Comments of

THE ILLINOIS, IOWA, KENTUCKY, & MISSOURI CORN GROWERS ASSOCIATIONS

On the National Highway Traffic Safety Administration and

U.S. Environmental Protection Agency's Proposed

SAFER AFFORDABLE FUEL-EFFICIENT (SAFE) VEHICLES RULE FOR MODEL YEARS 2021-2026 PASSENGER CARS AND LIGHT TRUCKS

Docket ID No. NHTSA-2018-0067; EPA-HQ-OAR-2018-0283

83 Fed. Reg. 42,986 (Aug. 24, 2018)

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EXECUTIVE SUMMARY

Vehicles certified to run on high-octane midlevel ethanol blends would increase engine efficiency at an affordable cost while reducing carbon emissions and weaning the nation off foreign oil. Moreover, unlike current premium gasoline, high-octane midlevel ethanol blends would be competitive with, and likely cheaper than, regular grade gasoline, unlocking more efficient vehicles and high-octane fuel for consumers at affordable prices.

EPA should support these fuels by removing regulatory barriers that prevent these fuels from competing in the marketplace. In particular, EPA should

a) Approve a midlevel ethanol blend as an alternative certification fuel,

b) Correct the anti-ethanol bias in EPA's calculation of fuel economy, and

c) Reinterpret the sub-sim law to facilitate the sale of higher ethanol blends.

The agencies should also support high-octane midlevel ethanol blends by accurately accounting for ethanol's displacement of petroleum and its carbon neutrality in their calculation of fuel economy and carbon-related exhaust emissions of vehicles certified to use midlevel ethanol blends:

d) Under the CAFE program, the agencies should

- Apply a petroleum-equivalency factor to a midlevel ethanol certification fuel, based on the gasoline portion of the fuel (e.g., 0.75 for E25, a blend of 25% ethanol and 75% gasoline); and
- Use a harmonic average to weigh the midlevel ethanol certification fuel results equally with the gasoline fuel results when calculating fuel economy for dual-fueled vehicles.

e) To extend similar treatment under the GHG program, EPA should

- Revise the carbon-related exhaust emissions formula to recognize that the ethanol portion of the midlevel ethanol certification fuel generates no net carbon emissions, because ethanol is derived from renewable, carbon-neutral biomass that absorbs atmospheric carbon dioxide; and
- Provide an incentive multiplier to encourage the sales of next-generation high-octane vehicles, as EPA already does to encourage electric vehicles.

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INTRODUCTION

I. UNLIKE CONVENTIONAL PREMIUM GASOLINE, MIDLEVEL ETHANOL BLENDS COULD ENABLE FUEL ECONOMY AND GHG BENEFITS AT AFFORDABLE PRICES.

The proposed SAFE rule requests comment on "the potential benefits, or disbenefits" of higher octane fuel.[1] In particular, the proposed rule requests comment on

> how increasing fuel octane levels would play a role in product offerings and engine technologies. Are there potential improvements to fuel economy and CO_2 reductions from higher octane fuels? Why or why not? What is an ideal octane level for mass-market consumption balanced against cost and potential benefits? What are the negatives associated with increasing the available octane levels and, potentially, eliminating today's lower octane fuel blends?[2]

The agencies mention the possibility of "today's premium grade becoming the base grade available, which could enable low cost design changes that would improve fuel economy and CO_2" in future vehicles.[3] Requiring a minimum octane grade gasoline would allow manufacturers to raise engine compression ratios. But under current regulatory conditions that prevent competition from midlevel ethanol blends (E20 to E40), this requirement would be costly.

There is a better way to increase fuel octane levels than mandating current premium fuel. Opening the market to competition from high-octane (98 to 100 Research Octane Number (RON)), midlevel ethanol blends would increase fuel octane levels and enable more efficient engines with or without an octane-minimum requirement. As explained in the separate comments filed by Urban Air Initiative, studies show that high-octane midlevel ethanol blends would enable more efficient engines and reduced CO_2 emissions. In addition, as explained in these comments, unlike premium gasoline, high-octane midlevel ethanol blends would be competitive with (and perhaps even a few cents cheaper than) regular

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[1] *Safer Affordable Fuel-Efficient (Safe) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks*, 83 Fed. Reg. 42,986, 43,041 (Aug. 24, 2018) ("Proposed SAFE Rule").

[2] *Id.*

[3] *Id.*

gasoline, unlocking more efficient vehicles and high-octane fuel for consumers at affordable prices.[4] Although a minimum-octane-level requirement could stimulate competition from midlevel ethanol blends, the attractive prices of midlevel ethanol blends alone could be sufficient to stimulate additional demand for high-octane fuel and enable more efficient high-compression vehicle engines, without the need for a mandate.

A. Conventional Premium Gasoline Is Inadequate to Enable Higher Octane Fuel.

Consumers today have three gasoline octane grade options at the pump—regular (87 Anti-Knock Index "AKI"),[5] midgrade (89–90 AKI), and premium (91 to 94 AKI).[6] These blends are produced as a "blend of 90% gasoline and 10% ethanol," or E10.[7] But sales of midgrade and premium E10 gasoline are flagging. Since the phaseout of leaded gasoline, "the average gasoline octane level has remained fundamentally flat starting in the early 1980s and decreased slightly starting in the early 2000s."[8] Within "the last 10 years, premium fuel sales volume has become stagnant at approximately 10% of the total fuel sales volume,"[9] even as manufacturers have increased the share of "premium-recommended" and "premium-required" vehicles they sell to comply with the fuel economy standards.[10]

The declining market share of premium gasoline is due to cost. From the mid-1990s until the late 2000s, premium was priced about 15 cents per gallon above regular grade gasoline at the pump.[11] Over the past decade, premium's markup has climbed to a record

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[4] *See* Dean Drake et al., Preliminary Report: Evaluating the Retail Costs of Potential Future High-Octane Gasoline Ethanol Blend Fuels 9 (2018) (attached as Exhibit A).

[5] AKI is the average of two test ratings—Research Octane Number or "RON" and Motor Octane Number or "MON"—that measure a fuel's resistance to pre-ignition in spark-ignition engines.

[6] Proposed SAFE Rule, 83 Fed. Reg. at 43,040.

[7] *Id.*

[8] *Id.*

[9] Derek Splitter et al., *A Historical Analysis of the Co-evolution of Gasoline Octane Number and Spark-Ignition Engines*, 16 Front. Mech. Eng. 12 (2016).

[10] *Id.* at 13, Fig. 11.

[11] Energy Info. Admin., Weekly Retail Gasoline and Diesel Prices https://www.eia.gov/dnav/pet/pet_pri_gnd_a_epm0_pte_dpgal_w.htm.

high of over 50 cents a gallon over regular gasoline prices, an 18% markup compared to regular grade gasoline.[12] *See* Figure 1. This increase is attributable to changes in both supply and demand. On the supply side, light crude produced by domestic fracking

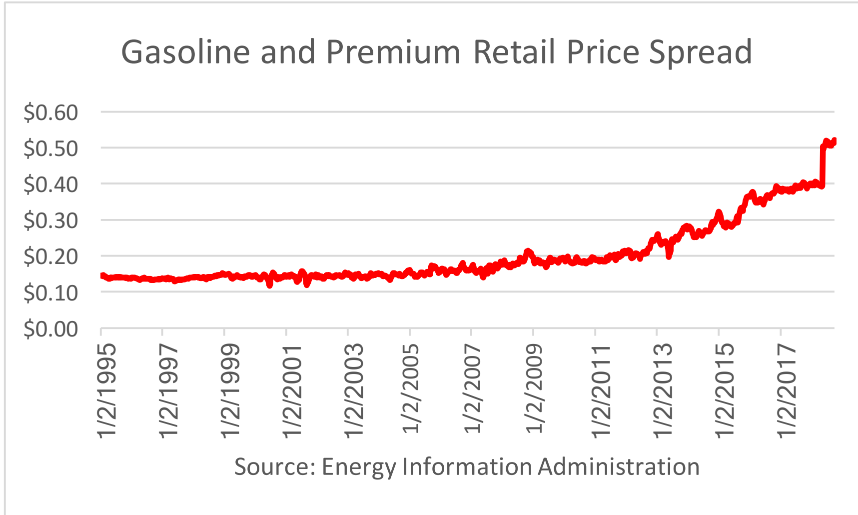

Figure 1

operations has a lower octane value than the crude it replaces, so costlier refinery operations are needed to upgrade refinery streams to premium blendstocks, which pushes up premium retail prices.[13] On the demand side, the sale of more premium-required or premium-recommended vehicles has likely exerted modest upward pressure on premium prices.[14] Premium's markup is not forecast to decline anytime soon.

Under current regulatory conditions that prevent competition from less costly octane additives, the cost to consumers of requiring premium would likely outweigh any fuel savings from increased fuel economy.

- A recent study by the Defour Group, commissioned by the Illinois Corn Growers Association, finds that, after accounting for the greater fuel economy enabled by 93 AKI E10 premium fuel, lifetime fuel costs for an

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[12] *Id.*; *see also* Energy Info. Admin., Growing Octane Needs Widen the Price Difference Between Premium and Regular Gasoline (June 21, 2017), https://www.eia.gov/todayinenergy/detail.php?id=31732.

[13] Tom Kloza, Octane in the Octagon 14 (June 2017) (showing that the price spread between premium and regular gasoline has increased in recent years due in part to the composition of tight oil), https://www.eia.gov/conference/2017/pdf/presentations/tom_kloza.pdf.

[14] Energy Info. Admin., *supra* note 12.

average model year 2023 vehicle running on premium would be $998 higher than for a vehicle running on regular E10.[15]

- Another study by the refinery consultancy MathPro, commissioned by USCAR, finds that a 95 Research Octane Number (RON) minimum requirement would cost refiners 2.9 additional cents a gallon and that a 98 RON minimum requirement would cost refiners an additional 18 cents a gallon, costs that would likely be passed on to consumers in the form of higher fuel prices.[16]

- Although an MIT study found that requiring a minimum 98 RON blend of E10 premium could lower annual fuel costs for consumers by a total of $0.4–6.4 billion *in 2040*, the study does not measure the transitional costs of a premium requirement, and it optimistically assumes that refiners would "adjust the price differential between regular and premium gasoline to ensure that purchasing higher-efficiency vehicles requiring premium was an economic choice for consumers."[17] The authors admit that at current premium prices, premium fuel costs would outweigh fuel economy savings in future vehicles.[18]

Consumers do not like paying more at the pump. Economic research suggests that when confronted with higher prices at the pump, even drivers of premium-recommended or premium-required vehicles may choose a cheaper fuel grade, degrading vehicle performance.[19] This reluctance to pay more suggests that even though requiring a minimum AKI standard is technically and economically feasible, consumers would continue to resist buying premium fuel while a cheaper regular grade remains available.[20] This could limit manufacturers' ability to increase compression ratios in the near term, before regular grade has been fully phased out of the market. Although premium-required vehicles can facilitate

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[15] Exhibit A, at 9.

[16] David S. Hirshfeld & Jeffrey A. Kolb, *Refining Economics of U.S. Gasoline: Octane Ratings and Ethanol Content*, 48 Envtl. Sci. & Tech. 11,065, 11,068, Table 2 (2014)

[17] Raymond L. Speth, *Economic and Environmental Benefits of Higher-Octane Gasoline*, 48 Envtl. Sci. & Tech. 6561, 6566 (2014).

[18] Raymond L. Speth et al. Potential Environmental and Economic Benefits of Higher-Octane Gasoline, CRC Workshop, at 18 (Oct. 28, 2015).

[19] Splitter, *supra* note 9, at 12 ("Economists and market analysts have shown that consumers tend to bias purchasing decisions to the current fuel at point-of-sale vendors.").

[20] *Id.* at 13.

a 1-point to 2-point increase in compression ratios with a minimum 91 AKI premium grade gasoline, manufacturers tend to increase compression ratios in such vehicles by only 0.4 points.[21] This is likely because manufacturers correctly assume that some not insignificant number of consumers will misfuel vehicles with regular gasoline and they conservatively design vehicles for that scenario. This problem could remain while regular gasoline is phased out of the market, limiting manufacturers' ability to increase compression ratios in the near term.

Another problem with making "today's premium grade becom[e] the base grade available" in the market is the variability of its octane rating. Premium grade ranges regionally from 91 AKI to 94 AKI.[22] But the variability in the AKI ratings of premium obscures more critical variability in RON ratings, which is a more accurate measure of knock-resistance in today's vehicles than the outdated AKI rating.[23] For this reason, a minimum RON requirement is highly preferable to a minimum AKI premium requirement.

Finally, legacy vehicles certified on regular gasoline are not optimized to use premium fuel. The agencies suggest that these vehicles would face higher costs if they had to use today's premium grade but "would not benefit from the use of the higher cost higher octane fuel."[24] This is an overstatement. Legacy vehicles would operate more efficiently on premium E10 fuel "with or without recalibration of the engine and controls."[25] If the agencies required the use of premium, "it may be technically feasible to update (or "reflash") the engine calibrations on existing vehicles to extract the most benefit from the improved fuel properties" to obtain a small 0.5% to 2.5% increase in fuel economy, and "a

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[21] Nat'l Research Council, Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles 67–68 (2015).

[22] 83 Fed. Reg. at 43,040.

[23] *See* Thomas G. Leone et al., *The Effect of Compression Ratio, Fuel Octane Rating, and Ethanol Content on Spark-Ignition Engine Efficiency*, 49 Envtl. Sci. & Tech. 10,778, 10,779–80 (2015) (hereinafter Leone 2015).

[24] 83 Fed. Reg. at 43,040.

[25] Leone 2015, *supra* note 23, at 10781.

lesser gain would be realized on most, if not all, vehicles without a calibration change."[26] Nevertheless, for legacy vehicles, the costs of premium would likely exceed any fuel economy savings, given premium prices.[27]

In short, under current regulatory conditions, a minimum premium grade standard would be very costly. Fortunately, the costs would be much lower (and indeed trivial) if the agencies opened the market up to competition from high-octane, midlevel ethanol blends.

B. High-Octane Midlevel Ethanol Blends Are the Best Available Means to Increase Gasoline Octane Levels.

High-octane, midlevel ethanol blends are a proven means to cost-effectively increase octane levels in the U.S. gasoline pool. High-octane midlevel ethanol blends would not require major changes in refinery operations. The fuels could be blended using the same blendstock as today's regular gasoline while delivering more octane value than premium fuel, due to ethanol's "high volumetric blending octane value in gasoline: (~115 to 135 RON)."[28] And because ethanol is projected to be less costly than gasoline on a volumetric basis, high-octane midlevel ethanol blends "could be price competitive with regular gasoline" and likely even less expensive.[29]

All the relevant studies have concluded that high-octane midlevel ethanol blends are a very cost-effective way to increase octane levels and facilitate increases in engine compression ratios.

Studies show that midlevel ethanol blends would reduce refiners' cost of producing higher octane fuel. In 2014, MathPro, a refinery consultancy, used a linear programming model to predict the effect of minimum RON requirements on refiners' costs, and concluded

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[26] *Id.*

[27] Exhibit A at 8.

[28] Hirshfeld & Kolb, *supra* note 16, at 11,067–68, 11,070 (modeling refinery costs for a 97 RON E30 fuel and finding that "the small cost increase reflects the fact that these BOBs [blendstocsks for oxygenate blending] have octane ratings similar to that of the BOB currently used for Regular-grade E10"); *see also* Scott Irwin & Darrell Good, *The Competitive Position of Ethanol as an Octane-Enhancer*, 6 farmdoc daily 22 (Feb. 3, 2016) (showing that the price of ethanol is significantly lower than the price of the high-octane aromatics it replaces).

[29] Splitter, *supra* note 9, at 15.

that producing higher RON gasoline would always be less costly for refineries that make blendstocks for higher ethanol blends instead of conventional E10, on a volumetric or energy basis. Indeed, higher ethanol blends dramatically shift the cost curve for refineries. Compared to a baseline with no RON standard:

- Producing all gasoline as 95 RON gasoline would cost refiners an additional 2.9 cents per gallon with E10, compared to the average cost of gasoline (all grades) produced today.[30] But it would only cost refiners 0.8 cents more per gallon with E20, saving refiners 2.1 cents per gallon. With E30, it would only cost refiners 0.1 more cents per gallon, saving refiners 2.8 cents per gallon. Furthermore, since the gasoline blendstock for the E20 and E30 gasolines in the study have a much lower octane rating than today's regular grade gasoline (which would allow refiners to lower the cost of those blendstocks), the actual refining costs for E20 and E30 fuels would be negative.[31]

- Producing 98 RON gasoline would cost refiners an additional 18 cents per gallon with E10 compared to the average cost of gasoline (all grades) produced today. But it would only cost refiners 5.2 cents more per gallon with E20, saving refiners 12.8 cents per gallon. With E30, it would only cost refiners 1.7 cents more per gallon, saving refiners 16.3 cents per gallon. Factoring in the lower octane and therefore lower cost of the E20 and E30 blendstocks, the actual refining costs for the E20 and E30 fuels would be negative.

- Producing 100 RON would not be economically feasible with E10. But it would feasible with E20 at an additional 12.9 cents per gallon, and with E30 at an additional 4.6 cents per gallon, compared to the average cost of gasoline (all grades) produced today. *See* Figure 2.[32]

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[30] The baseline gasoline consists of regular, mid-level and premium gasoline combined. Average gasoline has a higher octane rating and costs more than regular grade gasoline, so this comparison overstates the cost relative to regular gasoline.

[31] In the case of E20 and E30 fuels, all of the additional octane comes from the addition of ethanol. The additional refining specified in the MathPro study is needed only to tailor other fuel specifications to match today's gasoline. If E20 or E30 used existing regular grade gasoline blendstock instead of the customized blendstock envisioned by the study, the cost comparison to E10 would be even more favorable, because no additional refining would be necessary.

[32] Hirshfeld & Kolb, *supra* note 16, at 11,068, Table 2.

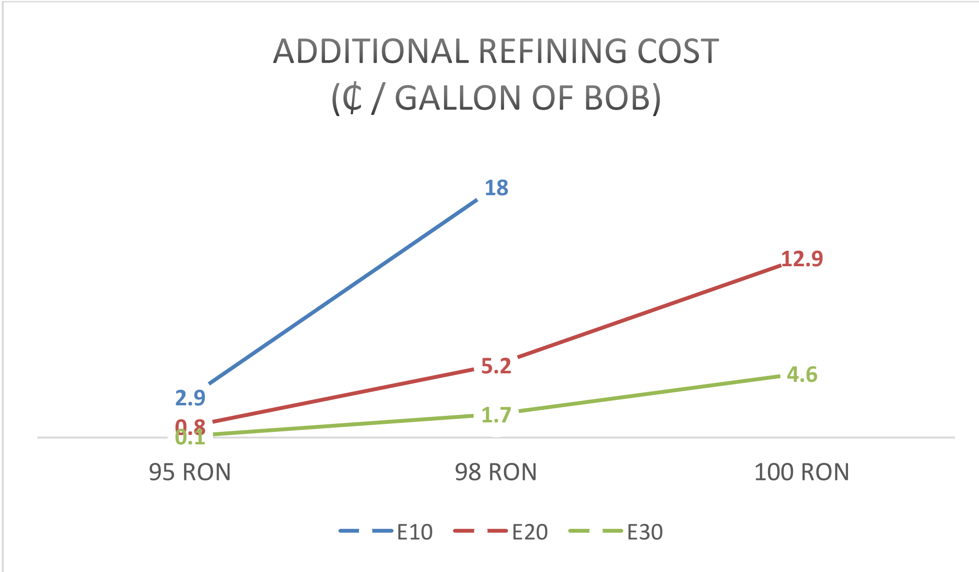

Figure 2

Lower refinery costs mean greater savings for consumers. A 2014 paper by MIT scientists used an ASPEN refinery model to project future fuel savings from 98 RON gasoline in 2040 and found that it would save $0.4 to $6.4 billion in 2040 compared to a baseline scenario without higher RON gasoline. With 98 RON E20, however, consumers would save $12.63 billion to $18.69 billion in 2040, largely because ethanol will cost less over the long-run and because, "[w]ith E20, few changes are required to refinery operations."[33] In other words, 98 RON E20 would deliver at least three times more fuel savings to consumers in 2040 than 98 RON E10 gasoline.

A recent study prepared by the Defour Group and reproduced as an exhibit to these comments predicts that a consumer would save nearly $300 in vehicle purchase costs and another $496 in fuel costs over the lifetime of a model year 2023 vehicle by using 98 RON E25 instead of regular. Consumers would save even more—nearly $1,000 in fuel costs—when operating a model year 2023 vehicle on 98 RON E25 instead of 91 AKI premium E10.[34]

The fuel savings projected in the study result from two simple facts:

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[33] Speth, *supra* note at 18, at 6555–66, Figure 4.

[34] Exhibit A, at 8.

(1) Blenders could produce E25 98 RON gasoline by simply adding more ethanol to today's gasoline blendstock, without changing refinery operations;[35]

(2) Ethanol is predicted to be significantly less expensive in the future than regular gasoline blendstock on a volumetric basis.[36]

Because unlike conventional premium gasoline, a 98 RON blend of E25 would be competitive with, and likely less costly than, regular grade gasoline, consumers would have no market incentive to use low-octane regular grade in vehicles optimized to use high-octane E25. Once E25 blends are widely available, manufacturers could therefore design high-compression ration engines without worrying about consumers misfueling with lower octane fuel.

High-octane midlevel ethanol blends would be widely available if EPA allowed manufacturers to design new vehicles for them and removed regulatory barriers. Some conventional vehicles on the market today are already designed to operate on ethanol blends up to E25.[37] An Oak Ridge study that evaluated an E25-compatible non-FFV (the 2015 Mini Cooper) found that in an aggressive driving cycle, a high-octane E25 blend improved efficiency by 3.6 percent and increased engine torque and power, allowing faster acceleration, showing that consumers would have reason to use the fuel even in legacy vehicles that are not optimized for high-octane midlevel ethanol blends.[38] Other vehicle manufacturers have told EPA they have E25-capable vehicle offerings in other markets that could be sold in "the US market if regulatory and commercial conditions warrant."[39]

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[35] *Id.* at 4.

[36] *Id.* at 6.

[37] *See* 2016 BMW X1 Owner's Manual 184, http://bit.ly/2tuOyjG ("Fuels with a maximum ethanol content of 25%, i.e. E10 or E25, may be used for refueling."); 2015 Mini Owner's Manual 172, http://bit.ly/2utpieV ("Fuels with a maximum ethanol content of 25%, i.e. E10 or E25, may be used for refueling.").

[38] Brian West, Effects of High-Octane E25 on Two Vehicles Equipped with Turbocharged, Direct-Injection Engines 18–19 (2018) (hereinafter "E25 Study").

[39] Julian Soell & R. Thomas Brunner, Mercedes-Benz, Comments on Proposed Tier 3 Rule, EPA-HQ-OAR-2011-0135-4676, at 4 (June 28, 2013).

The fueling infrastructure necessary for midlevel ethanol blends is likely adequate to make E25 high-octane fuel widely available, and the infrastructure could be expanded at a small cost. In addition to the E85 infrastructure, which can be adapted for E25,[40] there is a growing stock of E25-compatible fuel dispensers. Wayne Fueling Systems, one of the country's two major fuel dispenser manufacturers, announced in 2016 that in North America, it will only sell dispensers that are E25-compatible.[41] Other manufacturers are likely to follow suit, since "E25 equipment . . . is only marginally more expensive than conventional E10 equipment."[42] And "nearly all" underground storage tanks (USTs) are compatible with E25 and higher ethanol blends.[43]

Thus, if the agencies allowed high-octane midlevel ethanol blends to compete in the marketplace, auto manufacturers would design vehicles for these fuels, and retailers would sell these fuels.

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[40] Preexisting E85 dispensers can be used to dispense E25. *See* Dep't of Energy, Handbook for Handling, Storing, and Dispensing E85 and Other Ethanol-Gasoline Blends 3, 12, 29-30 (Feb. 2016). Currently, over 4,000 stations nationwide offer E85. Rachel Gantz, RFA Data: More than 4,000 U.S. Stations Offering E85 (Oct. 27, 2017), https://ethanolrfa.org/2017/10/rfa-data-more-than-4000-u-s-stations-offering-e85/. In addition, blender-pumps that can "make mid-level ethanol blends by mixing two parent blends stored in different storage tanks" are increasing in number. *Renewables Enhancement and Growth Support Rule*, Proposed Rule, 81 Fed. Reg. 80828, 80831 (Nov. 16, 2016).

[41] Wayne Fueling Systems, *Wayne Standardizes Offering for All North American Retail Fuel Dispensers to E25,/ B20* (Aug. 30, 2016), http://bit.ly/2bOX5F5. In addition, "retrofit kits are readily available (for $1,950) that enable an E10 dispenser to safely dispense E25." Caley Johnson et al., High-Octane Mid-Level Ethanol Blend Market Assessment 24 (Dec. 2015).

[42] Johnson et al., *supra* note 41, at 24 (E25 refueling equipment "requires only upgraded elastomer materials"). UL has recently revised its UL 87 a standard to provide the option of certifying gasoline fuel storage and dispensing products for up to 40% ethanol, in addition to E25 and E85. *See* UL 87A, Standard for Power-Operated Dispensing Devices for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0–E85) (2018).

[43] Johnson et al., *supra* note 41, at 25.

II. EPA SHOULD ENABLE HIGH-OCTANE MIDLEVEL ETHANOL BLENDS BY REMOVING REGULATORY BARRIERS AND RECOGNIZING THE PETROLEUM DISPLACEMENT AND THE CARBON-NEUTRALITY OF RENEWABLE ETHANOL.

The agencies seek comment on "incentives that encourage alternative fuel vehicles" including "high-octane fuel blends."[44] EPA also "requests comment on if and how EPA could support the production and use of higher octane gasoline consistent with Title II of the Clean Air Act."[45] In connection with this request for comment, EPA notes that "[s]takeholders suggested that mid-level (e.g., E30) high octane ethanol blends should be considered and that EPA should consider requiring that mid-level blends be made available at service stations. Higher octane gasoline could provide manufacturers with more flexibility to meet more stringent standards by enabling opportunities for use of lower CO_2 emitting technologies (e.g., higher compression ratio engines, improved turbocharging, optimized engine combustion)."[46]

As an initial matter, EPA should allow high-octane midlevel ethanol blends by removing regulatory barriers. EPA should:

(1) Approve a midlevel ethanol certification fuel with a minimum specified octane rating;
(2) Relatedly, correct the erroneous R-factor used in the fuel economy calculation for gasoline and apply that corrected equation to midlevel ethanol certification fuel;
(3) Acknowledge that midlevel ethanol blends can be introduced into commerce consistent with the sub-sim law, Clean Air Act 211(f), because ethanol is now a fuel additive used in certification; and
(4) Extend a 1-pound Reid Vapor Pressure waiver to ethanol blends with more than ten percent ethanol, as the President has directed.[47]

To further eliminate regulatory barriers, the agencies should also recognize the potential of midlevel ethanol blends to conserve energy and finalize an appropriate

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[44] *See* 83 Fed. Reg. at 43,445–46, Table X-4.

[45] Proposed SAFE Rule, 83 Fed. Reg. at 43,464.

[46] *Id.*

[47] This issue is discussed in detail in separate comments filed by the Urban Air Initiative.

petroleum-equivalency factor for midlevel ethanol blends that accounts for ethanol's displacement of petroleum-based gasoline and a carbon-neutrality factor that recognizes the renewable nature of ethanol's carbon content, as discussed below.

A. EPA Should Invite Automakers to Request a High-Octane Midlevel Ethanol Alternative Certification Fuel.

EPA has already acknowledged that allowing manufactures to certify vehicles with a high-octane fuel such as E30 (gasoline blended with 30% ethanol) could allow vehicle manufacturers "to raise compression ratios to improve vehicle efficiency as a step toward complying with the 2017 and later light-duty greenhouse gas and CAFE standards."[48] The National Research Council has also recommended that EPA treat vehicles and fuels as a system by considering, among other things, allowing manufacturers "the option to use E30" or other high-octane certification fuels to "facilitate the development of higher compression ration engines."[49]

The SAFE rule provides EPA with an excellent opportunity to reiterate its invitation to auto manufacturers to submit a request for a midlevel ethanol blend certification fuel. Representatives of some major U.S. automakers have already collaborated to draft a request for a midlevel ethanol alternative certification fuel that could be submitted if EPA expressed interest in approving such a fuel, as its discretion allows. In the alternative, EPA could propose a new certification fuel on its own, as it has done in the past.[50] ASTM recently

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[48] *Control of Air Pollution from Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards*, 79 Fed. Reg. 23,414, 23,528 (Apr. 28, 2014) ("Tier 3 Rule"); *see also* Proposed SAFE Rule, 83 Fed. Reg. at 43464 ("Higher octane gasoline [like E30] could provide manufacturers with more flexibility to meet more stringent standards by enabling opportunities for use of lower CO_2 emitting technologies (e.g., higher compression ratio engines, improved turbocharging, optimized engine combustion).").

[49] Nat'l Research Council, Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles 82 (2015).

[50] *See, e.g.*, *Recodification of Motor Vehicle Emissions Regulations*, 40 Fed. Reg. 27590, 27613-14 (June 30, 1975) (40 C.F.R. §§ 86.177-6(a) (gasoline), 86.177-6(b) (diesel)); *Standards for Emissions from Methanol-Fueled Motor Vehicles and Motor Vehicle Engines*, 54 Fed. Reg. 14426, 14563 (Apr. 11, 1989) (40 C.F.R. § 86.1213-90(c)); *Standards for Emission from Natural Gas-Fueled, and Liquefied Petroleum Gas-Fueled Motor Vehicles and Motor Vehicle Engines, and Certification Procedures for Aftermarket Conversions*, 59 Fed. Reg. 48472, 48513-14 (Sept. 21, 1994) (40 C.F.R. § 86.513-94(d) (natural gas); *id.* § 86.513-94(e) (Liquified Petroleum Gas)); *Control of Emissions from Nonroad Large Spark-Ignition*

approved specifications for a 100 RON test fuel that could inform EPA's selection of a certification fuel specification.[51]

B. EPA Should Correct its Fuel Economy Calculation to Avoid Penalizing Auto Manufactures That Certify New Vehicles Using Test Fuels Containing Ethanol.

To encourage automakers to use high-octane midlevel ethanol blends in certification, EPA must not penalize automakers for the lower energy content of midlevel ethanol blends, as required by law.[52]

EPA's current fuel economy equation is biased against ethanol because it fails to correct for changes in the energy content of the test fuel. The source of this error is a vehicle sensitivity measure in the fuel economy equation known as the R-factor, which measures "how vehicles respond to changes in the energy content of the fuel."[53] The current R-factor of 0.6 erroneously implies that a 10% change in the test fuel's energy content causes only a 6% change in vehicle fuel economy.[54] But the current R-factor is too small. As even EPA acknowledges, the real R-factor is closer to 1, so a 10% change in the energy content of the test fuel leads to a10% loss in fuel economy.[55] This means the current R-factor of 0.6 would underestimate the effect of a 10% change in energy content on fuel economy by almost 4%.

Engines, and Recreational Engines (Marine and Land-Based), 67 Fed. Reg. 68,242, 68,423 (Nov. 8, 2002) (§ 1065.801(a)) (E85).

[51] ASTM D8076-18, Standard Specification for 100 Research Octane Number Test Fuel for Automotive Spark-Ignition Engines.

[52] 49 U.S.C. § 32904(c) ("[T]he Administrator shall use the same procedures for passenger automobiles the Administrator used for model year 1975 . . . or procedures that give comparable results."); *see also Ctr. for Auto Safety v. Thomas*, 847 F.2d 843, 846 (D.C. Cir. 1988) (en banc) (Wald, C.J., concurring) ("By inserting the comparability requirement, Congress meant to insure that auto manufacturers be credited only with real fuel economy gains, not illusory gains generated by changes in test procedures."), *reh'g granted and opinion vacated on other grounds*, 856 F.2d 1557 (per curiam).

[53] Tier 3 Rule, 79 Fed. Reg. at 23,531.

[54] *Id.* (stating that the R-factor's "value is presently set at 0.6"); Proposed Tier 3 Rule, 78 Fed. Reg. at 29,913 (stating that the R-factor "account[s] for the fact that the change in fuel economy is not directly proportional to the change in energy content of the test fuel.").

[55] *Id.* at 4–5.

This 4% loss would be misattributed to vehicle fuel economy even though it is due entirely to changes in the test fuel.

EPA's erroneous R-factor deters automakers from requesting the approval of a high-octane midlevel ethanol blend certification fuel. As Mercedes explained in its Tier 3 comments, "given that the volumetric energy content of an E25 Tier 3 fuel would be almost 9% lower than an E0 fuel" currently used for fuel economy certification, correcting the R-factor "is a necessary step for the acceptance of" midlevel ethanol blends like E25.[56] Mercedes estimates that an "R-factor of 0.6, as is currently the case, would result in approximately [a] 5% volumetric fuel efficiency loss for an E25 fuel [compared to E0 fuel], which mathematically hinders any manufacturer seeking to certify a vehicle on such a fuel."[57] By contrast, a corrected R-factor of 1 would eliminate the energy penalty of the test fuel and ensure that the vehicle efficiency gains enabled by midlevel ethanol blends lead to directly proportional fuel economy gains, ensuring the results are not distorted by changes in the test fuel, as Congress intended in 1975.[58]

EPA should finalize an R-factor of 1.0 for the E10 gasoline test fuel, as the auto industry has requested.[59] EPA should also clarify that the same fuel economy equation that applies to gasoline would apply to any future alternative midlevel ethanol certification fuels requested by manufacturers.

With an R-factor of 1, the corrected fuel-economy equation for E10 and midlevel ethanol blends would be as follows:

$$\frac{(5{,}174 \times 10^4 \times CWF)}{\left[\left((CWF \times (NMOG + CH_4)) + (0.429 \times CO) + (0.273 \times CO_2)\right) \times NHV\right]}$$

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[56] Julian Soell & R. Thomas Brunner, Mercedes-Benz, Comments on Proposed Tier 3 Rule, EPA-HQ-OAR-2011-0135-4676 (June 28, 2013), at 4.

[57] *Id.*

[58] *See, e.g.*, West, E25 Study *supra* note 38, at 20–21, 24 (finding, when controlling for changes in energy content, a 5% fuel economy benefit on the two-cycle tailpipe test for a Ford F150 modified with a high-compression engine enabled by using high-octane E25 fuel instead of E10 certification fuel).

[59] Tier 3 Rule, 79 Fed. Reg. at 23,531 ("[T]he manufacturers commented that . . . EPA should finalize an appropriate test procedure adjustment in the Tier 3 rulemaking, including adoption of an 'R' factor of 1.0.").

where,

- 5,174 x 10^4 = density of H_2O at 60ºF x specific gravity of 1975 reference fuel × Net Heating Value (NHV) of 1975 reference fuel;
- CWF is the carbon weight fraction of the certification test fuel;
- NHV is the net heating value of the certification test fuel;
- NMOG is the non-methane organic gas [g/mi] in the exhaust gas as determined in accordance with applicable test procedures;
- CH_4 is the methane [g/mi] in the exhaust gas;
- CO is the carbon monoxide [g/mi] in the exhaust gas; and
- CO_2 is the carbon dioxide [g/mi] in the exhaust gas.

This formula, proposed by GM in the Tier 3 rule, is identical to the current fuel economy equation for gasoline vehicles, except that the R-factor is corrected to 1.0, and other technical adjustments are made to account for the oxygen content of ethanol's molecules and combustion products.[60]

C. EPA Should Acknowledge that the Sub-Sim Law No Longer Limits the Concentration of Ethanol in Market Fuel.

Section 211(f) of the Clean Air Act, also known as the sub-sim law, prohibits increasing the concentration of fuel additives that are not "substantially similar" to fuel additives used in vehicle certification.[61] In 1991, EPA's interpreted "substantially similar" to limit gasoline's oxygen content to 2.7% by weight, corresponding to a 7.5% cap on ethanol by volume.[62] At the time, all gasoline vehicles were certified using indolene—gasoline with no ethanol. But since model year 2017, manufacturers have been required to certify gasoline

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[60] *See* 40 C.F.R. § 600.113-12(h)(1). The current fuel economy equation for gasoline omits organic gases, measuring pure hydrocarbons only. *Id.* § 600.113-12(h). "[T]heir effect has been included" in the proposed formula "by virtue of using NMOG in the equation." Robert Babik, General Motors LLC, Comments on Proposed Tier 3 Rule, EPA-HQ-OAR-2011-0135-4288 (June 28, 2013), at 4.

[61] 42 U.S.C. § 7545(f)(1).

[62] 56 Fed. Reg. 5352 (Feb. 11, 1991).

vehicles with an E10 gasoline test fuel, which has approximately 3.8% oxygen by weight.[63] EPA's most recent interpretation of "substantially similar" is therefore plainly obsolete.

Now that the certification fuel contains 10% ethanol, ethanol is substantially similar to a fuel additive utilized in certification. Indeed, it is identical to the ethanol in the certification fuel. The sub-sim law therefore poses no need to prohibit the increased concentration of ethanol in market gasoline.

There is also no practical need to artificially cap ethanol content, at least for blends ranging up to 20% ethanol.[64] The purpose of the sub-sim law is to deter the introduction into commerce, or increased concentration in use of, fuels and fuel additives which may cause vehicles and engines to exceed their "emission standards"[65] But studies by the Department of Energy show that vehicles certified with E0 indolene can use gasoline with 20% ethanol without exceeding their emissions standards. An extensive study by Oak Ridge National Laboratory found no evidence that E15 or E20 damaged catalysts or otherwise contributed to increased emissions with aging in Tier 2 vehicles certified with ethanol-free gasoline.[66] The study also found that the immediate fuel effects of E15 and E20 on regulated tailpipe emissions were minor or insignificant.[67] The emission fuel effects reported in this Oak Ridge study "are largely consistent with findings of the DOE V1 study," a prior Oak Ridge and National Renewable Energy Laboratory study that found small or insignificant changes in vehicle tailpipe emissions when Tier 2 vehicles certified on E0 were tested with E15 and E20 test fuels.[68] A more recent Oak Ridge study tested a 2015 Mini Cooper certified with E0 and found that high-octane E25 fuel caused "no significant fuel-related changes to NMOG, NO_X or NMOG + NO_X" and regulated emissions were within the Tier 3 standard limits.[69]

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[63] 40 C.F.R. § 1065.710(b).

[64] If EPA finds that blends above E20 cause vehicles to exceed their emission standard, EPA can control ethanol content under 42 U.S.C. § 7545(c).

[65] *Ethyl Corp. v. EPA*, 51 F.3d 1053, 1058 (D.C. Cir. 1995).

[66] Brian H. West et al., Intermediate Ethanol Blends Catalyst Durability Program xv (Feb. 2012).

[67] *Id.*

[68] *Id*. (citing Keith Knoll, *Effects of Mid-Level Ethanol Blends on Conventional Vehicle Emissions*, SAE Tech. Paper 2009-01-2723, https://www.nrel.gov/docs/fy10osti/46570.pdf).

[69] West, E25 Study, *supra* note 38, at 24.

If midlevel ethanol blends of E20 and even E25 do not cause Tier 2 vehicles certified on E0 gasoline to exceed their emission standards, a fortiori, there is no reason to expect that vehicles certified using the new E10 certification fuel will exceed their emission standards when operating on midlevel ethanol blends. Thus, there is no practical reason to continue capping ethanol content in gasoline with an outdated interpretation of the sub-sim law. EPA should revisit its outdated 1991 interpretation to confirm that the sub-sim law no longer caps ethanol content in gasoline because ethanol is now a fuel additive used in certification.

D. The Agencies Should Finalize a Petroleum-Equivalency Factor for Midlevel Ethanol Blends Under the CAFE Program that Accounts for the Higher Alternative Fuel Content of These Blends.

To support midlevel ethanol blends, the Department of Transportation and EPA should account for the petroleum reduction effect of such fuels in calculating compliance under CAFE.

The Department of Transportation has authority to list a new liquid fuel under the CAFE program if doing so is "consistent with the need to conserve energy."[70] That concept is broadly defined to include not just increased energy efficiency but also "consumer cost" and the "foreign policy implications of our need for large quantities of petroleum, especially imported petroleum."[71] The Department of Transportation could conclude that high-octane midlevel ethanol blends conserve energy because they allow for the development of more efficient, high-compression engines and because they reduce consumer fuel costs and petroleum-based gasoline consumption.

Once the Department of Transportation has listed midlevel ethanol blends as a fuel under the CAFE program, EPA will have authority to finalize a petroleum-equivalency factor for a midlevel ethanol certification fuel, consistent with EPA's authority to determine "the quantity of other fuel that is equivalent to a gallon of gasoline."[72] In accounting for the

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[70] *Id.* § 32901(a)(10)(c).

[71] Proposed SAFE Rule, 83 Fed. Reg. at 43,210 (citing 42 Fed. Reg. 63,184, 63,188 (Dec. 15, 1977)).

[72] 49 U.S.C. § 32904(c).

lower petroleum-based content of high-octane midlevel ethanol blends, EPA would advance the CAFE program's purpose of conserving energy and reducing petroleum usage.

For example, when calculating the fuel economy of a vehicle certified with an E25 certification fuel, EPA could use a petroleum-equivalency factor 0.75, because a gallon of E25 fuel contains 0.75 gallons of petroleum-based gasoline. Thus, for a vehicle certified with E25, EPA would calculate fuel economy by dividing measured fuel economy by the petroleum-equivalency factor, as follows:

$$MPG_{CAFE} = \frac{MPG_{measured}}{0.75}$$

In the alternative, EPA could, consistent with the statutory treatment of "liquid alternative fuel,"[73] include a pro-rated petroleum equivalency factor of 0.15 for the denatured ethanol portion of the blended fuel.[74] Using this method, the petroleum equivalency factor for E25 would be 0.7875, which the agency could round to 0.79[75]

Using a petroleum equivalency factor of 0.75, a vehicle certified on E25 with a measured fuel economy of 40 miles per gallon would have a calculated fuel economy value of 53.3 miles per gallon.[76] This modest adjustment (compared with the much more generous adjustment for electric vehicles)[77] would serve the Administration's priorities of reducing

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[73] *Id.* § 32905(a) ("A gallon of a liquid alternative fuel used to operate a dedicated automobile is deemed to contain .15 gallon of fuel.").

[74] Under the statute, a midlevel ethanol certification fuel would not qualify as "liquid alternative fuel" limited by statute to a petroleum-equivalency factor of 0.15, because it does not consist entirely of "denatured ethanol" or a "mixture containing at least 85 percent . . . denatured ethanol." *Id.* §32901(a)(1).

[75] $0.75 + (0.25 \times 0.15) = 0.7875$.

[76] $(40 \div 0.75 = 53.33)$; *see* 49 U.S.C. § 32904(c) ("A measurement of fuel economy . . . shall be rounded off to the nearest .1 of a mile a gallon.").

[77] EPA uses a generous 0.15 petroleum-equivalency factor to calculate the fuel economy of electric vehicles, equivalent to multiplying actual fuel economy by 6.67. 10 C.F.R. § 474.3(b) (providing a petroleum-equivalency factor of "82,049 Watt–hours per gallon" for battery-electric vehicles and a petroleum-equivalency factor of "73,844 Watt–hours per gallon" for plug-in-hybrids). For example, under the CAFE program, a battery-electric vehicle with an actual energy-equivalent fuel economy of 53.5 miles per gallon (the Nissan Leaf) is treated as a vehicle with a fuel economy of 357 miles per gallon. Nat'l Research Council, Overcoming Barriers to the Deployment of Plug-in Electric Vehicles 115 (2015).

regulatory burdens on the use of "domestic energy resources" and promoting American agriculture and rural development. [78] It would also advance Congress' statutory goal of encouraging "the development of widespread use of . . . ethanol . . . as transportation fuel[] by consumers" and "the production of . . . ethanol . . . powered motor vehicles."[79]

Some manufacturers may choose to dual-certify vehicles on both gasoline and a midlevel ethanol certification fuel. Because such a vehicle may not qualify as a "dual fueled automobile," as that term is defined in 49 U.S.C. § 32901(9), the statutory and regulatory fuel economy framework applicable to flex-fuel vehicles may not apply.[80] EPA would therefore need to decide how to weigh the vehicle's fuel economy results when operating on both regular gasoline and the midlevel ethanol certification fuel. To facilitate a transition to high-octane fuel vehicles certified on midlevel ethanol blends, EPA could use a harmonic average to weigh the fuel economy values for each fuel until the market for such vehicles matures, at which time EPA could finalize a utilization factor based on real-world usage data.

Because flex-fuel vehicles can encourage the commercialization of high-octane midlevel ethanol blends, the Department of Transportation and EPA should also continue to support them by (a) continuing to apply a 0.15 liquid alternative fuel factor, as the law requires, and (b) finalizing a new F-factor that accounts for the expected growth in E85 consumption.[81]

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[78] *See* Executive Order 13,783, 82 Fed. Reg. 16093 (Mar. 31, 2017) ("[I]t is the policy of the United States that . . . agencies . . . appropriately suspend, revise, or rescind [existing regulations] that unduly burden the development of domestic energy resources beyond the degree necessary to protect the public interest or otherwise comply with the law."); Executive Order 13,790, 82 Fed. Reg. 20,237 (Apr. 28, 2017) ("It is in the national interest to promote American agriculture and protect the rural communities where food, fiber, forestry, and many of our renewable fuels are cultivated.").

[79] Alternative Motor Fuels Act of 1988, Pub. L. 100-494 § 2, 102 Stat. 2441, 2442 (Oct. 14, 1988).

[80] *See* 49 U.S.C. § 32901(a) (defining "dual fueled automobile" as a vehicle "capable of operating on alternative fuel" and defining "alternative fuel" to exclude fuels that are "substantially petroleum").

[81] *See* Draft Environmental Impact Statement, Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021-2026 Passenger Cars and Light Trucks, at 6-30 & fig. 6.2.4-3 (July 2018).

E. EPA Should Finalize a Carbon-Neutrality Factor that Accounts for the Renewable Nature of Ethanol Feedstocks.

To support high-octane fuel consistent with Title II of the Clean Air Act, EPA should treat the ethanol portion of the midlevel ethanol fuel as carbon-neutral, as it does for electricity.[82] In its 2010 lifecycle analysis, EPA recognized that carbon emitted from the combustion of ethanol is the same carbon that the corn plant absorbed from the atmosphere as it grew. Therefore, ethanol is carbon neutral: The release of carbon from ethanol at the tailpipe does not result in a net increase of carbon into the atmosphere.[83] EPA similarly concluded that forest biomass combusted at power plants is carbon-neutral for the same reason.[84] By contrast, petroleum tailpipe emissions release carbon stored deep underground for millennia, altering the global carbon cycle and contributing to the accumulation of atmospheric CO_2.

Consistent with the carbon-neutral, renewable nature of ethanol feedstocks, and consistent with EPA's treatment of electric vehicles under the current GHG program, EPA should assume that the ethanol carbon fraction of a midlevel ethanol certification fuel emits net zero carbon upon combustion.

To incorporate this carbon-neutrality assumption into EPA's carbon-related exhaust emissions (CREE) calculation, EPA could finalize a multiplier derived from the carbon content of the fuel's gasoline portion alone.[85] According to EPA, a typical gallon of E0

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[82] Electric vehicles are assumed to emit no greenhouse gas emissions when consuming electricity. 40 C.F.R. § 600.113-12(n).

[83] *See* Renewable Fuel Standard Program, Regulatory Impact Analysis 444 (2010) ("Over the full lifecycle of the fuel, the CO_2 emitted from biomass-based fuels combustion does not increase atmospheric CO_2 concentrations, assuming the biogenic carbon emitted is offset by the uptake of CO_2 resulting from the growth of new biomass. As a result, CO_2 emissions from biomass-based fuels combustion are not included in their lifecycle emissions results."); *accord id.* at 470, Figure 2.6-2 (indicating that corn ethanol has no tailpipe CO_2 emissions).

[84] *See* EPA's Treatment of Biogenic Carbon Dioxide (CO_2) Emissions from Stationary Sources that Use Forest Biomass for Energy Production 5 (Apr. 23, 2018), https://www.epa.gov/sites/production/files/2018-04/documents/biomass_policy_statement_2018_04_23.pdf

[85] *See* 40 C.F.R. § 600.002 ("Carbon-related exhaust emissions means the summation of the carbon-containing constituents of the exhaust emissions, with each constituent adjusted by a coefficient representing the carbon weight fraction of each constituent relative to the CO_2 carbon weight

gasoline contains 2,421 grams of carbon per gallon.[86] A typical gallon of denatured ethanol, by contrast, contains 1,571 grams of carbon per gallon.[87] An E25 certification fuel would therefore contain 2,209 grams of carbon per gallon, 82% of which would be attributable to gasoline.[88] This carbon fraction (0.82) would then be multiplied by the fuel's CREE, as measured according to the existing formula, to deduct ethanol's carbon emissions from the results. For example, a vehicle certified on E25 fuel with a measured CREE of 250 grams of carbon dioxide per mile would have an adjusted compliance value of 205 grams of carbon dioxide per mile.[89] This is substantially less generous than EPA's current assumption that electric vehicles emit no carbon at all (ignoring carbon emissions from upstream electricity generation) and EPA's use of a 2 and 1.6 sales multiplier for battery-electric vehicles and plug-in electric vehicles, respectively.[90]

To further reduce compliance costs and put midlevel ethanol blends on par with electric vehicles, EPA could extend a similar sales multiplier to vehicles that run on high-octane midlevel ethanol blends. The reasoning that justified EPA's temporary sales multipliers for electric vehicles supports equal treatment for next-generation midlevel ethanol-fueled vehicles. Like electric vehicles, they would significantly reduce GHG emissions, and offer "greater GHG emission reductions in the longer-term."[91]

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fraction[.] . . . [C]arbon-related exhaust emissions . . . are used to demonstrate compliance with fleet average CO_2 emission standards outlined in § 86.1818 of this chapter.").

[86] EPA, Average Carbon Dioxide Emissions Resulting From Gasoline and Diesel Fuel, Emission Facts, 420-F-05-001 (Feb. 2005).

[87] *See* James E. Anderson et al., *Octane Numbers of Ethanol-Gasoline Blends: Measurements and Novel Estimation of Molar Composition*, SAE Tech. Paper 2012-01-1274, Table 3 (measuring denatured ethanol fuel as containing 52.23 percent carbon with a density (specific gravity) of 0.795, equal to 1,571 grams of carbon per gallon). A gallon of pure (undenatured) ethanol has 1,557 grams of carbon per gallon. *See* WolframAlpha, http://bit.ly/2xQV4nM.

[88] $((1{,}571 \times 0.25) + (2{,}421 \times 0.75)) = 2{,}208$; $(2{,}421 \times 0.75) \div 2{,}208 = 0.82$.

[89] $250 \times 0.82 = 205$.

[90] 40 C.F.R. § 86-1866-12(b). EPA allowed manufacturers to multiply battery-electric vehicle sales by two in model year 2017, gradually phasing down to 1.5 by model year 2021. *Id.* § 86.1866-12(b)(1). EPA allowed a sales multiplier of 1.6 in model year 2017 for plug-in hybrids with a certain range, gradually phasing down to 1.3 in model year 2021. *Id.* § 86.1866-12(b)(2).

[91] Proposed SAFE Rule, 83 Fed. Reg. at 43,461; *see also* 2012 CAFE/GHG Rule, 77 Fed. Reg. 62,624, 62,812 (Oct. 15, 2012) (same).

CONCLUSION

High-octane, midlevel ethanol blends would increase efficiency and reduce CO_2 emissions and lower vehicular pollution. Unlike premium E10 gasoline, midlevel ethanol blends could unlock higher octane fuel for consumers at affordable costs. The agencies should support high-octane midlevel ethanol blends by removing regulatory barriers and recognizing the petroleum reduction and carbon-neutrality benefits of increasing ethanol levels in gasoline.