Environmental and Energy Study Institute

Fact Sheet

The Consumer and Fuel Retailer Choice Act: Environmental, Health & Consumer Considerations

September 2017

Today, 10 percent of the U.S. gasoline supply is provided by renewable fuel, primarily ethanol. Increasing the use of renewable fuel, which is more sustainable and less polluting than gasoline, will require the greater adoption of higher ethanol blends in the transportation fuel supply. While electrification of the light-duty fleet could achieve the greatest *potential* reductions in both tailpipe emissions and greenhouse gases (GHG), the lifecycle of the vehicle fleet and market realities suggest that the internal combustion engine will continue to dominate the light-duty fleet for several decades.

The transportation sector currently accounts for 27 percent of U.S. GHG emissions.[1] To address rising transportation greenhouse gas (GHG) emissions and air pollutants, steps are available to immediately reduce emissions from the transportation sector. Greater use of E15 (15 percent ethanol and 85 percent gasoline), a fuel usable by nearly 90 percent of cars on the road today, is one such step. Additionally, utilizing mid-level ethanol blends (E25 to E40) in the near future will optimize the cleaner, more fuel-efficient internal combustion engines being produced by automotive manufacturers.

The retail gasoline market has seen a marked uptick in sales and interest in E15 in the past few years, thanks to a combination of private-public partnerships and competitive pricing of E15 relative to other fuels. E15 offers drivers an improvement in emissions, price and performance over regular E10. However, with rising interest in E15, gasoline marketers and the ethanol industry have run into an obscure piece of air quality regulation—Reid Vapor Pressure (RVP) standards—that inadvertently block the year-round sale of E15. A bill in Congress, the *Consumer and Fuel Retailer Choice Act* (S.517, H.R. 1311), would amend the Clean Air Act to allow for the year-round sale of E15.

Fuel Volatility and Ozone Formation

For more information on octane, refer to EESI's 2016 Fact Sheet, From Lead to Ethanol: A Brief History of Octane.

Gasoline has two major properties that fuel refiners control: octane and Reid Vapor Pressure (RVP). Octane provides anti-knock properties; the higher the octane rating, the more efficiently the engine runs. While refiners keep the octane values constant throughout the year, the RVP rating in much of the country changes according to the seasons, to meet air quality standards set forward in the 1990 Clean Air Act Amendments. During the summer months, the volatility of gasoline (measured by RVP) is capped. These RVP requirements have received increased attention lately, as they have inadvertently blocked the year-round sale of E15 (15 percent ethanol, 85 percent gasoline) in most regions.

Ozone Formation

When the air temperature goes above 100 degrees Fahrenheit, gasoline vaporizes quickly.[2] These evaporative emissions occur more readily in the summer months and are a precursor to ozone. Commonly referred to as smog, ozone is a complex mixture formed when air pollutants react with each other in the presence of sunlight. Ground-

level ozone impairs lung functioning and contributes to increased incidences of asthma and other lung diseases, especially among children and the elderly. Ozone exposure is linked to increases in hospital visits, school absences, and use of respiratory medications. Long-term ozone exposure decreases lung function and may be linked to the development of chronic respiratory diseases, including chronic-obstructive pulmonary disease (COPD) and asthma.[2]

Gasoline Refiners Control for Ozone in Summer Months

There are three primary fuel blend types used in the United States: summer blends, winter blends, and Reformulated Gasoline (RFG). Summer blend-fuels are so named because they are required by EPA during the hotter summer months to control the formation of smog.[3] To reduce the formation of ozone from vehicle emissions, the EPA regulates the volatility of gasoline in warmer months, from June 1 to September 15. When blending fuels for different regions and regulations, U.S. refiners have a number of petroleum hydrocarbons to choose from, each providing different properties to the final blended fuel. The addition of ethanol to gasoline blendstock also changes fuel properties. Refiners comply with these regulations by changing the composition of the fuel blend in anticipation of the warmer season.

Fuel Volatility Regulations

Reid Vapor Pressure

Reid Vapor Pressure (RVP) is a measure of gasoline volatility, or its ability to vaporize. Each component of gasoline contributes to the overall RVP rating of a gasoline blend, and certain blending components have a higher RVP rating than others.[2] To cut smog levels, EPA requires that summer blends have an RVP cap of no more than 9 pounds per square inch (psi). In some National Ambient Air Quality (NAAQ) non-attainment areas, which have higher pollution levels, the cap is as low as 7.8 psi.[3] EPA allows states to require stricter standards (as low as 7.0 psi) in regions with poorer air quality. Refiners accomplish RVP targets by switching to less volatile blending components in the summer months.

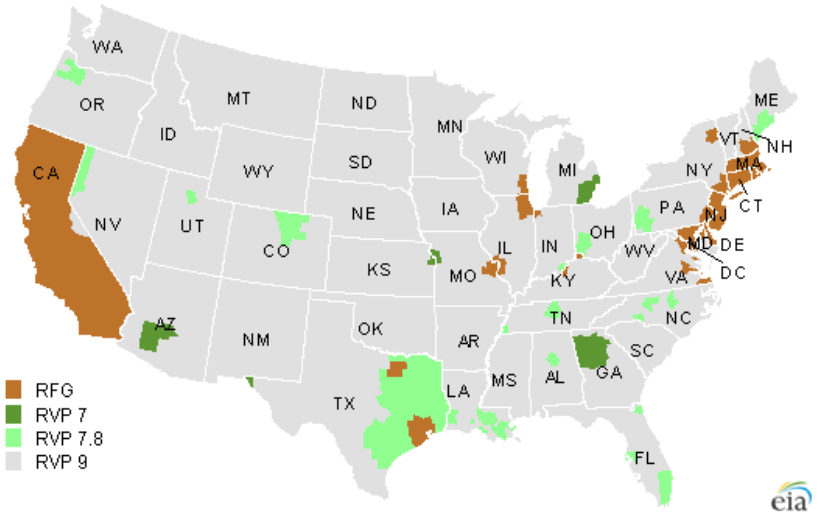

Fig 1: U.S. summer gasoline requirements, EIA.

Gasoline Blends Nationwide

Due to the variety of state, local and federal pollution standards, there is a patchwork of 14 different gasoline blends in the summer months, versus only a handful in the wintertime. In addition to summer blends, Reformulated Gasoline (RFG) is required year-round in about a third of the country, due to strict local ozone caps.[4] Since RFG has a lower RVP rating than the summer blends, RFG areas are not subject to the use of summer blends. Additionally, Alaska, Hawaii and U.S. territories do not have to comply with federal fuel volatility regulations.[3] A waiver for E15 would not supersede RFG regions or state and local restrictions.

Ethanol's Effect on Fuel Volatility

While neat (pure) ethanol has a lower vapor pressure than gasoline, the interaction of small amounts of ethanol in gasoline causes the ethanol to more readily vaporize. Therefore, mixing small amounts of ethanol and gasoline causes the RVP of gasoline to increase. As the ethanol content in gasoline increases, however, the RVP of the finished gasoline decreases. The addition of 10 percent ethanol (E10) to gasoline raises RVP by approximately 1 pound per

square inch (psi). However, at 15 percent ethanol, the National Renewable Energy Laboratory has found that the RVP is nearly the same as that of 10 percent ethanol. And, when increasing ethanol content beyond 15 percent, vapor pressure begins to decrease. A 50 percent blend (E50) has a lower RVP rating than gasoline.[5]

The one-pound waiver does not extend to blends above E10, despite E15 and higher blends having either the same, or lower RVP ratings than E10.[4] At the time the one-pound waiver was granted, blends higher than E10, such as E15 or E30, were not commercially available. High-ethanol blends, such as E85, do not require a RVP waiver, since their RVP rating is below that of gasoline.

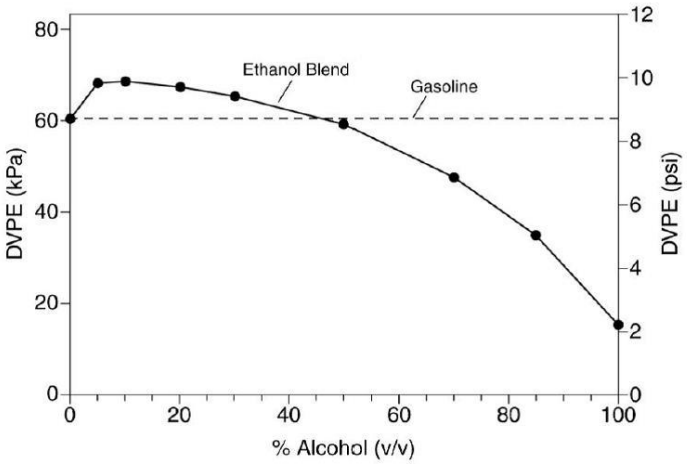

Figure 2: Ethanol's effect on RVP (Source: NREL)

Timeline of Federal Fuel Volatility Regulations:

1990: Congress passes the 1990 Clean Air Act Amendments (CAAA). Section 211(h) of the CAAA requires EPA to set stricter fuel volatility (RVP) standards to control for ozone between May 1 and September 15.

1992: EPA grants a 1-psi waiver (40 CFR 80.27) for ethanol-blended fuels containing between 9 and 10 percent ethanol.

1995: EPA requires the use of reformulated gasoline (RFG) year-round in areas with the worst levels of ozone pollution.

2010: EPA grants a partial waiver to E15 under the *Clean Air Act*. This waiver approved the use of E15 in 2007 and newer light-duty vehicles, as well as Flex-Fuel Vehicles (FFVs), but did not raise the RVP cap for fuels containing greater than 10 percent ethanol.[6] The waiver does not extend to older light-duty vehicles, heavy-duty gasoline engines, motorcycles, non-road engines and equipment.

2011: EPA extends the E15 waiver to 2001 and newer vehicles.[5]

Ethanol and Air Quality

When considering the air quality impacts of increasing the ethanol content of gasoline, both the evaporative emissions and tailpipe emissions must be considered. In general, the existing scientific literature supports the conclusion that increasing ethanol content from E10 to E15 reduces harmful volatile organic compound (VOC) emissions, displaces cancer-causing emissions, and reduces smog-forming potential, as well as cuts greenhouse gas emissions.[7] Ethanol blends above E15 further dilute the presence of these harmful compounds in gasoline.

Evaporative emissions: Evaporative emissions are gasoline vapors emitted from the fuel system and engine. When EPA assessed the impact of E15 on emissions from model year 2001 and newer vehicles, it found "E15 is likely to result in somewhat lower evaporative emissions compared to fuel currently sold in much of the country (E10) as a result of the lower volatility of E15."[5]

Volatile organic compounds (VOC): VOCs are a class of chemicals that vaporize at room temperature. The increased use of ethanol displaces the use of aromatic hydrocarbon additives in gasoline—specifically the BTEX complex (benzene, toluene, ethyl-benzene and xylene), which has a high cancer-causing potential. The displacement of BTEX means there is a resultant decrease in toxic VOCs, such as 1-3 butadiene, at the tailpipe. While increasing the ethanol content of gasoline from E10 to E15 does increase the cancer risk associated with acetaldehyde by 1 percent, **it decreases the cancer risk of 1-3 butadiene by 6.6 percent**.[6]

Ozone: The main ozone precursors are carbon monoxide (CO) and nitrous oxide (NOx). Carbon monoxide emissions *decrease* when using higher amounts of ethanol.[7] For NOx, numerous studies have found no statistically significant increase in NOx when increasing ethanol blending from E10 to E15.[7] Vehicle age likely has more of an impact on NOx emissions than increased ethanol use.[7]

Vehicle age: In 2007, the National Renewable Energy Lab (NREL) tested the impact of various ethanol blends on emissions in a series of older vehicles. Testing was performed with E0, E15 and E20 blends on make and model 2000 and 2009 vehicles. The vehicles were aged to 120,000 miles and, in some cases, 170,000 miles, using the various ethanol blends as well as ethanol-free gasoline (E0). NREL found that both **E15 and E20 blends did not result in higher tailpipe emissions in older vehicles**, as compared to ethanol-free fuels. Moreover, the use of E15 and E20 did not damage vehicle catalysts, a common concern.[8]

Greenhouse gases: Under the Renewable Fuel Standard (RFS), conventional ethanol (primarily corn ethanol) must meet a minimum greenhouse gas reduction of 20 percent relative to gasoline. Recent research from the U.S. Department of Agriculture has found that domestically-produced corn ethanol is, on average, 43 percent less GHG intensive than gasoline.[9] Cellulosic ethanol, sourced from crop wastes and purpose-grown crops (rather than edible plant matter), must be 60 percent less GHG intensive than gasoline. According to modeling from the U.S. Department of Energy, cellulosic ethanol can reduce GHG emissions between 90 and 115 percent, relative to gasoline, depending on the feedstock.[10] If corn ethanol is used, a 5 percentage point increase in ethanol blending (from E10 to E15) represents an additional 1.5 percent reduction in GHG emissions.[6] **Increasing the volume of ethanol from 10 to 15 percent of the fuel supply would therefore reduce greenhouse gas emissions from the transportation sector.**

Consumer Considerations

Vehicle Compatibility

In 2011, EPA approved the use of E15 in model year 2001 and newer vehicles, as well as all Flex-Fuel Vehicles (FFVs can run on ethanol blends up to 85 percent). Together, these vehicle classes make up nearly 90 percent of the cars on the road today.[11,5] Additionally, the Department of Energy's Oak Ridge National Laboratory undertook extensive vehicle testing on E15 and found no issues with vehicle performance or emissions.[7]

Today, automotive manufacturers are now moving in greater number towards explicitly approving the use of E15 in owner manuals for new vehicles. The owner manuals of 80 percent of 2017 vehicles approve the use of E15. This includes the 'Big Three' American manufacturers—Chrysler, General Motors, and Ford—as well as Honda, Toyota, Volkswagen Group, and Takata Motors.[9] **Both the 2016 BMW X1 and Mini Hardtop (a BMW subsidiary) approve the use of E25 (25 percent ethanol, 75 percent gasoline).**[12] As automotive manufacturers design more fuel-efficient vehicles, one can expect this trend of ethanol approval to continue. This is because the next generation of internal combustion engines use smaller, more efficient engines, which require higher-octane fuels; currently ethanol is the cheapest, cleanest source of octane.

Figure 3: E15 availability as of Sept. 2017, courtesy of Growth Energy.

E15 Availability

As of September 2017, 952 gasoline retailers in 29 states offer E15, though this number is fast increasing. The bulk of E15 is offered by independent retailers, as opposed to 'Big Five' branded gas stations (BP, Chevron, ConocoPhillips, Exxon Mobil, and Shell). This is up markedly from 342 stations in 2014.[13] While finished E15 can be delivered to the station by refiners, it is primarily mixed on-site using a blender pump.[14] Blender pumps draw fuels from two separate tanks and mix the fuels on-site. They are capable of dispensing a variety of biofuel blends greater than 10 percent (E10), such as E15, E25 and E85.

Blender pump capacity is currently being increased primarily through the Biofuels Infrastructure Partnership (BIP), a 2015 joint grant program between the U.S. Department of Agriculture, states, and the ethanol industry, to provide $210 million in funding for the installation of blender pumps at gas stations. Twenty-one states have received BIP funding. Through BIP, USDA estimates that the number of blender pumps will increase by 5,000 at 1,400 individual gas stations.

Price at the Pump

It's a common misconception that the seasonal price hike of gasoline is due to increased demand during summer months.[11] While demand does peak at about 10 percent more in August compared with January, demand is only one piece of the price increase.[11] As refiners switch over to summer blends between March and April to comply with RVP limits by June 1, a corresponding spike in retail prices occurs. Between 2000 and 2016, gasoline prices have increased anywhere from 9 to 42 percent between February and late spring, with the average price increase being 53 cents per gallon.[15] Summer blends are more expensive than other gasoline blends for a number of reasons beyond demand, including: 1) the use of more expensive blending components that comply with lower RVP ratings, 2) a more lengthy refining process to produce summer blends, 3) fuel changeover and, 4) a resulting lower yield per-barrel which translates to higher priced fuels.[11] Gas prices typically begin to decrease again in the fall, as refiners can switch back to winter blends on September 16.

Table 1: Gasoline prices tend to spike in late spring[11]

Year	Winter Price (Feb)	Peak Spring Gas Price	Price Increase	% Increase
2014	**$3.29**	**$3.71**	**$0.42**	**12.8**
2015	**$2.07**	**$2.84**	**$0.77**	**37.2**
2016	**$1.82**	**$2.40**	**$0.58**	**31.8**

Retailer Perspective

The number of gasoline retailers choosing to offer E15 is quickly increasing. Retailers choose to offer E15 because it is a price-competitive, higher octane option that offers higher profit margins to station owners. Sheetz, the largest E15 retailer in the United States, reports **pricing E15 anywhere at a three to ten cent discount, relative to E10.**[16] Higher ethanol blends could translate to further savings at the pump.

However, since E15 exceeds summertime RVP caps, it is considered a 'flex fuel,' during the summer months. As a result, gasoline retailers must label E15 pumps for "Flex-Fuel Vehicles Only" during summertime. The change in labeling results in a switch of all pump labels twice a year. This change-over is estimated to cost approximately $200 per year per station.[12]

> *"Sheetz is not selling E15 because of ethanol producers; we sell it because there is a consumer demand for the fuel… This lower cost, higher performing fuel allows Sheetz to provide superior selection and service to those who visit our stores."*
> *— Mike Lorenz, Executive VP of Petroleum Supply, Sheetz*

In 2017, the total cost of E15 labeling switch-outs cost gasoline retailers an estimated $200 million.[12] In addition to the cost associated with re-labeling pumps twice a year, sales of E15 drop during the summer months and do not recover quickly. Sheetz reports losing 40 percent of its E15 customer base, even after the transition back to winter blends on September 16.[14] Data from other E15 retailers shows similar sales losses after the E15 transition.

Conclusion

Gasoline retailers and consumers have shown increasing interest in a wider variety of fuel options, which offer increased performance and lower prices at the pump. Increasing ethanol blends from 10 percent (E10) to 15 percent (E15) also represents an improvement to air quality and greenhouse gas mitigation in the light-duty transportation sector and should, therefore, be considered a near-term option in greening the transportation sector.

As automotive manufacturers and regulators look to increase the efficiency of the internal combustion engine, a high-octane, low-carbon fuel merits consideration. A near-term transition to an optimized mid-level ethanol blend, between E25 (25 percent ethanol, 75 percent gasoline) and E40 (40 percent ethanol), would allow automotive manufacturers to design highly fuel-efficient engines that would significantly reduce petroleum consumption. This would achieve

multiple objectives, including lowering consumer fuel costs, reducing lifecycle greenhouse gas emissions, and meeting higher fuel economy standards.

However, until the one-pound waiver is extended to blends above E10, retailers will continue to face roadblocks when they consider increasing the fuel choices at their stations. A bipartisan coalition of members of both the House (H.R. 1311) and the Senate (S. 517) have offered legislation that would simply extend the one-pound waiver to blends above E10. Doing so would allow the sale of E15 to 2001 and newer vehicles during the summer months, and allow for increased use of higher ethanol blends. S. 517 currently has 17 cosponsors, and H.R. 1311 currently has 42 co-sponsors.

This fact sheet is available electronically (with hyperlinks and endnotes) at *www.eesi.org/papers*.

Author: Jessie Stolark
Editor: Carol Werner

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