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Ethanol: Cost, Supply, Alternative Uses, and Subsidy Levels

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At this writing, the clean air bill is working it's way through congress and the political and military crisis in the Middle East is contributing to a significant rise in international oil prices. Both situations create renewed interest in ethanol production from corn, and resurrect long-standing disagreements about fuel ethanol costs, uses, and subsidies.

In the debate over the clean air bill, ethanol program cost estimates varied widely depending on whether corn farmers, ethanol producers, or petroleum and automobile industries were performing the calculations. These differing "political" cost estimates disregard a substantial level of scientific agreement on expected ethanol program costs. At best, they result in a high level of public "disinformation", and at worst, poor policy. My purpose in this note is to summarize the current understanding of the potential role of ethanol as an automotive fuel.

Clean Fuel Engines

Auto industry claims that clean fuel engines will take years (late 1990s) to produce belie the fact that GM and Ford have produced ethanol engines commercially in Brazil for a number of years. Five millon ethanol engines run on Brazilian highways today. If we choose to mandate clean fuel use in specific U.S. areas, ethanol engines can be available quickly.

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Ethanol Production Capacity

Ethanol production from corn is currently 0.84 billion gallons per year, less than one percent of gasoline use (115 billion gallons). Full U.S. ethanol capacity may be closer to one billion gallons. One bushel of corn produces 2.5 gallons of ethanol and 18 lbs. of distillers dried grains under a dry-milling process. Wet milling produces a different set of by-products: 1.6 lbs. of corn oil, 2.5 lbs. of corn gluten meal, 12.5 lbs. of corn gluten feed and 15-18 lbs. of carbon dioxide. Ethanol production currently utilizes about 350 million bushels of corn annually. Adding one billion gallons of ethanol would require an additional 400 million bushels of corn, raising the U.S. price of corn about $0.10 per bushel. Adding two billion gallons of ethanol would raise corn prices $0.35 per bushel.

Brazil produces 3 billion gallons of ethanol per year from sugar cane, but has capacity to produce over 4 billion gallons and could be an additional supply source. Since sugar cane requires two years to mature, this excess Brazilian capacity would not be available to world markets for at least two years. Also, if high oil prices persist, Brazil would likely use part of this one billion gallon excess capacity for domestic use. A minor sugar cane based ethanol industry is also possible in the Caribbean.

Ethanol Production Costs

During the 1980s, costs of producing ethanol from corn ranged from $.90 to $1.50 per gallon depending on corn prices, ethanol by-product prices, and energy costs (USDA). At today's corn price of $2.50 per bushel, ethanol costs are $1.30 per gallon. Corn at $3.00 per bushel would raise this cost to about $1.50 per gallon.

Brazilian ethanol can be delivered to U.S. gasoline refineries for $1.00-1.10 per gallon, but the $.60 import duty brings the total U.S. market cost to $1.60- $1.70.

Ethanol Subsidies

The federal subsidy is $.60 per gallon of ethanol. State subsidies, on average, add another $.20 for a total subsidy of about $.80 per gallon. The federal subsidy is generally applied at the gas pump in the form of a $.06 exemption from the federal excise tax on each gallon of ethanol-gasoline mixture sold (10% ethanol, 90% gasoline). Recently, ETBE production (described below) has been cleared for an equivalent subsidy at the refinery level.

State subsidies vary in amount and form. In Ohio the state tax exemption is applied at the wholesale level directly to ethanol sales and is currently $.15 per gallon of ethanol. Thus, in Ohio, the net cost of ethanol to a gas station would be $.75 less than the market price of ethanol. For example, if ethanol sold for $1.30 per gallon, the net cost to the gas station would be $.55 per gallon ($1.30-$.75=$.55).

A $.60 per gallon import duty effectively shields U.S. ethanol producers from foreign competition. This import duty offsets the federal excise tax exemption. If we assume a cost of $1.10 per gallon of imported ethanol, than the net cost of imported ethanol to Ohio gas stations would be $.95 per gallon as compared to the $.55 per gallon for domestic ethanol ($1.10+$.60-$.75=$.95).

Ethanol Market Value (Without Subsidy)

Determining a non-subsidized market value (price) for ethanol is more complicated. Depending on how ethanol is used, its value can be significantly lower or higher than the gasoline it replaces. Unfortunately, we do not have enough experience with ethanol as a fuel market commodity and must rely on price estimates based on market prices of close alternatives. For example, as a pure fuel, ethanol has less energy than gasoline (fewer miles per gallon), and will command a market price only 75-80% of gasoline price (Brazil).

Alternatively, ethanol can be mixed directly with gasoline up to concentrations of 25 percent ethanol (Brazil has used a 22 percent mixture while U.S. subsidy regulations mandate a 10 percent mixture). A ten percent ethanol concentration will raise octane of gasoline by 2.7 octane numbers, adding value to the gasoline. This added octane value is harder to specify during this current period of octane transition, but should command an octane price premium over regular gasoline of $.35-.40 per gallon of ethanol at the ten percent rate of use.

A third use for ethanol is in ETBE, a new independent octane source. ETBE is a mixture of ethanol and isobutylene with an octane level of 111. It's ethanol component should command a $.15 premium over regular gasoline.

Policy Alternatives and Subsidy Level

Which use of ethanol is most appropriate to meet clean air needs and reduce reliance on imported oil? First, ethanol use as a pure fuel is very costly. If we assume oil prices in the mid $20 per barrel range by 1995, (wholesale regular at $.75 per gallon), then pure ethanol use would have a market value of $.55-.60 per gallon, less than one-half production costs. A subsidy of at least $.70 per gallon would be needed to cover current production expenses.

If sub-octane gasoline (84-85 octane) is made available to high pollution risk areas, then mixing ethanol directly with sub-octane gasoline would result in an ethanol market value of $1.10-1.15 per gallon, reducing the necessary subsidy level considerably. In this case, costs of a 10 percent ethanol-gasoline mixture in designated pollution areas would increase local fuel cost about 2 cents per gallon above gasoline (a subsidy of $.15-.20 per gallon of ethanol), a significantly lower cost for consumers and taxpayers.

General use of ethanol at the refinery level for all gasoline markets would be most easily obtained from ETBE. ETBE is readily moved through pipelines and more closely meets both refiners needs for an octane source, and other mandated fuel properties than do pure ethanol or ethanol gasoline mixtures. Market price of ethanol used in ETBE would be $.90 per gallon when oil is $25 per barrel. The cost (non-subsidized) of ETBE would be about 2-3 cents greater per gallon of gasoline than MTBE (methanol and isobutylene), a current octane source.

A Suggested Policy Reform

The current federal policy (as noted above), involves an exemption from federal excise taxes at the retail level for specific ethanol uses, (a 10% ethanol-90% gasoline mixture, and ETBE) with an offsetting import tax. The net result of this narrowly focused policy is a limited ethanol supply, a high priced product that has narrowly defined uses only, and an ethanol industry with periodic booms and busts as it operates on a fixed subsidy level, but faces volatile prices for corn (cost side) and oil (revenue side).

As we contemplate renewable fuels policies beyond 1993, a far better alternative would be a *variable ethanol subsidy paid directly to producers*. This would eliminate the current market price distortion and the need for an import tax. The variable subsidy would be determined periodically (monthly or quarterly), and would take into account average industry production costs and current corn and oil prices, eliminating the economic uncertainty associated with wide swings in corn and oil prices.

With a subsidy paid directly to U.S. ethanol producers, ethanol prices would then find their own competitive level in the market, and ethanol would be drawn automatically to it's best use. If imports could compete on a non-subsidized level, they could add to and help diversify our fuel sources.

The critical point is that public costs of supporting ethanol production can be minimized by making full use of ethanol octane properties simultaneously with clean air objectives, either through mixing with sub-octane gasoline or through ETBE. By removing the present price distortion caused by applying the subsidy at the retail level, ethanol will automatically find it's best use. Secondly, by allowing duty-free imports, these costs can be reduced further.

Many important public interests (clean air, diversified energy supplies, consumer and taxpayer costs) are lost in the debate over the private interests of corn farmers, ethanol producers, and automobile and oil companies. The economics are rather clear. We need to refocus public discussion on the important issues.