

## Meandering Through the Oil Industry: Part 5

*This technical article is in a series characterizing the process that the oil industry follows to bring us one of our favorite commodities, the gasoline that powers our Classics. This time, we balance the pros and cons of alcohol in fuels.*

### Alcohol in Fuel

By Brian Rohrback



As I have belabored in the previous articles in this set, gasoline is not a single thing, it is a complex mixture of up to about a thousand compounds that are distilled and reformed through catalytic and chemical means. There are many additives placed into the gasoline as produced in the refinery. Most of these are added after the fact and not in the refinery itself. They include fuel stabilizers, detergents, even marker compounds for traceability (we will have fun with markers in a future technical article). But nothing generates more discussion than the addition of alcohol to gasoline, whether it be for our Classics or for our daily drivers.

As automobiles evolve over time, it is expected that the fuels we use also evolve to fit our understanding of the science behind engine design, efficiency, and maintenance. We have the added overlay of political decision making which seems (to the author) to be a balance among legitimate environmental concerns, targeted subsidies, and using legislation to forward incompletely-researched agendas.

Even though the unsubsidized cost advantages of alcohol-gasoline blends are small (possibly negative), it is pretty clear that alcohol in our gasoline supply is here to stay. Alcohol use in fuel has increased roughly a factor of 10 since the year 2000 (The use of alcohol in motor fuel increased from 1.7 billion gallons in 2001 to 14.4 billion in 2016).

The alcohol that is most economic to product is the same one we employ to deliver the buzz in beer, wine, and whiskey: ethanol. Although we can generate alcohol from nearly any form of biomass (e.g., grains, grasses, sugarcane, potatoes, fruit), we mostly process corn (see Sidebar).

Myths abound when we talk about ethanol in gasoline and these get repeated without full consideration. Here is my list:

Does it reduce our dependence on foreign oil? – *Yes, but the claim is largely overblown. Only a few percent reduction in the petroleum portion of gasoline usage can really be attributed to our incorporation of alcohol.*

Are my car's emissions lower? – *Lower emissions will occur when*

*ethanol is added to the fuel but, as with the energy independence talk, the benefits are not huge.*

Will it change my gas mileage with ethanol in the mix? – *You should expect a decrease in gas mileage for a Classic or for modern iron. Because ethanol has 2/3 the energy of the gasoline it displaces, you should expect about a 3% reduction in MPG.*

Is ethanol more expensive than the hydrocarbon fuel it partially displaces? – *Government subsidies reduces the impact on the pump price. Eliminate the subsidies and ethanol is between 50% and 100% more expensive than the stuff that comes from a refinery (although the premium is dropping).*

I have a friend who was the head of Tesoro's refining operations (he was based in Texas). He commented on the significant tax advantages. They, along with nearly every other refiner, produce lower grade gasoline and blend the alcohol as an octane boosting agent. His comment:

*"In the state of Washington I don't think that you'll likely find any gas from major supplier stations that provide neat gasoline (no ethanol).*



## For a list of stations that sell pure, ethanol-free gasoline in the U.S. and Canada

<https://www.pure-gas.org/>

All the fuel shipped down the pipeline is now a sub-grade that requires ethanol to be added to meet the octane specification. You can, however, find an independent jobber that is making available premium sub-grade before they add in the ethanol. This would result in a mid-grade gasoline. But the economics of ethanol vs. gasoline is such that there is a strong incentive to add ethanol these days (tax credit and all)."

Alcohol is subsidized by tax dollars and government regulations. There really is some good and some bad to this subsidy. It is easier and cheaper to produce alcohol-free gasoline but these subsidies have stimulated a massive investment in infrastructure with jobs created in construction and supplier organizations. Plus, there is the science that is being advanced that eventually will lead to order of magnitude improvements in our ability to produce alcohol for fuels of all sorts. So, there is some investment in our future going on here that balances out the short-term economic folly.

So what does alcohol in gasoline do to the efficiency of the engine?

Well, as most everything I have described, it is complicated. Alcohol has only about two-thirds of the energy value as the gasoline range hydrocarbons it displaces. If we assume a 10% dollop of ethanol in our fuel purchase, that would mean about a 3% drop in fuel economy, all things staying equal. But alcohol, as race car technical mavens know, allows an engine to run at a higher compression ratio, thus extracting more power from the fuel. In the short run (because we do not change the compression settings on our cars) we should be able to note we are driving a slightly thirstier car when ethanol is in the mix.

Is this more information than you want? Hang on as I will launch more discussion of ethanol after I have had a few beers ;-)



## Corny Ole Ethanol

*The common way to make fuel-grade ethanol is the dry-mill method, which follows several processing operations:*

1. *First the corn is harvested and the kernels separated from the detritus.*
2. *Grinding the corn produces a powder, water is added along with enzymes and the whole lot is cooked generating a starchy mash (if it sounds like moonshining, it is).*
3. *Cooling the mash and adding yet another enzyme converts the starch into sugar (all this is just in place to make the yeast happy).*
4. *We add the yeast (single-cell micro-organisms, members of the fungus kingdom) to ferment the sugar into ethanol and carbon dioxide.*
5. *This mixture is distilled (still sounds like moonshine) to separate the ethanol from the solids.*
6. *Ethanol does not distill off all by itself; there is a thing called an azeotrope, which means that a combination of water and ethanol are the result of this distillation (a 5% water, 95% ethanol mix).*
7. *This 5% water can be largely removed by adding a small amount of benzene or gasoline to the alcohol.*
8. *One of the byproducts is high-quality animal feed and there is work to convert the remainder of the plant material (largely cellulose) into alcohol as well. There are significant challenges to this next-generation cellulose conversion.*