NGVAMERICA
Natural Gas Vehicles for America

Fact Sheet: Why Ethanol and Biodiesel Alone Can *Not* Achieve 35 Billion Gallons of Petroleum Displacement by 2017

In his 2007 State of the Union address, President Bush called for the use of 35 billion gallons of renewable and alternative transportation fuels per year by 2017. Farm fuel advocates interpret this to mean 35 billion gallons of ethanol and biodiesel. It is true that, if America is to reduce its dependence on foreign oil, we *must* produce and use more ethanol and biodiesel in our vehicles.

However, putting rhetoric, hyperbole and wishes aside, if the cold hard numbers are examined, it is clear that America must maximize its use of *all* available alternative fuels. It will be highly improbable – if not impossible – for ethanol and biodiesel *alone* to achieve President Bush's goal because:

- **We Won't Produce Enough Flexible Fuel Vehicles (FFVs)**
- **We Won't Use E85 In Every FFV All The Time**
- **We Can't Produce Enough Ethanol And Biodiesel**

Here's why:

ASSUMPTIONS

- **E10 Consumption:** Assume that through mandates or other means we can achieve the blending of 10 percent ethanol in every gallon of gasoline used by 2017. The U.S. Energy Information Administration (EIA) forecasts the U.S. will consume about 150 billion gallons of fuel for light-duty vehicles in 2017. If all light-duty fuel were blended with 10 percent ethanol, the demand for ethanol would be 15 billion gallons.[i] That leaves 20 billion gallons that must be provided through other means.
  - Caveat: Because of VOC pollution from lower blends of ethanol, it is questionable whether California – and certain other states -- will move to a 10 percent ethanol blend. Therefore, this assumption is optimistic.

- **Biodiesel Consumption:** Assume further that the U.S. also can produce and use 2 billion gallons of biodiesel in vehicles by 2017. That would reduce the gap to 18 billion gallons.

- Caveat: Biodiesel (B100) has about 8 percent less energy per gallon than petroleum diesel, so more gallons of biodiesel are needed to power a vehicle than a comparable volume of petroleum diesel.
- Caveat: EIA projects that the U.S. will use about 50 billion gallons of diesel fuel in 2017 for buses and freight trucks. The biodiesel industry currently advocates the use of a blend of 20 percent biodiesel (B20), but most manufacturers of diesel-fueled engines/vehicles discourage use of blends greater than B5 (and some support no more than B2). Therefore, to achieve the 2 billion gallon goal will require the widespread (if not universal) use of B5. This would be probably not happen voluntarily; it will require a Congressional mandate.
- Caveat: U.S. biodiesel manufacturers produced 250 million gallons of biodiesel in 2006. Production would have to increase eight-fold to achieve 2 billion gallons.
- Caveat: The total U.S. soybean production in 2006 was 3.19 billion bushels (a record). The biodiesel yield from soybeans is 1.4 gallons per bushel. Therefore it would take 1.43 billion bushels of soybeans to produce 2 billion gallons of biodiesel. This is equal to 49 percent of the total U.S. soybean crop in 2006.

- **E85 Consumption:** Therefore, for ethanol and biodiesel to displace 35 billion gallons a year in 2017, use of ethanol in E85 flexible fueled vehicles (FFVs) would have to make up the difference – i.e., the 18 billion gallons not achieved through the use of biodiesel and E10 blends. It would require over 52 million light-duty FFVs using E85 full time to use 18 billion gallons.[ii]

WE WON'T PRODUCE ENOUGH FFVS

- Unfortunately, there are a number of factors that mitigate against there being 52 million FFVs on the road in 2017:
  - Currently, automakers are producing less than 3 million FFVs per year.
  - There are about 6 million FFVs on U.S. roads today. To achieve 52 million FFVs on the road by 2017, the auto industry would have to add an average of 4.2 million FFVs per year for the next 11 years.
  - Many of these vehicles (especially the current ones) will be scrapped by 2017, so *annual* production will need to be greater – probably in the 5

million vehicle range. And since manufacturers will almost definitely not make that target over the next several years, production in the out-years will need to be even greater.

- There were 15.6 million gasoline light-duty cars and trucks sold in the U.S. in 2006. The U.S. Energy Information Administration forecasts that will grow to 16.7 million by 2017. So, it would not *seem* unreasonable for automakers to produce "only" 5 million FFVs per year (30 percent of all light-duty vehicles).
- That could be achieved if Congress mandated the production of FFVs. While there have been some indications that the Administration might request such a mandate, it seems highly unlikely that such a mandate would be passed by Congress. So automakers would have to produce these vehicles voluntarily.
- Almost all the FFVs sold in the U.S. are produced by GM, Ford and Daimler Chrysler. Other than DaimlerChrysler, only one other international manufacturer (Nissan) offers even one FFV model in the U.S. today. GM, Ford and DaimlerChrysler represent a shrinking percentage of all U.S. sales, so, unless the Toyota, Honda, and other larger international automakers opt to make and sell FFVs in large numbers, upwards of 50 percent of all GM's, Ford's and DaimlerChrysler's U.S. vehicles would need to be FFVs.
- While these automakers have indicated that they could do so (with DaimlerChrysler already saying they would do so), history has shown that most of the major environmentally driven technology shifts promised by Detroit have not come to pass – or certainly not in the time frame promised.[iii]

WE WON'T USE E85 IN EVERY FFV ALL THE TIME

- Even if there were 52 million FFVs on the road in 2017, the assumption that *all* FFVs will use E85 *all* the time is unrealistic.
  - Currently there are about 170,000 gasoline stations, only 1000 of which offer E85. Even if the number of E85 stations grows dramatically, there will be many times in 2017 when drivers will not have an E85 station nearby when they need to refuel, and, therefore, will refuel with gasoline.[iv]

- Even where E85 is available, many drivers will opt to refuel with gasoline because E85 will frequently be more expensive:
  - The vast majority of U.S. ethanol is produced from corn, and that is unlikely to change much over the next decade.[v] Even with the existing modest level of ethanol production, corn prices have more than doubled in the 13 months from the end of 2005 to January 2007. Development of better enzymes and other improvements in ethanol production technology should be expected, and these will lower the cost of production. However, the price of corn is likely to increase much more (not decrease) as ethanol takes an ever larger share of corn production. This will drive up the cost of ethanol even further, making it more expensive than gasoline in many markets.
  - Another reason for the higher cost of ethanol is that it currently cannot be shipped in petroleum pipelines. Today, ethanol is shipped by rail, barge and truck – with trucks being the most costly for long distances. Capacities of rail and barge systems used to ship ethanol are essentially under strain, and transportation costs for shipping ethanol are likely to increase as more ethanol is used. There have been recent discussions of the possibility of shipping low ethanol blends via petroleum pipelines, but not E85 or E100. Therefore, if pipelines for these higher blends are to be used, they would need to be dedicated to ethanol. Shipping by pipeline would eventually be the most economically way of transporting ethanol, but, at levels currently forecasted, pipelines are not economic and will not be economic even with the ethanol levels called for by the President.
  - Currently, ethanol blenders receive a tax credit equal to 51 cents per ethanol gallon. In addition to the blender credit, smaller producers also receive a 10-cent per gallon credit. Production of 35 billion gallons of ethanol per year in 2017 would cost the U.S. Treasury almost $17 billion per year -- almost a seven-fold increase from 2006. If Congress were to rescind some or all of this credit because of budget pressures, ethanol prices would increase accordingly.

For all the reasons above, it is highly unlikely that the *demand* for ethanol and biodiesel could reach 35 billion gallons by 2017.

WE CAN'T PRODUCE ENOUGH ETHANOL AND BIODIESEL

But if the *demand* were there, could the U.S. *supply* be there. The short answer is … no. Here's why:

- America does not have nearly enough arable land. It has been estimated that converting the entire U.S. corn crop to ethanol would only yield energy equal to 12 percent of our gasoline consumption -- or 16 billon gallons. Even assuming substantial improvements in corn conversion technology and the expansion of corn production to arable areas now producing other crops, ethanol production would fall far short of the 2017 goal.

- Corn for ethanol and soybeans for biodiesel compete for the same land. As the price of corn increases and becomes more profitable compared to other crops, farmers will begin switching those other crops for corn. Among those crops is soybeans – the primary U.S. feedstock for biodiesel. There are already examples of this happening. If soybeans ever became more profitable, it would swing the other way. But, in either case, growth of one will limit the growth of the other.

- To displace gasoline with ethanol would require a substantial diversion of increasing scare water resources. About 75 percent of the world's water demand is in the form of agricultural irrigation. As a rule of thumb, it takes 1,000 tons of water to produce one ton of grain. By definition, water limits are grain limits. To grow the corn necessary to produce one gasoline-gallon-equivalent of ethanol requires about 2,700 gallons of water.[vi] To put that into perspective, the water industry estimates that an average person uses 3000 gallons of water per month. To produce an extra 30 billion gasoline-gallon-equivalent would be the equivalent of adding another 2.25 *billion* people to the U.S. populations. The current U.S. population is a little over 300 *million*. Note that this does not even take into account the amount of water necessary to actually produce the ethanol – which is reported to be between 3 and 6 gallons of water per gallon of ethanol.

- The U.S. Energy Information Administration estimates that the practical limit for domestic ethanol production is about 700,000 barrels per day (or 10.7 billion gallons a year), a figure they do not think is realistic until 2030.

- America could import less expensive ethanol – primarily sugar cane ethanol from Brazil (we actually imported 616 million gallons in 2006). But

Congress and the Administration have imposed a 54-cent per ethanol gallon tariff on imported ethanol, which is not scheduled to expire until 2009. This tax makes most imported ethanol uncompetitive with U.S. corn ethanol. The President recently stated that he would not push for the tax's repeal. More importantly, despite all the hoopla, Brazil only produces a little over 4 billion gallons of ethanol per year – with production expected to grow to 7 billion gallons by 2010. Most of that is used in Brazil. So, even if Congress repealed the tax, Brazilian ethanol imports couldn't make too much of a contribution to the 35 billion gallon goal.

- The ultimate solution to ethanol production is ethanol produced from cellulosic crops, such as switchgrass. Unfortunately, just as with other over-the-horizon technologies such as fuel cell cars, the technology to produce competitively priced ethanol from cellulosic crops has not yet been developed. No cellulosic ethanol industry exists today, and, while there periodically are positive R&D announcements, it is unclear when or if cellulosic ethanol will be commercially available.

CONCLUSION

If America is to reduce its dependence on foreign oil, we *must* produce and use more ethanol and biodiesel in our vehicles. However, as explained above, it is highly improbable – if not impossible – for ethanol and biodiesel *alone* to achieve President Bush's goal of 35 billion gallons of renewable and alternative fuel by 2017. To have a chance of achieving this goal, America must maximize the use of all alternative fuels – especially natural gas.

END NOTES

[i] Actually, it would be 15.6 billion gallons. Gasoline contains 124,800 BTU per gallon. Ethanol has only about 76,100 Btu. Therefore, a gallon containing 10 percent ethanol and 90 percent gasoline (i.e., E10) would contain 119,930 Btu. To provide the equivalent of 150 billion gallons of gasoline would require 156 billion gallons of E10 or 15.6 billion gallons of E100.

[ii] This number is derived as follows.

1. Assume the average FFV will be getting 34 miles to a gasoline gallon by 2017 and driving 12,000 miles per year. The average FFV, therefore, would use 353 gasoline-gallon-equivalent of fuel.
2. The average ethanol content of "E85" is not 85 percent ethanol for two reasons. First, before it is shipped, pure ethanol is denatured by adding 5 gallons of gasoline to every 100 gallons of pure ethanol. Second, because of cold-starting problems, the amount of ethanol is reduced to as little as 70 percent ethanol by volume in cold months. Between these two factors, the average amount of ethanol in a gallon of E85 averages to about 75 percent.
3. But the amount of "additional" ethanol is even less. Above, we assumed that all gasoline would be blended with 10 percent ethanol. To keep from double counting and still have 75 percent ethanol in E85, the total ethanol added to E85 must be reduced by another 2.5 percentage points – or 72.5 percent.
4. Pure ethanol only has two-thirds of the energy content of gasoline. So to drive the same distance on a 353 gallons of gasoline would require 471 gallons of "E85", 72.5 percent of which is pure ethanol or 342 gallons of ethanol.
5. Dividing the 18 billion gallons by 342 gallons, results in over 52 million vehicles.

[iii] At the 2007 National Ethanol Vehicle Conference, Keith Cole, a Washington lobbyist for the General Motors, said it is *possible* there could only be 22 million FFVs on the road by 2015 – far short of the 55 million vehicles needed by 2017.

[iv] Actually, we've assumed it will be E10, but the 10 percent ethanol has already been taken into account above.

[v]Advocates for an ethanol-based transportation system point to cellulosic ethanol as the ultimate answer. However, it is questionable whether cellulosic ethanol could be a major factor by 2017. "Here in the United States, cellulosic ethanol, which could theoretically utilize non-food crops such as switchgrass, is often held up as the panacea for a truly green biofuel that needn't have much effect on food prices. Yet the process for extracting sugars from cellulose remains, 30 years since the government first started investing in research for it, is still just beyond the grasp of viable commercial-scale production. USDA chief economist Keith Collins recently told Congress not to expect significant fuel contributions from cellulose for 'some years into the future.'" ("Feeding the Beast," Tom Philpott. *The Grist Magazine*, 12/16/06). And, even if it started to be available, no one knows what the cost of cellulosic ethanol will be in 2017.

[vi] While the amount of water required varies by variety and weather, a rough calculation can be made as follows: Nebraska corn (as an example) requires 21 to 28 inches of water during the growing

season. One acre foot = 325,851 gallons. An acre-foot is the amount of water that would cover an acre one foot deep. Assume corn needs 24 inches of water or two acre feet, which is 651,702 gallons. The high side of corn yield in the US averages 145 bushels per acre.
So the water requirement for corn is about 4,500 gallons per bushel. Ethanol production is 2.5 gallons per bushel, which translates into 1.67 gasoline-gallon equivalent. Therefore, to grow the corn necessary to produce one gasoline-gallon-equivalent of ethanol requires about 2,700 gallons of water.