

Clean fuel worsens climate impacts for some vehicle engines

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A pioneering program by one of the world's largest cities to switch its vehicle fleet to clean fuel has not significantly improved harmful vehicle emissions in more than 5,000 vehicles – and worsened some vehicles' climate impacts – a new University of British Columbia study finds.

The study – which explores the impacts of New Delhi, India's 2003 conversion of 90,000 buses, taxis and auto-rickshaws to compressed natural gas (CNG), a well-known “clean” fuel – provides crucial information for other cities considering similar projects.

Of the city's more than 5,000 auto-rickshaws with two-stroke engines – a common form of transportation in Asia and Africa – the study found that CNG produced only minor reductions in emissions that cause air pollution and an increase in emissions that negatively impact climate change.

According to the researchers, the New Delhi's program could have achieved greater emission reductions at a cheaper price by simply upgrading two-stroke models to the cleaner, more fuel-efficient four-stroke variety.

“Our study demonstrates the importance of engine type when adopting clean fuels,” says lead author and UBC post-doctoral fellow Conor Reynolds. “Despite switching to CNG, two-stroke engine auto-rickshaws in Delhi still produce similar levels of particulate matter per kilogram of fuel to a diesel bus – and their climate impacts are worse than before.”

Published online in the journal *Environmental Science and Technology*, the study is the first to comprehensively examine the pollutant emissions from small vehicle engines fuelled with CNG. It included significant laboratory testing of Indian auto-rickshaws.

The study finds that as much as one third of CNG is not properly burned in two-stroke engines, producing high emissions of methane, a major greenhouse gas that contributes to climate change. CNG use also produced substantial emissions of high particulate matter from unburned lubricating oil, which can appear as blue smoke.

The findings show the importance of strong scientific data for policymakers and the need to consider small vehicles like auto-rickshaws in emissions reduction programs, according to the researchers.

“If policymakers have information about emissions and their potential impacts, they can make better decisions to serve both the public and the environment,” says Reynolds, who co-authored the study with Prof. Milind Kandlikar and post-doctoral fellow Andrew Grieshop from UBC's Liu Institute for Global Issues and Institute for Resources, Environment and Sustainability.



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According to the researchers, the study has broad implications for the design of public health interventions.

“Clean fuels are being used in Indian cities for transportation when they could save many more lives if used for cooking,” says Kandlikar. “The interests of the rural poor, particularly women and children, are being put below those of the urban consumer.”

According to the researchers, several Asian cities have more two-stroke auto-rickshaws than New Delhi. They say the study provides important information to other cities considering fuel-switching programs, especially those in rapidly industrializing cities in India, Pakistan, Bangladesh, Philippines, Thailand, and Indonesia, where major auto-rickshaw fleets exist.

View the study at: <http://pubs.acs.org/doi/abs/10.1021/es102430p>

Background:

About the Author

Dr. Conor Reynolds holds a Postdoctoral Research Fellowship from NSERC (the Natural Sciences and Engineering Research Council of Canada) in the Department of Civil and Environmental Engineering at the University of Minnesota, and he is a visiting research fellow at the Liu Institute. He is interested in interdisciplinary, policy-relevant research on climate and health co-impacts of energy use, particularly with respect to transportation in developing countries.

Conor received his BAI in Mechanical Engineering from the University of Dublin (Trinity College), Ireland, and his MASc in Mechanical Engineering and PhD in Resource Management and Environmental Studies from the University of British Columbia. His current research activities include: assessing strategies to reduce emissions from vehicles in India; measuring spatial and temporal variation in ambient air quality in different neighbourhoods in Bangalore to assess the impact of motor vehicle emissions; and examining how the built environment affects the safety of cyclists.

Dr. Andy Grieshop is a Postdoctoral Research Fellow at the Liu Institute for Global Issues. He is interested in technical and policy research at the intersection of energy use, the environment, climate change and development. He received his BS in Mechanical Engineering from UC Berkeley and his MS in Mechanical Engineering and PhD in Mechanical Engineering and Engineering and Public Policy from Carnegie Mellon University, in Pittsburgh, Pennsylvania, where he was a member of the multi-disciplinary Center for Atmospheric Particle Studies (CAPS). His research focuses on interactions between energy use and the environment and more specifically on improving our technical understanding of the emission and atmospheric transformations of air pollutants to inform effective control policies in both developed and developing countries. Prior to his time in Pittsburgh he led various other lives, working as a design engineer for a distributed energy technology start-up, teaching high school math and physics in New York City and building ecological toilets in a remote village in Mexico.

Professor Milind Kandlikar (PhD Carnegie Mellon) is an Associate Professor at the Liu Institute for Global Issues and Institute of Asian Research. His work focuses on the intersection of technology innovation, human development and the global environment. Dr. Kandlikar's current projects include cross-national comparisons of regulation of agricultural biotechnology; air quality in Indian cities; risks and benefits of nanotechnology; new technologies for sustainable transportation; and development and climate change. He has also published extensively on the science and policy of climate change.

About the Liu Institute for Global Issues

Named after Dr. Jieh Jow Liou, the Liu Institute conducts and facilitates research on global issues, mobilizing knowledge into solutions and policy. One of sixteen research units in the College for Interdisciplinary Studies (CFIS), the Institute takes an interdisciplinary problem-solving approach to explore new ideas and ways of learning to catalyze innovative thinking and positive societal change. Its current focus is on advancing sustainability, security, and social justice: understood as moving toward economic, social, and environmental interactions that promote the well-being of people in ways that are just, equitable, and sustainable.

Founded in 1998 by Professor Ivan Head and opened in 2000, the Institute acts as a hub for global research and emerging issues at the University of British Columbia (UBC).

A hallmark of the Institute is to provide innovative learning and research opportunities for UBC graduate students, postdoctoral fellows, faculty, and community members that help to bridge the gap between academics and practitioners.

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