NATIONAL CORN GROWERS ASSOCIATION

July 5, 2023

The Honorable Michael Regan, Administrator
Environmental Protection Agency
1200 Pennsylvania Ave. NW
Washington, DC 20460

RE: Docket No. EPA-HQ-OAR-2022-0829

Dear Administrator Regan:

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 multi-pollutant emission standards for model year (MY) 2027 through 2032 light and medium duty vehicles.

As the producers of the low carbon feedstock for low carbon ethanol, corn farmers are part of the solution to cut transportation emissions. We urge EPA to focus less on one solution, electric vehicles, and instead focus on outcomes and opening pathways for all low carbon fuels and technologies that enable more stringent vehicle emission standards, taking advantage of not only the low carbon benefits of higher ethanol blends, but also the cuts in toxic emissions, greater fuel efficiency and consumer cost savings that come with more renewables. For automakers to use new technologies and enhanced engines to meet stringent standards, they need updated fuel that enables new vehicles and fuels to work as a system to enhance greenhouse gas (GHG) and other tailpipe emissions reductions. Higher ethanol blends used with advanced engines optimized for higher octane would provide a much-needed pathway for low carbon, low-emission fuels.

Higher octane fuel is an essential tool for automakers to meet revised standards, but higher octane must also be clean octane to meet emission reduction goals. Clean octane from today's ethanol is 50 percent lower in GHG emissions than gasoline and replaces the most harmful hydrocarbon aromatics to improve air quality and prevent adverse health impacts. EPA failed to use the proposal to broaden the solutions that reduce transportation emissions by beginning a transition to low carbon, high-octane fuels to advance climate, air quality and environmental justice goals with these and future standards. Furthermore, alternative fuel vehicles such as flex-fuel vehicles, which have the potential to reach zero emissions, should be equitably incentivized through these vehicle standards.

In addition to improving this proposal to enable more solutions than only electric vehicles, NCGA urges EPA to advance a much-needed rulemaking addressing fuel quality to cut emissions from the millions of liquid fuel vehicles on the road now and the new vehicles that will be sold through the compliance period. Greater lifecycle emission reductions are available from sustainable, affordable low carbon ethanol through a clean, high-octane standard, by removing barriers to higher ethanol blends and by equitably incentivizing all alternative fuels and vehicles.

Sincerely,

Tom Haag

Tom Haag, President,
National Corn Growers Association

WWW.NCGA.COM

NATIONAL OFFICE
632 Cepi Drive
Chesterfield, MO 63005
(636) 733-9004

WASHINGTON, DC OFFICE
20 F Street NW, Suite 900
Washington, DC 20001
(202) 628-7001

OVERVIEW

As stated in the proposed rule, the transportation sector is the largest source of U.S. GHG emissions, representing 27.2 percent of total U.S. emissions. Within the sector, light-duty vehicles are the largest contributor, comprising 15.5 percent of total U.S. GHG emissions. Immediate progress toward decarbonizing the light duty fleet will help meet the Administration's goal of cutting emissions by 2030 and reaching net zero emissions by 2050. Achieving those decarbonization goals in transportation will require a mix of solutions. As recent analysis from the Rhodium Group concludes, a "portfolio of strategies is the lowest cost and most likely to succeed," including low carbon liquid fuels such as biofuels.[1] However, the singular focus of the currently proposed multi-pollutant emission standards for model year (MY) 2027 through 2032 light and medium duty vehicles on battery electric vehicles (BEVs), ignores the immediate and long-term benefits of leveraging a portfolio of various transportation technologies and the emission reductions they can achieve.

The proposed EPA standards for 2027 and later set very aggressive goals for reducing GHG and criteria emissions. Achieving these goals will require dramatic changes not only in vehicle design, but in the entire automotive supply chain. While the U.S. market share of BEVs will continue to expand, establishing regulations where success is solely contingent upon an unattainable tenfold increase in the production and sales of BEVs over the next eight years represents an avoidable mistake. The proposed rule would require huge investments and rapid growth in many industries, including the mining and processing of key minerals, the generation and distribution of electricity, and the recharging of electric vehicles.

There are many obstacles to this shift including geopolitics, long lead times, capital investments, and consumer acceptance. In order to achieve emission reduction goals in the most robust, rapid, and affordable way, EPA must instread encourage multiple additional solutions such as hybrid electric vehicles (including plug-in hybrids), reinstating meaningful flex-fuel vehicle credits, and the introduction of credits that encourage the utilization of internal combustion engines (ICE) designed to utilize higher blends of biofuels (such as ethanol) by recognizing the combined carbon and multi-pollutant emission reduction benefits of the engine technology and fuel.

Low-carbon liquid fuels have a unique and important role to play, immediately and in the long term. Fuels such as E15 (15% ethanol) are approved for and available for use in the millions of vehicles already on the road today, and thus offer immediate emissions benefits on a much larger scale than changes to only new vehicles. In the longer term, low-carbon or zero-carbon liquid fuels offer emissions solutions for market segments and customers that may not be well served by battery electric vehicles.

To foster a vibrant and competitive landscape of multiple solutions, it is critical for EPA to set performance-based and technology-neutral emissions standards. Unfortunately, the proposed standard falls short of this ideal. It is essential to look beyond the tailpipe and use life cycle analysis for fair comparisons and a "level playing field".

Under the Clean Air Act, EPA has an obligation to protect the health and welfare of Americans. While EPA projects the proposed standards will result in 7.3 billion cumulative tons of avoided GHG emissions through 2055, EPA leaves significant GHG emission reductions on the table if the agency fails to take steps in this proposal, or in a parallel action, to also improve liquid fuels along with vehicles. EPA must include complementary fuel improvements that would enable greater total GHG reductions, greater fuel efficiency and substantially greater air quality improvements than the current proposal offers.

Each year, sales of new vehicles displace a small fraction of the existing vehicle fleet. EPA estimates that 67% of new vehicles sales will be battery electric in 2032. The projections for battery electric vehicle adoption are based on very few—and very small—real-world data points. *See generally* 88 Fed. Reg. 29,187–90. Battery electric vehicles made up 5.8 percent of the new light-duty passenger vehicle market in 2022. *Id.* at 21,190. EPA needs these sales to increase by a factor of ten over the next 8 years.

[1] Rhodium Group, "Closing the Transportation Emissions Gap with Clean Fuels," January 15, 2021. https://rhg.com/research/closing-the-transportation-emissions-gap-with-clean-fuels/

Clearly, a large number of new vehicles that burn liquid fuels will continue to be produced for many years, and those vehicles will remain on the road for many additional years. According to data from the Department of Energy's Oak Ridge National Lab,[2] 16% of passenger cars and 32% of light-duty trucks remain on the road for more than 20 years. If new electric vehicles are more expensive or less attractive to consumers, older liquid-fueled vehicles will remain on the road even longer.

Low-carbon liquid fuels can achieve GHG reductions faster than new vehicles can displace the existing fleet. A relatively simple change such as replacing E10 (10% ethanol) with E15 (15% ethanol) can offer greater GHG reductions[3] than the phase-in of battery electric vehicles, because it can immediately affect a huge fleet of vehicles that are already in use.

But E15 is not the only way to achieve large emissions benefits with ethanol. To enable further displacement of petroleum by ethanol, many stakeholders have agreed to support E25 (25% ethanol) capability in all vehicles by 2028, and E30 by 2033, as specified in the Next Generation Fuels Act. However, EPA currently has authority to support the production of new vehicles with E25/E30 capability through new fuel standards, as well as incentivize flex-fuel vehicles (FFVs) with E85 capability. Getting these vehicles on the road quickly will build the foundation for future increases in cleaner liquid fuels, resulting in GHG and multi-pollutant emissions reductions.

Recognizing vehicles and fuels as a complete system, increasing the octane rating of the nation's fuel supply through a clean, high-octane standard would deliver greater GHG emission reductions from the approximate 281 million internal combustion engine (ICE) vehicles on the road today and the 100 million projected to be added by MY 2032, and during the 15 to 20 years those vehicles remain on the road after introduction.

PERFOMANCE BASED/TECHNOLOGY NEUTRAL RULEMAKING NEEDED

The EPA is proposing that upstream emissions accounting for BEVs, which under the current regulations would begin in MY 2027, would be removed under the proposed program; thus, BEVs would continue to be counted as zero grams/mile in a manufacturer's compliance calculation. This is clearly not a performance-based or technology-neutral proposal, and it would have dire consequences for all other technologies which could potentially reduce emissions at lower cost, more quickly, with fewer geopolitical implications (such as critical minerals), and with greater consumer acceptance.

A recent study[4] by Argonne National Lab, in cooperation with coauthors from the automotive and energy industries, shows a BEV with 400-mile range (BEV400) has lifecycle GHG emissions of about 250 g/mi. This is an improvement from a conventional internal combustion engine vehicle (ICEV) which is about 430 g/mi. However, the lifecycle GHG emissions of a BEV are far from zero. In fact, lifecycle GHG emissions of a BEV400 are comparable to other low-emission options such as E85 or PHEV. Regulations based only on tailpipe emissions are clearly inadequate for comparing BEVs to other pathways for reducing GHG emissions.

The Argonne report demonstrates that other "vehicle-fuel pathways" can compete with BEVs. For example, a conventional gasoline hybrid (HEV) achieves about 310 g/mi and E85 in a non-HEV FFV achieves 260 g/mi. The future potential of HEVs combined with FFV technology, utilizing E85, is comparable to future BEVs with wind and solar power.

The proposed rulemaking does not allow other vehicle-fuel pathways to compete with BEVs. By regulating only tailpipe emissions, and ignoring the rich literature of lifecycle analysis, EPA would create artificial incentives for auto manufacturers to pursue only BEVs. This could have disastrous impacts on both the cost and the GHG emissions of future vehicles. The same Argonne report found the cost and GHG emissions of a BEV are strongly affected by the driving range. A BEV with 400-mile range is dramatically more expensive than one with 200-mile range, and its lifetime GHG emissions are substantially worse. In fact, a BEV with 400-mile range has only a slight GHG benefit compared to a

---

[2] Davis and Boundy, "Transportation Energy Data Book: Edition 40", Oak Ridge National Laboratory report ORNL/TM-2022/2376, February 2022; https://tedb.ornl.gov/wp-content/uploads/2022/03/TEDB_Ed_40.pdf

[3] Fuels Institute report "Decarbonizing Combustion Vehicles: A Portfolio Approach to GHG Reductions", June 2023

[4] Kelly et al., "Cradle-to-Grave Lifecycle Analysis of U.S. Light-Duty Vehicle-Fuel Pathways: A Greenhouse Gas Emissions and Economic Assessment of Current (2020) and Future (2030-2035) Technologies", report ANL-22/27, June 2022

HEV or an E85 FFV. But the proposed rule counts all BEVs as zero GHG emissions, regardless of battery size – and regardless of vehicle size and weight.

Other concerns with BEVs are related to the supply of critical minerals for batteries. A report[5] by the International Energy Agency (IEA) says "mineral demand for use in EVs and battery storage is a major force, growing at least thirty times to 2040, it has taken on average over 16 years to move mining projects from discovery to first production. These long lead times raise questions about the ability of suppliers to ramp up output. The Democratic Republic of the Congo (DRC) and People's Republic of China were responsible for some 70% and 60% of global production of cobalt and rare earth elements respectively in 2019. The level of concentration is even higher for processing operations. China's share of refining is around 35% for nickel, 50-70% for lithium and cobalt, and nearly 90% for rare earth elements. High levels of concentration, compounded by complex supply chains, increase the risks that could arise from physical disruption, trade restrictions or other developments in major producing countries. Production and processing of mineral resources gives rise to a variety of environmental and social issues that, if poorly managed, can harm local communities and disrupt supply."

Toyota[6] and others[7] have argued for a balanced approach to emissions reductions using BEVs **and** other technologies, saying "perfect should not be the enemy of the good". The battery size[8] for a BEV is about 6 times larger than a PHEV (~75-145kWh vs. ~12-18kWh), and about 60 times larger than a HEV (~1.3-1.9kWh). Given the limited supply of battery materials, a large number of HEVs and PHEVs can clearly achieve substantially better GHG reductions than a small number of BEVs.

The proposed rulemaking assumes that BEVs will be the dominant technology for future emissions reductions. But relying on a single technology is a risky strategy; many factors could interfere including the supply and/or cost of critical minerals, lack of BEV recharging infrastructure, slow ramp-up of wind and solar power, poor customer acceptance of BEVs in some market segments, etc. EPA estimates that 67% of U.S. vehicles sales will be BEVs in 2032, but most major automakers predict much lower BEV sales, and the world's largest automaker predicts only 20% in 2030. For comparison, MIT predicts[9] that China will achieve only 40% in 2030 despite a head start and extremely strong government interventions. EPA should not base mandatory emissions standards on unrealistic predictions of BEV sales.

It is essential for EPA to utilize life cycle analysis to create a "level playing field" which encourages speedy adoption of HEVs, PHEVs, FFVs, and other technologies (in addition to BEVs) to achieve the most rapid, affordable, robust, and practical GHG emissions reductions in a wide range of vehicle segments, while satisfying diverse customer needs and preferences. Europe is already making progress towards regulation based on life cycle analysis.[10] [11]

UPSTREAM EMISSIONS

EPA's proposal continues to treat EVs as carbon neutral, without regard to the source of electricity powering the vehicles. Depending on the sources of electricity – whether coal, natural gas, wind or nuclear and the mix of those sources - full lifecycle emissions of EVs vary widely, masking the true GHG emissions from these vehicles. Without accounting for upstream emissions from these vehicles, full lifecycle emissions are not considered. Furthermore, EPA notes in the proposal that increases in electricity demand will result in increased non-GHG emissions for some upstream pollutants. EPA does a disservice to emissions reduction goals by accounting for upstream emissions from some fuels and vehicle technologies but not others, providing an advantage to the sources for which "wells-to-wheels" upstream emissions are excluded and concealing emissions from coal power generation, mineral extraction, and other high-carbon sources.

---

[5] International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions", 2021; https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

[6] Gill Pratt, Toyota Motor Corporation's Chief Scientist, open letter posted on Medium, August 2021; https://medium.com/toyotaresearch/more-straight-talk-about-toyotas-electric-vehicle-strategy-f0aba4be40

[7] Foster, Koszewnik, Wade, and Winer, "Pathways to More Rapidly Reduce Transportation's Climate Change Impact." Issues in Science and Technology, November 17, 2022; https://issues.org/reduce-vehicle-transportation-emissions-foster-koszewnik-wade-winer/

[8] https://insideevs.com/reviews/344001/compare-evs/

[9] https://news.mit.edu/2021/chinas-transition-electric-vehicles-0429

[10] https://www.goldmansachs.com/intelligence/pages/briefly/from_briefings_21-Jan-2020/new-era-in-co2-regulation.pdf

[11] Sala et al., "The evolution of life cycle assessment in European policies over three decades", International Journal of Life Cycle Assessment, December 2021; https://doi.org/10.1007/s11367-021-01893-2

FUEL QUALITY RULEMAKING NEEDED

The EPA proposed rulemaking requested "comment on potential future gasoline fuel property standards aimed at further reducing PM emissions, for consideration in a possible subsequent rulemaking". A major advantage of fuel property standards is that they affect emissions from all vehicles on the road today – not just new vehicles.

In response to EPA's request for input on fuel standards, NCGA supports EPA establishing a pathway to a higher minimum clean octane standard for fuel of at least 98 RON that enables mid-level ethanol blends to immediately and cost-effectively reduce both GHG and tailpipe emissions, supporting greater fuel efficiency and bringing lower carbon and lower cost fuels to the market.

Even with advancements in engine technology, automotive manufacturers are nearing a point where further improvements are difficult without a higher-octane fuel. This is because advanced downsized, down sped engines, and their associated technologies, make an engine more susceptible to knock. Due to its knock-limiting properties, a higher-octane fuel, such as a midlevel ethanol blend, enables engine designs featuring higher compression ratios, turbocharging, and down speeding and increases overall engine performance and efficiency.[12] According to Department of Energy (DOE) researchers at Oak Ridge National Laboratory, "the opportunity for further downsizing and down speeding 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."[13] Since 2016, DOE has completed extensive research through its Co-Optimization of Fuels and Engines initiative (Co-Optima) on innovating fuels and engines together and understanding the types of fuels that can improve engine performance and efficiency to reduce emissions.[14]

The recently concluded Co-Optima research[15] validates the solution of pairing clean octane and optimized engines to deliver greater environmental and economic benefits on the pathway to a net-zero transportation future, and DOE confirms ethanol's declining carbon intensity.[16]

- New fuel options can improve fuel economy by 10 percent with today's turbocharged engines, with an additional 15 percent improvement with advanced engines.
- Domestically sourced bio-based fuels produce 60 percent fewer GHG emissions than petroleum-based fuels.
- Optimized fuel and engine combinations also cut criteria pollutant emissions.

As DOE explained in its GHG analysis of high-octane fuel, determining GHG impacts of high-octane fuel 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 wells-to-wheels (WTW) emissions from high-octane fuel 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 percentage points of that total, and the additional 4 percentage

---

[12] 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.

[13] 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

[14] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Co-Optimization of Fuels & Engines," https://www.energy.gov/eere/bioenergy/co-optimization-fuels-engines

[15] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "On the Road to a Net-Zero-Carbon Transportation Future," https://www.energy.gov/eere/bioenergy/articles/road-net-zero-carbon-transportation-future

[16] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Ethanol vs. Petroleum-Based Fuel Carbon Emissions," https://www.energy.gov/eere/bioenergy/articles/ethanol-vs-petroleum-based-fuel-carbon-emissions

points of GHG reductions with the E25 fuel were realized from ethanol offsetting petroleum. For the E40 HOF, the ethanol content provided a 9 percent reduction in WTW GHG emissions.[17]

Current fuels with higher octane, marketed as premium grades, where ethanol blends are limited to 10%, are not cost-effective for consumers, and fall short of enabling the efficiency and emissions technology changes automakers need to advance transportation decarbonization. Because ethanol results in nearly half the emissions of gasoline and is on a pathway to future net-zero emissions, producing higher-octane fuel with a midlevel ethanol blend would do more to reduce GHG emissions and support the stringency goals of the proposed rule. Optimized vehicles powered by low carbon, high-octane fuel made from a midlevel ethanol blend would have much lower GHG emissions than vehicles running on either current E10 blends or premium E10 blends.

Higher ethanol content, reached by removing regulatory barriers to higher blends, would boost GHG reductions and replace harmful aromatics, providing a cost-effective low carbon fuel solution for consumers, including low-income consumers, and the environment.

LOW CARBON ETHANOL: MOVING TO NET ZERO

The Renewable Fuel Standard (RFS) has already resulted in more 1 billion metric tons of cumulative GHG savings from 2008-2021, exceeding original projections largely due to the reduced carbon intensity of corn ethanol, highlighting the importance of using biofuels like ethanol to enhance the GHG emissions reductions from transportation with the right policies.[18]

The most recent assessment from the Department of Energy's Argonne National Laboratory concludes corn ethanol's carbon intensity decreased 23 percent from 2005 to 2019 due to increased corn yield, reduced fertilizer intensity and improved ethanol production efficiency, with corn ethanol now between 44 and 52 percent lower in carbon intensity (CI) than the gasoline it replaces.[19] Argonne's conclusions are similar to analysis from Environmental Health and Engineering finding ethanol now results in 46 percent fewer GHG emissions compared to gasoline, due to improved corn production, ethanol production efficiencies and land productivity.[20]

Corn-based ethanol can reach net zero emissions with continued on-farm improvements and soil carbon sequestration, along with carbon capture technology and new efficiencies in ethanol production. Corn farmers are proud of our leadership in adopting conservation and best management practices. NCGA's recently released Corn Sustainability Report[21] details corn farmers' history of improvements and our commitment to further sustainability achievements by 2030.

Sustainable production means corn farmers today are producing more corn using less land and fewer resources. For example, planted corn acres in 2022, at 88.6 million acres, were less than planted acres in 2007, the year the RFS was expanded, at 93.5 million acres. USDA data also shows the area planted to principal crops in the United States is not expanding overall. Corn production has increased primarily because crop yields have increased from an average of 150 bushels per acre in 2007 to 173 bushels in 2022. With the average yield in 1980 at just 91 bushels per acre, productivity growth is a long-term trend.

Using the expertise of Argonne's scientists and the U.S. Department of Agriculture's data, we believe Argonne's Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies (GREET) model is the federal government's

[17] Theiss et al., 2016.
[18] Unnasch, S. & Parida, D., Healy, B. "GHG Emissions Reductions due to the RFS2: A 2022 Update," February 2023; chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://d35t1syewk4d42.cloudfront.net/file/2424/GHG%20Emissions%20Reductions%20due%20to%20the%20RFS2%20-%20Feb%202023.pdf
[19] Lee, Uisung & et al. ANL, "Retrospective Analysis of the U.S. Corn Ethanol Industry for 2005–2019: Implications for Greenhouse Gas Emission Reductions," (2021). https://onlinelibrary.wiley.com/doi/10.1002/bbb.2225
[20] Scully, Melissa J., et al, "Carbon intensity of corn ethanol in the United States: state of the science," (2021) Environmental Research Letters 16 043001. https://iopscience.iop.org/article/10.1088/1748-9326/abde08
[21] National Corn Growers Association Corn Sustainability Report: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://dt176nijwh14e.cloudfront.net/file/392/NCGA%20Sustainability%20Report_final_digital_07_29_21.pdf

most accurate tool for evaluating biofuel and energy lifecycle emissions. Because GREET is regularly updated, this model captures GHG emissions reductions from farmers' improved production practices and will incorporate the ongoing, voluntary climate-smart improvements in agriculture production this Administration supports, ensuring further carbon intensity reductions are accounted for in the LCA.

Corn production has improved across all measures of resource efficiency, including higher crop yields per acre, resulting in greater corn production using less land and fewer inputs, further fortifying ethanol as a sustainable, low-carbon renewable fuel. This progress is reflected in Argonne's most recent analysis, which builds on and is consistent with other recent reviews.

For example, a 2018 USDA study shows that ethanol then resulted in 39 to 43 percent fewer GHG emissions than gasoline.[22] Building on this progress, additional improvements on farms and in ethanol production supported by expanding markets for low carbon fuels could result in ethanol with up to 70 percent fewer GHG emissions than gasoline, according to USDA's analysis. Furthermore, according to California Air Resources Board (CARB) data, the CI of ethanol is more than 40 percent lower than the CI of gasoline.[23]

These increasing benefits have occurred without accounting for corn's ability to sequester carbon in the soil. 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. Although GHG lifecycle models do not currently account for this direct GHG reduction from corn production, NCGA believes the effect of corn crops on soil carbon sequestration, among other considerations, should be incorporated into current lifecycle analysis. This increase in soil carbon from corn production, when included, could result in a 20 gram/MJ carbon credit for corn-based ethanol.[24] Fully accounting for corn's carbon sequestration would further demonstrate significant low-carbon advantages of a high-octane midlevel ethanol blend.

CRITERIA POLLUTANTS AND PARTICULATE MATTER

Bringing high octane fuel to market in the form of midlevel ethanol blends will be significantly less capital-intensive than attempting to increase blend stock octane with hydrocarbon components at refineries. It will also be incredibly cleaner. The avoided production cost and offset emissions lower end-costs to consumers, reducing both economic costs and social costs related to health and environment, key considerations in advancing environmental justice and avoiding adverse impacts from oil refineries on communities that have historically borne them.

Increased volumes of ethanol in fuel displace the most harmful compounds from gasoline.[25] 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. These same aromatic hydrocarbons are also precursors to the formation of secondary organic aerosols (SOA), which in turn are a major contributor to particulate matter emissions (PM 2.5).

---

[22] Lewandrowski, Jan, and et. al, "The Greenhouse Gas Benefits of Corn Ethanol - Assessing Recent Evidence," (202) Biofuels, 11:3, 361-375. https://www.tandfonline.com/doi/full/10.1080/17597269.2018.1546488

[23] California Air Resources Board, Low Carbon Fuel Standard Reporting Tool Quarterly Summaries, based on data through Q3 2020 at https://ww3.arb.ca.gov/fuels/lcfs/lrtqsummaries.htm

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

[25] 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

According to EPA's review for the 2020 Anti-backsliding Study, ethanol does not form SOA directly or affect SOA formation. However, as EPA states, toluene is a large contributor to SOA. Ethanol's high-octane value "greatly reduces the need for other high-octane components including aromatics such as toluene."[26]

As explained in EPA's Fuel Trends Report: Gasoline 2006-2016, "Ethanol's high-octane value has also allowed refiners to significantly reduce the aromatic content of the gasoline, a trend borne out in the data." EPA's data shows that aromatics' share of gasoline volume dropped from nearly 25 percent to 19.3 percent, and benzene volume dropped from 0.99 percent to 0.58 percent between 2000 and 2016, the same time as ethanol blending increased from 1 percent to at least 10 percent.

EPA's data demonstrates the air quality and human health benefits of increased ethanol blending in gasoline by replacing harmful aromatics with clean octane from ethanol. Limiting the aromatics content of gasoline and using higher ethanol blends in high octane fuel would further reduce risks from SOA formation and exposure to PM 2.5, which causes serious respiratory, cardiovascular, and other health harm, including premature death, according to the American Lung Association. The same GDI engine advancements that help lower GHG emissions have the unfortunate side effect of increasing particulate emissions, which could be reduced by use of midlevel ethanol blends.

Petroleum-based aerosol particles represent a significant source of pollution, especially in population-dense urban areas. Health issues related to PM and other emission-based pollutants can be reduced by lowering the volume of petroleum in the domestic gasoline pool, which can be accomplished by increasing octane with higher ethanol blends and replacing more hydrocarbon aromatics with ethanol.

It is well known that particulate emissions are a strong function of aromatic fuel components with a high double bond equivalent and low vapor pressure, and the particulate forming potential is well represented by the "PMI" metric developed by Honda.[27] The value of the PMI metric has been validated in many other studies including the joint auto-oil Coordinating Research Council[28] and the EPA.[29] PMI and particulate emissions can be reduced by altering refinery processes to reduce heavy aromatic content of the fuel, and, as noted, ethanol can replace those aromatics.

Perhaps the most credible and comprehensive study on the effects of ethanol on particulate emissions topic was published by the University of California Center for Environmental Research and Technology.[30] The study showed statistically significant improvements in particulate emissions for E15 compared to E10.

EPA should adopt rules to limit PMI of both finished fuels and the hydrocarbon blend stocks used for E10, E15, and E85. Limiting PMI of hydrocarbon blend stocks will ensure that the particulate emissions benefits of ethanol are not offset by negative changes at refineries.

Improved fuel property standards should be a high priority because they can achieve significantly lower particulate emissions and dramatically lower GHG emissions. California's Low Carbon Fuel Standard already recognizes the importance of fuel standards, and it has led to dramatic increases in sales of E85 and other low-carbon biofuels. High-octane low-carbon fuels are a key enabler for continued GHG emissions improvements in the millions of liquid-fueled vehicles which will be produced over the next 10+ years, as documented by the U.S. Department of Energy Co-Optimization of Fuels & Engines initiative and in numerous other studies, such as those by MIT and by automakers. A detailed proposed blueprint for future high-octane low-carbon fuels exists in the Next Generation Fuels Act, and EPA has the statutory authority to make these changes without waiting for Congress to act.

[26] U.S. Environmental Protection Agency, Clean Air Act Section 211 (v)(1) Anti-backsliding Study, (2020) Appendix A, Page 61.
[27] Aikawa, Sakurai, and Jetter, "Development of a Predictive Model for Gasoline Vehicle Particulate Matter Emissions", SAE paper 2010-01-2115, 2010; https://doi.org/10.4271/2010-01-2115
[28] Coordinating Research Council, "Evaluation and Investigation of Fuel Effects on Gaseous and Particulate Emissions on SIDI In-Use Vehicles," Report No. E-94-2, March 2016; http://crcsite.wpengine.com/wp-content/uploads/2019/05/CRC_2017-3-21_03-20955_E94-2FinalReport-Rev1b.pdf
[29] US Environmental Protection Agency, "Exhaust Emission Impacts of Replacing Heavy Aromatic Hydrocarbons in Gasoline with Alternate Octane Sources", report EPA-420-R-23-008, April 2023
[30] Tang et al., "Expanding the ethanol blend wall in California: Emissions comparison between E10 and E15", Fuel, June 2023; https://doi.org/10.1016/j.fuel.2023.128836

In summary, EPA should pursue stringent new fuel standards – not only for reduced particulate emissions but also for dramatically lower GHG emissions. Fuel standards can achieve benefits much more quickly than standards which only impact new vehicles.

FLEX FUEL VEHICLES and CREDITING

Beyond ethanol's utility in all gasoline engines to reduce GHG emissions, other alternative vehicle technologies can also harness the GHG reductions and air quality benefits of ethanol, such as Flex Fuel Vehicles (FFVs). FFVs utilizing higher blends of low carbon ethanol, such as E85, can provide immediate emissions reductions without tangibly altering the price of the vehicle and reducing fuel costs. In fact, E85 is typically sold at a substantially lower price than gasoline, translating to monetary savings in addition to the significant air pollution savings.

Compared to gasoline, E85 leads to significant reductions in NOx and GHG emissions. E85 avoids use of toxic hydrocarbon aromatics in gasoline that are precursors to secondary organic aerosols that result in harmful fine particulate matter emissions that cause serious respiratory, cardiovascular, and other health harm, including premature death, according to the American Lung Association.

Incentivized to reduce emissions through the state's Low Carbon Fuel Standard (LCFS), in California some FFVs are even powered by a blend of 15 percent renewable naphtha with 85 percent ethanol. These vehicles use zero fossil fuels, have improved air emissions profiles, and have an extremely low carbon intensity.

Despite the GHG and criteria pollution reduction benefits of FFVs, as well as the low cost to purchase and fuel these vehicles, automakers have cut back on FFV models and now offer very few choices to consumers. 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. To encourage introduction of a wider range of low emission vehicle choices, NCGA believes EPA must provide equitable crediting across the spectrum of low emission vehicles, including FFVs.

NCGA also urges EPA to take steps to update the F-factor in the fuel economy formula to a forward-looking F-factor of at least 0.2, as we outlined in 2020 comments in response to Docket EPA–HQ–OAR–2020-0104. Furthermore, we urge EPA to reinstate the 0.15 volumetric conversion factor for FFVs. EPA should reharmonize the 0.15 factor for FFVs in these standards, and, if not, in future standards. This change would accurately reflect the significant carbon emissions reductions from FFVs using E85 because the carbon emissions from the fuel are the release of carbon taken up through crop growth.

EPA's STATUTORY AUTHORITY and ACTIONS NEEDED

NCGA believes EPA should take the following actions to improve the proposal and through rulemaking on fuel property standards:

Set a minimum fuel octane level of 98 RON, phasing out lower octane fuels as new optimized vehicles enter the market.
NCGA believes EPA has ample authority to regulate fuel octane because of the impact higher fuel octane would have on reducing GHG and criteria emissions from the vehicle fleet. EPA has previously acknowledged the agency has authority to regulate fuel octane under Section 211(c).

Approve a high-octane, midlevel ethanol blend vehicle certification fuel (98-100 RON, E25-E30).
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 low carbon fuel.

Correct the fuel economy formula by updating the R-Factor to 1.0 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 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.[31]

Setting the R-factor to 1.0 sets fuel economy results on an energy basis. In application, the R factor equation is a "fuel response factor," adjusting for more than just energy density. An R of 1.0 essentially converts fuel economy to mile per gallon gasoline equivalent (MPGge), which is how other alternative fuels such as propane, natural gas, and electricity have been compared to their gasoline counterparts for decades. Setting R to 1.0 provides equitable treatment to renewable ethanol that other alternative fuels already receive. This change could help speed the transition to certification with Tier 3 fuel as well as encourage vehicle manufacturers to seek certification for even higher ethanol blends, such as E15 or the high octane E30 EPA suggested in its Tier 3 proposal several years ago. Manufacturers are not incentivized to build dedicated high-octane vehicles that reduce GHG emissions when those low carbon benefits are penalized by a low R factor.

Lower summer vapor pressure to 9 psi or less for all fuel or provide parity in Reid Vapor Pressure (RVP) treatment for all ethanol blends with E10.
Higher ethanol blends such as E15 offer an immediate decarbonization opportunity and support a transition to low carbon, high octane fuel. However, outdated RVP rules and the oil industry's refusal to produce lower volatility blend stock prevents E15 – which is lower in evaporative, tailpipe and GHG emissions – from reaching the market on the same terms as standard E10 fuel.

By using existing authority in the Clean Air Act to require lower volatility conventional gasoline blend stock during the summer months to reduce emissions of volatile organic compounds and decrease the potential for ozone formation, EPA would simultaneously open the market to E15 year-round. NCGA urges EPA to take this action to improve air quality while simultaneously eliminating outdated barriers to cleaner, low carbon higher ethanol blends like E15 and future high-octane fuel.

Update Fuel Related Testing and Certification Requirements
As NCGA recommended to EPA in 2020 comments on Docket EPA–HQ–OAR–2016-0604, actual tailpipe carbon emissions, regardless of the test fuel, must continue to be the only measure of vehicle emissions performance in vehicle testing. CO_2 test adjustments would needlessly complicate vehicle test procedures. Relying solely on test results eliminates uncertainty, averaging and potential for inaccuracies in procedures to adjust emission test results for the fuel.

Lower GHG emissions from vehicles benefit consumers, our environment, and our energy security. Just as updating the test fuel from E0 to E10 reduced GHG emissions by blending cleaner, renewable ethanol with gasoline, E15 and future clean, high-octane fuels that blend more ethanol will further reduce emissions and improve fuel economy when used with optimized engines. Vehicle test procedures for Tier 3 fuel, or any future certification fuel, must not create impediments to low carbon fuels such as E15 and higher blends and the vehicle technologies that help reach our mutual goal of lower GHG emissions. Stringency of the standards is best maintained through the Administrator's authority to adjust the standards, as EPA is using in this proposal, not by adjusting emission test results.

Adopt Argonne's GREET Model
Argonne's Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model is the federal government's most accurate tool for evaluating biofuel and energy lifecycle emissions. Adopting a true "wells-to-wheels" methodology will help to ensure an accurate accounting of total carbon intensity so that all low carbon fuels and technologies are compared on full and accurate lifecycle emissions on a technology and feedstock neutral basis.

Update the F-factor in the fuel economy formula to a forward-looking F-factor of at least 0.2.

Reinstate the 0.15 volumetric conversion factor for FFVs.

---

[31] 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.