

UC Riverside developing biofuel formulations for California

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Researchers at the University of California, Riverside's College of Engineering – Center for Environmental Research and Technology (CE-CERT) are working with the state of California to develop diesel formulations with higher levels of renewable biofuels.

This research supports several California legislative measures and regulations that aim to increase the use of [renewable fuels](#) and reduce [greenhouse gases](#). These include AB 32, which requires the state to develop regulations that will reduce carbon dioxide-equivalent [greenhouse gas emissions](#) to 1990 levels by 2020, and the California Air Resources Board's (CARB's) Low Carbon Fuel Standard (LCFS).

In the first major step of this effort, researchers at CE-CERT have evaluated the potential impacts of using biodiesel in diesel sold through California. Biodiesel may provide significant reductions in [carbon dioxide emissions](#) because it is produced from [renewable sources](#), such as soybeans, that absorb carbon dioxide while growing.

Biodiesel use and production is already expanding rapidly in the United States. Over the past decade, it jumped from 2 million gallons in 2002 to 1.1 billion gallons in 2011, according to the National Biodiesel Board.

Although biodiesel provides benefits in a number of emissions components, such as hydrocarbons, carbon monoxide, and particulate matter, one issue with biodiesel use in California is its potential to increase nitrogen oxide (NO_x) emissions, a key contributor to smog.

The CE-CERT study found that adding biodiesel at levels of 20 percent and higher would likely increase NO_x emissions, but several strategies were proposed that could potentially mitigate such increases, including blending with more advanced renewable diesel fuels or through the use of additives. Results were less conclusive for biodiesel blends near the 5 percent, which are the levels most likely to be implemented in the state in the near future.

"The results show that research is still needed to find optimal biofuel blends that achieve maximum environmental benefits in all aspects," said Thomas D. Durbin, a research engineer at CE-CERT and the lead author of the recent journal article in *Environmental Science and Technology* where the findings were outlined.

He continued: "One of CE-CERT's missions is to help bring new environmental, sustainable technologies to the marketplace and we are now one step closer with biodiesel by understanding how small changes in fuel composition can affect emissions."

The research finding in the journal article, and a related report, are the most comprehensive look at the impact of blending biodiesels with California diesel, which is the cleanest in the nation. CE-CERT researchers have also done extensive studies comparing California diesel with diesel fuels found in other states, where less stringent fuel emission standards apply.

Two researchers at CE-CERT, which is part of UC Riverside's Bourns College of Engineering, co-authored the paper with Durbin. They were: Kent Johnson, an assistant research faculty member at the center, and Maryam Hajbabaie, a graduate student researcher at the center. Three CARB researchers were also co-authors: Robert Okamoto, Alexander Mitchell and Marcie Pullman.

The same CE-CERT team, along with Wayne Miller, CE-CERT's associate director, and scientists at UC Davis and Arizona State University, produced a related report for CARB.

The findings outlined in the journal article stem from tests using two heavy-duty engines: a 2006 engine with no exhaust aftertreatment, and a 2007 engine with a diesel particle filter (DPF). The tests were conducted on an engine dynamometer over four test cycles that simulated different driving conditions.

In the coming months, several follow-up studies are planned, including: more comprehensive testing with 5 percent biodiesel blends; adding additives to reduce NOx emissions in 20 percent biodiesel blends; and evaluating the impact of biodiesel blends have on emissions from light-duty vehicles, such as passenger cars. This will include the development of certified biofuel and biodiesel blends that can be sold in [diesel](#) fuel throughout California.

Provided by University of California - Riverside

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