



REAL-WORLD EMISSIONS FROM MODERN DIESEL CARS

New analysis by the International Council on Clean Transportation documents the wide discrepancy that exists between official *certification* or *type-approval* emissions of nitrogen oxides (NO_x) from new diesel passenger cars and actual NO_x emissions from those vehicles during *real-world*, everyday operation.

This study comes on the heels of a recent report by the ICCT showing that a similar gap between official and real-world emissions of CO₂ from passenger cars in Europe widened to 38% in 2013—i.e., CO₂ emissions (and fuel consumption) during everyday operation were on average more than a third higher than the certification values obtained for vehicles via laboratory type-approval test.¹

CONTEXT

- » Nitrogen oxides (NO_x) can have serious adverse health effects. In particular, nitrogen dioxide is the main precursor to ground-level ozone, which causes significant respiratory problems that can lead to premature death.
- » Ambient NO_x concentrations in Europe regularly exceed current EU air quality standards (200 µg/m³ one-hour average for nitrogen dioxide, 40 µg/m³ one-year average), especially in urban areas.
- » Europe's transport sector, with its 50% passenger car diesel share, is the single largest contributor (about 40%) to total ambient NO_x concentrations.
- » Standards regulating NO_x and other exhaust emissions from passenger cars in the EU (the so-called *Euro standards*) have become more stringent over time. The permissible limit for emissions of nitrogen oxides (NO_x) from diesel cars declined from 500 milligrams per kilometer (mg/km) under Euro 3 (effective January 2000) to 80 mg/km under Euro 6 (effective September 2014). This means that NO_x emissions from new diesel cars in the EU should be about 85% lower than 15 years ago.
- » Passenger vehicles are certified as meeting the Euro standards on the basis of test results (termed *certification* or *type-approval* values) obtained under laboratory conditions. But previous studies have indicated that on-road performance does not dependably reflect these laboratory results.
- » A 2011 study² measuring pass-by emissions from more than 80,000 vehicles in the United Kingdom using *remote sensing* technology demonstrated that actual, on-road NO_x emissions from diesel cars decreased only slightly, from about 1,000 mg/km under Euro 3 to about 800 mg/km under Euro 5, even as the standards became significantly more stringent: 500 mg/km for Euro 3, tightening to 180 mg/km for Euro 5. That is, while the regulation mandated a 64% reduction in new-car NO_x emissions, actual overall NO_x emissions fell only by about 20%, and remained more than 4 times higher than the regulatory limits for new cars.

1 <http://www.theicct.org/laboratory-road-2014-update>

2 Carslaw et al. (2011). *Recent evidence concerning higher NO_x emissions from passenger cars and light duty vehicles*. *Journal of Atmospheric Environment* 45 (2011) 7053-7063.

THE ICCT STUDY

- » The ICCT study analyzed the on-road emissions performance of fifteen new diesel passenger cars, twelve certified to the Euro 6 standard and three to the US equivalent (Tier 2 Bin 5), using *portable emissions measurement systems* (PEMS), which provide a continuous stream of vehicle data signals including emission rates, velocity, acceleration, road gradient and exhaust temperature.
- » Emissions were measured over 97 trips, totaling more than 140 hours of operation and 6,400 kilometers driven.
- » The high temporal and spatial resolution of PEMS datasets permitted the analysis to link elevated NO_x mass emission rates to the driving conditions that caused them.
- » This is the first systematic analysis of the real-world performance of Euro 6 equivalent diesel passenger cars, and the most comprehensive profile available of the on-road behavior of these vehicles.

HIGHLIGHTS OF THE RESULTS

- » **On average, real-world NO_x emissions from the tested vehicles were about seven times higher than the limits set by the Euro 6 standard.** If applied to the entire new vehicle fleet, this would correspond to an on-road level of about 560 mg/km of NO_x (compared to the regulatory limit under Euro 6 of 80 mg/km). This is compelling evidence of a real-world NO_x compliance issue for recent-technology diesel passenger cars, for both the EU and US test vehicles.
- » **In most cases the exceedances found could not be attributed to “extreme” or “untypical” driving.** Instead, they were due to transient increases in engine load typical of everyday driving (e.g., going up a slight incline), or to normal regeneration events in the diesel exhaust aftertreatment systems.
- » **Performance differences among the vehicles tested indicate that the technologies for *real-world clean diesels* already exist.** Some of the tested vehicles had average emissions slightly above or below Euro 6 emission limits, suggesting that the technologies to achieve that level of performance are available, but that policies are not yet in place that can force manufacturers to use these technologies and calibrate them to effectively control emissions over the majority of in-use operating conditions, not just those covered by the test cycle.

The European Commission's *Real Driving Emissions* (RDE) working group is preparing for the introduction of on-road PEMS testing as part of the passenger-car type-approval process in the EU. **The results of this study strongly support this approach to improving type-approval testing for new passenger vehicles.**

According to the timeline established by the European Commission, a regulatory proposal to add PEMS testing to the vehicle certification process will be brought forward to the Member States by the end of 2014. This so-called Euro 6+ regulation could take effect in 2017.

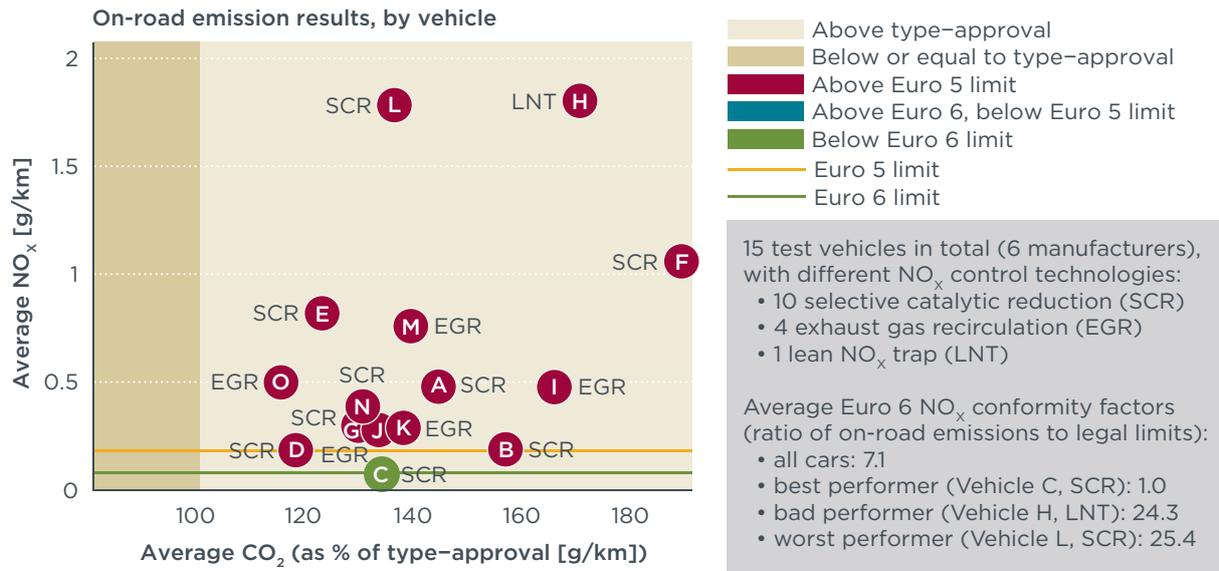


Figure 1. On-road emissions of nitrogen oxides (NO_x) from 15 Euro 6-equivalent diesel passenger cars, as measured by portable emissions measurement systems (PEMS)

Diesel cars: Nitrogen oxides (NO_x) emissions (in g/km)

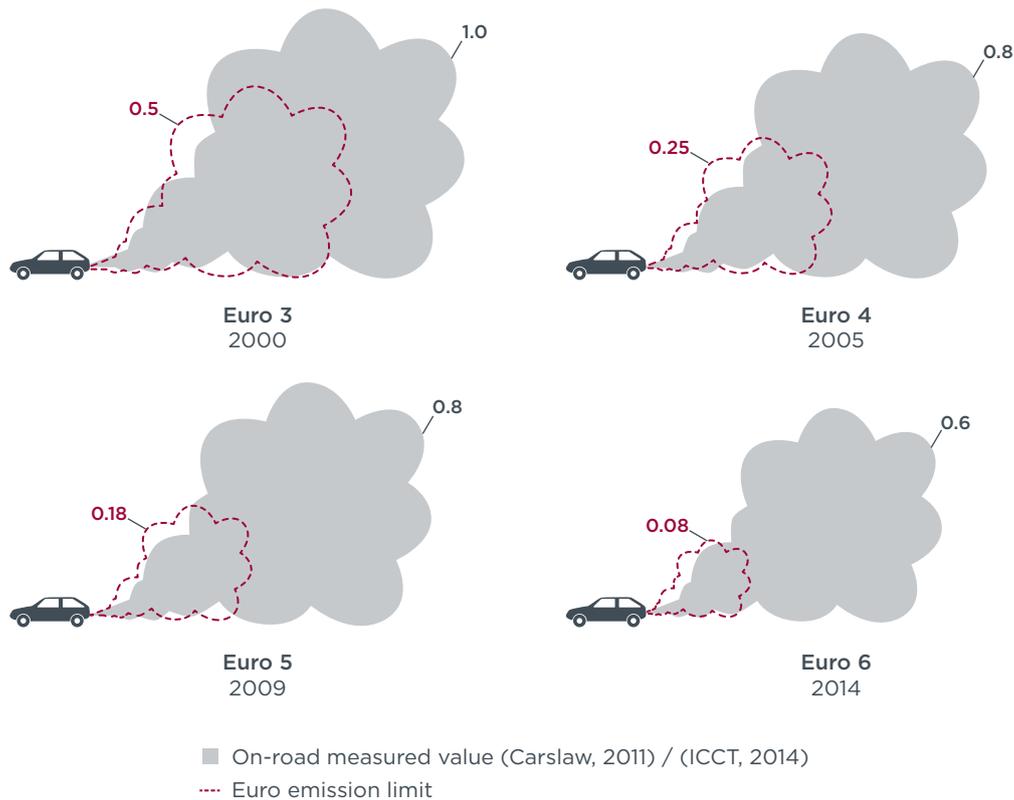


Figure 2. NO_x emission limits for diesel cars in the EU were lowered by 85% between 2000 (Euro 3) and 2014 (Euro 6). But over that period on-road emission levels decreased only about 40%.

FURTHER INFORMATION

Real-world exhaust emissions from modern diesel cars: A meta-analysis of PEMS data from EU (Euro 6) and US (Tier 2 Bin 5 / ULEV II) diesel passenger cars.

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DOWNLOAD <http://www.theicct.org/real-world-emissions-diesel-cars>

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The International Council on Clean Transportation is an independent nonprofit organization founded to provide first-rate, unbiased research and technical analysis to environmental regulators.

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