Written Testimony of

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Before the U.S. Senate Committee on Environment & Public Works

Environmental Impacts of E15

For a Hearing on S.517, the Consumer and Fuel Retailer Choice Act

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My name is Jonathan Lewis. I am Senior Counsel at the Clean Air Task Force, a nonprofit organization that works to help safeguard against the worst impacts of climate change by catalyzing the rapid global development and deployment of low carbon energy and other climate-protecting technologies through research and analysis, public advocacy leadership, and partnership with the private sector.[1] I lead the Clean Air Task Force's efforts to limit the negative effects that liquid biofuels and biomass-based power generation can have on climate change and the broader environment.

I want to thank Chairman Barrasso, Ranking Member Carper, and the rest of the Environment and Public Works Committee for inviting me to testify today, and for holding this hearing. It is important to the Clean Air Task Force and others that are dedicated to the protection of the environment and public health that any efforts that could result in amendments to the Clean Air Act should proceed through regular order, so that the potential consequences for public health and the environment can be fully considered.

The Clean Air Task Force has several concerns about E15, including its impact on climate change, air quality, water quality, and habitat protection. These comments focus on two of these concerns: the potential climate impact of the additional ethanol production that could result from S.517 and the likelihood that greater use of E15 will increase ozone formation.

ETHANOL PRODUCTION AND CLIMATE CHANGE

Allowing E15 to be used year-round would expand the market for ethanol, and if history is any guide, much—if not all—of that new market space will be filled by corn ethanol:

[1] www.catf.us

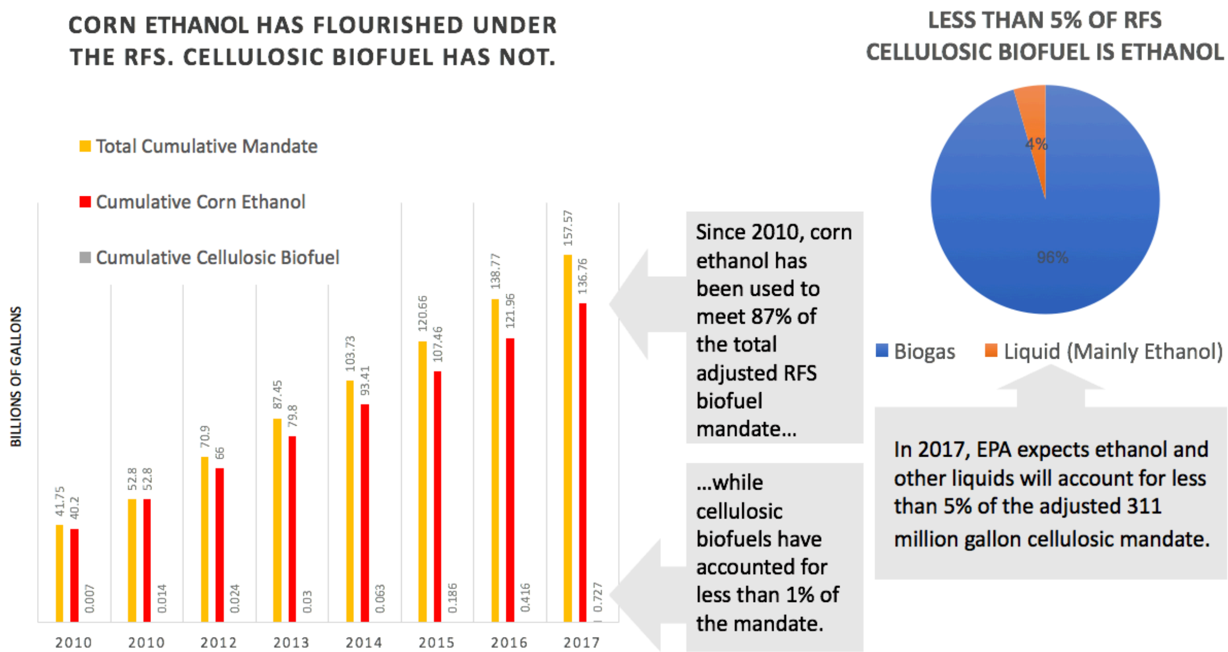

FIG. 1: Corn ethanol and cellulosic biofuel have accounted for 86.8% and 0.5%, respectively, of the total cumulative RFS volume obligations during 2010-2017; EPA projects that cellulosic ethanol will account for about 4% of the adjusted cellulosic biofuel volume obligation for 2017.[2]

According to the US Environmental Protection Agency's own data, the incremental additional corn ethanol produced in response to the 2007 expansion of the Renewable Fuel Standard (RFS) has higher lifecycle greenhouse gas emissions than gasoline.

The National Research Council looked at the EPA lifecycle GHG emissions data in 2011 and reported that:

> EPA found corn-grain ethanol, regardless of whether the coproduct is sold wet or dry, to have life-cycle GHG emissions higher than gasoline in 2012 or 2017 unless it is produced in a biorefinery that uses biomass as a heat source.

And further that:

> Thus, according to EPA's own estimates, corn-grain ethanol produced in 2011, which is almost exclusively made in biorefineries using natural gas as a heat source, is a higher emitter of GHG than gasoline.[3]

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[2] Volume obligation data for corn ethanol, cellulosic biofuel, and total renewable fuel from EPA Renewable Volume Obligation Rules (2010-2017); data for 2017 cellulosic biofuel volume obligation from EPA, Renewable Fuel Standard Program: Standards for 2017 and Biomass-Based Diesel Volume for 2018, 81 Fed. Reg. 89746, 89760 (December 12, 2016).

[3] Lester Lave, *et al*. 2011. *Renewable Fuel Standard: Potential Economic and Environmental Effects of U.S. Biofuel Policy* 221 (Report by the National Research Council Committee on Economic and Environmental Impacts of

For EPA to find a scenario under which incremental additional corn ethanol would achieve a 20% net reduction in life-cycle GHG emissions, it had to start its modeling analysis in 2022, which allowed the Agency to (a) ignore 60% of the land use change emissions that should have been attributed to expanding corn ethanol production; and (b) assume a greater volume of ethanol would be produced in biorefineries that burn biomass to generate process heat.[4]

The ethanol industry argues that EPA's analysis is flawed and that corn ethanol's lifecycle greenhouse gas emissions are significantly less than those of gasoline. But the studies that reach this conclusion dramatically undercount emissions from RFS-driven land use changes—just as EPA did in 2010. Many of the studies (including a 2017 report released by the United States Department of Agriculture[5]) rely extensively on an industry-funded, non-peer reviewed 2014 staff report from Iowa State University that uses questionable data and makes several important methodological errors.[6]

The ethanol industry's defense of corn ethanol's climate impact also ignores the rebound effect. The RFS has increased the supply of motor vehicle fuel in the United States by requiring refiners to add billions of gallons of biofuel into the US fuel supply each year. Fuel markets are influenced by a variety of factors, but higher supply usually begets lower prices. Drivers buy more fuel than they would have, and emit more GHG as a result.

A key factor in determining the RFS's climate impact is the extent to which the mandated biofuels actually displace petroleum fuels. As explained by the University of Minnesota's Jason Hill *et al.*, "increasing the supply of low-carbon fuel only partially displaces fossil fuel. This results in lower GHG emissions only when the savings from the reduction in carbon intensity outweighs the increase in GHG emissions from additional fuel use."[7]

Hill *et al*. generously assume that every 100 gallons of biofuel mandated by the RFS displace 50 energy-equivalent gallons of gasoline or diesel. They also assume (again, generously) that all of the biofuels used to comply with the RFS—even corn ethanol—

Increasing Biofuels Production) (internal citations omitted).
(http://www.nap.edu/openbook.php?record_id=13105)

[4] *See* CATF, *Corn Ethanol GHG Emissions Under Various RFS Implementation Scenarios* (2013) (http://www.catf.us/resources/whitepapers/files/20130405-CATF%20White%20Paper-Corn%20GHG%20Emissions%20Under%20Various%20RFS%20Scenarios.pdf).

[5] Flugge, M. *et al*., *A Life-Cycle Analysis of the Greenhouse Gas Emissions of Corn-Based Ethanol*. Report prepared by ICF under USDA Contract No. AG-3142-D-16-0243. January 12, 2017.

[6] *See* Babcock, B. A., & Iqbal, Z., *Using Recent Land Use Changes to Validate Land Use Change Models*. Center for Agricultural and Rural Development, Iowa State University (2014) (*e.g.*, study uses unreliable FOAstat data on planted area and land abandonment, and makes selective use of Brazilian land use data to support the paper's crop intensification narrative while ignoring period extensification was more prevalent; study also makes unsupported assumptions about the drivers behind decisions to double-crop and about the relationship between regional and global agriculture markets) (http://www.card.iastate.edu/publications/dbs/pdffiles/14sr109.pdf).

[7] Jason Hill *et al*., *Climate consequences of low-carbon fuels: The United States Renewable Fuel Standard*, ENERGY POLICY 97 (2016) 351-353.

actually achieve the GHG reduction targets set by Congress in 2007. The resulting analysis indicates that the RFS is not a useful tool for mitigating climate change:

> Taking this [50%] fuel market rebound effect into account and assuming the biofuels in RFS2 achieve their targeted GHG emissions reductions in all years, RFS2 actually leads to a net increase in GHG emissions of 22 million metric tons in 2022, and of 431 million metric tons cumulatively from 2006 to 2022. In sum, this mandate for the production of less GHG intense fuels actually increases net GHG emissions to the atmosphere relative to no action due to the low amounts of gasoline being displaced. In other words, RFS2 increases GHG emissions instead of reducing them when individual fuel GHG reduction targets are met.[8]

The bulk of the additional greenhouse gas emissions identified by Hill *et al*. is attributable to corn ethanol, which has accounted for 87% of the biofuel used to comply with the RFS over the last ten years.

We need low/zero-carbon liquid fuels to decarbonize the transportation sector. Biofuels can play a role in this effort—particularly with respect to aviation—but we need to move away from policies that promote the use of conventional biofuels and toward policies that support the development and deployment of fuels made from waste, algae, and other feedstocks that do not depend on farmland. By expanding the use of E15 without first developing the capacity to produce an adequate supply of climate-beneficial biofuels, this bill could undermine climate change mitigation efforts by encouraging additional production of corn ethanol.

E15 AND OZONE FORMATION

The United States has made significant progress in tackling ozone pollution, but elevated ozone levels continue to cause or contribute to severe health problems. Reducing ozone pollution must remain a top priority for local, state, and federal authorities.

Ozone forms when volatile organic compounds (VOCs) and nitrogen oxides (NOx) mix in the atmosphere in the presence of sunlight. Ozone is particularly dangerous during summer months, when sunlight is more abundant (therefore allowing more ozone formation) and when hotter temperatures can worsen the incidence and severity of diseases that are aggravated by ozone pollution, such as asthma, emphysema, and chronic obstructive pulmonary disease. Violations of the National Ambient Air Quality Standard (NAAQS) trigger requirements for reducing the emissions of these precursor pollutants through deployment of emissions control strategies and the use of pollution offsets in the affected areas.

Adding ethanol to gasoline affects the emissions of both VOCs and NOx. The VOC impact is complicated:

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[8] *Id*.

- E10, or gasoline that contains 10% ethanol, is more volatile than straight gasoline. The additional volatility causes increased evaporation of VOCs into the atmosphere.
- E15 is slightly less volatile than E10, so a switch from E10 to E15 could result in a slight reduction in VOC release.
- The volatility continues to decrease gradually as the ethanol blend level is increased, but as Dr. Janet Yanowitz and others have shown through their research, gasoline-ethanol blends do not achieve lower volatility than straight gasoline until the proportion of ethanol reaches approximately 50%.[9]

For VOCs, the net result from a shift from E10 to E15 is likely either a wash or slightly decrease in VOC emissions.

The impact of ethanol blends on NOx formation is more straightforward. If the amount of ethanol blended into gasoline is increased, the oxygen content of the fuel also increases. In older vehicles (pre-2007) and newer vehicles that have not been adequately maintained, higher oxygen levels typically result in hotter combustion temperatures, which in turn typically results in higher NOx formation.

There is uncertainty about these effects, but our interpretation of the available research is that while E15 use may be associated with equal or less VOC pollution relative to E10, E15 combustion will tend to produce more NOx than E10 combustion.

Modern light duty engines, especially those that have been built since 2007, have computerized fuel injection systems that work with a three-way catalyst to limit the release of NOx from the tailpipe. Older cars that do not have this emissions control technology—as well as newer cars in which the emissions controls may have degraded—are less effective at capturing the additional NOx that is created when they run on E15. (The current fleet is characterized by a mix of these vehicles and by the miles they are driven.)

The potential additional NOx emissions are important, because in most parts of the country, ozone formation is more sensitive to changes in NOx emissions than it is to changes in VOC emissions. According to a modeling study produced by EPA last month (May 2017),

> The model results suggest that a much larger area of the country would experience ozone reductions with NOx emissions reductions compared to an equivalent percentage reduction in anthropogenic VOC. Further, the ozone

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[9] Robert L. McCormick (National Renewable Energy Laboratory) and Janet Yanowitz (Ecoengineering Inc.), *Discussion Document—Effect of Ethanol Blending on Gasoline RVP* (March 26, 2012) (transmitted to Kristy Moore, Renewable Fuels Association) (http://www.ethanolrfa.org/wp-content/uploads/2015/09/RVP-Effects-Memo_03_26_12_Final.pdf).

improvements from NOx emissions reductions tend to be larger in magnitude than those shown for VOC emissions reductions.[10]

The EPA analysis finds that in most cities, the impact of NOx reductions on ozone formation is 1.5 – 5 times greater than the impact of comparable VOC reductions. In nonurban areas, EPA found NOx reductions are over 10 times more impactful than VOC reductions.[11]

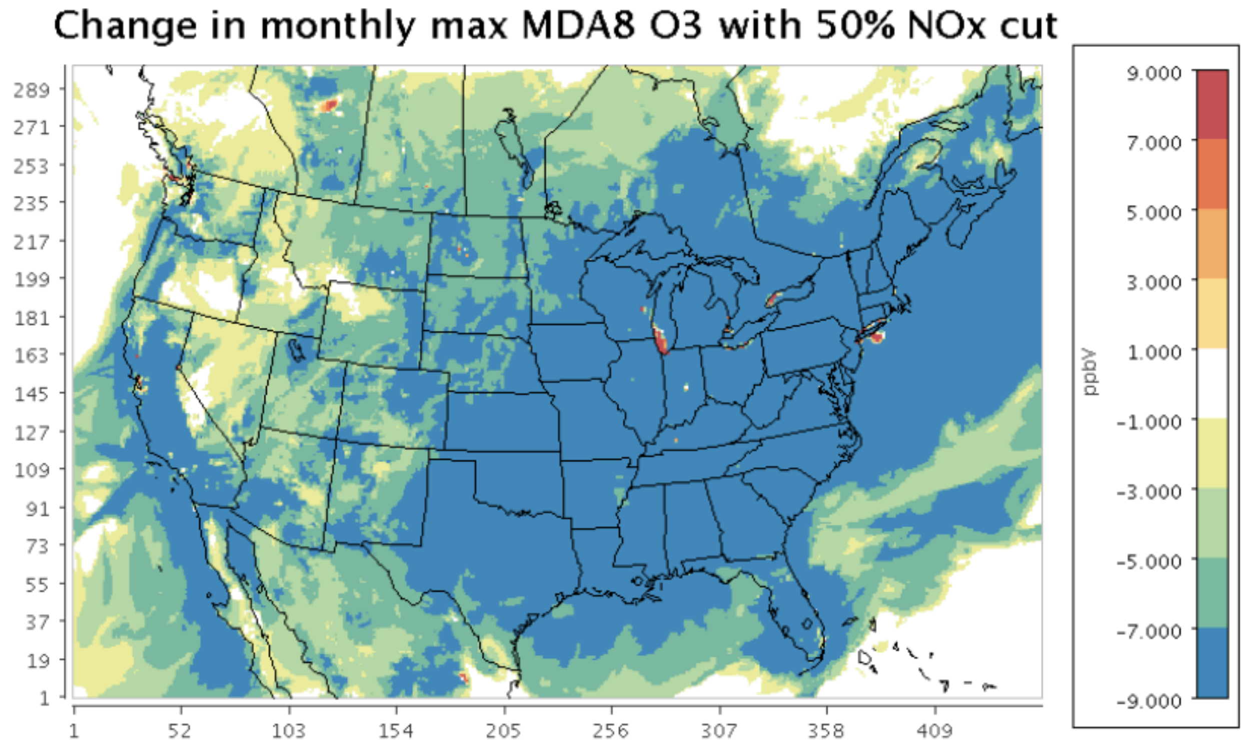

FIG. 2: US EPA conducted ozone modeling for the Continental United States to determine geographic regions sensitive to changes in precursor emissions NOx and VOCs (EPA 2017). Except for a few isolated areas, peak ozone was more responsive to changes in NOx emissions, with estimated reductions of over 7 ppb for a 50% emissions cut for virtually all areas of the US designated nonattainment for the 2008 ozone standard.

VOC reductions remain important to public health and the environment, and we should continue to require efforts to drive down VOC emissions. Because of these efforts, the percentage of VOC emissions due to the automobiles has dropped to 13 percent of the total inventory; mobile sources, meanwhile, have become the dominant source of NOx emissions. When it comes to determining the net impact that increased use of E15 will have on ozone formation, the potential for increased NOx emissions are the more important factor.

[10] EPA Office of Air Quality Planning and Standards, Air Quality Modeling Group, *Supplemental Information for Ozone Advance Areas Based On Pre-Existing National Modeling Analyses* (May 2017) (https://www.epa.gov/sites/production/files/2017-05/documents/national_modeling.advance.may_2017.pdf).
[11] *Id*.

Although the emissions increases due to introduction of E15 may be relatively modest, several areas of the country experience ozone readings that are just below or just above the level of violation for the ozone National Ambient Air Quality Standard (NAAQS):

CSA/CBSA Name	2013-15 Design Value (ppm)
Salt Lake City-Provo-Orem, UT	0.076
San Jose-San Francisco-Oakland, CA	0.076
Yuma, AZ	0.076
Chicago-Naperville, IL-IN-WI	0.075
Grand Rapids-Wyoming-Muskegon, MI	0.075
Las Vegas-Henderson, NV-AZ	0.075
Philadelphia-Reading-Camden, PA-NJ-DE-MD	0.075
Chico, CA	0.074
Redding-Red Bluff, CA	0.074
Atlanta--Athens-Clarke County--Sandy Springs, GA	0.073
Boston-Worcester-Providence, MA-RI-NH-CT	0.073
Cleveland-Akron-Canton, OH	0.073
Pittsburgh-New Castle-Weirton, PA-OH-WV	0.073
San Luis Obispo-Paso Robles-Arroyo Grande, CA	0.073
Sonora, CA	0.073
South Bend-Elkhart-Mishawaka, IN-MI	0.073
Detroit-Warren-Ann Arbor, MI	0.072
El Paso-Las Cruces, TX-NM	0.072
Manitowoc, WI	0.072
Payson, AZ	0.072
Baton Rouge, LA	0.071
Cincinnati-Wilmington-Maysville, OH-KY-IN	0.071
Columbus-Marion-Zanesville, OH	0.071
Harrisburg-York-Lebanon, PA	0.071
Reno-Carson City-Fernley, NV	0.071
St. Louis-St. Charles-Farmington, MO-IL	0.071
Washington-Baltimore-Arlington, DC-MD-VA-WV-PA	0.071
Flagstaff, AZ	0.070
Milwaukee-Racine-Waukesha, WI	0.070
New Orleans-Metairie-Hammond, LA-MS	0.070
Oklahoma City-Shawnee, OK	0.070

TABLE 1: Excerpt of 2013-15 Ozone Design Values for areas whose pollution levels are near the 2008 and 2015 ozone standards of 0.075 and 0.070 ppm. Modest increases in emissions could prevent some areas currently out of attainment from reaching it or push some areas that just meet the standard back above it.

Small incremental increases in summer ozone due to increased NOx formation from the introduction of E15 in the summer might be enough to push or keep these areas over the limit, triggering increased adverse health impacts and additional control requirements.

The Clean Air Task Force has been able to find no peer-reviewed, published analysis of the potential impact on ozone levels of allowing the sale of E15 year-round, nor are we aware that U.S. EPA has analyzed this potential shift. There is considerable uncertainty about the effect of E15 on VOC and NOx emissions, and about the net impact that E15 has on ozone formation. Therefore, before legislation that allows the sale of E15 during the summer ozone season is enacted, we urge that more research be conducted to better understand how the use of E15 affects VOC and NOx emissions from a wide range of engine types, engine model years, and engine usage patterns. In other words, we should look before we leap. The last thing that areas that are otherwise on the verge of meeting their ozone targets need is the introduction of additional NOx emissions into their relevant airsheds, which could result in nonattainment or could trigger the requirement of proving offsetting NOx reductions on other pollution sources.

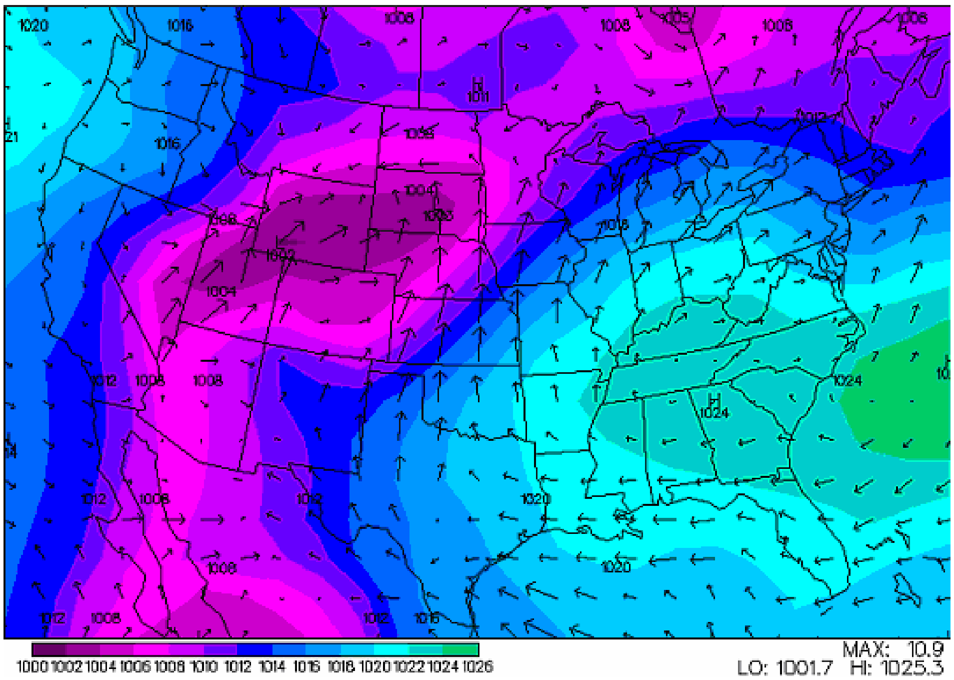

FIG. 3: Classic Bermuda High Pressure wind flow patterns typical of high ozone episodes in the Ozone Transport Region (OTR). Sunny conditions prevail, with emissions transported from the Gulf States through the Midwest, en route to the East Coast Megalopolis.

To summarize, the Clean Air Task Force's best read of the available research is, first, that a shift from E10 to E15 would likely cause an increase in NOx emissions from automobiles, especially from cars and trucks that were built before 2007. Second, because the lion's share of areas experiencing high levels of ozone are especially sensitive to NOx emissions, the detrimental impact on ozone pollution associated with E15's higher NOx emissions is likely to outweigh any beneficial impact that may be associated with E15's lower VOC emissions.

For these reasons, in the absence of further research into the impact of E15 on NOx emissions and ozone formation, the Clean Air Task Force is opposed to changes to the Clean Air Act that would allow increased, year-round use of E15.