Corn Ethanol:

Laundering Fossil Fuels, Bilking Taxpayers, Damaging the Environment

By T. W. Patzek

Corn ethanol is the fuel du jour. It's domestic. It's not oil. Ethanol's going to help promote "energy independence." Magazines trumpet it as the motor vehicle fuel that comes from the "Midwest rather than the Mideast." But is it really?

THE U.S. AGRICULTURAL INDUSTRY DEPENDS HEAVILY ON NATURAL GAS, COAL, AND PETROLEUM FOR ITS EXISTENCE.

There is plenty of corn, to be sure. American farmers grow about 42% of the world's output. It's the single largest crop on earth (the sugarcane crop is larger, but it contains more water). In 2004, U.S. corn output could have fed the entire population of China. However, a mere 2% of U.S. corn goes directly to feed people; another 19% goes into processed foods (e.g., the high-fructose corn syrup additive in almost every processed food product in our supermarkets). The majority of U.S. corn goes to feed livestock, even though corn makes cattle sick and produces antibiotic-resistant bacteria.

These uses still leave mountains of excess corn stashed all over Midwest fields, waiting to rot or be processed into ethanol.

Interestingly, the National Corn Growers Association has been asking every corn grower to lobby Congress to increase domestic production of fossil fuels by opening the Arctic National Wildlife Reserve and the Outer Continental Shelf for exploration and production, and by drilling everywhere on U.S. territory for oil and gas. Why? Because the U.S. agricultural industry depends heavily on natural gas, coal, and petroleum for its existence. Nitrogen derivatives and other fertilizers drive the high yields achieved by U.S. farmers. Corn farming devours about 40% of these fertilizers. Nitrogen fertilizers, accounting for roughly half the total energy input per acre of harvested corn, are made from natural gas that is badly needed for other uses, such as home heating, cooking, and power generation. Today, the U.S. imports 15% of its natural gas and 60% of its oil. Furthermore, it is the world's largest importer of nitrogen fertilizers, mostly from Trinidad, Tobago, Canada, Russia, and Saudi Arabia.

The farm sector also depends significantly on natural gas and petroleum for transportation, refrigeration, irrigation, crop drying, heating farm buildings and homes, and pesticides and herbicides.

Accounting for the direct costs, roughly 40% of the calorific value of industrial corn grain comes directly from the use of fossil fuels, mostly natural gas, but also coal and petroleum. This grain could be burned in efficient corn stoves to provide home heating for the Midwest, or it could be ground, fermented, and distilled to produce ethanol.

Because corn grain is a nascent, or "baby" fossil fuel, it takes a lot of energy to transform it into ethanol. For example, the best performance guarantee by ICM, Inc. of Kansas, states that a dry-mill etha-

THE ENERGY DEBIT OF MAKING ETHANOL

By Michael J. Economides

Let's do a simple calculation, using Patzek's findings, to show how the ethanol hype violates basic principles of material and energy balances. (Every freshman engineering student understands this type of calculation.) We call this a control volume approach.

Take one gallon of ordinary gasoline. To replace that gallon with an equivalent number of BTUs requires 1.4 gallons of ethanol. Since corn is the only significant source of ethanol touted by its lobby, let's look at corn-based ethanol production. The process of converting corn into ethanol consumes 58 percent of the corn's BTU content. Another 11 percent of those BTU's are burned in moving the ethanol to the consumer at the service station. Thus, 69 percent of the energy contained in the corn is lost during processing and transportation. That leaves just 31 percent for conversion into fuel. So we take that 0.31 and divide the 1.4 gallons of ethanol (mentioned above) by it, in order to match the BTU content of one gallon of ordinary gasoline. It becomes clear that you need corn with an energy content the equivalent of 4.5 gallons of ethanol, in order to produce the 1.4 gallons we started with (1.4 / 0.31 = 4.5).

But here is the punchline. About 40 percent of corn's calorific value comes from fossil fuels that are used during the cultivation, harvesting, and transportation of the crop. Therefore, to produce 4.5 gallons of ethanol (which remember, due to conversion losses mentioned above, yields just 1.4 gallons of actual ethanol for use as motor fuel) requires farmers to use about 1.8 gallons of ordinary gasoline equivalent, in the forms of natural gas (for fertilizer) and motor fuel (primarily diesel). Thus, to produce enough ethanol to replace one gallon of fossil gasoline, farmers and processors consume at least 1.8 gallons of fossil fuels.

Incredibly, this calculation is conservative because it assumes that the ethanol manufacturing process is self-contained, that is, that incoming corn provides all operating energy and that ethanol is transported by ethanol-burning trucks. If we use a more logical methodology, the 1.8 gallons could actually double! In short, no matter what the environmentalists, farmers, and super hawks have to say, the numbers for ethanol just don't add up. ET

nol plant will spend an incredible 58% of ethanol's calorific value on direct distillation and co-product processing costs. If corn or ethanol must be moved from the Midwest to either coast, there is an additional transportation cost of up to 11% of ethanol's calorific value. An average U.S. refinery uses less than 12% of gasoline or diesel fuel's calorific value to produce and distribute them. Therefore, it takes from roughly 5 to 12 times more fossil energy to refine corn grain into ethanol than it does to convert crude oil into gasoline or diesel fuel.

Ethanol refineries also use huge amounts of water. An average dry-mill plant needs about 750,000 gallons of processing water per day. Some of this water is recycled, but the rest must be obtained from a local water supply. Clean drinking water is becoming scarce in much of the Midwest, especially across its western area. An average ethanol refinery emits dozens of dangerous chemicals into the air, such as toluene, ethylbenzene, acetone, formaldehyde, acetaldehyde, acrolein, benzene, styrene, and furfural. In line with the current schizophrenic attitude towards ethanol production, the U.S. Environmental Protection Agency has just proposed allowing ethanol refineries to more than double their legal air emissions, from 100 to 250 tons per year.

There are serious questions about the sustainability of corn production. Iowa has lost about half of its 14 inches of top soil to erosion. Fertilizer runoff and farm chemicals have polluted much of the Mississippi River basin, and that runoff flows all the way into the Gulf of Mexico. Over the last 20 years, the runoff from Midwestern corn and wheat fields into the Gulf of Mexico has totaled between 2,000 and 10,000 tons of nitrate per day. Over the next 70 years, thanks to agribusiness and industrial agriculture, the most productive grassland ecosystem on earth may be completely destroyed, neutered by overproduction. As they continue to be degraded, Midwestern fields will have to become larger and be subsidized even more with fossil energy.

Industrial crop production (corn, wheat, soybeans, etc.) causes environmental damage and loss of human health valued at between $5.7 and $16.9 billion per year. The annual hidden subsidies to agribusiness from environmental resources are estimated at $25 to $100 per hectare.

If one compares a corn field with a prairie, the conclusion is that the prairie runs on sunlight, while the corn field runs on fossil fuels. The most eloquent testimony to this effect was given by Theresa Schmalshof of the National Corn Growers As-

sociation, before the House Subcommittee on Energy and Mineral Resources in Washington, D.C. on May 19, 2005. She said that corn farmers will "face huge obstacles if our nation cannot come to grips with its desire to have limitless resources, like natural gas, for production and not realize that these resources have to come from somewhere. I am sure the members of the subcommittee as individuals know this well. However, Congress seems unaware of this fact. We can produce corn, but we need you to produce the kind of policy that enables us to use the needed resources to do so."

Thus corn agriculture is a scheme to launder fossil fuels into an industrial raw material, while damaging the environment of roughly half the continental U.S. land mass, and poisoning most rivers, streams, and coastal waters.

American taxpayers have spent a staggering $143.8 billion on farm subsidies over the past ten years, more than $104 billion of which (72%) went to 10% of recipients – some 312,000 large farming operations, cooperatives, partnerships, and corporations that collect, on average, more than $33,000 every year. Most of this money goes to support the prices of just three commodities: corn, soybeans, and wheat. Only a small fraction is spent on conservation and restoration programs. For example, in Iowa only 14.6% of farm subsidies was spent on them.

As long as agribusiness receives tens of billions of dollars each year in crop-price and environmental subsidies, it obtains a significant gift from the taxpayers: industrial raw materials (e.g., corn grain) at rock-bottom prices, which can be processed into, say, ethanol at a significant profit.

Top world producers of ethanol and their fuel consumption
(billion gallons per year)

Country	Ethanol 2004[a]	Gasoline Equivalent[b]	Motor Gasoline	Diesel Fuel
Brazil	3.99	2.39	4.3[c]	7.2[c]
U.S.	3.54	2.12	140[b]	45[b]
China	0.96	0.57	13.2[d]	7.5[c]
India	0.46	0.28	2.4[c]	9.7[c]
France	0.22	0.13	4.7[c]	8.7[c]
Russia	0.20	0.12	8.5[c]	3.7[c]
South Africa	0.11	0.07	2.5[c]	1.1[c]
U.K.	0.11	0.07	7.2[c]	5.2[c]

[a]Renewable Fuels Association
[b]Ethanol Volume ×0.95×0.63
[c]World Resources Institute, Energy Resources Database, 2001
[d]U.S. DOE EIA, 2004
[e]2004 estimate from www.vecc-sepa.org.cn/eng/index.jsp

This profit is further enhanced by a subsidy of 50 cents per gallon of ethanol – also courtesy of the taxpayers – via the Federal Volumetric Ethanol Excise Tax Credit (VEETC). But it does not end there. States and local communities lavish further subsidies on ethanol producers.

There are yet more subsidies. The distance driven by a properly tuned car is directly proportional to the calorific value of the car's fuel. Ethanol has 63 percent of the calorific value of gasoline. What does that mean? In terms of driving distance, one gallon of E85 is equivalent to 0.701 gallons of unleaded gasoline. If ordinary gasoline sells for $3.09/gallon and E85 at $2.49/gallon, as shown in the adjoining photograph, the customer is misled into thinking ethanol is a good deal. However, the energy-equivalent price of 1 gallon of E85 is $2.49/0.701=$3.55. So, in fact, the buyer of E85 gasoline subsidizes the ethanol seller with $3.55 - $3.09 = $0.46 per gallon of E85. By using 20 gallons of E85 per week, a driver will spend an additional $500 per year.

So one might ask, what is achieved in the U.S. with corn ethanol, the concomitant fossil fuel expenditures, and environmental damage? One answer is shown in Table 1. Corn ethanol has about the same effect on U.S. motor gasoline consumption as proper inflation of passenger car tires. The impact of ethanol is much larger in the other countries in Table 1 simply because they use 10 – 60 times less gasoline than the U.S., despite together having roughly half of the global population.

The U.S. has spent enough time, money, and natural and human resources on pursuing the mirage of replacing its runaway aggregate consumption of fossil fuels (petroleum + natural gas + coal) with biomass. Better solutions lie on the demand side: limiting consumption, improving efficiency, consuming more locally, fostering local biofuel production and consumption, etc. The world's consumers need more transportation fuel. Unfortunately, despite all the rhetoric and politics, ethanol is not the solution. ET