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Blended Ethanol Has a 43.4 g/MJ Carbon Intensity Rating or Lower When Accounting for Aromatics Reduction

Study breaks new ground in assessing ethanol's blending carbon intensity

September 29, 2021 – Two studies conducted by Transport Energy Strategies (TES) and THiggins Energy Consulting show that gasoline blended with ethanol lowers carbon intensity (CI) even more than what is modeled today and what is shown in recent studies. A key finding in both studies is that blended ethanol not only displaces some of the gasoline but enables a reduction of aromatics in all of the gasoline in the blend. Aromatics have a high CI, and their reduction further decreases the GHG impact of the E10. This advantageous blending attribute is due to ethanol's high octane rating and has been neglected in prior literature.

"For years, the ethanol industry has touted the value of displacing aromatics with ethanol from an air pollution and public health standpoint, but no one has, to our team's knowledge, ever considered what displacement might mean for carbon intensity and for reducing GHG emissions," said Tammy Klein, founder and CEO of Transport Energy Strategies and a member of the study team. "Our findings break new ground."

GREET assessments, along with a study for the US Department of Agriculture and the current values used by the California Air Resources Board, yield an average CI for ethanol that is 40.4% below the value for petroleum gasoline. A recent study led by Harvard presents a deeper reduction. Using the 40.4% ethanol advantage, and assuming a CI of 93 g/MJ for gasoline, the CI of ethanol is estimated at 55.5 g/MJ.

Displacement of petroleum gasoline to form E10 offers direct benefits from the low CI of the ethanol. In *Well-to-Wheels Carbon Intensity for Ethanol Blended Fuels*, the TES study team found that when both direct displacement and reduction of aromatics in the blend are attributed to ethanol as the enabling additive, a "reduced blending CI" (BCI) of 43.4 g/MJ is found for ethanol when it is used in E10. Similarly, for anticipated market blending, the BCI for E20 is 44.8 g/MJ, a greater reduction than the 55.5 g/MJ from unblended ethanol. If the 52.4 g/MJ CI for unblended ethanol from the GREET estimate alone is used, the BCI for ethanol in E10 is about 40 g/MJ.

Refinery modeling, economic considerations, availability of feedstocks and examination of gasoline properties supported the conclusion in *Quantifying Ethanol CI Benefits in Gasoline Composition* that as ethanol is blended into gasoline, so aromatics are reduced to maintain a constant octane rating. "The primary refinery option for lower octane is through lower severity or throughput for the gasoline reformer," said Terry Higgins, president of THiggins Energy Consulting. "This, in turn, reduces both gasoline aromatic content and carbon intensity. When blended in gasoline, ethanol offers higher GHG benefits than well to wheels studies recognize for pure ethanol."

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Transport Energy Strategies (http://www.transportenergystrategies.com) is a consultancy that provides market and policy intelligence, research analysis and strategic advice to clients on a range of global transport energy issues. THiggins Energy Consulting is a consultancy that provides refinery modeling providing energy consulting services to the petroleum and related industries with a primary area of focus on the impact of fuel quality trends on refining and application of new refining technology.