass is harvested just like hay, meaning many farmers don’t need extra equipment to start growing it.

PESTICIDES: Once established, the crop needs very little pesticide or fertilizer and regenerates itself after harvest for 25 years or longer.

CONSERVATION: Switchgrass can be grown on Conservation Reserve Program land and creates a natural habitat for wildlife.

Mitchell, who helped complete a five-year study on switchgrass with several other UNL researchers, said that, of all the perennial prairie grasses, “switchgrass shows the most potential.” Based on estimates, the study showed switchgrass produced 540 percent more energy than was needed to grow the crop and convert it to ethanol. The researchers also found that switchgrass fields produced about 300 gallons of ethanol per acre, or about 50 gallons less than an acre of corn will yield.

“One bale [of switchgrass] will make about 50 gallons of ethanol,” Mitchell said.

And all of those bales could add up. An April 2005 study by the USDA and the U.S. Department of Energy predicted the United States could realistically produce about 1.3 billion tons of biomass for ethanol.

The National Renewable Energy Laboratory calculated that this biomass could replace more than half of the transportation fuel burned each year in the U.S., as reported in a 2007 article in National Geographic magazine.

With so much research put into unlocking the potential of perennial grasses, it is easy to put other crops on the back burner.

UNL sweet-sorghum researcher Dweikat is accustomed to such treatment.

“When the president said ‘switchgrass,’ the dam and the water broke and all the money came to switchgrass,” he said.

Dweikat believes sweet sorghum is a better solution, calling it “an ideal crop for ethanol production.”

Sweet sorghum is a drought-tolerant crop with tall, juicy stalks. The juice in the stalks is between 12 percent and 23 percent sugar. As an energy crop, sweet sorghum shares many benefits with switchgrass. Dweikat said sweet sorghum costs about \$20 per acre to grow, about half the cost of corn. Sweet sorghum needs less water than corn and very little nitrogen to grow. And sweet sorghum is not a food crop.

“Growing sweet sorghum could release some of the pressure on corn and food prices,” he said.

The juicy stalks are what make sweet sorghum unique. Dweikat said enough juice exists in one acre of the crop to produce between 400 and 800 gallons of ethanol, depending on the concentration of sugar. He believes he can eventually increase that number to 1,000 gallons per acre by combining different hybrids. The leftover stalks can then be collected and taken through the cellulosic process.

After four years of studying the crop, however, Dweikat hasn’t received the funding to experiment on a large scale. Instead, he has relied mostly on his small plots on UNL’s East Campus and watches with intrigue when area farmers dabble with the crop.

One such dabbler is Harold Witulski, a 77-year-old retired farmer. In 2007, Witulski planted one acre of sweet sorghum near his home, six miles southwest of Beatrice. Although he knew about the crop’s potential as an energy crop, he planted it to make syrup.

“I was just kind of experimenting,” he said. “I like to try new things.”

After removing the heads and leaves of the sweet sorghum plants by hand, Witulski transformed his silage chopper into a silage squeezer, which squeezed the juice out of the stalks. He then cooked the juice into a molasses-like substance and used it to make cookies.

Although the majority went toward sweets, Witulski also made a little ethanol.

“All you have to do is get the right yeast, and you don’t have to cook it,” he said.

Dweikat hoped Witulski would plant another acre this year with one of his breeds of sweet sorghum.

“I might try a little bit of his new seed, but I’m getting old,” Witulski said.

Dweikat acknowledges the potential of feedstocks like woody forest residue, corn stover and

FACTS FEEDSTOCK

☞ Switchgrass will yield nearly 540 percent as much energy as it takes to grow it.

– USDA agronomist Rob Mitchell

☞ An April 2005 study predicted that the United States could produce 1.3 billion tons of feedstock for ethanol production.

– Departments of Agriculture and Energy

☞ Sweet sorghum can yield 400-800 gallons of ethanol per acre. Corn yields about 350 gallons per acre.

– University of Nebraska–Lincoln agronomist Ismail Dweikat

☞ Sweet sorghum needs between 12 and 15 inches of water per year to grow healthily.

– University of Nebraska–Lincoln agronomist Ismail Dweikat

☞ Sweet sorghum costs about \$20 per acre to grow, making raising it about half as expensive as corn.

– University of Nebraska–Lincoln agronomist Ismail Dweikat

☞ The U.S. Department of Energy budgeted \$726 million for renewable energy projects in 2007.

☞ The Energy Independence and Security Act of 2007 requires that the U.S. use 36 billion gallons of fuel from advanced biofuels, which includes cellulosic ethanol, by 2022.

CELLULOSIC

Cellulosic ethanol production is thought to hold the key to the future of ethanol in the United States. In December 2007, the Energy Independence and Security Act of 2007 allocated more than \$4 billion over the next eight years for advanced biofuel research, development and production.

PHOTOGRAPH BY KOSUKE KOIWAI

Biomass from grasses, crop waste or woody materials is pretreated with either acid or gas to free cellulose from the lignin cell walls.



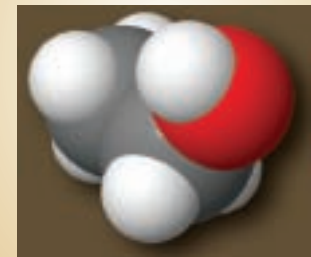
Gas-treated biomass is partially combusted, and the hydrogen and carbon monoxide exhausts are fermented into sugars and ethanol.

Released from the cell, the chemically complex cellulose is exposed to enzymes to "digest" it into simple sugars like glucose and pentose.

Micro-organisms convert the simple sugars to ethanol through a fermentation similar to wet and dry-mill ethanol production.

Distillation takes advantage of ethanol's lower boiling point to vaporize the fuel but not the water. The cooled ethanol vapor recondenses.

The remaining water is removed from the distilled ethanol. A denaturant is added to make it undrinkable, then the fuel is ready to sell.



Left over lignin is a useful byproduct of cellulosic ethanol production. It can be burned to fire the still at the plant or used industrially.

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garbage but questions their longevity.

“After a while, you’re going to run out of wood,” he said. “You need something that grows, and grows fast.”

As far as Dweikat is concerned, it is only a matter of time before his sweet little crop becomes one of the main feedstocks for alternative ethanol.

Alternative feedstocks for ethanol production seem like a no-brainer. Perennial grasses and sweet sorghum are simple to grow, cheap and easy on the environment. Others, like wood chips and garbage, are just lying around in forests and landfills. But in the United States, not a single plant is producing commercial cellulosic ethanol on a massive scale. Nor is a single vehicle in the country running on cellulosic ethanol.

Most of the problem stems from the fact that cellulose is a difficult substance to break up. Scientists have been trying to find a cost-effective way to do so since the 1990s, but they aren’t quite there yet.

“Some people are still underestimating how difficult it is going to be,” Mark Emalfarb, president and chief executive of biotechnology company Dyadic, told *The New York Times* in April 2007.

Breaking down cellulose molecules requires the use of several expensive enzymes, which can cost up to five times more per gallon than the enzymes needed for corn-based ethanol.

Still, progress has been made. The U.S. Energy Department hopes to bring the overall cost of producing cellulosic ethanol to \$1.07 per gallon by 2012. Production currently costs about twice that amount per gallon. To help the cause, the Energy Department designated \$726 million for renewable energy projects in 2007 — in part, to help scientists and researchers reduce the processing cost of cellulosic ethanol.

One such scientist is Y.H. Percival Zhang, assistant professor of biological engineering at Virginia Tech University. Zhang has developed a new process that replaces the expensive high-pressure, high-temperature cooking process with a much cooler reaction that occurs at around 120 degrees Fahrenheit. Zhang said that once an ethanol plant is built to use his process, the production costs would be anywhere from \$1 to \$1.20 per gallon of cellu-



PHOTOGRAPH BY KATE VEIK

“When the president said ‘switchgrass,’ the dam and the water broke and all the money came to switchgrass.”

Ismail Dweikat

UNL sweet-sorghum researcher

losic ethanol — a price competitive with corn ethanol. But such a plant is several years away, and Zhang said he doesn’t think cellulose will compete with corn until 2015.

“We’re still trying to get the money,” he said. “It’s a good process. We just need money and need time to build everything.”

While scientists like Zhang have worked diligently to develop new processes to make cellulosic ethanol, others have stumbled upon possible solutions by chance.

For years, Susan Leschine, a microbiology professor at the University of Massachusetts, examined soil and sediment samples from around the world for the ideal plant-eating microbe. In the end, she discovered the type of microbe she was looking for just a short drive from her lab.

In the moist dirt of the Quabbin Reservoir, roughly 65 miles west of Boston, one of Leschine’s lab assistants scooped up what she eventually dubbed the “Q” microbe. Leschine said she knew

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about three and a half years ago that she had something unique.

“We just decided to try adding higher concentrations of cellulose into cultures of the Q microbe; and not only did it digest it, it made ethanol as the only product,” she said.

Reducing a two-step process into one is the key to the Q microbe’s potential. And because the microbe occurs naturally, it saves time and money.

“The techniques for synthetic biology exist, but it’s a pretty complex process, and it takes a lot of person hours to do that,” Leschine said. “By luck, we found this microbe that already has those properties we were looking for.”

Leschine is also the chief scientist of SunEthanol, a small company with an equity investment from VeraSun Energy. SunEthanol is now preparing to build a pilot plant in Missouri with the hope of riding the Q microbe to eventual commercial production.

“This first round is really tough,” Leschine said. “The capital cost is huge.”

Initial costs, infrastructure challenges and the difficulties of developing a market for a new crop are among the reasons that Ken Cassman, UNL professor of agronomy and horticulture, is skeptical about the feasibility of alternative ethanol feedstocks in the near future.

“At the same time, you have to do two things: Develop a new crop for a market, and a market for a new crop,” he said.

But the ethanol industry is taking baby steps to reach mass commercial production of cellulosic ethanol. Test plants are popping up across the nation, including in Nebraska. Abengoa Bioenergy opened its test plant in York in October 2007, thanks in part to a \$17-million grant from the U.S. Department of Energy. Abengoa will apply what it learns from the York plant, which makes ethanol from wheat straw, to a planned commercial-scale

plant in Hugoton, Kan. The test plant in York is a 1/100th scale plant. The Energy Department has provided Abengoa with an additional \$76-million grant to help build the Kansas plant.

Private investors are also starting to jump on board. In January 2008, The New York Times reported that General Motors bought a stake in Coskata, a start-up company from Warrenville, Ill. Coskata plans to make ethanol from feedstocks other than corn.

According to researchers, private investments like these are important to ensure the future of cellulosic ethanol. But suppose everything for the industry goes smoothly and ethanol from feedstocks other than corn takes off.

“Cellulosic ethanol will have to be regional,” Leschine said.

“Using biomass and making liquid transportation fuels from it will definitely happen, but there’s going to be lots of different ways it’s going to work.”

Cassman said he thinks the biggest challenge for cellulosic ethanol, once the process is profitable, will be infrastructure. Current ethanol plants would require modifications to switch to cellulosic feedstocks. Ethanol can't be transported through pipelines because of its tendency to pick up water. Also, storing the massive amounts of feedstock the government is asking for may prove difficult.

Part of the solution to many of these issues seems to be a regional ethanol system.

"I think that's exactly where it's going," said Mitchell, the switchgrass researcher.

In switchgrass's case, Mitchell said, the crop for a cellulosic plant must come from a 30-mile radius to make economic sense.

Zhang, the Virginia Tech bioengineer, echoed Mitchell's analysis.

"As more and more ethanol is produced from biomass rather than corn, you will need to promote the local economy," he said. "So you should use local resources for local ethanol."

Meanwhile, some ethanol supporters remain skeptical about a shift from corn.

"Farmers are never going to do this — they are never going to get rich doing this. There will never be enough money in it to convince people to do it," said Shawn Griner, a rancher in Iowa.

Others believe that improving corn yields could keep corn in the ethanol game for a long time. However, Cassman said he doesn't think yields will increase fast enough in the long run to keep up.

For farmers like Jeff Walmsley, the whole thing is pretty simple.

"It all comes down to the economics of it," said Walmsley, who farms near Norfolk. In the past, Walmsley has planted several grasses similar to sweet sorghum to use as silage for his cattle. Although he grows mostly corn and soybeans now, he said it was simple and cheap to grow the other crops.

Walmsley has converted several engines on his farm to run on ethanol, and he likes to do the same for other farmers. He said if a cellulosic plant opened near Norfolk and it was somewhat competitive with corn, he'd plant whatever crop was needed to support it.

According to Cassman, in 10 to 20 years, Walmsley may have more crop choices if he wants to support ethanol.

"I think corn ethanol eventually limits itself and maybe extinguishes itself altogether," Cassman said. 🌾

PHOTOGRAPH BY KATE VEIK

The Nine-Mile Prairie spans 230 acres, and is owned by the University of Nebraska Foundation. Located northwest of Lincoln, Neb., the prairie's name refers not to its size but that it is 5 miles west and 4 miles north of the University of Nebraska campus. About 350 plant species and more than 80 species of birds have been observed on the prairie.



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