

Exploring Ethanol blends

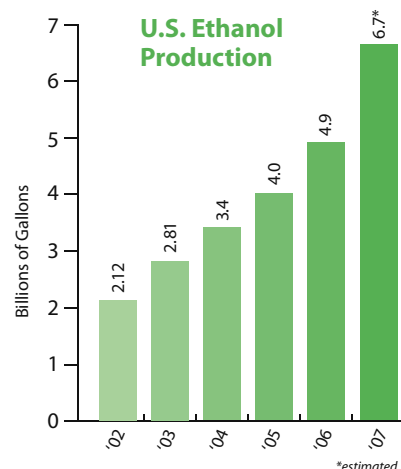
Beyond Ten Percent

"Will ethanol be confined by the boundaries of the blend market, or is a larger and more meaningful role possible?"

By Kristin Brekke

Ethanol's benefits to society are many, a true success story that is only in its beginning chapters. In these opening scenes, all stakeholders - ethanol, agriculture, automotive, public policy, petroleum - have an opportunity to draft the role that ethanol will play in America's energy portfolio. The decisions we make will either curb or encourage ethanol's growth.

The use of ethanol is nearing such a crossroads. Will ethanol be confined by the boundaries of the blend market, or is a larger and more meaningful role possible? Those with a progressive eye toward the future are exploring the possibility of expanding the standard blend definition beyond ten percent.



Ethanol production and use, by the numbers

In 2006, the U.S. ethanol industry produced 4.9 billion gallons of the renewable fuel, up from 4 billion the previous year. The increases in ethanol production over the past several years have been impressive, as an industry has grown up from the grassroots and is beginning to make a real impression in the fuel supply.

Even given this rate of growth, ethanol remains a small portion of the overall fuel supply. With the nation consuming a whopping 140 billion gallons of gasoline annually, the ethanol industry's 2006 production comes in at 3.5 percent of that total. However, today nearly half of America's gasoline - 46 percent - contains some percentage of ethanol, demonstrating its value as a blend component and supply extender nationwide.

The 10 percent blend is by far the most common way ethanol is retailed in the United States, with 99 percent of the ethanol produced here being used for E10, or blends up to that 10 percent level such as California's 5.7 percent mixture.

Under the umbrella of the ethanol topic, E85 does often generate more media attention than its E10 counterpart, though only about one percent of America's ethanol ends up as this alternative fuel blend. E85 availability is growing, now offered as a choice at 1200 gas stations, but much more roll-out is needed until it can have a larger presence at the nation's 168,000 gas stations.



The “E10 everywhere” scenario

How much ethanol could the U.S. possibly consume each year? With E10 and E85 as the two main blends available today, the total potential ethanol use depends upon the infrastructure available to distribute and use these fuels.

E10 has the advantage of being compatible with all makes and models of vehicles and the ability to be incorporated into the existing fuel distribution system. The “blend market” is the nation’s capacity to consume 10 percent ethanol - currently considered the standard blend - in each gallon of gasoline.

Though the math would show that 14 billion gallons of ethanol is the upper limit of this blend market, 10 percent of the 140 billion gallons of gasoline consumed annually, most experts agree that the practical limitation is less than that. An E10-everywhere scenario likely offers the U.S. the ability to utilize about 12 billion or 13 billion gallons of ethanol on an annual basis.

The total potential for E85 use is harder to pin down, given the current debate over “compatible” infrastructure and the questions surrounding how quickly those issues can be resolved and how quickly new equipment can be rolled out. With more stations added to the E85 roster and more Flexible Fuel Vehicles (FFVs) rolling off assembly lines each year, there is a growing role ready for this important ethanol blend as well.

With ethanol production coming online at current rates and with cellulosic technologies showing such promise to open doors to exponentially larger production levels, does the blend market offer ethanol a chance to be all it can be? The blend market - as currently defined - could be one of those limiting factors in the ethanol story.

Redefining the blend market

“Ethanol offers a wealth of benefits to the nation - for a strong economy, clean air, for energy independence - but the scope of these benefits is determined by the scope of ethanol use. The larger the markets are for ethanol, the more meaningful

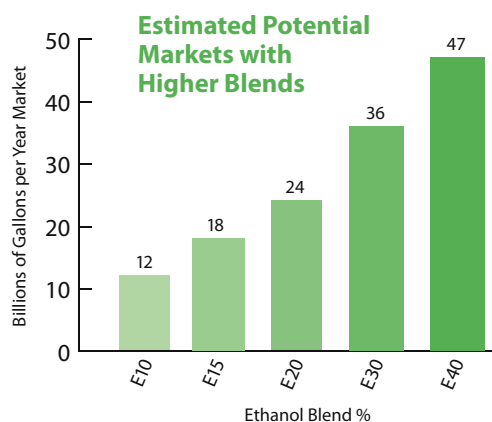
opportunities there are to enact these positive societal changes,” said Brian Jennings, Executive Vice President of the American Coalition for Ethanol (ACE). “It is critically important that we not let barriers be created in ethanol’s path where no barriers need to be,” Jennings added. “And that is why we’re asking whether it’s possible to expand ethanol’s ‘standard’ definition beyond 10 percent.”

A simple, yet significant question - is it possible to move beyond 10 percent as a standard ethanol blend for non-FFV, unmodified vehicles? If the answer is yes, the impacts could be dramatic.

As it stands today, an E10 blend market out of 140 billion gallons of gasoline equals about 12 billion gallons of ethanol annually, factoring in a small reduction for any practical limitations that may occur in getting ethanol into each and every gallon of U.S. gasoline.

If E20, 20 percent gasoline and 80 percent ethanol, become a possibility as a standard formulation, the blend market would then increase to 24 billion gallons, including that same “practical limitations” factor as noted above.

Looking at the possibility of E30, the nation’s total capacity to consume ethanol would climb to about 36 billion gallons per year. E40 would translate to about 47 billion gallons. These are large increases over the current blend, but even a small increase - to E15, for example - would increase our ability to use ethanol to 18 billion gallons annually, a 30 percent increase over the current E10 blend market.



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“The burden of proof is on the ethanol stakeholders to show that these higher blends are a real possibility. There are a few solid pieces of research which can be pointed to at this time.”

“Could blends beyond 10 percent perform well in standard, unmodified vehicles? The initial evidence suggests yes, and ACE is making sure that this subject is studied more fully,” Jennings added. “It is important for the stakeholders to come to the table now and begin a dialog on this important matter.”

Testing toward higher blends

There is currently not a large body of scientific evidence proving unequivocally that blends beyond E10 will work in standard automobiles, nor is there much documentation demonstrating that they wouldn't work. Yet the burden of proof is on the ethanol stakeholders to show that these higher blends are a real possibility. There are a few solid pieces of research which can be pointed to at this time.

In 1999, a study was conducted on two ethanol blends - E10 and E30 - by the Minnesota Center for Automotive Research at Minnesota State University at Mankato. The one-year project, “Use of Mid-Range Ethanol / Gasoline Blends in Unmodified Passenger Cars and Light Duty

Trucks,” focused on fuel economy, emission characteristics, drivability, and component compatibility of using E10 and E30.

The test sample included 15 vehicles of various years, makes, and models provided by shareholders of the Corn Plus ethanol plant in Winnebago, Minnesota. The ultimate goal, according to the final study, was “to provide evidence to the EPA regarding the performance of in-use vehicles on higher concentrations of ethanol than the current 10 percent blends.”

The research did find fairly wide variances in the fuel economy of the E30 blend, ranging from 1.28 percent to 14.66 percent lower than the E10, but the most noteworthy results were in the category of drivability:

“In this study, there were no reports of cold starting, vapor lock, or hard starting conditions that have been associated with higher concentrations of ethanol. During the duration of the study there were no drivability complaints. The cars all seemed to start with no long duration of cranking. There were also no reported cases of hesitation with the E30 blend of fuel.”

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Ambient temperatures ranged from zero degrees to above 90 degrees Fahrenheit during the testing.

In addition, the material compatibility portion of the testing concluded no harmful effects from using E30 in a standard, unmodified auto:

“There was no conclusive data showing harm as a result of running on the higher blend of ethanol. The data collected from the general maintenance forms also showed no fuel system damage during the duration of this study. No apparent danger to any engine or fuel system components by running on the E30 blend of fuel was found.”

A 2005 study commissioned by ACE found similar results in the category of drivability. The ACE Fuel Economy Study, directed by veteran fuel researcher Allen Kasperon, examined the fuel economy, cost per mile of operation, and drivability of E10, E20, and E30 in three unmodified, non-FFV cars - a Chevrolet Impala, a Ford Taurus, and a Toyota Camry.

The study reports: “In light of the fact that the three vehicles were not flexible fuel vehicles, it is especially significant to note that no warning lights were displayed at any time during the testing on any of the fuel blends. The data logging computer monitors all warning light systems and did not record any malfunction indicator lights (MIL), diagnostic trouble code lights (DTC), or emissions DTCs.”

In older vehicles, it has been assumed that the oxygen sensor caused a malfunction indicator light to be displayed when fuel with too much ethanol was used since the oxygen sensor did not recognize fuel with a much higher oxygen content. The ACE study found that, in all vehicles used, the short- and long-term fuel trim adjusted the air-to-fuel ratios normally and recorded all operation on all fuel blends as being within a normal range.

ACE is working with a research lab to expand this pilot study to gain more in-depth data on this subject. Instead of delving deeply into one particular ethanol blend, such as E20, the organization is currently researching a wide variety of mixtures between E10 and E85 to find what may be considered “optimal.”

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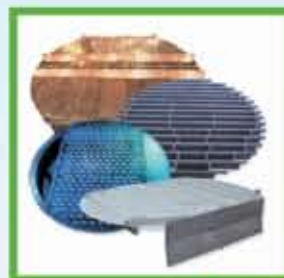
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Long-term effects of E85 use in a non-FFV

The ACE pilot fuel economy study and the Minnesota E30 study showed good drivability results for these higher blends in standard vehicles, but the scope of the research was not large enough to provide a long-term view of the results.

Last year, ACE had the opportunity to examine the long-term effects of such ethanol use. Ron Fagen, President of ethanol plant builder Fagen Inc. of Granite Falls, Minnesota, donated his 2000 Chevy Tahoe for research purposes. The Tahoe was not an FFV but had run for more than 105,000 miles almost exclusively on E85.

ACE enlisted professionals at Lake Area Technical Institute (LATI) in Watertown, South Dakota to disassemble the Tahoe to examine the long-term effects of using E85 in an unmodified engine. Ron Skatvold, head of the automotive department at LATI, oversaw the research.

The study found the Tahoe to have no significant wear and tear attributed to the use of E85 in the non-flex fuel engine, and in some cases engine parts were in better condition than on a comparable vehicle that had run on straight unleaded.

The fuel lines in the Tahoe were not found to be brittle, as is often suggested will happen when running higher concentrations of alcohol through a non-FFV fueling system. The spark plugs, cam shaft, catalytic converter, and cylinders were found to be in normal condition, with no premature wear for the amount of miles on the vehicle.

The Tahoe's armatures were found to have only slight wear, while the armatures taken out of a comparable vehicle that had run on unleaded had actually failed around the 80,000 mile mark.

"In our research, we noticed the cleanliness of the engine, and the lack of wear with the amount of mileage that the engine had," Skatvold said. "I think that is really significant."

A video documenting the Tahoe research is available on ACE's website, www.ethanol.org. Visit "Ethanol 101" under the "All About Ethanol" menu heading.

Minnesota model

The state of Minnesota, a pioneer in the use and production of ethanol, has required 10 percent ethanol in virtually all gasoline since 1997. It was the first state to enact an ethanol-blended fuel requirement, part of the dual approach of building up both in-state production capacity and in-state demand for the product.

Two years ago, in another progressive move, the state legislature took its commitment to ethanol a step farther with its eye on 20 percent ethanol.

The new law states that 20 percent ethanol will be required in each gallon of gasoline as of August 30, 2013, unless ethanol replaces 20 percent of the state's gasoline volume by December 30, 2010. The Minnesota requirement can be met by selling enough E10 and E85 to bring ethanol's total presence to 20 percent of the state's fuel, or if this 20 percent threshold is not met, E20 motor fuel will be the state's new fuel of choice.

Minnesota officials calculate that, in order to meet the goal of 20 percent gasoline replacement, the use of E85 in the state would need to at least double - increasing by a factor of 2.37 - each year. An estimated 1.8 million FFVs in Minnesota would need to use E85 at least 50 percent of the time.

The state is moving forward on both fronts, with an aggressive campaign to increase the use of E85, in what Governor Pawlenty has dubbed "E85 Everywhere," and with initial regulatory efforts leading toward the approval of E20 as a motor fuel.

Regulatory work

As with any new fuel, extensive regulatory work needs to occur before approval can be granted. This can be a lengthy process, so ethanol leaders are beginning the steps now to set the wheels in motion.

"The Minnesota effort is so important because it dives into the issue of higher blends, using E20 in this case, and begins a process of going through the necessary steps with the EPA," Jennings said. "The data collection that is occurring is critically

important to exploring the entire issue of higher blends going forward.”

E20, for example, would need to receive a waiver from the U.S. Environmental Protection Agency to become an approved fuel. In order to certify E20, or any other “new” blend of ethanol, under section 211(f)4 of the Clean Air Act, the EPA needs to receive documentation in five areas: materials compatibility, drivability, tailpipe and evaporative emissions, health effects, and durability.

Minnesota is working on these aspects of E20, with the exception of health testing. On that front, officials are waiting for results from tests being conducted by the EPA on E10. These results were expected in December 2005, but have been delayed and are expected to be available sometime this year.

The first step is to do preliminary testing on E20 to begin collecting data and see if there are any major areas of concern. If no major issues arise, additional tests must be designed and funded before full application to the EPA can be made.

Materials compatibility research, the first area in which documentation is required, is underway at Minnesota State University at Mankato. Phase one examines metals used in fuel system components, with phase two looking at plastic components. The second phase began last fall, with the third phase - examining elastomer components - beginning at a later date.

The drivability research is being conducted at the University of Minnesota with 80 existing vehicles in the university’s motor pool. Forty pairs of vehicles are being tested, one vehicle in the pair using E20 and the other using unleaded gasoline. Vehicles in the study include Ford, Chrysler, General Motors, and Toyota models, 2000 to 2006 model years, with V8, V6, L4, and hybrid power engines.

In conjunction with the Renewable Fuels Association, emissions testing is being done in a private lab with three vehicles representing a range of older and newer technologies.

Results of each of these studies will help Minnesota pursue a waiver from the EPA, a prerequisite for the full implementation of E20 as a new motor fuel.

These Minnesota studies and the ACE findings, once complete, will be extremely useful in determining the next steps the ethanol industry needs to take.

Senator John Thune (R-SD) is urging the EPA to begin preparations now for the future use of ethanol blends beyond 10 percent. In a letter this spring to Administrator Stephen Johnson, Thune notes that the agency will soon be receiving a waiver request from the state of Minnesota asking for the approval of E20. He encouraged the agency to EPA to begin expeditiously reviewing any and all issues associated with such a waiver application.

“With approval of gasoline with a higher percentage of ethanol that American consumers can safely use in all types of vehicles, we can expand and ensure the market for ethanol and further reduce America’s dependence on foreign sources of energy. I’m hopeful that the EPA will move forward on my request and begin preparing for this upgrade,” Thune said.

By approving higher blends of ethanol for non-flexible fuel vehicles, Thune says the agency can help ensure a viable market for ethanol, give consumers greater choice in transportation fuels, and ensure that the U.S. ethanol industry does unnecessarily encounter a “blend wall” just as so much progress is being made.

“It will not work”

Are there technical hurdles that stand in the way of incorporating more ethanol into the fuel used by non-FFVs? The Minnesota study, ACE study, Tahoe disassembly, and much anecdotal evidence suggest no. Others remain unconvinced.

“To put E20 in the fleet that’s out there is going to corrode every non-ethanol fueling system. We absolutely guarantee the destruction of the engine and the fuel injection system if we go the E20 route. It will not work.”

“In order to certify E20, the EPA needs to receive documentation in five areas: materials compatibility, drivability, tailpipe and evaporative emissions, health effects, and durability.”

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This statement was made in an April 7 interview in the *Detroit Free Press* by General Motors Corp. Vice Chairman Bob Lutz.

“Certainly a conversation with the automakers is foremost on the agenda,” Jennings said. “The auto companies play a major role in this, from the standpoint of materials compatibility and of warranties. We look forward to working with them to explore this issue.”

Jennings noted that building up a body of evidence is key, to demonstrate to the auto companies that the problems they predict do not materialize in real-world use of blends beyond 10 percent

ACE officials have planned meetings with officials from both Toyota and General Motors this summer in hopes of opening a dialog on this topic.

Public policy steps beyond the blend market

S. 987, the “Biofuels for Energy Security and Transportation Act of 2007”, has emerged as the likely vehicle for a new Energy Bill to move forward in the United States Senate. Introduced by Senators Bingaman (D-NM) and Domenici (R-NM), this bill includes a large Renewable Fuels Standard calling for 36 billion gallons of renewable fuels use by 2022.

This proposed 36 billion gallon RFS is truly historic because it is the first time a bill has been adopted to move the RFS beyond the ethanol blend market threshold, seeking a long-term, significant role for both corn-based and cellulosic ethanol and ensuring the opportunity to develop higher-blend ethanol markets.

The legislation was marked up by the Senate Energy Committee on May 2, passing by a margin of 20 to 3. Officials say they expect the bill to be on the Senate floor sometime this month.

In addition to this significant new RFS that looks beyond the E10 blend market, another piece of federal legislation addresses higher blend infrastructure. In March, Senators Dorgan (D-ND) and Craig (R-ID) introduced the Security and Fuel Efficiency Energy Act of 2007 (SAFE Act) which contains the first-ever tax credit for blender pumps.

Blender pumps, similar to what have been used for diesel for a number of years, utilize two underground tanks that dispense the particular fuel mixture desired by the customer. In the case of ethanol blender pumps, one tank holds E85 and one holds unleaded gasoline, and these two fuels can be mixed to deliver mid-range ethanol blends like E20, E30, and E40.

“ACE is particularly pleased with the inclusion of a new and meaningful tax credit for the purchase and installation of blender pumps. The Dorgan-Craig legislation is the first ever to look to the future of this type of higher ethanol blends infrastructure,” Jennings said. “Early this spring the ACE board of directors had voted to support infrastructure for higher ethanol blends by working with Congress to provide incentives to petroleum marketers to purchase and install blender pumps, and the Dorgan-Craig legislation is a product of that effort.”

In next month’s issue, *Ethanol Today* will continue this series on higher ethanol blends, taking an in-depth look at blender pumps and the experience of two South Dakota stations who have installed this infrastructure and are offering not only E85, but also E20, E30, and in one case E40, to their customers.