NATIONAL CORN GROWERS ASSOCIATION

October 26, 2018

Acting Administrator Andrew Wheeler
Environmental Protection Agency
1200 Pennsylvania Ave. NW
Washington, DC 20460

Deputy Administrator Heidi King
Natl. Highway Transportation Safety Admin.
1200 New Jersey Ave. SE
Washington, DC 20590

RE: Docket No. EPA-HQ-OAR-2018-0283 and NHTSA-2018-0067

Dear Acting Administrator Wheeler and Deputy Administrator King:

On behalf of more than 40,000 dues-paying corn farmers nationwide and more than 300,000 corn growers who contribute to corn checkoff programs in their states, the National Corn Growers Association (NCGA) appreciates the opportunity to comment on the proposed SAFE Vehicles Rule.

As producers of the primary feedstock used for ethanol production, corn farmers have a strong vested interest in the future of transportation fuels. Ethanol is an affordable, readily available, low-carbon and cleaner-burning source of octane. Automakers must have the tools to meet future emissions and efficiency standards, both cost-effectively and safely for drivers. Octane is an essential tool.

Without a change in fuel, automakers are reaching the limits on the efficiency gains that can be achieved with technology changes. We urge you to consider fuels and vehicles as a system of high-octane fuel used with optimized engines. As such, NCGA appreciates the agencies' request for comments on the benefits of considering the impacts of increased fuel octane levels available to consumers, as well as the request for comments on how the Environmental Protection Agency could support the production and use of higher-octane gasoline consistent with the Clean Air Act.

Our detailed comments show benefits for fuel economy and emissions reductions from the use of high-octane fuels in vehicles with optimized engines. Using ethanol to meet a higher octane level would minimize changes in fuel cost, compared to the increased use of costly and harmful hydrocarbon aromatics. While ethanol may not be the only source of fuel octane, it is the lowest cost - and lowest carbon - octane source currently available, and corn ethanol's carbon footprint is shrinking.

NCGA supports one national program for vehicle standards. High-octane, low-carbon fuel can help harmonize federal and state standards and is a needed compromise solution on future standards. Thank you for considering our comments.

Sincerely,

Lynn E Chrisp

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EXECUTIVE SUMMARY

The U.S. transportation sector accounts for 29 percent of domestic energy use, 70 percent of domestic petroleum consumption, and 27 percent of the nation's greenhouse gas emissions.[1] With a third of our energy dedicated to transportation, changes in this sector can have large impacts on the economy, human health and safety, domestic energy security and consumer choice. When needed, the agencies have enabled prior transitions in our fuel system, such as the phase out of lead and ending the use of MTBE. This rule has the potential to begin the next future fuel transition, a transition to high-octane liquid fuels, which will result in positive, far-reaching impact. Failing to act at this time would be a significant lost opportunity.

NCGA appreciates that EPA and NHTSA have undertaken a joint rulemaking to establish new Corporate Average Fuel Economy (CAFE) and greenhouse gas (GHG) emissions standards for passenger cars and light trucks covering model years 2021 through 2026. These standards, which are directly related, will influence vehicle and fuel choices for years to come. Harmonizing these standards achieves the same net effect via application of the same or similar performance and compliance flexibilities. New standards must be based on the most recent fuel and vehicle technologies while considering economic projections to cost-effectively protect consumer safety, protect air quality and human health, maintain vehicle affordability, support domestic energy security and avoid undue regulatory burdens.

While the agencies analyzed a range of vehicle standards for this proposed rule, NCGA's comments focus on the need to consider vehicles and fuels as a system for setting new standards. This approach will ensure manufacturers have a full range of compliance flexibilities, including higher octane fuels, to meet vehicle standards. We support parity in compliance flexibilities and credits so that some technologies are not given preference over others. NCGA supports one national program for vehicle standards, and we believe a transition to a higher-octane fuel helps support the overarching mutual goals of both the federal government and individual states.

EPA and NHTSA are well-prepared to address fuel octane in the SAFE Vehicles Rule. Last year, the agencies sought comments on the Trump Administration's reconsideration of the January 2017 Determination that vehicle standards set in 2012 for model years through 2025 remained appropriate. The agencies specifically asked for comments on the impact of the standards on advanced fuels technology, including the potential for high-octane blends, before ultimately finding that those standards were no longer appropriate. In developing this rule, the agencies considered those public comments. They also took input on the potential for high-octane fuels in meetings with organizations such as the High Octane Low Carbon Alliance (HOLC), as referenced in the proposed rule.

Increasing octane requirements now would provide vehicle manufacturers the pathway to further develop technology options to meet GHG emissions and fuel economy standards, lower fuel costs to consumers, and support sustainable job growth in America well into the future. A transition to high-octane midlevel ethanol blend fuel, beginning with model year (MY) 2023, meets consumers' vehicle preference for increased utility, acceleration and performance; provides automakers the quality liquid fuel needed for their advanced engine technologies; meets agency safety objectives; and reduces environmental impacts related to automobile transportation.

FUEL OCTANE: AGENCIES' REQUEST FOR COMMENTS

[1] EIA. 2018. Energy Information Administration. Use of Energy in the United States Explained: Energy Use for Transportation. June 22, 2018. https://www.eia.gov/energyexplained/?page=us_energy_transportation#tab2

1) Please comment on the potential benefits, or dis-benefits, of considering the impacts of increased fuel octane levels available to consumers for purposes of the model. More specifically, please comment on how increasing fuel octane levels would play a role in product offerings and engine technologies.[2]

For years, automakers have met increasingly aggressive fuel economy standards and tailpipe emissions targets. To hit these moving targets, automakers explored an array of technologies and strategies, each promising a varying degree of improvement across efficiency and emission metrics. Increasing the octane level in gasoline to better synchronize with today's advanced internal combustion engines is one of the more promising strategies. Pairing these engines with certain higher-octane fuel improves vehicle performance and efficiency while using less energy and releasing fewer emissions, particularly when the octane source is a midlevel ethanol blend.

Driving Transportation and the American Consumer

More than 98 percent of the vehicles produced for model year 2017 run on gasoline.[3] The average vehicle operates in the domestic fleet for 11 years, and liquid transportation fuels will be an essential part of the market for years to come.

Consumers continue to prefer the internal combustion engine (ICE) over alternative powertrains; they also demonstrate a preference for larger vehicles. Because automakers continue to improve fuel efficiency across all vehicle classes, the larger, more inefficient vehicle classes (i.e. SUVs, CUVs, trucks) have significantly narrowed the fuel economy gap with historically more efficient vehicle classes (i.e. small and medium cars).

Although smaller cars remain more efficient, because all vehicle classes have steadily increased fuel economy, a growing share of consumers' purchase decisions demonstrate a willingness to sacrifice smaller fuel efficiency gains for the preferred utility, space and perceived safety offered by larger vehicles. In a 2018 report on vehicle sales, the Fuels Institute found that the share of CUVs grew from 10 percent to 35 percent of all vehicles. During the same period, nearly all other classes lost market share.[4]

Current Vehicle Technology

Since EPA began recording vehicle technology trends in 1975, the advancements in vehicle technology have been remarkable. The two most tangible benefits besides increased overall performance are improved fuel economy and reduced emissions. EPA's 2017 report finds that MY 2016 vehicles improved fuel economy and reduced emissions from the previous year, averaging 24.7 mpg (up 0.1 mpg) and 359 grams of CO_2 / mile (down 2 g/mi), respectively. Both set industry records. Since MY 2004, CO_2 emissions decreased 22 percent while fuel economy improved 28 percent (5.4 mpg or roughly 0.5 mpg/year).[5]

Such dramatic improvements in both fuel economy and emissions reduction would not be possible if the automotive industry was not constantly advancing new technology. Over the last decade, manufacturers have increasingly adopted emerging performance-based technologies. EPA's trends report calls

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[2] 83 Federal Register 43041 (August 24, 2018)

[3] EPA. 2018a. U.S. Environmental Protection Agency. Light-Duty Automotive Technology, Carbon Dioxide Emissions, and Fuel Economy Trends: 1975 Through 2017. January 2018. EPA-420-S-18-001. Accessed online at https://www.epa.gov/fuel-economy-trends

[4] Fuels Institute, 2018. Driving Vehicle Sales—Utility, Affordability, and Efficiency. July 30, 2018. https://www.fuelsinstitute.org/Research/Driving-Vehicle-Sales-Utility-Affordability

[5] EPA, 2018a.

attention to six such technologies: Gasoline direct injection, turbocharging, cylinder deactivation, non-hybrid start/stop, continuously variable transmissions, and the adoption of transmissions with seven or more speeds.

Fuel Octane and Advanced Engines

Despite these impressive advancements in engine technology, manufacturers are nearing a point where further advancements will be difficult without a higher-octane fuel. This is because advanced downsized, downsped engines, and their associated technologies, make an engine more susceptible to knock. Because of its knock-limiting properties, a higher-octane fuel such as a midlevel ethanol blend, enables engine designs featuring higher compression ratios, turbocharging, and downspeeding and increases overall engine performance and efficiency.[6] According to Department of Energy researchers at Oak Ridge National Laboratory, "the opportunity for further downsizing and downspeeding of engines to improve fuel economy is limited by the available octane rating of fuels…[which] allow higher efficiency designs of naturally aspirated and turbocharged engines dedicated to use the high octane fuel."[7]

A variety of properties determine a fuel's efficacy and efficiency in an engine. Much of the efficiency benefit realized from today's engines is a direct result of mitigating knock at high load – these engines work because they don't knock.[8] According to **Figure 1,** which shows the relative contribution of select fuel properties in realizing increased engine efficiency, Research Octane Number (RON) and octane sensitivity contribute most to engine performance.

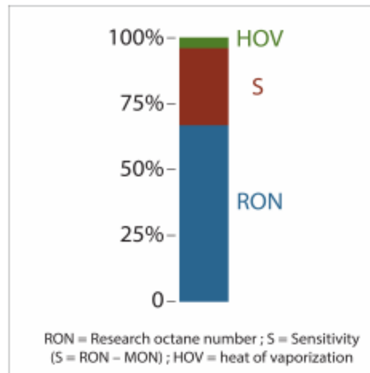

Figure 1: *Relative contribution of fuel properties to increased engine efficiency (Farrell et al., 2018).*

The efficiency improvement that comes from increasing compression ratio is achievable only when the fuel's anti-knock properties (its octane rating and sensitivity) are also improved. For today's high-efficiency engines, a fuel's RON is considered a more reliable predictor of knock performance in comparison to its Motor Octane Number (MON) or Anti-Knock Index (AKI). High-efficiency engines often employ direct fuel injection to enable operation at low speed and high load. With DI, intake air stays at a fixed temperature and does not undergo heating or vaporization before entering the cylinder. As such, the RON test procedure better reflects how today's engines perform under real-world driving conditions, and much of the developed world uses RON as a metric to describe octane rather than AKI.

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[6] Leone, T., Olin, E., Anderson, J., Jung, H. et al. 2014. "Effects of Fuel Octane Rating and Ethanol Content on Knock, Fuel Economy, and CO2 for a Turbocharged DI Engine," SAE Int. J. Fuels Lubr. 7(1):9-28, 2014, doi:10.4271/2014-01-1228.

[7] Theiss, T., T. Alleman, A. Brooker, A. Elgowainy, G. Fioroni, J. Han, S. Huff, C. Johnson, M. Kass, P. Leiby, R. U. Martinez, R. McCormick, K. Moriarty, E. Newes, G. Oladosu, J. Szybist, J. Thomas, M. Wang, B. West. 2016. Summary of High-Octane Mid-Level Ethanol Blends Study. Oak Ridge National Laboratory, National Renewable Energy Laboratory, and Argonne National Laboratory. Available at: http://info.ornl.gov/sites/publications/files/pub61169.pdf

[8] Farrell, John, John Holladay, and Robert Wagner. 2018. Fuel Blendstocks with the Potential to Optimize Future Gasoline Engine Performance: Identification of Five Chemical Families for Detailed Evaluation. Technical Report. U.S. Department of Energy, Washington, DC. 2018. DOE/GO-102018-4970.

Benefits of Ethanol as the Octane Additive

With an octane rating of 112, ethanol is clearly high octane, but ethanol also has high sensitivity and a high heat of vaporization. Both characteristics allow for greater engine performance and efficiency for DI engines than is indicated simply by the RON value of the fuel. High-octane, midlevel ethanol blends offer characteristics that allow further efficiency improvements over high-octane fuels made with lower blends of ethanol, such as the current E10 fuel, as shown in **Figure 2.**[9]

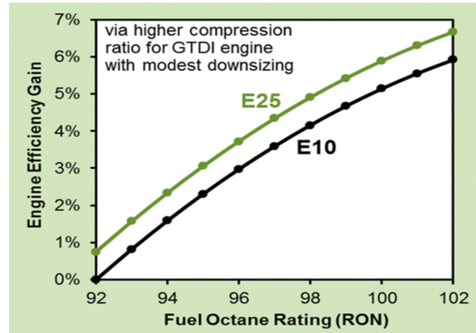

Figure 2: *Engine efficiency gains from increasing fuel octane rating through ethanol content and compression ratio increases from a GTDI engine with modest downsizing (Leone, 2015).*

Researchers at the Massachusetts Institute of Technology assert that: "The type of fuel chosen can have a profound impact on knock suppression through its beneficial chemical characteristics and the compounding impact of its evaporation with direct injection. High octane [sic] gasoline and alcohol fuels have been proven to reduce the propensity to knock due to their molecular structure… In addition, alcohol-based fuels have a higher heat of vaporization than traditional gasoline fuels, resulting in even lower charge temperatures, further reducing the probability of knock."[10]

A movement toward higher-octane fuel featuring higher blends of ethanol works to increase engine performance and improve fuel efficiency in future model year vehicles. Not only does such adoption of high-octane fuels meet the goals of the automakers and regulators, it also aligns with consumer preference for the increasingly advanced technologies harnessed by the ICE. Providing consumers with higher octane fuels to match advancements in engine technology is the most feasible, realistic way to effect substantial change at the nexus of energy and the environment. It aligns with current market trends; it aligns with current technological realities and industrial capabilities; and it aligns with consumer preferences.

2) Are there potential improvements to fuel economy and CO2 reductions from higher octane fuel Why or why not?[11]

As demonstrated through numerous studies, the potential and possibility of higher-octane,[12] lower-carbon[13] fuel have not gone unnoticed by the agencies. Both EPA and NHTSA have previously recognized the potential of higher-octane fuels to enable spark-ignition engine advancements, including in EPA's Tier 3 rulemaking.[14] EPA requested additional information on the potential for high-octane blends during the reconsideration of the January 2017 Determination and received detailed responses.

Numerous engine testing experiments—on different engines and vehicles, under varying test conditions, and using a spectrum of ethanol blends—have produced what's now quite a large body of evidence

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[9] Leone et al., 2014.

[10] Smith, P., Heywood, J., and Cheng, W. 2014. Effects of Compression Ratio on Spark-Ignited Engine Efficiency. SAE Technical Paper 2014-01-2599, 2014, doi:10.4271/2014-01-2599.

[11] 83 Federal Register 43041 (August 24, 2018)

[12] EPA, 2008. Cost and Effectiveness Estimates of Technologies Used to Reduce Light-duty Vehicle Carbon Dioxide Emissions. March 2008.

[13] EPA, 2010. Renewable Fuel Standard Program: Regulatory Impact Analysis, section 2.6. February 2010.

[14] EPA, 2013. Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards. March 2013.

demonstrating ethanol's ability to increase engine efficiency and efficacy while lowering emissions.[15,16,17] In 2016, DOE researchers reviewed other recent engine testing efforts to quantify the potential of E25 to E40 fuel in their *Summary of High-Octane Mid-Level Ethanol Blends Study*.[18] In summarizing the studies on octane, midlevel ethanol blends used in dedicated high-octane vehicles achieved efficiency gains of 5 to 10 percent, more than overcoming any energy density differences with E10.

Through a 2017 literature review, Ricardo, Inc. found studies broadly supported the conclusion that "splash blending ethanol is a highly effective means of raising the octane rating of gasoline and enabling low-cost efficiencies and reduced emissions in modern spark-ignition engines."[19] Study examples from the literature review show that increasing the fuel octane rating to 98 RON by blending 25 percent ethanol led to efficiency improvements of 5 percent in DI engines with higher compression ratios. Another analysis reviewed found GHG emission reductions of 6 to 9 percent with a 99 RON E30 fuel used with engines having the compression ratio increased from 10:1 to 13:1. For a complete description of the studies Ricardo reviewed and the findings, see **Appendix 1**.

Oak Ridge National Laboratory Engine Testing

To help demonstrate the fuel efficiency gains and emissions reductions from higher octane fuel, NCGA and state corn grower associations have been supporting vehicle testing research at Oak Ridge National Laboratory (ORNL). This research has demonstrated significant fuel efficiency gains from downspeeding and downsizing with increased compression ratio. The latest ORNL engine testing focused on the impacts of E25 on two vehicles: a 2016 Ford F150 pickup truck and a 2015 MINI Cooper S. A detailed explanation of our engine testing projects with ORNL, including tests run, fuels used, and results is available below in **Table 1.**

The 2016 Ford F150 pickup truck features a 3.5-liter EcoBoost V6, turbocharged, direct-injection engine with a 6-speed automatic transmission. When tested in standard configuration with 99 RON E25, results showed a 2.2 percent improvement in the truck's efficiency during high-load cycles and during full-throttle acceleration over 92 RON E10. Testing for particulate matter showed a 35 percent reduction. After increasing the compression ratio (CR) from 10:1 to 12.2:1 and using E25, results showed improvements in fuel economy (5 to 6 percent depending on test/load) and acceleration (0.4 seconds on 15 to 80 mph time).[20]

The owner's manual for the MINI Cooper S recommends higher octane fuel for the vehicle and explicitly approves the use of ethanol blends up to E25. The 2015 model features a 4-cylinder, 2.0-liter turbocharged, direct-injection engine with a 6-speed manual transmission. At a heavier test weight and load, the 100 RON E25 fuel resulted in faster acceleration during 15 to 80 mph time trials with a median increase of 0.8 seconds. When a Power Module is installed and combined with E25, acceleration improves significantly—by an impressive 2.4 seconds. There were no statistically significant changes to various emissions scores, except for tailpipe carbon monoxide and particulate matter which both showed a reduction with E25. Collectively, these results "demonstrate the potential for maintaining

[15] Leone et al., 2014.
[16] Splitter, D.A., and Szybist, J.P., 2014. Experimental Investigation of Spark-Ignited Combustion with High-Octane Biofuels and EGR. 2. Fuel and EGR Effects on Knock-Limited Load and Speed Energy & Fuels, 28(2): 1418-1431, doi:10.1021/ef401574p
[17] Jung, H., Leone, T., Shelby, M., Anderson, J. et al., "Fuel Economy and CO_2Emissions of Ethanol-Gasoline Blends in a Turbocharged DI Engine," *SAE Int. J. Engines* 6(1):422-434, 2013, doi:10.4271/2013-01-1321.
[18] Theiss et al., 2016.
[19] Ricardo, Inc., Literature Review of Ethanol Use for High Octane Fuels, August 22, 2017, Page 3
[20] West, B., Huff, S., Moore, L., DeBusk, M. & Scott Sluder. 2018. Effects of High-Octane E25 on Two Vehicles Equipped with Turbocharged, Direct-Injection Engines. ORNL/TM-2018/814. September 2018.

acceleration performance with extreme downsizing when manufacturers design turbocharged engines for high-octane fuels."[21]

Table 1: *Corn Engine Testing Engagement with ORNL Since 2016*

	Engine Specs	Tests	Results
2016 Ford F150	– 3.5-liter V6 – Turbocharged – Direct-injection – 6-speed automatic transmission	Baseline E10 and E25 – FTP, HFET, US06, WOT, factory test weight – CR 10.1:1 E25 – FTP, HFET, US06, WOT, factory test weight – CR 12.2:1	E25 (no changes to CR or pistons) – Improved efficiency on high-load cycles – Particulate emissions reduced by roughly one third – WOT Acceleration 0.4 seconds quicker in 15-80 mph tests E25 with high-compression pistons – MPGge improved 5-6% – 4% efficiency gains across the board – Additional WOT acceleration improvement
2015 Mini Cooper	– 2.0-liter I4 – Turbocharged – Direct-injection – Factory pistons and drivetrain – 6-speed manual transmission – Owner's Manual approves E25	Baseline E10 – Mini Cooper test weight, EPA Shift Schedule E10 and E25 – Downsped – downsizing (increased test weight) – WOT acceleration tests	E25 – Encouraging emissions results – Fuel efficiency gains realized – Acceleration 0.4 seconds quicker in 15-80 mph elapsed time tests using 99 RON E25 – Use of aftermarket tuner chip with E25 improved acceleration time by 2.4 seconds
2013 Cadillac ATS	– 2.0-liter I4 – Turbocharged – Direct-injection – 6-speed manual transmission – Factory CR 9.5:1	E0 through E30 – Downsped and downsized E10 and E25 – CR from 9.5:1 to 10.5:1 – Downsped driveline	E0 through E30 (no change to CR) – Efficiency gains of 5-10% with downspeeding E10 and E25 (increased CR) for 3 drive cycles – E0-equivalent fuel efficiency gains – CO_2 reductions – Modest gains from E10 to E25 for the downsped 10.5:1 CR suggest higher CR may yield additional benefits
1.6L Ford EcoBoost Engine	– Turbocharged I4 – Direct-injection	E10 and E25 – Increased CR 10.1:1 to 11.4:1 – Engine maps support vehicle modeling	99 RON E25 CR 10.1:1 to 11.4:1 modeling results – Energy consumption decreased about 1-5% on cycles – Fuel economy near parity with baseline E10 on US06 cycle – Tailpipe CO_2 emissions lower on all cycles compared to baseline

Further Demonstrated GHG Reductions

As DOE explained in its well-to-wheels (WTW) GHG analysis of high-octane fuel (HOF), determining GHG impacts of HOF relative to current gasoline requires accounting for vehicle efficiency gains, refinery operation changes and GHG emissions changes from ethanol blending. DOE's results show the largest impacts on WTW emissions from HOF come from efficiency gains and the level of ethanol blending.

- DOE's modeling compared 100 RON E25 and E40 fuels to baseline E10. When used in HOF vehicles, the E25 reduced WTW GHG emissions by a total of 8 to 9 percent (or 36-40 g CO_2e/mile driven) compared to baseline E10. The vehicle efficiency gains from HOF reduced GHG emissions by 4 percent of that total, and the additional 4 percent of GHG reductions with the

[21] West et al., 2018

E25 fuel were realized from ethanol offsetting petroleum. For the E40 HOF, the ethanol content provides a 9 percent reduction in WTW GHG emissions.[22]

- A 2016 study modeled the impact on refinery emissions related to producing E10 and E30 blends across varying octane ratings. Results showed GHG reductions of 12 and 27 percent, respectively.[23]

- Researchers at MIT modeled a scenario where the country transitioned to a 98 RON gasoline by 2040. If this high-octane fuel represented 80 percent of liquid fuel consumption by 2040, total gasoline energy consumption would decrease by 3 to 4.4 percent, which is equivalent to a reduction of 19 to 35 million metric tons of CO_2 in 2040, or nearly 3 to 5 percent of tailpipe emissions from light duty vehicles.[24]

3)What is an ideal octane level for mass-market consumption balanced against cost and potential benefits?[25]

NCGA believes a 98 RON minimum octane standard offers greater potential benefits for automakers, regulators and consumers. A 98 RON minimum octane is also ideal from a cost-effectiveness standpoint.

A minimum octane level of 98 RON is needed to enable the greatest efficiency gains and CO_2 reductions from engine technologies that depend on octane. A 98 RON fuel used with an optimized engine allows for efficiency gains between 4 and 5 percent as an E10 and E25 fuel, respectively. A lower minimum octane standard, such as a 95 RON, enables efficiency gains of just 2 to 3 percent, depending on whether the blend is an E10 or E25.[26]

Costs of Higher Octane

The Agencies state that one advocacy position for high-octane fuels has been for today's premium fuel to become the base grade of fuel, enabling design changes that would improve fuel economy and reduce GHG emissions. However, the agencies cite fuel costs as a concern, stating, "Challenges associated with this approach include the increased fuel cost to consumers who drive vehicles designed for current regular octane grade fuel that would not benefit the use of the higher cost higher octane fuel. The net costs for a shift to higher octane fuel would persist well into the future."[27]

Current higher-octane fuels, such as E10 blends marketed as premium grades, are not cost-effective and will fall short of enabling the efficiency and emissions technology changes automakers need. Transitioning current premium fuel to the new "regular fuel" as a higher octane E10 blend, such as a 95 RON E10, would be significantly more expensive to consumers than current regular E10 fuel.
However, a higher RON level met through increased ethanol blending, would reduce fuel costs compared to higher RON fuels with less ethanol content. Incremental refining costs to produce a 98 RON E20 or E30 fuel could be between $0.02-$0.05 per gallon, respectively, based on one analysis. Incremental refining costs are

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[22] Theiss et al., 2016.
[23] Kwasniewski, Vincent & Blieszner, John & Nelson, Richard. 2015. Petroleum refinery greenhouse gas emission variations related to higher ethanol blends at different gasoline octane rating and pool volume levels. Biofuels, Bioproducts and Biorefining. 10. n/a-n/a. 10.1002/bbb.1612.
[24] Speth, R., Chow, E., Malina, R., Barrett, S., Heywood, J. & W. Green. 2014. Economic and Environmental Benefits of Higher-Octane Gasoline. *Environmental Science & Technology*. doi: 10.1021/es405557p
[25] 83 Federal Register 43041 (August 24, 2018)
[26] Leone, et. al 2015.
[27] 83 Federal Register 43041 (August 24, 2018)

estimated to be nearly $0.20 per gallon to produce a 98 RON fuel using 10 percent ethanol.[28] Because of the availability and effectiveness of ethanol as an octane enhancer, a midlevel blend 98 RON fuel is cleaner and more cost-effective.

Analysis presented at the Ag-Auto-Ethanol Work Group annual meeting on October 16-17, 2018 by the Defour Group compares the economics of a 95 RON E10 fuel and a 98 RON E25 fuel. This analysis builds on Hirshfeld, et al.'s use of a linear programming model to estimate the refining economics of increasing fuel octane ratings and ethanol content. This additional analysis shows that the presence of a 98 RON high-octane midlevel blend in the market, along with a 95 RON E10 fuel, would change the economics of high-octane fuel and fuel pricing.

When additional ethanol is blended to reach 98 RON, it allows for a lower-octane base gasoline blendstock, which costs less to produce at the refinery. Coupled with the low cost of ethanol added to raise octane, the finished high-octane midlevel blend is less expensive. This updated analysis concludes that a 98 RON E25 fuel would be cost comparative with the current regular fuel, accounting for a transition with both 95 RON and 98 RON fuels in the market. Competition resulting from having different fuel options at the pump results in downward price pressure on the premium E10; however, due to the higher-octane blendstock, that fuel will continue to cost more than current regular fuel.

Using more ethanol enables a larger increase in fuel octane, allowing for greater efficiency improvements, at a lower cost. When more refining is needed to increase fuel octane, as with current premium E10 blends, the cost will be greater. Furthermore, 95 RON fuel limits possible efficiency improvements. An E25 blend means more octane at a lower price than current premium fuel. Drivers of model year 2023 and later vehicles optimized to use a higher RON fuel would not pay more for fuel over the lifetime of the vehicle. Further, because ethanol results in lower emissions than gasoline, producing higher-octane fuel with a midlevel blend also reduces emissions, even if the standards alternative chosen is a freeze at 2020 standards. Optimized vehicles running on the fuel after model year 2023 would have lower GHG emissions than current E10 blends or premium E10 blends.

Air Quality and Health Benefits from Midlevel Blends

Bringing a 98 RON fuel to market in the form of midlevel ethanol blends will be less capital-intensive for refiners than attempting to increase blendstock octane with hydrocarbon components. It will also be incredibly cleaner. The avoided cost to refiners and offset emissions lower end-costs to consumers—reducing both economic costs at the pump and social costs related to health and environment.

Increased volumes of ethanol displace the most harmful compounds from gasoline.[29] These aromatic hydrocarbon additives (i.e. benzene, toluene, ethylbenzene, xylene – or BTEX) have high cancer-causing potential. Increasing the ethanol volume in fuel to a midlevel blend has a positive impact on tailpipe emissions of toxins, including significant reductions in particulates and carbon monoxide.

The petroleum-based aerosol particles released when gasoline is combusted represent a significant source of pollution, especially in population-dense urban areas. These secondary organic aerosols (SOAs) fall into the class of pollutants called Particulate Matter (PM). Health issues related to PM and other emission-based pollutants can be reduced by lowering the volume of petroleum in the domestic gasoline pool.

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[28] Hirshfeld, D. & Kolb, J. & Anderson, J. & Studzinski, W. & Frusti, J. 2014. Refining Economics of U.S. Gasoline: Octane Ratings and Ethanol Content, Environmental Science and Technology. *48* (19), 11064-11071. DOI: 10.1021/es5021668

[29] Environmental and Energy Study Institute. Ethanol and Air Quality – Separating Fact from Fiction. October 12, 2018. https://www.eesi.org/articles/view/ethanol-and-air-quality-separating-fact-from-fiction

PM from air pollution affects regional visibility and public health, as it can penetrate deeply into the lungs and cause respiratory issues. A 2013 study released by the Harvard Center for Risk Analysis focused on premature mortalities associated with SOAs. The use of hydrocarbon aromatics, based on a 2005 baseline, resulted in national mortality rates that "correspond with approximately $13.6 billion to $34.9 billion in total social costs," and these costs rise to nearly $50 billion annually when assuming higher levels SOAs are attributable to vehicle costs in urban areas.[30]

Adopting a high-octane, midlevel ethanol blend would substantially offset a sizeable amount of the volume of BTEX and other hydrocarbon particles in the gasoline pool. The increased octane level from ethanol would limit the need for added hydrocarbon aromatics and lower the overall volume of petroleum-based fuel needed in the gasoline pool. NCGA agrees with the agencies' decision to consider the larger, more complete body of research demonstrating the significant health effects and social costs related to overdependence on petroleum during this rulemaking process.

4)What are the negatives associated with increasing the available octane levels and, potentially, eliminating today's lower octane fuel blends?[31]

The transition to higher octane fuel and phase out of lower octane fuel blends may present challenges, but, as with past fuel transitions, those challenges can be met, and needed changes are being addressed today. A positive outcome to this rule would accelerate these changes. Furthermore, a fuel transition will have long-lasting, positive impacts on consumers, automakers, domestic energy security, air quality and human health, as well as agriculture. On the other hand, failure to act on this issue, may quite likely prove detrimental for the American public. NCGA offers further evidence supporting this fuel transition.

Ethanol Feedstock Availability

Corn farmers are prepared to supply corn to achieve, and expand, current levels of ethanol production:

- Through the 2017 crop year, 5.5 billion bushels of U.S. corn were used to produce 15.8 billion gallons of ethanol. Ethanol production also returned the equivalent of 1.24 billion bushels of corn for livestock feed in the form of distillers dried grains.
- Ethanol production has not had a significant impact on total agricultural land use, even as ethanol hit its highest production level in 2017.
- According to USDA data, planted corn acres in 2012 were nearly 8 million more than in 2018, and planted corn acres in 2007, the year the Renewable Fuel Standard was expanded, were nearly 4 million greater than this year.

The October 2018 World Agriculture Supply and Demand Estimate report from the U.S. Department of Agriculture projects a 2018/2019 corn crop of 14.77 billion bushels, which is a slight increase compared to 2017/2018 production.[32] USDA is also forecasting a 1.8-billion-bushel carry-out for the 2018 marketing year, down slightly from the 2-billion-bushel carry-out for the 2017/2018 marketing year. While meeting new demand for ethanol, corn has kept up with demand across sectors. This includes our largest market—livestock feed—as well as food and industrial uses and increasing international demand from exports.

Corn ethanol sustainability gains begin at the farm, where more corn is grown today on less land:

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[30] Stackelberg, K., Buonocore, J., Bhave, P., & Joel A. Schwartz. (2013). Public health impacts of secondary particulate formation from aromatic hydrocarbons in gasoline. *Environmental Health*201312:19. https://doi.org/10.1186/1476-069X-12-19

[31] 83 Federal Register 43041 (August 24, 2018)

[32] U.S. Department of Agriculture, World Agriculture Supply and Demand Estimates, October 2018

- Corn yield has grown at an annual average rate of 1.95 bushels per acre (bu/acre) since 1936
- Corn yields improved from 91 bu/ac in 1980, to 150 bu/ac in 2006, to nearly 177 bu/ac in 2017; USDA now projects a 2018 average yield of 180.7 bu/ac
- Farmers produced 6.64 billion bushels of corn in 1980 using 3.2 lbs. of primary nutrients (nitrogen, phosphorus, potassium) per bushel; by 2014, farmers doubled production while cutting nutrient use in half, producing 14.2 billion bushels with 1.38 lbs. of nutrients per bushel.

Additional GHG Reduction Benefits of Corn-Based Ethanol

Corn ethanol's carbon footprint is shrinking as agricultural practices and technologies improve, while the fossil fuel carbon footprint is expanding as the oil production from tar sands and tight oil supplies increases. LCA estimates are dynamic, so previous estimates do not capture advancements. EPA last updated its LCA for corn-based ethanol in 2010, projecting that corn-based ethanol would produce 21 percent fewer GHG emissions by 2022 when compared to gasoline. These numbers do not reflect all the positive sustainability advances by the corn and ethanol industries throughout the past decade. However, the USDA LCA and Argonne National Laboratory's GREET model include more recent data pertinent to these gains.

Argonne's GREET model continues to show steady improvement in corn ethanol's lifecycle GHG profile. The 2016 GREET model shows corn-based ethanol's carbon intensity is 45 percent below the carbon intensity of baseline gasoline; the 2010 GREET model has corn-based ethanol's carbon intensity 19 percent below that of baseline gasoline.

USDA's 2017 analysis shows corn-based ethanol currently results in 43 percent fewer life cycle GHG emissions when compared to conventional gasoline.[33] If current GHG-reducing technologies and trends continue, GHG emissions reductions could reach 48 percent by 2022. Furthermore, if new ethanol and corn production technologies become more widespread, emissions reductions could be 76 percent less than gasoline, according to USDA.

These increasing benefits have occurred even before accounting for corn's carbon sequestration. Corn as a crop can serve as a carbon sink. As a photo-synthetically superior C4 plant, corn has an extraordinary ability to sequester carbon and move fertilizer nutrients back to the surface for plant growth rather than polluting ground water. Corn's extensive, deep root system makes it one of the few plants with this important capability to make crop production sustainable.

High-yield corn—combined with the steady adoption of best practices such as reductions in tillage intensity—is sequestering carbon from the atmosphere into the soil. This sequestration is increasing soil carbon levels and reducing atmospheric CO_2. According to the Journal of Soil and Water Conservation, the potential to sequester atmospheric carbon in soil is greatest on lands currently used for annual crops; most remarkably, there is potential to sequester carbon in the soil at an annual growth rate of 0.4 percent each year.[34] The results of tracking soil organic carbon (SOC) advancements on select USDA-specified agricultural land areas is estimated to have sequestered an estimated 309 metric tons of CO_2-equivalent in less than a decade.[35] Although GHG lifecycle models do not currently account for this direct GHG reduction from corn production, NCGA believes research increasingly indicates the need to account for these direct effects corn and biofuel feedstock crops have on soil carbon stocks.

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[33] ICF prepared for USDA, A Life-Cycle Analysis of the Greenhouse Gas Emissions of Corn-Based Ethanol, January 12, 2017

[34] Chambers, A. & Lal, R. & Paustian, K. 2016. Soil carbon sequestration potential of US croplands and grasslands: Implementing the 4 per Thousand Initiative. Journal of Soil and Water Conservation. doi:10.2489/jswc.71.3.68A

[35] *ibid*

Argonne National Laboratory continues to review the GREET model, including gaps in the emissions accounting. We believe the effect of corn crops on soil carbon sequestration, among other considerations, should be incorporated into current LCA models. This increase in soil carbon from corn production, when included, could result in a 20 gram/MJ carbon credit for corn-based ethanol.[36] Fully accounting for corn's carbon sequestration would further demonstrate significant low-carbon advantages of a high-octane midlevel ethanol blend.

Fossil Fuel's Growing Carbon Footprint

While corn growers continue paving the way in terms of sustainability and productivity, ethanol producers have demonstrated similar advances. Together, corn ethanol's LCA continues to improve across the supply chain. The same cannot be said for the route chosen by oil companies and their product's overall LCA. With conventional reserves increasingly exhausted, oil companies are harnessing unconventional techniques and new technologies to extract resources once thought unreachable. These developments—namely hydraulic fracturing (fracking) for tight oil and tar sand bitumen production—are many times more energy- and water-intensive.[37] This trend provides a stark comparison and reiterates, today more than ever, the importance of using clean, renewable biofuels to offset petroleum.

Meeting Infrastructure Needs

For a fuel transition, it is important to consider issues associated with storing and dispensing a higher-octane fuel in the existing infrastructure, considering both the aboveground and the underground equipment. NCGA has made significant investments to support infrastructure development and deployment for high-octane midlevel blends. Further details about infrastructure readiness can be found in **Appendix 2.**

COMPLIANCE FLEXIBILITIES

Supporting the production and use of higher-octane gasoline consistent with CAA Title II

NCGA agrees with EPA's statement that higher octane gasoline could provide manufacturers with more flexibility to meet emissions reductions standards by enabling the use of technologies such as high-compression ratio engines.[38] Phasing out lower-octane fuels and phasing in a higher minimum octane standard would allow automakers to meet standards with vehicles designed to use these new fuels.

Continued reduction of GHG emissions and improving fuel economy are worthy objectives with world-wide support from consumers and governments. Liquid transportation fuel predominates the market and will continue to be used in the transportation sector for the foreseeable future. Enhancing fuels and optimizing combustion technologies is necessary to continue improving efficiency and reducing emissions. With EPA support, a cleaner, more powerful fuel can advance the vehicle fleet with broad vehicle-availability as early as model year 2023.

The transportation sector now accounts for the largest portion of U.S. GHG emissions, at 28 percent.[39] Within the transportation sector, light-duty vehicles are the source for 60 percent of the GHG emissions attributed to the transportation sector. Between 1990 and 2016, emissions from the transportation sector increased more than any other sector. Raising gasoline octane is an effective way to reduce these emissions.

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[36]American Coalition for Ethanol, The Case for Properly Valuing the Low Carbon Benefits of Corn Ethanol, 2018

[37] Gordon, D., A. Brandt, J. Bergerson, and J. Koomey. (2015). Know your oil: Creating a global oil-climate index. Washington, DC: Carnegie Endowment for International Peace.

[38] 83 Federal Register 43464 (August 24, 2018)

[39] EPA. U.S. Transportation Sector Greenhouse Gas Emissions 1990-2016; July 2018

EPA is tasked with ensuring the protection of Americans' health at the least cost and best value. EPA is charged with achieving the greatest degree of emissions reduction, taking into consideration availability, costs, and lead-time of technologies and available fuels. EPA can regulate fuels, vehicles, or both to achieve these reductions. Therefore, we believe EPA must take actions to support adoption of high-octane, low-carbon fuel to enable efficiency improvements and emissions reduction; remove market barriers to expanded use of the lowest-cost octane source, which is ethanol; and update test methods and environmental assessment of ethanol blended fuels to reflect the most recent technology and best available science.

Specifically, in response to EPA's request, NCGA believes EPA should take the following actions to support the production and use of higher-octane gasoline consistent with Title II of the Clean Air Act:

1) **Set a minimum fuel octane level of 98 RON and phase out low octane fuels as new optimized vehicles enter the market in MY 2023.**
NCGA believes EPA has ample authority to regulate fuel octane because of the impact higher fuel octane would have for reducing GHG emissions from the vehicle fleet. EPA has previously acknowledged the agency has authority to regulate fuel octane under Section 211(c). Higher octane, with ethanol as a source of octane, would result in a cost-effective fuel that offers automakers a technologically and economically feasible means to meet emissions standards. Additionally, the high-octane fuel would enable vehicle technologies that offer more benefits than other options. A high-octane standard would enable GHG emissions reductions that are not otherwise achievable and enable reductions beyond the proposed preferred alternative.

If automakers continue to design vehicles around the current lower octane fuels on the market, higher vehicle technology costs for automakers to meet standards with those fuels would lead to increased vehicle costs.[40] Automakers would pass those higher costs on to consumers. When automakers have the option of higher-octane fuel, the vehicle cost to consumers is less than without higher octane fuel.

A higher RON level, met through greater ethanol blending, would reduce fuel costs. As discussed previously in our comments, the higher ethanol content of the midlevel blend 98 RON fuel makes it more cost effective than the current premium fuel. This high-octane midlevel blend would be cost-competitive with current regular fuel.

Finally, a higher RON level met through greater ethanol blending would reduce CO_2 emissions. At the refinery level, production of a 98 RON E20 fuel reduces refinery CO_2 emissions by nearly 5 percent, and a 98 RON E30 blend would reduce refinery emissions by more than 10 percent. Conversely, even a 95 RON E10 would result in a small increase in refinery emissions.[41] On a WTW basis, based on the previously discussed DOE analysis, the greater vehicle efficiency enabled by a higher RON fuel accounts for about half of the GHG emissions reductions with a 5 percent efficiency gain, and the percentage of the ethanol blend determines the additional GHG reduction from the HOF.[42]

2) **Approve a high-octane, midlevel ethanol blend vehicle certification fuel such as a 98 RON E25.**
EPA's timely approval of a high-octane, midlevel ethanol blend vehicle certification fuel would enable automakers to expedite design and testing of optimized vehicles for use with this new fuel. We believe EPA should propose or invite automakers to propose submission of this certification fuel in conjunction with this rulemaking

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[40] USCAR March 15, 2018 presentation, "Wells-To-Wheels Analysis of High-Octane Fuels: Cost and CO_2 Emissions

[41] Hirshfeld, et al. 2014

[42] Thiess, et al. 2016

3) **Correct the fuel economy formula by updating the R-Factor to be at or nearly "1" to reflect documented operation of modern engine technology.**
Correcting the R-Factor in the fuel economy formula would support automakers developing high efficiency engines that require higher octane ratings and a higher ethanol content. EPA has acknowledged that the current EPA-mandated R-Factor of 0.6, originally established in the 1980s, is outdated and fails to achieve the statutory purpose of making fuel economy testing on today's fuel equivalent to fuel economy testing in 1975. An update to the fuel economy formula is necessary.

A change to 1 from 0.6 would reflect results of analysis by the Department of Energy and EPA using modern engines and fulfill previous observations and commitments from EPA to address this issue. Published studies have shown that R for modern vehicles should be around 0.93 to 0.96.[43]

Without this overdue correction, ethanol use will continue to be unjustifiably penalized in the fuel economy formula. Without a correction to the fuel economy formula, automakers are discouraged from developing high-efficiency engines that require fuel with a higher octane rating and greater ethanol content to enable that octane rating.

4) **Extend a RVP waiver of 1 psi to all gasoline containing at least 10 percent ethanol.**
NCGA appreciates the Administration's recent decision for EPA to issue a rule to address RVP parity for E15 and treat E15 the same as E10. EPA's rulemaking will be an important step forward in addressing this regulatory barrier. E15 and midlevel blends have lower evaporative emissions than E10. Allowing these fuels to reach the market on the same terms as E10 furthers the goal of reducing evaporative emissions.

5) **Adopt the Argonne National Laboratory GREET model to determine updated lifecycle carbon emissions for ethanol.**
The Energy Independence and Security Act of 2007 established lifecycle GHG emission thresholds for different types of renewable fuel when compared to lifecycle GHG emissions for gasoline or diesel. EPA last updated its lifecycle analysis for corn-based ethanol in 2010, projecting that corn-based ethanol would produce 21 percent fewer GHG emissions when compared to gasoline by 2022.

In comparison, the Department of Energy developed a system to account for full lifecycle emissions, the Greenhouse gas and Regulated Emissions and Energy use in Transportation (GREET) model, more than 30 years ago. The GREET model measures GHG emissions for all corn production and ethanol manufacturing activities. The assumptions used in the GREET model are perpetually under review, and the model is updated regularly. The 2016 GREET model shows the carbon intensity of corn-based ethanol is 45 percent below that of baseline gasoline.

To be effective, model assumptions must incorporate the latest science and data. The lifecycle profile of biofuels shows continuous improvement. But—with EPA's reliance on outdated modeling—the agency's conclusions understate the significant production and sustainability improvements by corn and corn ethanol industries over the last decade. Accurately quantifying ethanol's GHG reductions is imperative when assessing vehicle standards.

6) **Establish meaningful credits to automakers to incentivize transition to HOF vehicles and continue to support flex-fuel vehicles.**

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[43] Sluder, C., West, B., Butler, A., Mitcham, A. et al. 2014. Determination of the R Factor for Fuel Economy Calculations Using Ethanol-Blended Fuels over Two Test Cycles. SAE Int. J. Fuels Lubr. 7(2):2014, doi:10.4271/2014-01-1572.

Well-structured vehicle credit programs remain an impactful, cost-effective means for the government to encourage the introduction and adoption of new products and technologies. Credit program have the potential to provide clarity and stability in the market—this encourages automakers and provides assurances to corn growers, ethanol producers and fuel retailers.

7) **Provide equal treatment to vehicle technologies that reduce carbon emissions.**
EPA proposes to continue treating electric vehicles as carbon neutral, without regard to the source of electricity powering the vehicle, and EPA offers a sales multiplier to electric vehicles. EPA should level the playing field for vehicle technology by acknowledging high-octane fuels. Doing so would involve the agency supporting a transition to high octane by treating the ethanol portion of the fuel as carbon neutral. The carbon emitted from ethanol production is the same carbon the corn plant absorbed from the atmosphere, resulting in no net carbon. Further, EPA should consider a sales multiplier for vehicles optimized to run on high-octane fuel to enable GHG emissions reductions and support a transition to a cleaner fleet.

ONE NATIONAL PROGRAM

NCGA supports harmonization between federal and state vehicle standards to provide regulatory certainty and minimize market disruption. We believe taking steps to support the production and use of high-octane, low-carbon fuels could help bridge the gap on standards between the federal government and states. When automakers have more tools to meet vehicle standards, expanded cost-effective compliance options support reaching mutual agreement on standards.