NOVEMBER 2021

Air quality impacts of biodiesel in the European Union

This factsheet summarizes the results of two recent studies, "Air quality impacts of biodiesel in the United States" and "Air quality impacts of palm biodiesel in Indonesia," in the context of the European vehicles and fuels markets. These studies present meta-analyses on the exhaust emission impacts of blending biodiesel from various feedstocks under different conditions based on a comprehensive literature review. In this factsheet, we present results of the meta-analyses adjusted for European conditions.

POLICY BACKGROUND

The European Union (EU) has been a leader in developing emission standards aimed at reducing exhaust emissions associated with fuel combustion. These include four major air pollutants: nitrous oxides (NO_x), unburned hydrocarbons (HC), carbon monoxide (CO), and particulate matter (PM). Although the implementation of emission control technologies to comply with European emission standards has largely reduced the formation of these compounds, significant public health concerns persist. Exhaust emissions are often associated with burning conventional fossil fuels, but they are also formed when burning biodiesel.

Europe currently blends biodiesel at the pump at approximately 7% blend rates, or B7. This blend level is expected to remain the standard diesel blend in the future. Biodiesel blends of 20%, or B20, were also approved for sale in 2015 under EN 16709 fuel standards and are available in separate fueling pumps at some locations. In the EU, biodiesel is sourced from three primary feedstocks: roughly 40% of biodiesel is sourced from rapeseed, 20% from used cooking oil (UCO), 20% from palm oil, and the remainder from soybean oil, animal fats, and other feedstocks such as sunflower oil.

KEY FINDINGS

Under European conditions, blending biodiesel into diesel fuel increases NO_x emissions from vehicles and this effect has likely gotten worse over time. For EU-specific results, the data used in the aforementioned reports was filtered to only include studies using rapeseed, UCO, palm oil, animal fats, and soybean oil feedstocks. The data was also filtered to only include tests conducted on vehicles adherent to Euro emission standards.

With the introduction of modern vehicles equipped with common-rail direct fuel injection systems and low-sulfur diesel, the diesel fuel baseline has become cleaner, widening the gap between conventional diesel and biodiesel NO_x emissions rates. At B7 blend rates (7% biodiesel and 93% diesel), we find NO_x emissions to be 0.9% greater than a pure diesel and HC and PM emissions to be 1.2% and 2.0% lower, respectively

icct
THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

(Table 1). These emission effects are larger for higher biodiesel blends such as B20. The emission effects of CO are insignificant for this dataset.

Table 1. Biodiesel emissions effects at B7 and B20 blend rates for EU fuel mix.

Blend	NO_x	HC	CO	PM
B7	0.9%	-1.2%	Insignificant	-2.0%
B20	2.6%	-3.5%	Insignificant	-5.7%

In addition to variations among blend levels, related analysis of the U.S. and Indonisian markets found that the biodiesel emissions effect varies by on-road driving conditions, feedstock type, fuel injection system, and the inclusion of emission control technologies. Specifically, PM effects are highest under low load, or urban driving conditions, and NO_x effects are highest in vehicles equipped with key emission control technologies, including diesel particulate filters, diesel oxidation catalysts, and exhaust gas recirculation systems. In some cases, emission control devices appear to be less effective when biodiesel blends are used, and in others the biodiesel may directly degrade the systems.

Our research also finds that the biodiesel NO_x effect worsens with common-rail direct fuel injection systems, which have been widely adopted by auto manufacturers since 2000. Common-rail systems are more efficient than older fuel injection systems but increase NO_x emissions, and this effect is worsened when biodiesel is used. For example, the biodiesel NO_x effect roughly doubles between studies tested on unit injector systems versus studies tested on common-rail fuel injection systems across our EU-specific dataset.

In summary, our findings demonstrate that biodiesel has no clear benefit for air quality in the EU, especially in modern vehicles and urban environments.

RELATED PUBLICATIONS

Title: Air quality impacts of palm biodiesel in Indonesia
Authors: Jane O'Malley, Stephanie Searle
Download: https://theicct.org/sites/default/files/publications/Indonesia-air%20quality-eng-jan2021.pdf

Title: Air quality impacts of biodiesel in the United States
Authors: Jane O'Malley, Stephanie Searle
Download: https://theicct.org/sites/default/files/publications/US-biodiesel-impacts-mar2021.pdf

Contact: Jane O'Malley, j.omalley@theicct.org

www.theicct.org
communications@theicct.org
twitter @theicct