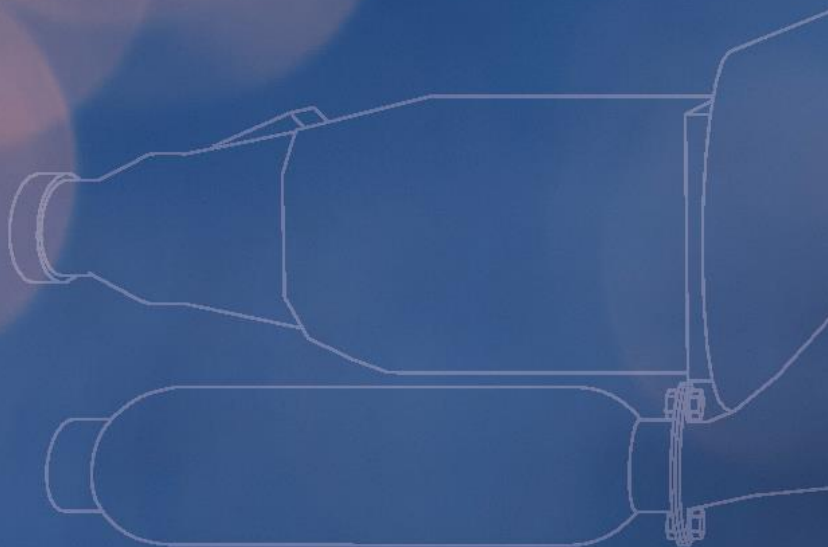


 **TRANSPORT &
ENVIRONMENT**

New diesels, new problems



Transport & Environment

Published: January 2020

© 2020 European Federation for Transport and Environment AISBL

Editeur responsable: William Todts, Executive Director

Further information

Anna Krajinska
Emissions Engineer
Transport & Environment

anna.krajinska@transportenvironment.org

Mobile: +447761536337

Square de Meeûs, 18 – 2nd floor | 1050 Brussels, Belgium

www.transportenvironment.org | [@transenv](https://twitter.com/transenv) | fb: Transport & Environment

Acknowledgements

This report was prepared by Transport & Environment based largely on data obtained from the testing programme commissioned by Transport & Environment and undertaken by Ricardo, UK in July/August 2019. Analysis was undertaken by Anna Krajinska. The report was written by Anna Krajinska and Jens Müller with input from Julia Poliscanova, Florent Grelier and Greg Archer. The executive summary was written by Jack Hunter, with input from the authors. The Editor-in-Chief is William Todts.

The Authors would like to express their gratitude to Jon Andersson from Ricardo UK, Felipe Rodriguez and Yoann Bernard from ICCT as well as Axel Friedrich for their critical reviews.

Executive summary

Diesel car sales are in free fall. The Dieselgate scandal caused a collapse in customer confidence exacerbated by increasing restrictions on diesel car use in cities. In an attempt to ensure past investments in diesel technology can provide a return, the car industry claim new diesel cars are now "clean". This report demonstrates that the strictest EU car pollution controls are failing to stop large amounts of dangerous particle pollution from diesel cars. It presents the results of independent lab tests which reveal that even the latest diesel models are a serious health hazard.

This is mainly because the best available pollution control technology, diesel particle filters (DPFs), has to be cleaned ('regenerated') regularly which causes diesel vehicles to 'spill out' large amounts of pollution roughly every 480km¹. Tests show these spikes can occur in urban areas and last as long as 15km, during which emissions of **dangerous particle pollution surge to over 1,000 times their normal rate**. This flaw was written out of EU emissions tests: when the extreme particle emission peaks occur, emission limits are ignored and tests reinitiated although more stringent regulation was discussed as early as 2007.² T&E estimates that **more than 45 million cars** carry the technology in Europe, producing pollution spikes which occur once a fortnight on average. The findings disprove automotive industry claims that the newest Euro 6d-temp diesel models are clean,^{3,4,5,6} which should be acknowledged when designing clean air policies, and especially the future post-Euro 6 standard.

Particle pollution is increasingly seen as 'pollution enemy number one'. Ambient particulate matter is ranked as the 6th highest risk factor for total deaths globally⁷. Particle pollution affects more people than any other pollutant, according to the World Health Organisation (WHO)⁸, with 77% of the inhabitants of European cities exposed to levels above WHO guidelines.⁹ Progress to reduce the pollution problem across Europe has come to a near complete stop, according to the latest data from the European Environment Agency (EEA).¹⁰ It is also the type of air pollution that is 'most closely associated with increased cancer incidence, especially **lung cancer**'.¹¹ Chronic exposure to particulate matter is linked to **cardiovascular and respiratory diseases**.¹² In particular, the number of particles in the air is increasingly seen as a strong determinant of adverse health effects. Exposure to high numbers of particles **can even have immediate negative effects on the heart**¹³. **Ultrafine particles** (smaller than the size of a typical virus) could be the **most dangerous form**, as they can penetrate deep into the body¹⁴ and have just been linked to brain cancer.¹⁵ Ultrafine particles are emitted in large amounts by internal combustion engines.

Particle pollution was considered solved after **DPFs** became a mandatory part of the exhaust systems for all new diesel cars in 2013.¹⁶ However, in order to work they **must be cleared periodically** in an automatic on-road process known as regeneration. This process causes pollution spikes, particularly of the number of particles, and is poorly regulated under the latest Euro 6 regulations although more stringent regulation of regenerations was discussed as early as 2007.¹⁷ As emission limits don't have to be met on regenerating tests, the current type-approval method of taking regeneration into account involves dividing the large spike in emissions by several hundred kilometres, effectively diluting the large pollution peaks. However, even this does not apply to the number of particles emitted¹⁸.

To understand how polluting the latest diesel vehicles are, Transport & Environment asked a **world leading and independent laboratory (Ricardo)** to test **two of Europe's most popular diesel cars** approved under the latest Euro 6d-temp standard that carmakers argue delivers 'clean diesel'. The vehicles tested are a **Nissan Qashqai** and an **Opel/Vauxhall Astra**. The Nissan was the 2nd best selling car in the class C SUV segment, and the Opel/Vauxhall was the 4th best selling in

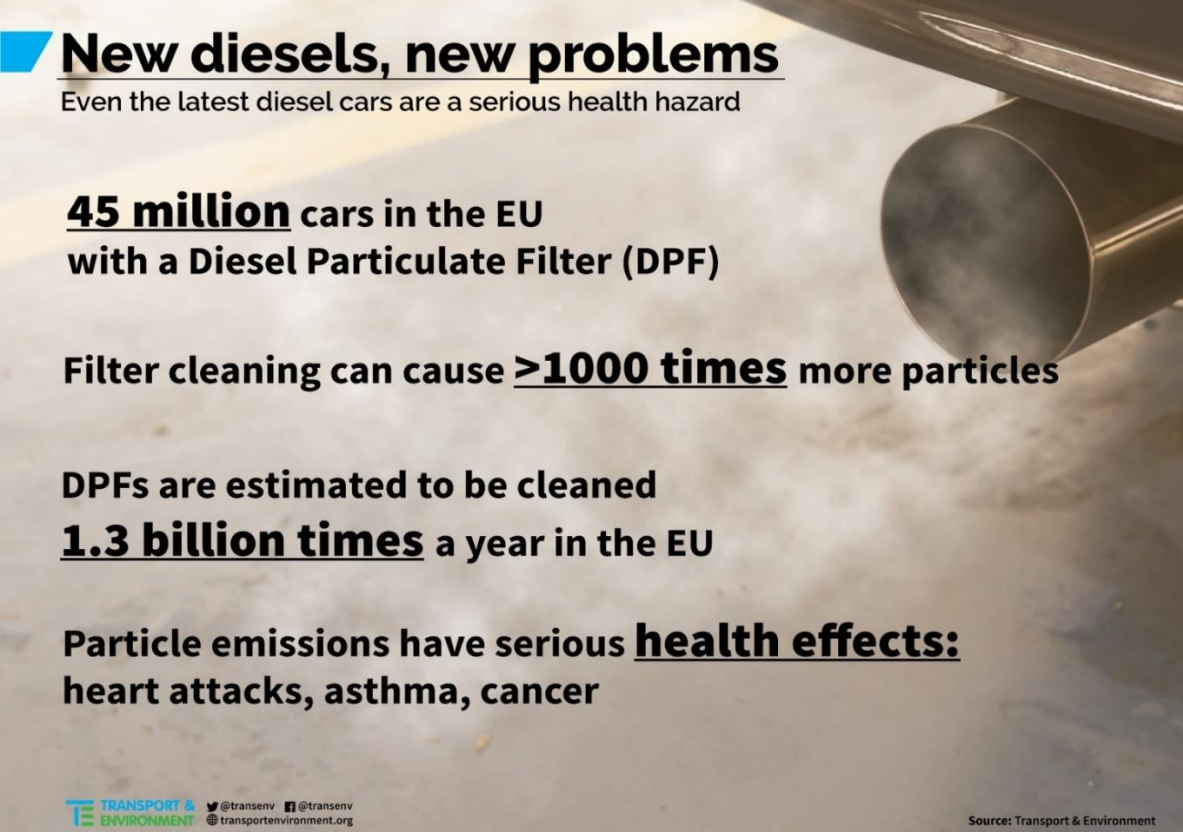
the C segment in Europe in 2018¹⁹. The laboratory tests simulated real-world driving and measured a range of pollutants including those **which are currently unregulated** and difficult to measure on the road, such as ultrafine particles, volatile and semi-volatile particles and ammonia. The results were compared to official type-approval data where available.

The main findings are:

- **On laboratory test cycles based on the EU's new 'Real Driving Emissions' tests, more than 1,000 times more particles were emitted during DPF regeneration.** The cars would have exceeded the legal limits for the number of particles emitted if these emissions were not ignored by the EU emissions standard. All tests during which a regeneration occurred witnessed a steep increase in the number of regulated particles compared to tests in which a regeneration did not occur. The particle number emissions limit of $6 \times 10^{11}/\text{km}$ for solid particles larger than 23nm was exceeded by between 32-115% on all tests where a full regeneration occurred.²⁰ But current regulations do not apply the legal limit to regenerating tests.
- **However, both models respected legal limits for gaseous pollutants and particulate matter** (nitrogen oxides, carbon monoxide, total hydrocarbons, total hydrocarbons and nitrogen oxides, particulate matter). This is positive although it comes a full 12 years after the definition of these limits in EU law. However, during regeneration, emissions of all of these pollutants increased significantly.
- The regeneration blind spot in regulations mean that between **60-99% of emissions of all regulated particles is ignored for the two test cars.**
- **A large proportion of particles are not even measured today but constitute a serious health risk.** Currently only solid particles which are larger than 23nm in diameter are regulated. However, when solid particles as small as 10nm were measured the total PN emissions increased by between 11-184% compared to when only regulatory particles were measured. This means that large amounts of particle pollution are completely neglected from a regulatory point of view, despite potentially being the most harmful to human health.
- **Regeneration events for the Astra occurred almost twice as often as during type-approval.** The distance between two DPF regenerations was 419km for the Astra; this is almost half of the distance determined at type-approval. A similar distance of 423km was determined for the Qashqai.
- **Approximately 45 million diesel cars cause a total of 1.3 billion regenerations per year in the EU.** T&E estimates that there are approximately 45 million diesel cars fitted with a DPF in the EU²¹. Given that the average EU diesel mileage is estimated to be between 13,600 to 23,200 km²², a DPF regeneration is estimated to occur, on average, every other week for most diesel cars²³, or 1.3 billion times each year in the EU.²⁴
- **DPF regeneration can occur in all driving conditions, including in and around urban areas.** While regeneration is more likely to occur during higher speed driving, Emissions Analytics reported as early as 2013 that DPF regeneration occurs during urban driving also. This is necessary to prevent filter clogging, especially when cars are driven exclusively in urban areas.²⁵ Moreover, during the tests particle number emissions continued to be higher during urban driving for 30 minutes after the end of regeneration.

These results suggest that DPFs are not the definitive solution to the diesel particle problem many had suggested, and instead can cause substantial peaks of air pollution during real-world driving conditions.

For public health, **what matters is the actual emissions from the vehicle**, not only whether an emissions limit measured using a specific test is met. The results of this test programme suggest that the **newest Euro 6d-temp diesel cars respect legal limits within the boundary conditions of regulatory tests** but that there are **still serious gaps** in the new regulatory tests that fail to capture all driving conditions and **spikes in particle number emissions**. There are also a **number of harmful pollutants** that are **entirely unregulated**. That means it is incorrect to say that diesel is now 'clean'.



New diesels, new problems

Even the latest diesel cars are a serious health hazard

45 million cars in the EU
with a Diesel Particulate Filter (DPF)

Filter cleaning can cause **>1000 times** more particles

DPFs are estimated to be cleaned
1.3 billion times a year in the EU

Particle emissions have serious **health effects:**
heart attacks, asthma, cancer

TRANSPORT & ENVIRONMENT | @transenv | @transenv | transportenvironment.org

Source: Transport & Environment

These findings should prompt regulators to:

- Acknowledge that even the latest **Euro 6d(-temp) diesel cars** are highly polluting and design clean air policies accordingly, including access rights to Zero/Low-Emission Zones, purchase incentives and similar policies.
- **Emission limits need to set a pathway towards zero pollutant emissions and must be reduced downwards as soon as possible.** T&E recommends that the European Commission be ambitious and aim for the post-Euro-6 emission limits to be the most stringent emissions limits globally.
- Design the future post-Euro 6 standard in a way that requires emission limits for all pollutants, including particle number, to be met under all driving conditions, and also during DPF regeneration. Currently unregulated pollutants, such as ammonia and ultrafine particles smaller than 23 nanometers, must also be included.
- The new Commission should use the new EU type approval framework to **monitor on-road compliance** and take corrective measures where necessary. This will require allocating significant additional resources to agencies and services dealing with emissions testing as well as the creation of an EU-level agency or authority to oversee tests, enforcement and possible fines and recalls.

Endnotes Executive Summary

- ¹ AA, [‘DPFs can be problematic’](#) accessed 16/10/2019
- ² Jon Andersson, Barouch Giechaskiel, Rafael Muñoz-Bueno, Emma Sandbach, Panagiota Dilara, ‘Particle Measurement Programme (PMP) Light-duty Inter-laboratory correlation exercise final report’ June 2007
- ³ CNN Business, [Ivana Kottasová, ‘Volkswagen nearly killed diesel cars. Now it says they’re back’, 30th of January 2019](#)
- ⁴ [www.peugeot.co.uk/bluehdi](#) accessed 18/11/2019
- ⁵ [https://www.spokanemercedes.com/mercedes-benz-clean-diesel/](#) accessed 18/11/2019
- ⁶ [https://www.vauxhall.co.uk/fleet/range/ecotec/diesel-engines.html](#) accessed 18/11/2019
- ⁷ Health Effects Institute, [‘State of Global Air’, Boston, 2018](#)
- ⁸ WHO, [Air Pollution - Key Facts, 2 May 2018](#)
- ⁹ European Environment Agency: [Air Quality in Europe - 2019 Report, October 2019](#)
- ¹⁰ European Environment Agency: [Air Quality in Europe - 2019 Report, October 2019](#)
- ¹¹ WHO, [Air Pollution - Key Facts, 2 May 2018](#)
- ¹² WHO, [Air Pollution - Key Facts, 2 May 2018](#)
- ¹³ Peters, A., Hampel, R., Cyrys, J. et al, [‘Elevated particle number concentrations induce immediate changes in heart rate variability: a panel study in individuals with impaired glucose metabolism or diabetes’, Particle and Fibre Toxicology, 2015](#)
- ¹⁴ Health Effects Institute, [‘Understanding the Health Effects of Ambient Ultrafine Particles, 2013](#)
- ¹⁵ Weichenthal et al., [‘Within-City Spatial Variations in Ambient Ultrafine Particle Concentrations and Incident Brain Tumors in Adults’, Epidemiology, 2019](#)
- ¹⁶ [https://www.acea.be/industry-topics/tag/category/air-quality](#) accessed 11/11/2019
- ¹⁷ Jon Andersson, Barouch Giechaskiel, Rafael Muñoz-Bueno, Emma Sandbach, Panagiota Dilara, [‘Particle Measurement Programme \(PMP\) Light-duty Inter-laboratory correlation exercise final report’, 2007](#)
- ¹⁸ Unless a regeneration occurs on two consecutive tests. In this case emission limits apply to the second test only.
- ¹⁹ JATO Dynamics, [Data for Automotive News Europe, Volume 10, Issue 2, February 2019](#)
- ²⁰ The Conformity factor (CF) for PN was not taken into account during this testing programme as the CF exists to account for any measurement error in the portable emissions measurement system (PEMS) compared to regulatory laboratory equipment. Regulatory lab-based equipment was used to measure emissions during this testing programme, therefore a CF shouldn't be applicable.
- ²¹ Estimated number of Euro 5b and Euro 6 diesel cars sold between 2011 and the first half of 2019 in the EU based on combined data from ICCT's Pocketbook, Element Energy and ACEA, taking into account that some older models may have been scrapped. Some manufacturers implemented DPFs on diesel vehicles before the Euro 5b legislation came into force, however these were not included in the total DPF fleet figure due to the difficulty associated with obtaining data for which vehicles were and were not fitted with a DPF and detailed enough EU-wide registration data per model.
- ²² Belgium data: Belgian Federal Ministry of Mobility, England: UK Department of Transport, France: French Ministry of Environment, Germany: KBA, Italy: Atmospheric Pollution Research, The Netherlands: [BOVAG-RAI](#)
- ²³ Based on a regeneration distance of 480 km from the [British Motoring Association](#)
- ²⁴ Based on 28 regenerations per year
- ²⁵ The Telegraph, [David Motton, ‘Emission tests ‘substantially underestimate’ pollution pumped out by diesels’ 29th May 2014](#)