FACT SHEET: GLOBAL

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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

IMPACTS AND MITIGATION OF EXCESS DIESEL NO_X EMISSIONS IN 11 MAJOR VEHICLE MARKETS

A NEW STUDY PUBLISHED IN *NATURE* OFFERS THE FIRST QUANTITATIVE ANALYSIS OF THE GLOBAL IMPACTS OF REAL-WORLD ON-ROAD DIESEL NO_X EMISSIONS ON PUBLIC HEALTH AND THE ENVIRONMENT

Approximately one third of nitrogen oxide (NO_X) emissions from diesel vehicles worldwide are "excess" emissions—discharged in vehicle exhaust during normal everyday operation in amounts over and above limits defined in vehicle emissions regulations, such as Euro VI or 6. According to new research published in *Nature*, NO_X from diesel vehicle exhaust was linked to 107,600 premature deaths worldwide in 2015. Of these, ~38,000 are attributable to excess NO_X emissions. The study also determined that more stringent NO_X emissions-control standards, coupled with effective compliance and enforcement programs, could avert 174,000 premature deaths annually by 2040.

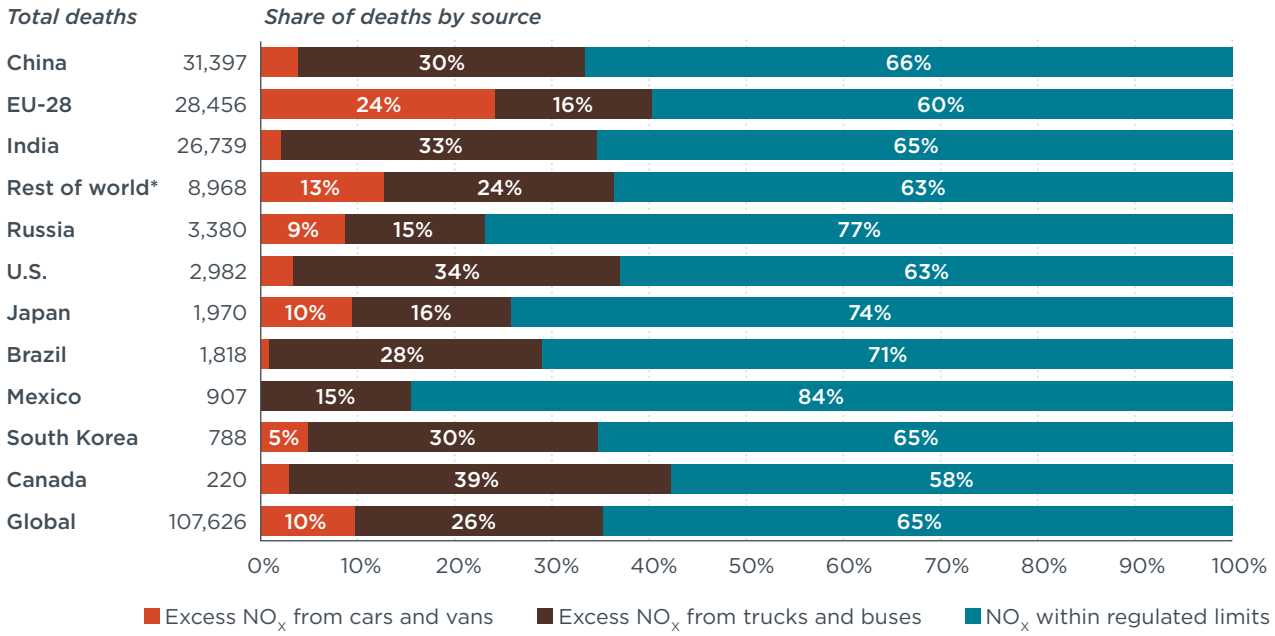
KEY FINDINGS

- The 11 regions examined for the *Nature* study (Australia, Brazil, Canada, China, the EU, India, Japan, Mexico, Russia, South Korea, and the U.S.) account for more than 80% of new diesel vehicle sales in 2015, and about 59% of worldwide diesel NO_X emissions: ~13.1 million metric tons out of 22.4 million. Of those 13.1 million tons, about a third (4.6 million) were "excess"—over and above regulatory limits.
- Heavy-duty vehicles account for 76% of all excess diesel NO_X in the 11 regions studied. China, India, the EU, Brazil, and the U.S. together contribute 90% of excess NO_X from HDVs.
- Light-duty vehicles (LDVs) account for 24% of excess diesel NO_X. Europe alone contributes 68% of excess NO_X emissions from LDVs in the 11 regions studied.
- 107,600 premature deaths in 2015 were associated with diesel NO_X emitted in the 11 regions studied. That total will rise to 183,600 in 2040 unless more effective action is taken to control diesel NO_X emissions.
- Excess NO_X emissions specifically were linked to ~38,000 premature deaths worldwide in 2015.
- China suffers the largest health burden from total diesel NO_X emissions (31,397 premature deaths in 2015). The number of premature deaths from excess diesel NO_X emissions specifically is highest in Europe (11,400 in 2015).

POLICY CONTEXT

- Euro VI standards for HDVs in Europe, and the equivalents in Japan and the U.S., have succeeded in reducing real-world NO_X emissions in line with regulatory emission limits. Euro VI heavy-duty trucks and buses emit closer to certification limits (1–1.5 times emission limits) than those certified to Euro IV (1.3–2.2 times) and Euro V (1.9–3.9 times) standards.
- Implementing Euro VI-equivalent standards in regions that have yet to do so, including China, Brazil, Mexico, Russia, and Australia, would

Annual premature deaths attributable to on-road diesel vehicle NO_x emissions, 2015



**Counts only those premature deaths resulting from NO_x emissions produced in the other regions shown here.*

avert 90% of the premature deaths caused by excess diesel NO_x emissions today. Such standards would also drastically reduce health impacts from particulate matter emissions and near-term climate impacts from black carbon.[1]

» Emissions standards for LDVs in Europe have been less successful at controlling real-world NO_x emissions. Euro 4 and Euro 5 standards yielded no real-world reduction compared with Euro 3 standards. First-generation Euro 6 cars do in fact produce 50% lower real-world emissions than Euro 5 cars, and implementation of the real-driving emissions (RDE) test will help. But additional changes to the Euro 6 regulation in the EU to improve procedures for the RDE test and defeat device screening could further reduce real-world diesel NO_x emissions: from 4 times the regulatory limit to 1.2 times that limit, equivalent to a 70% emission reduction.[2]

» US Tier 3 regulations, which are being phased in by the U.S. and Canada from 2017 to 2025 (together with LEV III regulations in California) will, according to estimates, result in the lowest real-world NO_x emissions (0.01 grams per km) of any adopted regulation for LDVs.

» Adopting stringent "next-generation" standards that achieve a 90% reduction in NO_x compared to Euro 6/VI in the 11 regions studied could avert approximately 174,000 premature deaths from exposure to $PM_{2.5}$ and ground-level ozone in 2040—or about 2% of $PM_{2.5}$-related premature deaths and 7% of ozone-related deaths globally.

» Compared to current regulations, next-generation standards would reduce regional $PM_{2.5}$ and ozone mortality in 2040 by 26% in Mexico, 11% in Brazil, and 7% in the EU. In Mexico and Brazil, ~85% of those regional air-quality benefits could be achieved with Euro 6/VI standards. And in the EU, ~60% of the regional air-quality benefits are achievable by strengthening the RDE test.

METHODOLOGY

» Emission inventories were estimated for 11 major vehicle markets by combining NO_x emission factors with dates of implemented vehicle regulations;

1 Chambliss et al. The impact of vehicle and fuel standards on premature mortality and emissions. http://www.theicct.org/global-health-roadmap. Miller et al. Impacts of world class vehicle efficiency and emissions regulations in select G20 countries. http://www.theicct.org/impacts-of-world-class-vehicle-efficiency-and-emissions-regulations-in-G20-countries.

2 Miller, J. and Franco, V. Impact of improved regulation of real-world NO_x emissions from diesel passenger cars in the EU, 2015–2030. http://www.theicct.org/rde-passenger-car-nox-impacts-eu

extensive historical data on diesel vehicle activity, sales, and population; and vehicle activity projections through to 2040.

- Real-world NO_x emission factors were based on a review of >30 studies of emission factor modeling and in-use emissions testing; these studies cover thousands of vehicles and were conducted mainly in the U.S., Europe, China, and Japan.
- Diesel NOx emissions were projected for several scenarios, including a baseline, theoretical compliance with current standards, expanded adoption of Euro 6/VI emissions standards, improved compliance and enforcement of light-duty vehicle emissions standards (e.g. through strengthened RDE programs), and implementation of next-generation emissions standards.
- NOx emission impacts on PM2.5 and ozone concentrations were simulated using the GEOS-Chem chemical transport model combined with high-resolution satellite-derived exposure data.
- Health, crop yield, and climate impact models were used to estimate the damages from PM2.5 and ozone derived from diesel NOx emissions and benefits of future regulations.

FURTHER INFORMATION

Title: *Impacts and mitigation of excess diesel NO_x emissions in 11 major vehicle markets*

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Related information:
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