UNIVERSITY OF ILLINOIS CHICAGO
Energy Resources Center

Research Brief

Health and Environmental Benefits of E15 All Year Long Sales in Iowa

Prepared by:
Steffen Mueller, PhD; Principal Economist; University of Illinois Chicago, Energy Resource Center

November 29, 2021

This research brief summarizes the health and greenhouse gas benefits of enabling retailers in Iowa to sell E15 to consumers all year long without interruption. E15 all year long use can provide additional substitution of carcinogenic aromatics which are currently added to gasoline by refiners to increase gasoline's octane rating and prevent engines from premature combusting. Ethanol has been identified as a less harmful substitution for aromatics.[1]

Moreover, once released into the atmosphere aromatics also form ultrafine particulate matter pollutants which are responsible for additional mortalities.[2,3] Importantly, particulate matter emissions have also been identified as a multiplier in COVID related deaths.[4]

The US Environmental Protection Agency, in its regularly released Fuel Trends Report shows that the decrease in aromatics from the year 2000 was commensurate with an increase in ethanol blending. On page 8 that report states: "Ethanol's high octane value has also allowed refiners to significantly reduce the aromatic content of the gasoline, a trend borne out in the data."[5] Selling E15 all year long in Iowa ensures that a much higher percentage of harmful aromatics is displaced by ethanol in the fuel resulting in reduced mortalities and cleaner air.

---

[1] Mueller, S.; Dennison, G.; Liu, S. An Assessment on Ethanol-Blended Gasoline/Diesel Fuels on Cancer Risk and Mortality. Int. J. Environ. Res. Public Health 2021, 18, 6930. https://doi.org/10.3390/ijerph18136930

[2] "The formation of PM2.5 from VOC Precursors is caused when volatile organic gases in secondary organic aerosol (SOA) are oxidized by species such as the hydroxyl radical (OH), ozone (O_3), and nitrate (NO_3). After oxidation of the VOC, some of the oxidation products have low volatilities and condense on available particles becoming part of the PM. VOCs from the **aromatic group** are the most significant contributor to SOA from anthropogenic sources." Source: William Hodan and Willliam Barnard. "Evaluating the Contribution of M2.5 Precursor Gases and Re-entrained Road Emissions to Mobile Source PM2.5 Particulate Matter Emissions".

[3] Public health impacts of secondary particulate formation from aromatic hydrocarbons in gasoline; Stackelberg et al.; Environmental Health Volume 12, Article number: 19 (2013) https://ehjournal.biomedcentral.com/articles/10.1186/1476-069X-12-19#Tab5

[4] Air pollution and COVID-19 mortality in the United States: Strengths and limitations of an ecological regression analysis. https://www.science.org/doi/10.1126/sciadv.abd4049

[5] Fuel Trends Report: Gasoline 2006 - 2016 ; Office of Transportation and Air Quality; U.S. Environmental Protection Agency; EPA-420-R-17-005; October 2017; https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100T5J6.pdf

Additionally, ethanol has a much lower carbon footprint than gasoline. Pure ethanol emits only half of the greenhouse gas emissions than gasoline.[6] A recent World Health Organization report documents that climate change is not only responsible for property damage but also mortalities.[7]

Environmental modeling by the University of Illinois at Chicago, Energy Resources Center has shown the following:

- In 2019, the last non-pandemic statistical year, Iowa consumed 1,284,329,057 gallons of E10 (additional ethanol blends including E85 were also sold). Iowa's gasoline share is about one percent of the national consumption. A switch of the E10 gallons to E15 would save an additional 258,894 tonnes CO_2e annually.

- The 258,894 tonnes CO_2e are worth **$11.1 million annually** in avoided damages. This assumes $43/tonne CO_2e in damages used by the US EPA for regulatory impact analyses.[8] The EPA states that this number includes "changes in net agricultural productivity, human health, property damages from increased flood risk, and the value of ecosystem services due to climate change."

- The substitution of aromatics with the use of E15 over E10 will provide reductions in mortalities and health savings. Stackelberg et al. point out that "evidence is growing that aromatics in gasoline exhaust are among the most efficient secondary particulate matter precursors."[9] A previous UIC study utilized the speciated emissions database from the supporting information in Stackelberg and determined that each one percent by vol. reduction in aromatics saves 258 mortalities from reduced exposure to PM2.5 originating from aromatic hydrocarbons in gasoline and $2.35 billion avoided monetary damages, nationwide. [10]

- Immediately, all year long sale of E15 in Iowa will dilute current aromatics in gasoline. Additionally, refiners will start to substitute ethanol directly for aromatics based on the economic consideration that ethanol provides the lowest cost octane. This process has been observed during the introduction of E10 and described in the above cited EPA Fuel Trends Report. Assuming a further 5% reduction in aromatics from E15 introduction and Iowa's national gasoline share of one percent would result in a reduction of aromatics related mortalities of 13 mortalities valued at **$117.5 million**.[11] Additional health savings from reduced particulate matter emissions will likely be realized.

---

[6] "Retrospective analysis of the U.S. corn ethanol industry for 2005-2019: implications for greenhouse gas emission reductions; Uisung Lee, Hoyoung Kwon, May Wu G, Michael Wang; Biofpr 2021.

[7] https://www.who.int/heli/risks/climate/climatechange/en/

[8] Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis; Interagency Working Group on Social Cost of Greenhouse Gases, United States Government; August 2016. https://www.epa.gov/sites/production/files/2016-12/documents/sc_co2_tsd_august_2016.pdf

[9] K. Stackelberg et al.; "Public health impacts of secondary particulate formation from aromatic hydrocarbons in gasoline"; Environmental Health volume 12, Article number: 19 (2013); https://ehjournal.biomedcentral.com/articles/10.1186/1476-069X-12-19#Tab5;

[10] Avoided Mortalities from the Substitution of Ethanol for Aromatics in Gasoline with a Focus on Secondary Particulate Formation; Steffen Mueller, PhD; University of Illinois at Chicago Energy Resources Center; August 12, 2019; https://erc.uic.edu/wp-content/uploads/sites/633/2020/03/UIC_Indirect_Aromatics_SOA_Paper_FINAL_8_12_2019.pdf

[11] For monetary damages from mortalities, we multiplied the mortalities per ton by the Value of Statistical Life (VSL) of $9 million which measures willingness to reduce the risk of death. This value is also used consistently across several publications including Stackelberg et al.