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“High Octane Fuels and High Efficiency Vehicles: Challenges and Opportunities”

Statement of Paul Jeschke

On behalf of the Illinois Corn Growers Association

Chairman Shimkus, Ranking Member Tonko, thank you for inviting me here to speak about what high-octane fuel can do for America’s farmers.

As a corn farmer from the village of Mazon, Illinois, I never imagined that I would be sitting in this chamber in our Nation’s capital, talking about the role that corn farmers could play in growing the high-octane fuel of the not-too-distant future.

But that is exactly what I am here to talk about today. I will make the following key points in my presentation:

- High-octane midlevel ethanol blends would enable improvements in vehicle efficiency beyond what is feasible with high-octane gasoline hydrocarbons.
- Unlike high-octane gasoline, high-octane midlevel ethanol blends would benefit society and rural communities by lowering prices at the pump and reducing pollution while increasing farm income.
- Needless regulatory barriers are blocking midlevel ethanol blends. Unless these barriers to midlevel ethanol blends are removed, a minimum octane standard would do little or nothing to expand the market for ethanol.
- We need:
 - A one-pound RVP waiver for ethanol blends above ten percent,

- A new high-octane, midlevel ethanol blend certification fuel, such as a 98–100 RON E25 fuel;
- A corrected fuel economy equation that does not penalize ethanol blends;
- Technology-neutral fuel economy and greenhouse gas (GHG) equations that do not penalize ethanol blends and treat all alternative fuels alike to the extent that they reduce petroleum consumption and greenhouse gas emissions; and
- A corrected lifecycle analysis of the greenhouse gas benefits of corn ethanol.

Mr. Chairman, now is right time to discuss corn ethanol’s role in a high-octane future.

I. HIGH-OCTANE MIDLEVEL ETHANOL BLENDS WOULD ENABLE IMPROVEMENTS IN VEHICLE EFFICIENCY AND PROVIDE A MARKET INCENTIVE TO BLEND MORE ETHANOL INTO GASOLINE.

There is a growing consensus that high-octane fuels are needed to increase vehicle efficiency and reduce greenhouse gas emissions. Automotive engineers believe that continued improvements in internal combustion engine efficiency are simply not sustainable without high-compression engines, enabled by high-octane fuel.¹ For that reason, major automakers, including GM, Ford, and Fiat Chrysler, have endorsed high-octane fuel as a means to deliver greater vehicle fuel economy and performance to consumers at affordable costs.²

¹ See Derek Splitter et al., *A Historical Analysis of the Co-Evolution of Gasoline Octane Number and Spark-Ignition Engines*, 1 *Front. Mech. Eng.* 1, 17 (Jan. 6, 2016) (the “relaxation of the fundamental coupling between fuel octane number and engine compression ratio” since the 1970s “is a long-term unsustainable trajectory, as for a given octane number engine compression ratio will ultimately be limited by available technologies.”).

² See, e.g., Sam Abuelsamid, *GM Exec Calls for Premium Gas to Be the New Regular*, *Forbes* (Mar. 12, 2018); Matt Schmitz, *Automakers Push for Higher Octane to Meet Fuel Economy Standards*, *cars.com* (Apr. 15, 2016), <https://www.cars.com/articles/automakers-push-for-higher-octane-to-meet-fuel-economy-standards-1420684421731/>.

But the high-octane fuel that automakers need is not being supplied by the market. Since the beginning of the lead phase-out in the 1970s, octane levels in the U.S. gasoline pool have stagnated and even declined.³ Premium gasoline's share of the market has also declined.⁴ High-octane gasoline hydrocarbons are simply too expensive. Today's premium fuel can be 40 to 80 cents more expensive than regular unleaded, and its octane rating varies.⁵ Clearly, consumers deserve more affordable high-octane choices at the pump. That is where corn farmers and corn ethanol come in.

As octane ratings have flat-lined, farm income has been falling, partly as a result of stagnant ethanol demand. Farm incomes have been low on Illinois farms since 2014, eroding our ability to withstand economic stressors.⁶ Incomes in 2015 were near zero, the lowest level ever since we have been keeping records, even considering the challenges farmers faced in the 1980s.⁷ 2017 incomes were not much better—an average \$45,000 per farm.⁸ In 2018, farm incomes are projected to be low again.

A high-octane midlevel ethanol blend presents an opportunity to raise farm incomes by expanding the market for ethanol. Ethanol provides the octane that automakers and drivers need. If ethanol is allowed to fill that need, I see opportunities for my grandchildren to farm if they choose to do so.

³ Dep't of Energy, Office of Energy Efficiency & Renewable Energy, Fact #940: August 29, 2016, *Diverging Trends of Engine Compression Ratio and Gasoline Octane Rating*, <https://www.energy.gov/eere/vehicles/fact-940-august-29-2016-diverging-trends-engine-compression-ratio-and-gasoline-octane>.

⁴ Splitter et al., *supra* note 1, at 12 (“[W]ithin the last 10 years, premium fuels sales volume has become stagnant at approximately 10% of the total fuel sales volume. Simultaneously, the absolute cost increase of premium-grade fuel has increased compared to that of regular-grade fuel.”).

⁵ Splitter et al., *supra* note 1, at 13.

⁶ See Gary Schnitkey, Forecast of 2017 Net Income on Grain Farms in Illinois: Lower than in 2016 but Better than Expected, *farmdocdaily* (Nov. 21, 2017), <http://farmdocdaily.illinois.edu/2017/11/forecast-of-2017-net-income-on-grain-farm-illinois.html>.

⁷ *Id.*

⁸ *Id.*

A. High-Octane Midlevel Ethanol Blends Would Enable Increases In Engine Efficiency.

Ethanol is simply the most cost-effective octane additive available in the marketplace.⁹ A midlevel ethanol blend consisting of approximately 25 to 30 percent ethanol, splashed into today's regular gasoline blend stock, would have an octane rating of 98 to 100 Research Octane Number (RON), higher than today's premium.¹⁰ This enables higher compression ratios in next-generation engines which could yield vehicle fuel economy or performance gains. In addition to its high-octane rating, automotive engineers believe that ethanol's high sensitivity (RON-MON), high heat of vaporization, and improved part-load efficiency could enable further improvements in engine efficiency.¹¹

EPA has already recognized that high-octane midlevel ethanol blends would "help manufacturers who wish to raise compression ratios to improve vehicle efficiency as a step toward complying with . . . greenhouse gas and CAFE standards."¹²

Automakers agree. In 2014, the Auto Alliance and the Association of Global Automakers submitted comments to EPA explaining that ethanol's "in cylinder cooling effect" and high-octane rating make a "mid-level gasoline-ethanol blend" particularly well suited for "improv[ing] vehicle efficiency and lower[ing] GHG emissions," through

⁹ See David S. Hirshfeld et al., *Refining Economics of U.S. Gasoline: Octane Ratings and Ethanol Content*, 48 *Envtl. Sci. & Tech.* 11065, 11067–68 (2014) (noting ethanol's "high volumetric blending octane value in gasoline: (~115 to 135 RON)"); 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).

¹⁰ 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.* 10778, 10780 (2015) (Premium-grade . . . [is] usually listed as 91-93 AKI minimum, corresponding to 96–98 RON") (hereinafter Leone (2015)).

¹¹ See *id.* at 10,784, 10,779 (listing ethanol's "efficiency benefits independent of octane value"); Thomas L. Darlington et al., *Modeling the Impact of Reducing Vehicle Greenhouse Gas Emissions with High Compression Engines and High Octane Low Carbon Fuels*, SAE Tech. Paper 2017-01-0906, at 4 (Mar. 28, 2017) (same); Hirshfeld, *supra* note 9, at 11065 (noting that in addition to its high-octane value, "[e]thanol also has a high latent heat of vaporization and high sensitivity (RON minus MON), contributing to improvements in knock resistance in direct-injection and turbo-charged engines, allowing further increases in CR. Ethanol can also increase efficiency at part-load operation, regardless of engine architecture.").

¹² Tier 3 Rule, 79 *Fed. Reg.* at 23528–29.

“increas[ing] the engine compression ratio” and “downsizing of the engine.”¹³ GM similarly “supported the future of higher octane and higher ethanol content in order to provide a pathway to improved vehicle efficiency and lower GHG emissions.”¹⁴ Engineers from Ford, GM, and Fiat Chrysler have shown that blending an additional 20% ethanol into today’s E10 gasoline to produce high-octane E30 would enable a three-point increase in engine compression ratios, which would increase engine efficiency by 6% (7% in downsized engines) and would reduce tailpipe carbon dioxide emissions by 6 to 9.1%, depending on the test cycle.¹⁵

A substantial body of research by the Department of Energy and its national laboratories also indicates that ethanol is an optimal high-octane fuel component. The Department of Energy’s Co-Optima project¹⁶ has isolated ethanol as one of a handful of biomass-based blendstocks with the necessary fuel properties to support the development of high-octane fuel vehicles.¹⁷ As early as 2013, Department of Energy scientists at Oak Ridge National Laboratory noted that midlevel ethanol blends such as E30 open the potential for

¹³ Alliance of Automobile Manufacturers & Association of Global Automakers, Comments on Proposed Tier 3 Rule, EPA-HQ-OAR-2011-0135-4461, at 52 (July 1, 2013); *see also* Mercedes-Benz, Comments on Proposed Tier 3 Rule, EPA-HQ-OAR-2011-0135-4676, at 4 (June 28, 2013) (“Higher octane fuels permit higher compression ratios which directly improve efficiency while downsizing engines also results in greater fuel efficiency. The optimized combination of those two actions with gasoline direct-injection provides remarkable gains in fuel economy but requires high octane market fuel—higher octane than is available today.”).

¹⁴ General Motors LLC, Comments on Proposed Tier 3 Rule, EPA-HQ-OAR-2011-0135-4288, at 14 (June 28, 2013).

¹⁵ Leone (2015), *supra* note 10, at 10785, Table 2; *see also* Leone et al., *Effects of Fuel Octane Rating and Ethanol Content on Knock, Fuel Economy, and CO₂ for a Turbocharged DI Engine*, SAE 2014-01-1228, at 22 (“The E30-101 RON fuel enabled increasing CR to 13:1 with improved knock behavior compared to the baseline E10-91 RON fuel at 10:1 CR. At 13:1 CR, the E30-101 RON fuel gave a 6.0% benefit in EPA M/H CO₂ emissions and 9.1% benefit in US06 Highway CO₂ emissions.”).

¹⁶ The Co-Optima project is a scientific initiative that “aims to simultaneously transform both transportation fuels and vehicles in order to maximize performance and energy efficiency, minimize environmental impact, and accelerate widespread adoption of innovative combustion strategies.” Dep’t of Energy, Office of Efficiency & Renewable Energy, Co-Optimization of Fuels & Engines, <https://www.energy.gov/eere/bioenergy/co-optimization-fuels-engines> (last visited September 28, 2017). The initiative is a “collaboration between the U.S. Department of Energy (DOE), nine national laboratories, and industry.” *Id.*; *see also* John Farrell, Co-Optimization of Fuels & Engines (Co-Optima) Initiative: Recent Progress on Light-Duty Boosted Spark-Ignition Fuels/Engines (June 14, 2017) (explaining the initiative’s progress and future plans for spark-ignition fuels and engines research).

¹⁷ Robert L. McCormick et al., *Selection Criteria and Screening of Potential Biomass-Derived Streams as Fuel Blendstocks for Advanced Spark-Ignition Engines*, 10 SAE Int’l J. Fuels Lubr. 442, 454 (2017).

[higher] engine compression ratios and expanded downsize + downspeed powertrain approaches, providing clear pathways to improved vehicle fuel economy using existing engine technologies.”¹⁸ For that reason, the study concluded that midlevel ethanol blends “could offer a very plausible path toward simultaneous CAFE and RFS2 compliance.”¹⁹

The National Academy of Sciences (NAS) also agrees that midlevel ethanol blends could enable substantial efficiency improvements. As the NAS found in 2015, increasing compression ratios through the use of high-octane fuel would result in “up to [a] 3 percent reduction in fuel consumption for naturally aspirated engines” and possibly “greater reductions” in “turbocharged engines.”²⁰ The NAS further noted that midlevel ethanol blends “[w]ith a higher minimum octane level” could reduce fuel consumption “by up to 5 percent,” and further noted that ethanol’s “high-octane rating has the potential to provide for an increase in fuel economy by increasing the compression ratio” in optimized vehicles.²¹ The NAS therefore stressed the need to consider “the option to use E30 as a certification fuel” as a path to compliance with future CAFE and GHG standards.²²

B. High-Octane Midlevel Ethanol Blends Would Be Highly Competitive.

As EPA has recognized, midlevel ethanol blends would “provide a market incentive to increase ethanol use beyond E10.”²³ Indeed, high-octane midlevel ethanol blends would increase choice at the pump and lower costs for consumers while simultaneously increasing farm income and lowering RIN costs for refiners.

Midlevel ethanol blends give consumers what they want—clean, efficient fuel at a low cost. A recent study calculates that from 2012 to 2040, the retail cost of a gallon of high-

¹⁸ Derek A. Splitter & James P. Szybist, *Experimental Investigation of Spark-Ignited Combustion with High-Octane Biofuels and EGR. 1. Engine Load Range and Downsize Downspeed Opportunity*, 28 *Energy & Fuels* 1418, 1419 (2014).

¹⁹ *Id.*

²⁰ Nat’l Research Council, *Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles* 67, 401 (2015).

²¹ *Id.* at 60, 69.

²² *Id.* at 82.

²³ Tier 3 Rule, 79 Fed. Reg. at 23528–29.

octane E25 fuel would likely average 4 cents *less* than the cost of regular grade E10.²⁴

Another recent study, prepared by the Defour Group, predicts that a consumer would save \$155 in fuel costs over the lifetime of a model year 2025 vehicle by using E25 instead of regular grade E10.²⁵ Using E25 instead of premium E10 would save a consumer \$695 in fuel costs over the lifetime of a model year 2025 vehicle.²⁶

These savings would amount to billions of dollars every year nationwide. A study by MathPro, a petroleum refinery consultancy group, estimates that widespread use of a 92 AKI (97 RON) blend of E30 could lower annual aggregate wholesale gasoline costs by \$6.4 billion in 2025 and by \$11.7 billion in 2035.²⁷

Compared to available high-octane alternatives, a midlevel ethanol blend would impose trivial costs on refiners, and no costs at all if EPA simply extends the 1-pound RVP waiver to midlevel ethanol blends, as the Clean Air Act permits. A high-octane, midlevel ethanol blend with a 1-pound waiver could be simply splash-blended into today's regular gasoline blendstock, without any new refinery investments or changes in operations.²⁸ Even without RVP relief for higher ethanol blends, a MathPro study found that producing a single future 98 RON gasoline with E30 would cost refiners only an additional 1.7 cents a gallon.²⁹ According to the study, “[t]his small cost increase reflects that fact that these BOBs have octane ratings similar to that of the BOB currently used for Regular-grade E10.”³⁰ By contrast, transitioning to a high-octane fuel with E10 would require significant upgrades at a

²⁴ Darlington, *supra* note 10, at 6 (“[O]ver the projection until 2040, E25 is about 4 cents per gallon lower than E10”).

²⁵ Drake, Comparing the Cost of Two Different Grades of High Octane Motor Fuel in Future High Efficiency Vehicles 14 (2017).

²⁶ *Id.*

²⁷ MathPro, Analysis of the Refining Costs and Associated Economic Effects of Producing 92 AKI Gasoline in the U.S. Refining Sector 3, Table S-1 (Oct. 30, 2012). The study assumes that wholesale ethanol remains priced at parity with wholesale gasoline on a per gallon basis, as it has been in the past.

²⁸ See Hirshfeld et al., *supra* note 9, at 11067.

²⁹ *Id.* at 11068, Table 2.

³⁰ *Id.* at 11067.

substantial cost to refiners—18 cents a gallon in the case of a 98 RON fuel.³¹ Even producing a 95 RON E10 gasoline with an RVP waiver would cost refiners more—2.9 cents a gallon.³² The math is simple. A high-octane midlevel ethanol blend is the most cost-effective way to produce high-octane fuel.

Midlevel ethanol blends would also reduce greenhouse gas emissions. As AFPM concedes in its testimony, producing higher octane fuel through changes in the gasoline blendstock would “result[] in higher CO₂ emissions from refinery facilities.”³³ By contrast, midlevel ethanol blends would actually *reduce* CO₂ and other greenhouse gas emissions on a lifecycle basis.³⁴

Midlevel ethanol blends would also be better for air quality than high-octane hydrocarbons. As AFPM admits in its testimony “increasing octane out of the refinery is likely to increase some stationary source emissions,” and “regional air quality issues may be challenging.”³⁵ Simply splash-blending more ethanol into gasoline to blend high-octane fuel, by contrast, would reduce refinery emissions. It would also reduce motor vehicle pollution by displacing dirty aromatics with clean-burning ethanol. Expanding ethanol production would also pose no substantial environmental compliance challenge for ethanol plants, as most ethanol plants are outside ozone non-attainment areas—where they do little harm—and many ethanol plants in attainment areas are likely exempted from the Clean Air Act’s permitting rules.³⁶

³¹ *Id.* at 11068, Table 2.

³² *Id.*

³³ Testimony of Chet Thompson, AFPM, at 8.

³⁴ See Han et al., Well-to-Wheels Greenhouse Gas Emissions with Various Market Shares and Ethanol Levels, ANL-ESD-10-15, 64 (2015) (finding that in addition to reducing tailpipe carbon dioxide emissions, E25 would reduce upstream GHG emissions by 5% and E40 would reduce upstream emissions by 10%, compared to regular E10); Hirshfeld et al., *supra* note 9, at 11070 (“For a given RON, refinery CO₂ emissions and crude oil use decrease with increasing ethanol content in the gasoline pool, due primarily to the reduction in BOB volume and RON.”).

³⁵ Testimony of Chet Thompson, AFPM, at 13, 14.

³⁶ See 40 C.F.R. 52.21(b)(1)(i) (excluding “ethanol production facilities” from the definition of “major emitting facility,” and thus raising the PSD permitting applicability threshold to 250 tons per year, in contrast to the 100 tons per year threshold that applies to “petroleum refineries”).

C. The Ethanol Supply Would Be Adequate to Produce High-Octane Midlevel Ethanol Blends.

Widespread use of midlevel ethanol blends would not strain corn ethanol production. The National Renewable Energy Laboratory and Oak Ridge National Laboratory have modeled several market penetration scenarios for high-octane fuel. An aggressive scenario in which all new vehicles are optimized for E25 after 2018 would require increasing ethanol production to 21.1 billion gallons by 2035.³⁷ Despite this large increase in the amount of ethanol required for this particular scenario, the study concludes that “feedstock availability and cost are not expected to be obstacles to the substantial development of” high-octane fuels, “across all of the scenarios considered.”³⁸

A more recent analysis by the Defour Group confirms that if all vehicles produced beginning in 2025 were optimized for an E25 high-octane fuel, approximately 22 billion gallons of ethanol would be required by 2055, meaning that ethanol production would need to increase by only 5.8 billion gallons over 30 years, equivalent to less than a 1% increase in ethanol production each year.³⁹ Another analysis by ProExporter, an agricultural commodities consultancy, estimates that even if E25 use increased to represent 70% of the motor gasoline supply by 2030, the ethanol supply would be sufficient to meet the needs of the expanded market.⁴⁰

Corn farmers could easily provide enough corn to meet the required ethanol demand. Nationwide adoption of a midlevel ethanol blend would require only a modest increase in the share of the corn crop devoted to ethanol and dried distillers grains (a high-protein, high-nutrient feed that displaces corn feed). In 2016, the U.S. produced slightly over 15 billion bushels of corn.⁴¹ Ethanol and dried distillers grains production used slightly over

³⁷ Caley Johnson et al., *High-Octane Mid-Level Ethanol Blend Market Assessment* 55, tbl.15 (Dec. 2015).

³⁸ *Id.* at 75.

³⁹ Drake, *supra* note 25, at 9–10.

⁴⁰ The ProExporter Network, *Mid-Level Ethanol Blends: Can We Produce Enough Fuel Feedstocks?* (Oct. 22, 2015).

⁴¹ USDA, *U.S. Average Corn Yield, Crop Production 2016 Summary* 11 (Jan. 2017) (15,148 million bushels).

5 billion bushels of corn, or approximately a third of the corn crop.⁴² Of that amount, only about 3.5 billion bushels, or about a quarter of the corn crop, is attributable to ethanol.⁴³ Dedicating an additional 1.5 billion bushels of the corn crop (or 10% of the current crop) to ethanol production would yield an additional 4.2 billion gallons of corn ethanol at today's yields, a supply that is more than adequate to widely commercialize high midlevel ethanol blends.⁴⁴ This expansion would not require a substantial expansion of corn acreage. That is not surprising, given that corn farmers are growing more corn per acre than ever before. Just last year, Illinois farmers grew a record crop, with more than 200 bushels of corn harvested per acre. That kind of yield was unheard of when I started farming over four decades ago.

Even this overstates the amount of corn acres required to meet the additional ethanol demand. Corn yields and ethanol plant yields are projected to keep increasing, meaning that every year, fewer acres will be required to sustain the same ethanol production.⁴⁵ By contrast, refinery gasoline yields have remained stagnant for decades and are unlikely to increase in the future.⁴⁶

D. The Fueling Infrastructure Would Be Adequate to Support Midlevel Ethanol Blends.

Our Nation's fueling infrastructure can already accommodate midlevel ethanol blends, and with only minor investments the needed fueling infrastructure could be readily available nationwide. In addition to the legacy E85 infrastructure, which can be adapted for

⁴² USDA, ERS Feed Outlook (Jan. 17, 2017) (5,325 million bushels), *available at* <http://www.worldofcorn.com/#corn-used-of-ethanol-and-ddg-production>.

⁴³ This accounts for the fact that "only the starch fraction of the corn kernel (66 percent) is used for ethanol production." USDA, 2015 Energy Balance for the Corn-Ethanol Industry, at 2 (Feb. 2016).

⁴⁴ Assuming a yield of 2.8 gallons per bushel, slightly below the running average for 2017. *See* Renewable Fuels Ass'n, Industry Statistics: Monthly Implied Average Ethanol Yield (Gallons per Bushel) (last updated April 1, 2018), *available at* <http://bit.ly/2rDqtpO>.

⁴⁵ USDA, USDA Agricultural Projections to 2026, at 28, tbl.5 (Feb. 2017), *available at* <https://www.ers.usda.gov/webdocs/publications/82539/oce-2017-1.pdf?v=42788> (predicting that from the 2015/16 season to 2026/27 season, yields will increase by 20.4 bushels per harvested acre); Energy Info. Admin., Corn Ethanol Yields Continue to Improve (May 13, 2015), <https://www.eia.gov/todayinenergy/detail.php?id=21212>.

⁴⁶ Energy Info. Admin., Data U.S. Refinery Yield, https://www.eia.gov/dnav/pet/xls/PET_PNP_PCT_DC_NUS_PCT_M.xls.

E25,⁴⁷ there is a rapidly growing stock of E25-compatible fuel dispensers. Since 2016, Wayne Fueling Systems, one of the country’s two major fuel dispenser manufacturers, has only sold dispensers that are E25-compatible.⁴⁸ Other manufacturers are likely to follow suit, because E25 equipment is only marginally more expensive than E10 equipment.⁴⁹ In addition, “retrofit kits are readily available (for \$1,950) that enable an E10 dispenser to safely dispense E25.”⁵⁰ And “nearly all” underground storage tanks are compatible with E25 and higher ethanol blends.⁵¹

Corn farmers are doing their part to facilitate the transition to high-octane fuel. Our corn checkoff dollars (the money that corn farmers invest to build markets for our crop), have been used to fund research in high-octane fuels and install compatible pumps, tanks, and lines at retail stations. We have done a small part of this work, and we are ready to do more to build a future in which ethanol is free to compete.

II. REGULATORY BARRIERS ARE BLOCKING MIDDLELEVEL ETHANOL BLENDS.

High-octane midlevel ethanol blends are the liquid fuel of the future. Unfortunately, that future is being stifled by red tape in Washington D.C. EPA regulations prevent drivers from enjoying the performance benefits and fuel savings of midlevel ethanol blends.

Until these barriers are fixed, it is simply not true that a minimum octane standard would “provide the biofuel industry with the opportunity to expand its market share.”⁵² The

⁴⁷ 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 3,300 stations nationwide offer E85. *See* Dep’t of Energy, Alternative Fuels Data Center, Alternative Fueling Station Locator, <http://bit.ly/2rZo87Y> (last visited Oct. 5, 2017). 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 thanks to funding from the U.S. Department of Agriculture. *Renewables Enhancement and Growth Support Rule*, Proposed Rule, 81 Fed. Reg. 80828, 80831 (Nov. 16, 2016).

⁴⁸ Wayne Fueling Systems, *Wayne Standardizes Offering for All North American Retail Fuel Dispensers to E25, / B20* (Aug. 30, 2016), <http://bit.ly/2bOX5F5>.

⁴⁹ Caley Johnson et al., High-Octane Mid-Level Ethanol Blend Market Assessment 24 (Dec. 2015) (E25 refueling equipment “requires only upgraded elastomer materials.”).

⁵⁰ *Id.*

⁵¹ *Id.* at 25.

⁵² Testimony of Chet Thompson, AFPM, at 2.

reality is that anticompetitive regulations prevent the ethanol industry from expanding its market share, regardless of its value as an octane enhancer.

I discuss these barriers in turn.

A. EPA’s Misinterpretation of the One-Pound RVP Waiver Is Blocking Midlevel Ethanol Blends.

EPA has needlessly interpreted the one-pound RVP waiver of the Clean Air Act as limited to E10, making it infeasible to sell higher ethanol blends year-round.

In 2011, EPA approved E15 for use in Model Year 2001 and newer vehicles under a waiver pursuant to the “sub-sim” law, section 211(f)(4) of the Clean Air Act.⁵³ EPA intended to remove unwarranted regulatory barriers to using biofuels. But that commendable purpose has been frustrated: E15 has failed to achieve widespread market acceptance, because EPA excluded these fuels from the 1 psi RVP waiver statute, limiting the times of the year in which they can be sold. At the time, EPA insisted that a 1 psi RVP waiver was granted by Congress in 1990 to gasoline-ethanol blends of at least 9 volume percent *and no greater than* 10 volume percent ethanol.⁵⁴ EPA’s interpretation was wrong at the time, and we are pleased to read reports that EPA is preparing to correct its regulation.⁵⁵

The fact is that Congress did not limit the waiver to E10. Congress granted a 1 psi RVP waiver to “fuel blends containing gasoline and 10 percent denatured anhydrous ethanol.”⁵⁶ Midlevel ethanol blends contain gasoline and 10 percent denatured anhydrous ethanol. And the text of section 211(h)(4) contradicts EPA’s interpretation.⁵⁷ When Congress adopted the 1 psi waiver statute, it included a special affirmative defense for

⁵³ *Partial Grant of Clean Air Act Waiver Application Submitted by Growth Energy to Increase the Allowable Ethanol Content of Gasoline to 15 Percent*, 76 Fed. Reg. 4662 (Jan. 26, 2011) (hereinafter E15 Partial Waiver).

⁵⁴ *See Regulation to Mitigate the Misfueling of Vehicles and Engines With Gasoline Containing Greater Than Ten Volume Percent Ethanol and Modifications to the Reformulated and Conventional Gasoline Programs*, 76 Fed. Reg. 44406, 44433–35 (July 25, 2011) (hereinafter Misfueling Rule).

⁵⁵ Kelsey, Tamborrino, *Morning Energy: Wheeler-ing and Dealing*, Politico (Apr. 12, 2018), <https://www.politico.com/morningenergy/>.

⁵⁶ 42 U.S.C. § 7545(h)(4).

⁵⁷ *Id.*

downstream fuel sellers and carriers who can show that, among other things, “the ethanol portion of the fuel blend does not exceed its waiver condition under” section 211(f)(4).⁵⁸ E15 blends comply with the text of this requirement: the “ethanol portion” of an E15 blend “does not exceed” the 15 percent ethanol concentration allowed by the sub-sim waiver that EPA granted under section 211(f)(4). This safe harbor confirms Congress’s intent to extend the 1 psi RVP waiver to blends containing more than 10 percent ethanol, as long as they are consistent with the sub-sim law.⁵⁹ Congress could have limited the affirmative defense to fuel blends with *no more than* 10 percent ethanol, but Congress rejected a bill that would have done just that.⁶⁰ Instead, Congress linked the RVP statute to section 211(f), which empowers EPA to approve higher levels of ethanol.

Any notion that Congress intended to limit the 1 psi RVP waiver to E10 was refuted by Congress in 2005. In that year, Congress added section 211(h)(5), allowing States to exempt themselves from the 1 psi waiver’s application to “*all* fuel blends containing gasoline and 10 percent denatured anhydrous ethanol.”⁶¹ If the 1 psi waiver applied only to E10 and excluded higher ethanol blends, Congress’s use of the word “all” would have been superfluous.⁶²

EPA’s needlessly restrictive interpretation of the 1 psi RVP waiver provision is “unmoored from the purposes and concerns” of the Clean Air Act.⁶³ The purpose of section

⁵⁸ *Id.* (second sentence).

⁵⁹ In the Misfueling Rule, EPA asserted that the reference to section 211(f)(4) in the deemed to comply provision somehow implies that Congress limited the 1 psi RVP waiver to no more than 10 percent ethanol. 76 Fed. Reg. at 44434. That is illogical. If Congress wanted to limit the 1 psi waiver to E10, it would have specified fuels containing *no more than* 10 percent ethanol, instead of cross-referencing section 211(f)(4), which allowed EPA to approve higher levels of ethanol.

⁶⁰ Clean Air Act Amendments, H.R. 3030, 101st Cong., § 214 (1990) 101st Cong., 1st Sess. (July 27, 1989).

⁶¹ Energy Policy Act of 2005, Pub. L. 109-58, § 1501(c), 119 Stat. 594, 1074–75 (2005), *codified at* 42 U.S.C. § 7545(h)(5).

⁶² In the Misfueling Rule, EPA said this State exemption provision (section 211(h)(5)) would provide States with no relief from the 1 psi waiver (section 211(h)(4)) if section 211(h)(4) were interpreted to include blends of more than 10 percent ethanol. 76 Fed. Reg. at 44434–35. This argument is circular. Both provisions use the same phrase (“fuel blends containing gasoline and 10 percent denatured anhydrous ethanol”), so the exemption in section 211(h)(5) covers the same class of fuels as the waiver in section 211(h)(4).

⁶³ *Judulang v. Holder*, 565 U.S. 42, 64 (2011).

211(h) is to control the volatility of commercial gasoline.⁶⁴ But EPA's interpretation ensures that only the most volatile gasoline-ethanol blends are sold. As acknowledged by EPA, "the addition of ethanol to gasoline" above 10 percent ethanol "decreases blend volatility."⁶⁵ In addition, as EPA has recognized, higher ethanol blends lower the reactivity (*i.e.*, the tendency to form ozone) of the resulting emissions.⁶⁶ By restricting the 1 psi waiver to gasoline with no more than 10 percent ethanol, EPA's interpretation discourages the sale of a less volatile fuel with less reactive emissions, undermining the objectives of the RVP control program and increasing ozone pollution.

EPA's interpretation also violates all of Congress's purposes in providing a 1 psi waiver for ethanol blends. Congress granted that waiver to achieve the "beneficial environmental, economic, agricultural, energy security and foreign policy implications" of ethanol blending.⁶⁷ Congress determined that a small increase in evaporative emissions was justified by ethanol's countervailing reduction of tailpipe emission: "ethanol burns cleaner than pure hydrocarbon gasoline and thus cause[s] fewer tailpipe emissions."⁶⁸ Congress recognized that these benefits of ethanol blending could not be achieved without a waiver because of the high "cost of producing and distributing" a "sub-nine pound RVP gasoline" blendstock.⁶⁹ Instead of fulfilling Congress's intent, EPA's restrictive interpretation limits the beneficial implications of ethanol blending. It irrationally requires E15 blenders to purchase costly sub-9 psi RVP blendstocks that refiners are unwilling to sell, and it thereby increases tailpipe and evaporative pollution and dependence on foreign petroleum.

⁶⁴ Congress enacted the volatility program to reduce "commercial gasoline volatility." S. Rep. No. 101-228, at 109 (1989).

⁶⁵ Proposed REGS Rule, 81 Fed. Reg. at 80851.

⁶⁶ See EPA, Report to Congress on Public Health, Air Quality, and Water Resource Impact of Fuel Additive Substitutes for MTBE 63 (Feb. 2009) ("With additional ethanol use, the ethanol content of VOC should increase. Ethanol is less reactive than the average VOC. Therefore, this change should . . . reduce ambient ozone levels.").

⁶⁷ S. Rep. No. 101-228, at 110 (1989).

⁶⁸ *Id.*

⁶⁹ *Id.*

EPA should revoke that interpretation and affirm that the statutory waiver extends to all gasoline containing 10 percent ethanol, including higher ethanol blends.

B. EPA Should Let Automakers Certify New Vehicles on Midlevel Ethanol Blends.

To sell vehicles designed to run on high-octane midlevel ethanol blends, automakers need to be able to certify their vehicle emissions with these fuels. But no midlevel ethanol test fuel is currently approved.

“Before a manufacturer may introduce a new motor vehicle into commerce, it must obtain an EPA certificate indicating compliance with the requirements of the Act and applicable regulations.”⁷⁰ To obtain the necessary certificate, automobile manufacturers must test new vehicle models for compliance with air toxic emissions standards using a special “test fuel” (or “certification fuel”) whose properties are defined by EPA.⁷¹ The same procedures and test fuel are used to ensure that manufacturers meet NHTSA and EPA’s increasingly stringent fuel efficiency and greenhouse gas standards on a fleet-wide basis.⁷²

The makeup of the test fuel therefore determines the kinds of engines that car companies are able to design, build, and sell. It also determines the kinds of fuel that may lawfully be sold, because the composition of commercial fuel is governed by the Clean Air Act’s “sub-sim” law, which requires that fuels and fuel additives be “substantially similar” to test fuels used in certification.⁷³

Under 40 C.F.R. § 1065.701(c), EPA may approve an auto manufacturer’s request for an alternative certification fuel.

In the Tier 3 rulemaking that applied this rule to light-duty vehicles, EPA suggested that the Agency would approve an alternative certification fuel “if manufacturers were to design vehicles that required operation on a higher octane, higher ethanol content gasoline

⁷⁰ *Ethyl Corp. v. EPA*, 306 F.3d 1144, 1146 (D.C. Cir. 2002); *see* 42 U.S.C. § 7522(a)(1) (prohibiting sale of vehicles without a certificate of conformity).

⁷¹ *See* 42 U.S.C. § 7521 (authorizing EPA to prescribe emission standards); *id.* § 7525(a)(4)(A) (authorizing EPA to set and revise “test procedures” and test “fuel characteristics”).

⁷² *See* 2012 CAFE Rule, 77 Fed. Reg. 62624.

⁷³ 42 U.S.C. § 7545(f)(1)(B).

(e.g., dedicated E30 vehicles or [flexible-fuel vehicles] optimized to run on E30 or higher ethanol blends).⁷⁴

But the auto industry has yet to apply for such a fuel, because as discussed below, EPA's erroneous fuel economy equation penalizes ethanol blends.

But EPA does not have to wait for a formal request. EPA should approve a new test fuel on its own initiative, as the Agency has done in the past, so that automakers have the opportunity of designing more efficient vehicles optimized for midlevel ethanol blends.

C. EPA's Erroneous Fuel Economy Equation Is Blocking Midlevel Ethanol Blends.

EPA's badly outdated fuel economy equation (used to demonstrate compliance with CAFE regulations) penalizes ethanol blends and violates the law.⁷⁵ The current fuel economy equation includes adjustments meant to control for changes in the test fuel that affect fuel economy. These adjustments implement EPA's obligation to make fuel economy testing on today's fuel comparable to fuel economy testing in 1975 by adjusting for changes in the test fuel that affect fuel economy.⁷⁶ This prevents EPA from changing the stringency of the CAFE standards through surreptitious changes in the test fuel.⁷⁷

EPA has not met its obligation under the law, because the current fuel equation fails to adjust for changes in energy content. The fuel economy equation includes an adjustment called the R-factor, a measure of "how vehicles respond to changes in the energy content of

⁷⁴ Tier 3 Rule, 79 Fed. Reg. at 23528.

⁷⁵ See 40 C.F.R. §§ 600.113-12(h).

⁷⁶ 26 U.S.C. § 4064(c) ("Fuel economy . . . shall be measured in accordance with testing and calculation procedures . . . utilized by the EPA Administrator for model year 1975 . . . or procedures which yield comparable results."); 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 *General Motors Corp. v. Costle*, Nos. 80-3271, 80-3272, & 80-3655 (6th Cir. 1982) (Mem.) (requiring EPA to initiate a rulemaking that would establish an "adjustment factor" reconciling current test procedures with previous ones).

⁷⁷ *Ctr. for Auto Safety v. Thomas*, 847 F.2d 843, 846 (D.C. Cir.) (en banc) (Wald, C.J., concurring), *reh'g granted and opinion vacated on other grounds*, 856 F.2d 1557 (D.C. Cir. 1988) (per curiam) ("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.").

the fuel.”⁷⁸ The current R-factor of 0.6 implies that a 10% change in the test fuel’s energy content, for example, causes only a 6% change in fuel economy.⁷⁹ Oak Ridge National Laboratory has shown that the current R-factor of 0.6 is too low and should be closer to one.⁸⁰ EPA itself has acknowledged that the current R-factor is wrong and suggested that a corrected value might lie “between 0.8 and 0.9.”⁸¹ The auto industry has asked EPA to adopt an R-factor of 1.0.⁸² But EPA has yet to correct the R-factor.

EPA’s failure to fully adjust for changes in test fuel energy content penalizes ethanol by discouraging automakers from using midlevel ethanol blends in certification. A midlevel ethanol test fuel would have a lower energy content than 1975 test fuel. That means that if manufacturers were forced to use the current fuel economy equation to certify vehicles with a midlevel ethanol blend test fuel, they would be penalized for doing so because the illusory fuel economy losses generated by the lower energy content of the test fuel would not be fully corrected.

When EPA fixes the fuel economy equation, automakers will no longer be penalized when they certify on ethanol blends, and they will have a natural incentive to request an alternative certification fuel with higher ethanol content.

D. EPA Rules Unfairly Favor Electric Vehicles, Blocking Midlevel Ethanol Blends.

EPA has unfairly favored electric vehicles in its light-duty vehicle GHG standards.⁸³ EPA’s rules have undermined the broad range of technological choices that Congress

⁷⁸ Tier 3 Rule, 79 Fed. Reg. at 23531.

⁷⁹ *Id.*

⁸⁰ Oak Ridge Nat’l Lab., Preliminary Examination of Ethanol Fuel Effects on EPA’s R-factor for Vehicle Fuel Economy 12 (2013) (“The current factor of 0.6 which is called out in CFR is clearly too low, and a proper factor for modern vehicles is closer to unity, as might be expected from improved air/fuel ratio control common for more modern vehicles.”).

⁸¹ Aron Butler et al., Analysis of the Effects of Changing Fuel Properties on the EPA Fuel Economy Equation and R-Factor, at 1, Memorandum to the Tier 3 Docket, EPA-HQ-OAR-2011-0135 (Feb. 28, 2013).

⁸² Tier 3 Rule, 79 Fed. Reg. at 23531 (“[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.”).

⁸³ See Illinois Corn Growers Ass’n & Missouri Corn Growers Ass’n, Comments on EPA’s Reconsideration of the Final Determination of the Mid-Term Evaluation of Greenhouse Gas Emissions

wanted to encourage through the CAFE program, including flex-fuel vehicles, by treating electric vehicles as a favored technology for compliance.⁸⁴

As Illinois Corn explained in its comments on EPA's midterm evaluation of the GHG standards, EPA should adopt a technology-neutral regulatory scheme that treats all alternative fuels alike to the extent they reduce petroleum consumption and greenhouse gas emissions. Specifically, in consultation with the Department of Transportation, EPA should design a petroleum-equivalency factor for a midlevel ethanol certification fuel based on its gasoline content, consistent with the Agency's authority to determine "the quantity of other fuel that is equivalent to a gallon of gasoline."⁸⁵ For example, when calculating the fuel economy of a vehicle certified with an E25 certification fuel, EPA would use a petroleum-equivalency factor 0.75, because a gallon of E25 fuel contains 0.75 gallons of petroleum-based gasoline.

Under the GHG standards, EPA should treat the ethanol portion of the midlevel ethanol fuel as carbon neutral, as it does with electricity.⁸⁶ 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, tailpipe emissions add nothing to ethanol's lifecycle carbon emissions.⁸⁷ Consistent with that lifecycle analysis, and consistent with EPA's treatment of electric vehicles under the current GHG program, EPA should assume that the ethanol fraction of a midlevel ethanol certification fuel emits net zero carbon upon combustion. By contrast, petroleum tailpipe emissions release carbon stored deep underground for millennia. As the Agency has explained in the past, EPA has

Standards for Model Year 2022-2025 Light-Duty Vehicles, EPA-HQ-OAR-2015-0827-9581, at 12–15 (Oct. 5, 2017), <https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0827-9581>.

⁸⁴ *Id.* at 15.

⁸⁵ 49 U.S.C. § 32904(c).

⁸⁶ Electric vehicles are assumed to emit no greenhouse gas emissions when consuming electricity. 40 C.F.R. § 600.113-12(n).

⁸⁷ *See* Renewable Fuel Standard Program, Regulatory Impact Analysis 444 (2010) ("Over the full lifecycle of the fuel, the CO₂ emitted from biomass-based fuels combustion does not increase atmospheric CO₂ concentrations, assuming the biogenic carbon emitted is offset by the uptake of CO₂ resulting from the growth of new biomass. As a result, CO₂ emissions from biomass-based fuels combustion are not included in their lifecycle emissions results."); *accord id.* at 470, Figure 2.6-2 (assuming that corn ethanol has no tailpipe CO₂ emissions).

discretion to consider upstream GHG emission effects when calculating emissions under the GHG standards.⁸⁸

Congress could also act to ensure that midlevel ethanol blends are treated fairly in the fuel economy and GHG standards through legislation.

E. EPA’s Lifecycle Analysis of Corn Ethanol’s GHG Emissions Underestimates the Potential GHG Reductions of Midlevel Ethanol Blends.

To accurately estimate the GHG benefits of high-octane midlevel ethanol blends, EPA should jettison its outdated 2010 lifecycle analysis for corn ethanol, and adopt the recent lifecycle analysis performed by USDA or the Department of Energy.

In its March 2010 RFS Rule, EPA performed a lifecycle analysis of renewable fuel GHG emissions, as required by statute.⁸⁹ EPA concluded that by 2022, corn ethanol produced by biorefineries using natural gas and corn oil fractionation technology would achieve annual lifecycle greenhouse gas (GHG) emissions savings of just 21 percent compared to 2005 gasoline.⁹⁰ EPA “recognize[d] that as the state of scientific knowledge continues to evolve in this area, the lifecycle GHG assessments for a variety of fuel pathways will continue to change.”⁹¹ EPA therefore committed to “further reassess . . . the lifecycle estimates” on an ongoing basis,⁹² and to incorporate “any updated information we

⁸⁸ See 2012 CAFE/GHG Rule, 77 Fed. Reg. at 62819 (“EPA . . . believes that although section 202(a)(1) of the Clean Air Act does not require the inclusion of upstream GHG emissions in these regulations, the discretion afforded under this provision allows EPA to consider upstream GHG emissions[.]”); 2010 CAFE/GHG Rule, 75 Fed. Reg. 25,324, 25,437 (May 7, 2010) (claiming authority to “ma[k]e adjustments to a compliance value to account for upstream emissions”).

⁸⁹ See *Regulation of Fuels and Fuel Additives: Changes to Renewable Fuel Standard Program*, 75 Fed. Reg. 14,670, 14,785 (Mar. 26, 2010) (hereinafter 2010 RFS Rule) (representing that the 2010 LCA included the “most up to date information currently available on the GHG emissions associated with each element of the full lifecycle assessment”); 42 U.S.C. § 7545(o)(1)(H) (requiring EPA to perform a lifecycle analysis to determine whether renewable fuels meet the required GHG reduction thresholds under the RFS program).

⁹⁰ 2010 RFS Rule, 75 Fed. Reg. at 14,786 (“The results for this corn ethanol scenario are that the midpoint of the range of results is a 21% reduction in GHG emissions compared to the gasoline 2005 baseline.”); 2010 RFS RIA, *supra* note 87, at 469–70.

⁹¹ 2010 RFS Rule, 75 Fed. Reg. at 14,765.

⁹² *Id.* (“Therefore, while EPA is using its current lifecycle assessments to inform the regulatory determinations for fuel pathways in this final rule, as required by the statute, the Agency is also committing to further reassess these determinations and lifecycle estimates.”); *accord id.* at 14,785.

receive into a new assessment of the lifecycle GHG emissions performance of the biofuels being evaluated in [the 2010] rule.”⁹³

As summarized in a recent report commissioned by USDA, “a large body of information has become available since 2010—including new data, scientific studies, industry trends, technical reports, and updated emission coefficients—that indicates that . . . actual emissions . . . differ significantly from those projected” by EPA’s 2010 lifecycle analysis.⁹⁴ Whereas EPA’s outdated analysis estimated that corn ethanol would only be 21 percent less carbon-intensive than gasoline in 2022, USDA’s up-to-date analysis shows that corn ethanol is actually 43 percent cleaner today, and that corn ethanol’s advantage will grow to 48 percent by 2022.⁹⁵

EPA has an opportunity to update its lifecycle analysis in its triennial Biofuels Report to Congress. The Energy Independence and Security Act of 2007 requires EPA to submit a Biofuels Report to Congress every three years on the environmental impacts of the RFS.⁹⁶ But EPA has not submitted a Biofuels Report since 2011.⁹⁷ Following a program evaluation by EPA’s Inspector General, which determined that EPA was not meeting its statutory obligations, EPA agreed to submit a new Biofuels Report to Congress by the end of 2017, a deadline that EPA has also missed.⁹⁸ EPA can use its forthcoming report to adopt USDA’s more accurate lifecycle analysis of corn ethanol’s GHG emissions, so that EPA can accurately estimate the benefits of high-octane midlevel ethanol blends.

Correcting these estimates would improve EPA’s administration of the RFS and promote Congress’s goal of energy independence through renewable fuel production. It

⁹³ *Id.*

⁹⁴ ICF, A Life-Cycle Analysis of the Greenhouse Gas Emissions of Corn-Based Ethanol 4–5 (Jan. 12, 2017).

⁹⁵ *Id.* at 168.

⁹⁶ Energy Independence and Security Act of 2007, Pub. L. 110-140 § 204, 121 Stat. 1492, 1529 (Dec. 19, 2007).

⁹⁷ EPA, Office of Inspector General, EPA Has Not Met Certain Statutory Requirements to Identify Environmental Impacts of Renewable Fuel Standard 4 (Aug. 18, 2018) (“ORD issued its first report to Congress in December 2011. . . . [T]here have been no subsequent reports since 2011.”).

⁹⁸ *Id.* at 14.

would also promote U.S. ethanol exports by signaling to U.S. trading partners that U.S. corn ethanol is a cost-effective means of meeting their carbon-reduction goals. Approximately 42 countries have adopted biofuel blending mandates.⁹⁹ Those countries must be persuaded that U.S. corn ethanol imports are consistent with their climate and sustainability policies. Congress should ensure that EPA’s forthcoming report accurately accounts for ethanol’s substantial greenhouse gas benefits.

⁹⁹ United Nations, Second Generation Biofuel Markets: State of Play Report 11 (2016) (“In 2014, mandates are in place in 42 countries. Within these policy frameworks, various jurisdictions mandate specified bioethanol blends.”).