EMISSIONS IMPACTS OF THE ELIMINATION OF THE 1-PSI RVP WAIVER FOR E10

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SUMMARY

The U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 3.0 model has been used to estimate the impact on air emissions from on-road gasoline/ethanol-powered vehicles if the 1-psi Reid vapor pressure (RVP) waiver for 10% ethanol blends were to be eliminated. The model was run for the years 2025 and 2030 in the state of Missouri to determine the percentage change in emissions due to the removal of the waiver. Missouri was chosen as a representative state because it has both rural and urban areas, temperatures in the mid-range of those in the United States as well as mostly urban areas that have required reformulated gasoline (RFG) and significant parts of the state that have no RFG requirements. The percentage change calculated for Missouri was adjusted for the entire United States proportionally by the amount of fuel affected by the change, and then applied to the total national on-road gasoline/ethanol emissions as estimated by the EPA.

Table 1. Estimated Impact of Removal of 1-psi Waiver on U.S. Emissions using MOVES3.0 in tons/year in the Years 2025 and 2030.

Year	2025			2030		
Pollutant	CO	NOx	VOC	CO	NOx	VOC
Tons/Year Eliminated by elimination of 1-psi Waiver	-43,000	-690	-4,500	-43,000	-180	-3,200

The impact of the removal of the waiver would be beneficial to air quality, as emissions of carbon monoxide (CO), oxides of nitrogen (NOx) and volatile organic compounds (VOCs) would be reduced. In addition, if the elimination of the 1-psi waiver leads to the replacement of E10 with E15, it will also decrease greenhouse gases and particulate emissions.

EPA MOVES3 MODEL

MOVES3 is a complex emission modeling system for mobile sources. It is based on individual physical processes, which are then scaled up on the basis of fleet-average emission factors, and a database which includes information on the use-rates of different types of vehicle, and the properties of fuel used in each region of the country. The model is the culmination of over 40 years of development during which multiple versions have been refined, reflecting new data on emissions sources and new thinking on emissions processes, as well as changes in vehicle technology and fuels. While the model estimates are only as good as the limited emissions data upon which it has been based, it is the best available method for estimating the emissions impact of a nationwide change in fuel.

This analysis used the latest version of MOVES3, i.e. MOVES3.0.2, as available in October of 2021.

FUEL SUBJECT TO THE 1-PSI WAIVER

The U.S. Environmental Protection Agency (EPA) set a maximum allowable RVP level of 9.0 psi for all gasoline fuels for the summer ozone season (June 1 to September 15, for most of the country). However, E10 fuel was allowed a 1-psi increase in RVP in areas in which the 9.0 psi limit applies and also in the six regions subject to a federal 7.8 psi standard (Denver regional, Reno, Portland, Salem, Beaumont-Port Arthur and Salt Lake City).

Certain areas of the United States are not affected by the 1-psi waiver, and thus would not be affected by its removal, because they are:

- required to sell federal reformulated gasoline (RFG);
- required to sell California RFG (i.e., the entire state of California);
- subject to a SIP-approved state fuel rule that requires an RVP of less than 9.0 psi to meet the requirements of the federally approved SIP (Maine, New York, east Texas and Vermont); or
- Alaska, Hawaii and the territories which are not subject to RVP limits on gasoline and gasoline-ethanol blends.

Since the proportion of fuel subject to the 1-psi waiver is not exactly the same in Missouri as in the entire United States, the EIA database[1] for fuel consumption by state was consulted to determine the amount of conventional gasoline[2] and reformulated gasoline in Missouri and in the United States. Conventional gasoline sold in areas that are not subject to 1-psi waiver was subtracted from the total conventional gasoline sold in the U.S. to get a total for the United States reflecting the amount of fuel subject to the 1-psi waiver.

Roughly, 61% of the fuel used in the US is impacted by the 1-psi waiver in the summer months, and 68% of the fuel in Missouri. Thus, the percentage impact of the 1-psi waiver in the entire US was scaled down slightly to account for this difference.

[1] Eia.gov, Prime Supplier Sales Volumes, October 19, 2021.
[2] Includes both oxygenated and unoxygenated fuels although virtually all gasoline in the United States contains the oxygenate ethanol

Table 2. Fuel sales volumes from the U.S. Energy Information Administration in thousand gallons/day averaged for 2019.

Area	Conventional Gasoline (not RFG) mostly Subject to 1-psi Waiver	RFG (not Subject to 1-psi Waiver)	Conventional Gasoline not Subject to 1- psi Waiver	Total Subject to 1-psi Waiver	Total Gasoline	Proportion Subject to 1- psi Waiver
Missouri	5,375.6	2,519.3	0	5,375.6	7,894.9	68%
Maine		1,179.6	752.3			
Vermont		0	716.2			
New York		8,620.7	6,252.9			
Texas[3]	11,568.8	18,361.1	11,568.8			
Alaska		0	703.8			
Hawaii		0	1,275			
United States	243,768.4	123,537.7	21,269 (equal to sum of above)	222,499.4 (equal to total conventional gasoline minus conventional gasoline not subject to 1-psi waiver)	367,306.1	61%

[3] Only the eastern part of Texas is subject to the SIP requirement that limits E10 fuel; an estimate was made that this affects roughly one half of Texas fuel consumption

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Missouri was selected as a trial state because it is reasonably representative of typical U.S. conditions which affect emissions: a state with both urban and rural traffic patterns, a climate which is neither especially hot nor cold relative to the rest of the United States (which affects evaporative and tailpipe emissions), urban and suburban areas that have required reformulated gasoline (RFG), and significant rural parts of the state that have no RFG requirements. Clearly, it would be ideal to represent the United States using the entire database of meteorological data, traffic conditions and vehicle counts that are in the MOVES model for the entire United States, but using one state to determine the percentage change in emissions was considered a reasonable tradeoff to the long run times required for including the entire nation.

National total onroad emission estimates for total CO, NOx and VOCs from gasoline vehicles were available from the EPA.[4] The percentage change in emissions due to the removal of the 1-psi waiver was calculated for Missouri. This percentage was decreased slightly to account for the proportion of affected fuel in Missouri (68%) versus the entire US (61%) (see Table 3) and then multiplied by the total US emissions.

The percentage change in fuel emissions in Missouri due to the elimination of the 1-psi waiver was calculated by the MOVES3.0.2 model and is shown in the table below. The estimated emissions from the entire United States, scaled up as describe above is also included in the table. The results show that eliminating the 1-psi waiver for E10 results in reduced emissions of CO, NOx, and VOCs.

Table 3. Estimated Impact on Emissions if 1-psi waiver were removed.

	2025			2030		
	CO	NOx	VOC	CO	NOx	VOC
Impact on Missouri[5](%)	-0.41%	-0.14%	-0.66%	-0.54%	-0.07%	-0.59%
Impact on US (%)	-0.37%	-0.12%	-0.59%	-0.48%	-0.06%	-0.53%
US total emissions (thousand tons/year)[6]	12,000	570	760	9,000	300	600
Impact on US (thousand tons/year)	-43	-0.690	-4.5	-43	-0.180	-3.2

[5] As of April 2021, RFG was no longer required in the Kansas City, Missouri area (86 FR 14007). Since 2019 was the most recent year for which there was normal (i.e. non-COVID era) fuel usage, the scale-up between Missouri and the US was done with 2019 data. In order to match RFG fuel usage to emissions, the model runs were done assuming that the Kansas City area would still use RFG (as it did in 2019) and continue to be unaffected by the 1-psi increase in 2025 and 2030.

[6] EPA, Overview of EPA's Motor Vehicle Emission Simulator (MOVES3), EPA-420-R-21-004, March 2021

COMPARISON WITH SIMILAR ANALYSIS CONDUCTED IN JULY 10, 2015 WITH MOVES2014.

As with this analysis, a previous analysis by Air Improvement Resources, Inc. (AIR, Inc.) was conducted on a limited scenario to provide a rough idea of the impact on the entire United States. Both this and the previous analysis limited their study to gasoline vehicles, and did not include emissions from off-road vehicles. AIR, Inc. did not attempt to scale up their estimates to the entire year, but only reported emissions changes for a single month, July. To estimate the impact for the entire year the percentage change in the AIR estimate was reduced by a factor of 3 because the percentage change is only in effect for (roughly) 4 out of 12 months per year.

Both show similar trends in emissions, but differences are due to changes in the model between MOVES2014 and MOVES3 as well as the different mode of scaling up to reflect annual emissions impacts for the entire country. EPA ran the two models and found that the total national estimated emissions of pollutants between MOVES3.0 and MOVES2014 differ significantly, on the order of 10% to 20%[7] for the pollutants listed below in the 2020's.

Table 4. Comparison of Results of this Analysis using MOVES3.0 model to Previous Analysis using MOVES2014 model.

	2025		
	CO	NOx	VOC
This Analysis: MOVES3.0 (adjusted for entire country)	-0.37%	-0.12%	-0.59%
AIR, Inc. Analysis: MOVES2014 (adjusted for annual emissions)	-0.25%	-0.03%	-0.42%

[7] EPA, Overview of EPA's Motor Vehicle Emission Simulator (MOVES3), EPA-420-R-21-004, March 2021.

ADDITIONAL E15 BENEFITS

Permitting the 1-psi waiver for E10, but not E15, has become a significant impediment to E15 use because of the difficulty of obtaining lower RVP gasoline blendstock for the E15 fuel, as long as E10 remains the default choice. Just as the 1-psi waiver was implemented to allow E10 to overcome barriers to its introduction, the elimination of the waiver would allow E15 to overcome the barriers to its introduction. The use of E15 in place of E10 will decrease emissions by an amount that will be even more important than the reduction in emissions from lower vapor pressure E10.

E15 reduces emissions of greenhouse gases. Depending on its source, the ethanol available today typically reduces greenhouse gas (GHG) emissions between 35%[8] and 45%[9] in comparison to the equivalent amount of fuel energy from petroleum. This means that replacing petroleum gasoline with ethanol will significantly reduce the climate impact of transportation emissions.

Soon-to-be published results of emissions testing of twenty recent-model year vehicles operating on E15 and E10 (reflecting what CARB predicts will be the most common technology groups on the road in 2025 in California) found large reductions in particulate matter (PM) mass and number as well as total hydrocarbons . Although the difference was not statistically significant, the emissions of CO, NOx and many individual organic compounds, as well as the ozone forming potential of the organics was also on average lower with E15 than E10.

CONCLUSION

The U.S. EPA MOtor Vehicle Emission Simulator (MOVES) 3.0 model was used to estimate the impact on air emissions from on-road gasoline/ethanol-powered vehicles if the 1-psi Reid vapor pressure (RVP) waiver for 10% ethanol blends were to be eliminated. The model was run for the years 2025 and 2030 in the state of Missouri to determine the percentage change in emissions due to the removal of the waiver. The percentage change calculated for Missouri was adjusted for the entire United States proportionally by the amount of fuel affected by the change, and then applied to the total national on-road gasoline/ethanol emissions as estimated by the EPA.

The results showed that eliminating the 1-psi RVP waiver for E10 would result in reductions of CO, NOx, and VOC emissions from the on-road light-duty vehicle fleet. As these pollutants are known precursors to ozone formation, eliminating the 1-psi RVP waiver for E10 would result in improved air quality and reduced ozone. By facilitating greater consumption of E15, the removal of the 1-psi waiver for E10 would also reduce lifecycle GHG emissions.

[8] https://www.arb.ca.gov/fuels/lcfs/lrtqsummaries.htm LCFS Quarterly Data Spreadsheet (October 29, 2021)

[9] https://iopscience.iop.org/article/10.1088/1748-9326/abde08