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# The EU's response to the "dieselgate" scandal

**Briefing Paper**  
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## Executive summary

**I** Poor air quality is a major concern for EU citizens and policymakers alike. It is linked to hundreds of thousands of premature deaths and generates significant costs to the economy. Road transport is a major contribution to air pollution through vehicle emissions. The EU first legislated to reduce vehicle emissions in 1970, and introduced the Euro emission standards in the early 1990's.

**II** The question of discrepancies between laboratory and vehicle emissions on the road was brought into sharp focus with the discovery of the manipulation of vehicle emissions systems by the Volkswagen group, the so-called "dieselgate" scandal, which came to light in 2015. The manipulation sought to produce significantly lower emissions during official tests than during usual driving.

**III** The problems raised by "dieselgate" stimulated the EU to accelerate initiatives already underway or to take new actions. Subsequently approved EU legislation aims to prevent the re-occurrence of such problems. The European Parliament set up an enquiry into emissions measurements to examine the issue.

**IV** This briefing paper sets out the actions taken, at the level of the European Union and Member States, and describes changes made to the system for measuring vehicle emissions after September 2015. The paper does not seek to assess whether the actions taken and proposed have solved the problem.

**V** The emission scandal has accelerated many legislative changes to the EU system of vehicle emissions checks:

- The Commission is now empowered to review the work of national type-approval authorities, test vehicles, withdraw or suspend type-approvals, and impose penalties.
- Testing vehicles in circulation is now mandatory in Member States, either by means of in-service conformity checks or in the framework of market surveillance activities.
- A new laboratory test, the Worldwide Harmonized Light Vehicle Test Procedure (WLTP), has been introduced to tackle the large gap between CO<sub>2</sub> emission levels as measured in the laboratory and on the road.

- A Real-Driving Emissions test (RDE) has been introduced to measure NO<sub>x</sub> emissions.
- Interested third parties may now conduct emission tests.

**VI** The Commission plans to improve the current situation in which data on vehicle emissions testing is limited, fragmented, and not easy to access. Despite the recent legislative actions:

- It may take many years to improve city air quality, given the large number of highly-polluting cars already on the roads.
- While over 10 million vehicles of different brands have been recalled, the limited data available indicates that the impact on NO<sub>x</sub> emissions has been small.
- While the RDE test introduction has led to a significant reduction of NO<sub>x</sub> emissions of diesel cars, the impact could have been even greater if the initially proposed temporary NO<sub>x</sub> limit of 128 mg/km was adopted, instead of 168 mg/km.

**VII** For the legislative changes introduced, it will take some time for improvements to become apparent. The following challenges may impact the effective implementation of these changes:

- The effectiveness of the market surveillance checks will depend on the set-up and implementation by the Member States.
- While the scope for car optimization has been narrowed and the Commission's recent legislation provides for better monitoring of the gap between laboratory figures and CO<sub>2</sub> emissions on the road, manufacturers may find new flexibilities in the WLTP laboratory test to lower their CO<sub>2</sub> emissions.
- There is a risk that manufacturers optimise vehicles for the RDE test and that NO<sub>x</sub> emissions outside the RDE boundaries remain high. Testing cars in circulation beyond RDE parameters may address this risk.
- The newly introduced independent third-party testing may be limited due to the high costs of performing WLTP and RDE emissions tests.



# Introduction

## Air pollution and greenhouse gases

**01** According to the World Health Organisation (WHO), air pollution is the biggest environmental risk to health in Europe<sup>1</sup>. The European Environment Agency (EEA) estimates that more than 1 000 premature deaths occur each day due to air pollution. EU road transport is a significant source of air pollution. In 2015, it was responsible for 39 % of atmospheric nitrogen oxides (NO<sub>x</sub>) and 11 % of particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) emissions<sup>2</sup>. The European Court of Auditors has recently concluded that the air quality needs to be more effectively addressed in the EU<sup>3</sup>.

### Picture 1 – Cars on the road in Brussels



Source: European Parliament.

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<sup>1</sup> WHO, “Ambient Air Pollution: A global assessment of exposure and burden of disease”, 2016, p. 15.

<sup>2</sup> EEA, “Air quality in Europe — 2018 report”, 2018, pp. 8, 24 and 64.

<sup>3</sup> ECA, Special Report No 23/2018 “Air pollution: Our health still insufficiently protected”.

**02** Greenhouse gases warm the atmosphere and contribute to climate change. Carbon dioxide (CO<sub>2</sub>) is the greenhouse gas emitted in the greatest quantity, accounting for 80 % of the total<sup>4</sup>. According to the EEA, greenhouse gas emissions from road transport rose by 22 % between 1990 and 2016 and were responsible for about 20 % of the EU's total greenhouse gas emissions in 2016<sup>5</sup>.

## Measuring vehicle emissions in the EU

**03** Before a new model of vehicle can be sold in the EU, the manufacturer must submit it to the "type-approval" process<sup>6</sup>. This process certifies that a vehicle prototype meets all EU safety, environmental and production requirements. Manufacturers usually collect separate certificates for individual components and systems before applying for type-approval for the whole vehicle. Emissions tests can be carried out by a different type-approval authority than that which issues the type-approval for the whole vehicle.

**04** Type-approval authorities (TAAs) are the national authorities in charge of granting type-approval to new vehicle models. These authorities give accreditation to technical services (TSs), which are the bodies that actually test vehicles. The technical services may carry out tests at their own facilities (if they have them) or on car manufacturers' premises. This type-approval process is performed by national authorities and is valid across the EU.

**05** Market surveillance authorities (MSAs) are national bodies responsible for checking whether products on the market in their country comply with EU standards. They should use all available information, including results of their own product tests, in order to identify products, which endanger health, safety or the environment. Market surveillance authorities can impose penalties and, ultimately, ban products from sale in their country.

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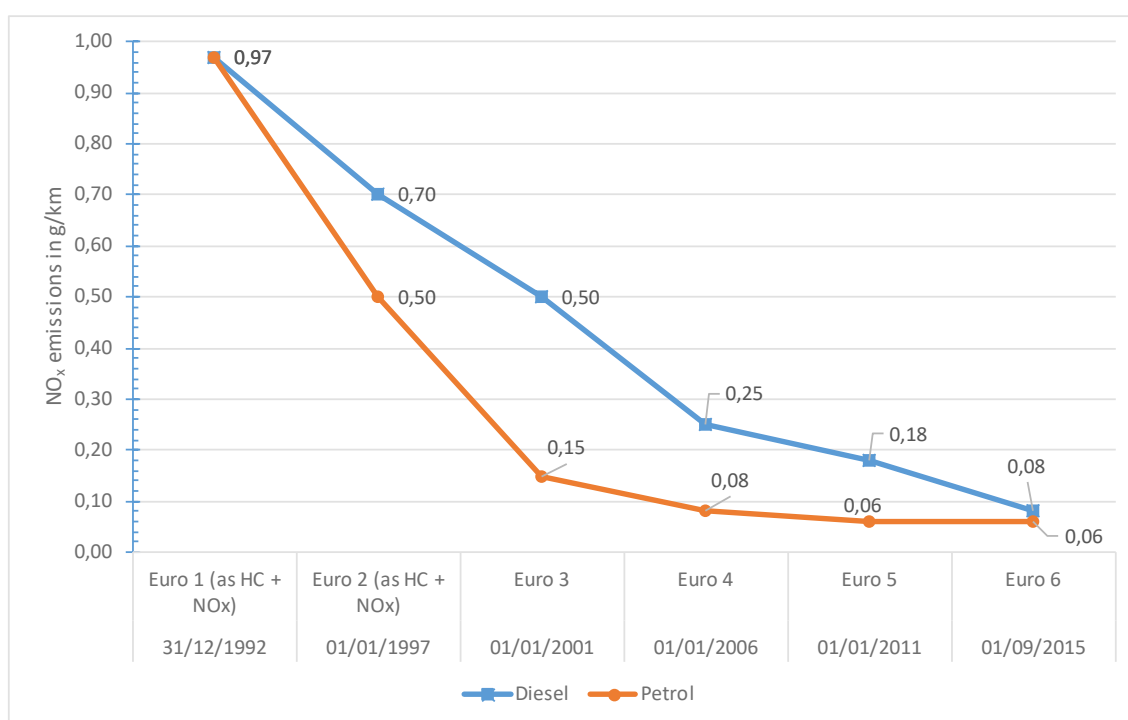
<sup>4</sup> ECA, "Landscape review: EU action on energy and climate change", 2017, p. 10.

<sup>5</sup> EEA, [Transport and Environment Reporting Mechanism \(TERM02\) and Progress of EU transport sector towards its environment and climate objectives](#), November 2018.

<sup>6</sup> A new car model has to comply with over 70 technical, safety and environmental requirements (see Annex II of Regulation (EU) 2018/858 of the European Parliament and of the Council (OJ L 151, 14.6.2018, p. 1)).

**06** For passenger cars, the EU regulates the following air pollutants by setting legal emissions limits (Euro limits): carbon monoxide (CO), total hydrocarbons (THC), non-methane hydrocarbons (NMHC) and nitrogen oxides (NO<sub>x</sub>). It also regulates the prevalence of airborne particles, measured in terms of particulate matter (PM) and particle number (PN). New vehicle models are tested during the type-approval procedure to ensure their emissions do not exceed these legal limits. **Figure 1** shows the evolution of the NO<sub>x</sub> legal limit for diesel and petrol cars from 1992.

**Figure 1 – Euro standards for NO<sub>x</sub> emissions, with dates when they became mandatory for newly registered cars**



Source: ECA, based on EU legislation.

**07** Nitrogen oxides (NO<sub>x</sub>) are produced when fuel is combusted in an engine in the presence of air. NO<sub>x</sub> is a mixture of nitric oxide (NO), which is not harmful, and nitrogen dioxide (NO<sub>2</sub>) which causes a range of environmental and health problems. The proportion of harmful NO<sub>2</sub> in the NO<sub>x</sub> emissions of a diesel engine is far higher than that of an equivalent petrol engine<sup>7</sup>.

**08** Over the years, manufacturers have improved engine combustion and developed additional exhaust after-treatment technologies to meet emissions standards. These

<sup>7</sup> EEA, "Explaining road transport emissions", 2016, p. 11.



include particulate filters for diesel engines<sup>8</sup> and selective catalytic reductions, which use urea to reduce NO<sub>x</sub> emissions.

**09** Diesel fuel contains more energy per litre than petrol. Diesel engines are also more efficient than petrol engines in terms of consumption. These two advantages have led many European countries to provide incentives to support the use of diesel engines<sup>9</sup>. While air pollutants can be significantly reduced if a suitable exhaust after-treatment technology is used, CO<sub>2</sub> emissions are directly proportionate to diesel or petrol consumption.

**10** The EU introduced mandatory CO<sub>2</sub> emission standards for new passenger cars in 2009<sup>10</sup>. These standards do not apply to individual models, but rather to a carmaker's range of models as a whole – “fleet-average emissions”. The first target for fleet-average CO<sub>2</sub> emissions of new cars sold in the EU was set at 130 g/km for 2015, a second target of 95 g/km was set for 2020-21<sup>11</sup>. Each vehicle manufacturer's target is adjusted according to the average mass of the models in its range. **Figure 2** shows the 2017 fleet-average emissions of nine major manufacturing groups.

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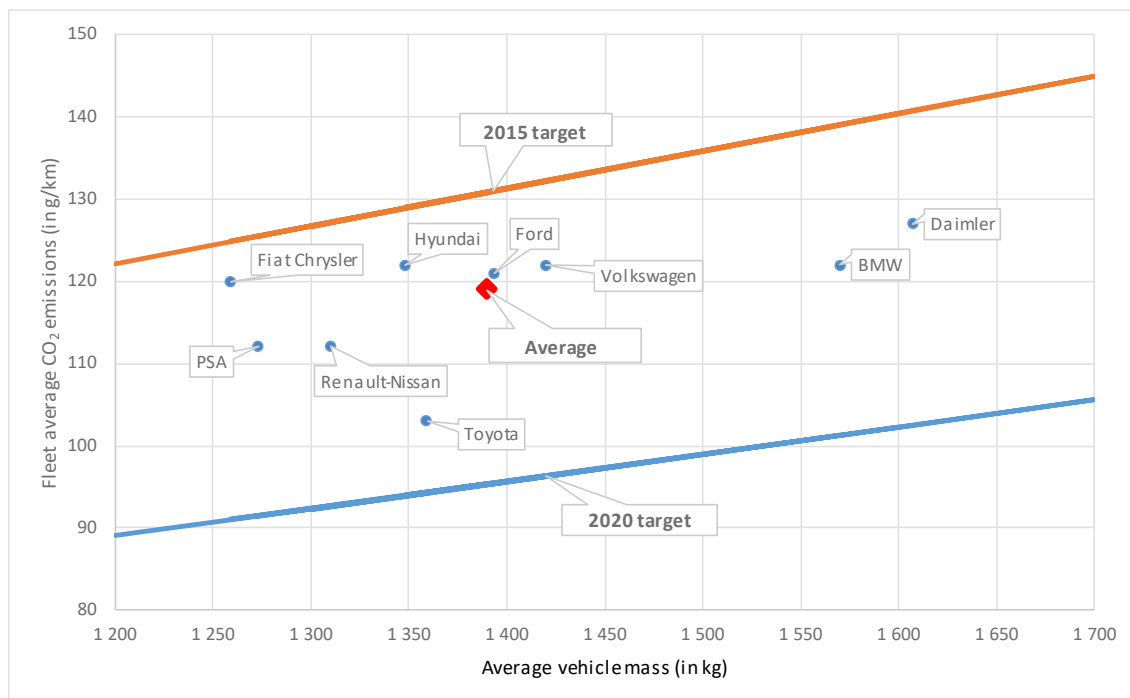
<sup>8</sup> Diesel Particulate Filter (DPF) started being installed in some Euro 5 and became compulsory for Euro 6 diesel vehicles. It reduces the total particulate matter mass emissions by approximately 98 % (Z. Gerald Liu, Devin R. Berg and James J. Schauer, 'Detailed Effects of a Diesel Particulate Filter on the Reduction of Chemical Species Emissions', 2008, p. 8).

<sup>9</sup> EEA, “[Explaining road transport emissions](#)”, 2016, p. 50.

<sup>10</sup> Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO<sub>2</sub> emissions from light-duty vehicles (OJ L 140, 5.6.2009, p. 1).

<sup>11</sup> Regulation (EU) No 333/2014 of the European Parliament and of the Council of 11 March 2014 amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO<sub>2</sub> emissions from new passenger cars (OJ L 103, 5.4.2014, p. 15).

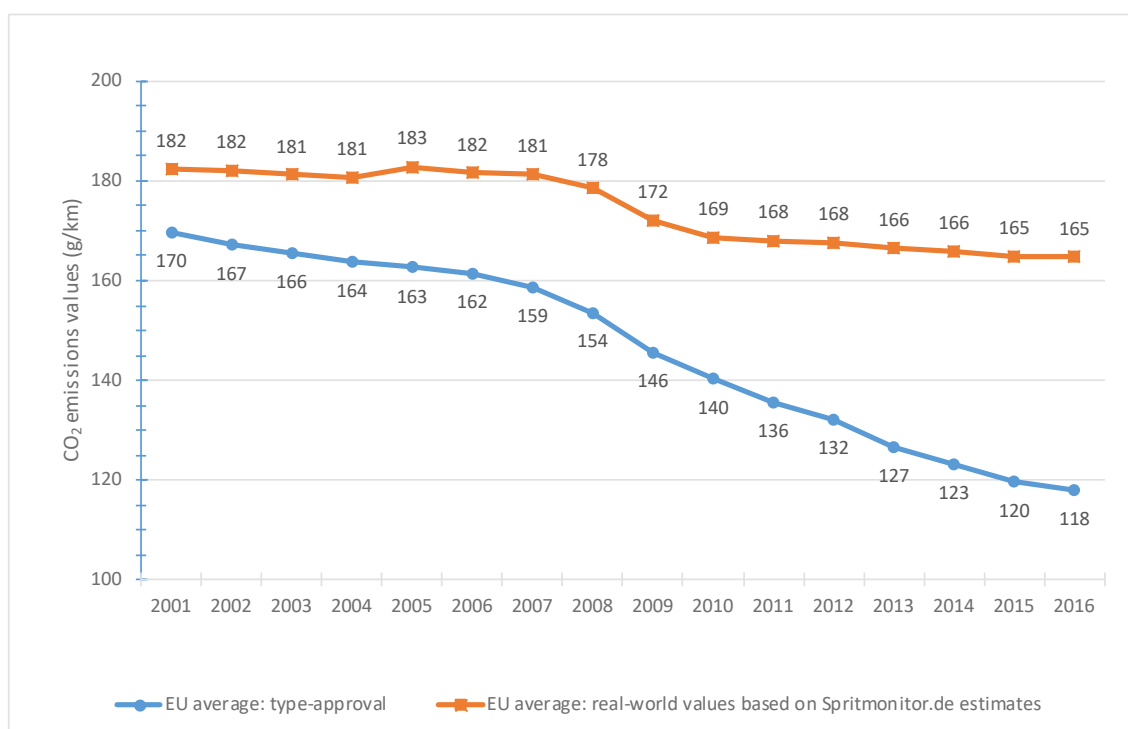
**Figure 2 – Average fleet CO<sub>2</sub> emissions per manufacturing group in 2017**



Source: The International Council on Clean Transportation (ICCT), "CO<sub>2</sub> emissions from new passenger cars in the EU: Car manufacturers' performance in 2017", 11.7.2018, p. 3.

**11** **Figure 3** illustrates the divergence between type-approval CO<sub>2</sub> emissions measured in laboratory and those measured on the road. The ICCT has estimated that while the type-approval CO<sub>2</sub> values were successfully reduced by almost 31 % from 2001 to 2016, in reality there was only a 9 % reduction in terms of emissions on the road.

**Figure 3 – Average CO<sub>2</sub> emissions on the road versus type-approval emissions figures of new passenger cars in Europe**



Source: ICCT, From laboratory to road: a 2017 update of official and real world fuel consumption and CO<sub>2</sub> values for passenger cars in Europe, p. 51<sup>12</sup>.

**12** The Parliament and the Council are in the process of adopting legislation governing post-2020 CO<sub>2</sub> emissions targets for cars and vans. The Commission has proposed a 30 % reduction of the average EU fleet CO<sub>2</sub> emissions of light-duty vehicles (passenger cars and light commercial vehicles/vans) between 2021 and 2030<sup>13</sup>. The Parliament voted to increase this reduction to 40 %<sup>14</sup>. The new EU fleet-wide targets proposed for 2025 and 2030 are set as percentage reductions applied to a starting point representative of an EU fleet-wide emission target in 2021 based on results from laboratory emissions testing.

<sup>12</sup> Based on Spritmonitor.de estimates and type-approval data from the European Environment Agency (EEA, 2016).

<sup>13</sup> Proposal for post-2020 CO<sub>2</sub> targets for cars and vans - COM(2017) 676 final.

<sup>14</sup> Text adopted by the European Parliament - 2017/0293(COD).

## The “dieseldgate” scandal

**13** The Volkswagen emissions scandal, widely known as “dieseldgate”, broke in September 2015, when the United States Environmental Protection Agency (EPA) formally accused Volkswagen of violating US emissions standards<sup>15</sup>. Volkswagen subsequently admitted that a “defeat device” had been installed in 11 million diesel-fuelled vehicles worldwide<sup>16</sup>. These devices were able to detect when a vehicle was being tested in a laboratory and activate its emissions control system for compliance with NO<sub>x</sub> emissions standards. However, outside a laboratory setting, the device would switch off the emissions control system, and the vehicle would produce emissions well above the US legal NO<sub>x</sub> limit.

**14** Even before this development, it was widely known that a vehicle’s NO<sub>x</sub> emissions on the road exceeded those measured in a laboratory (see **Figure 4**). The scandal revealed that one of the reasons for this difference was the use of defeat devices<sup>17</sup>.

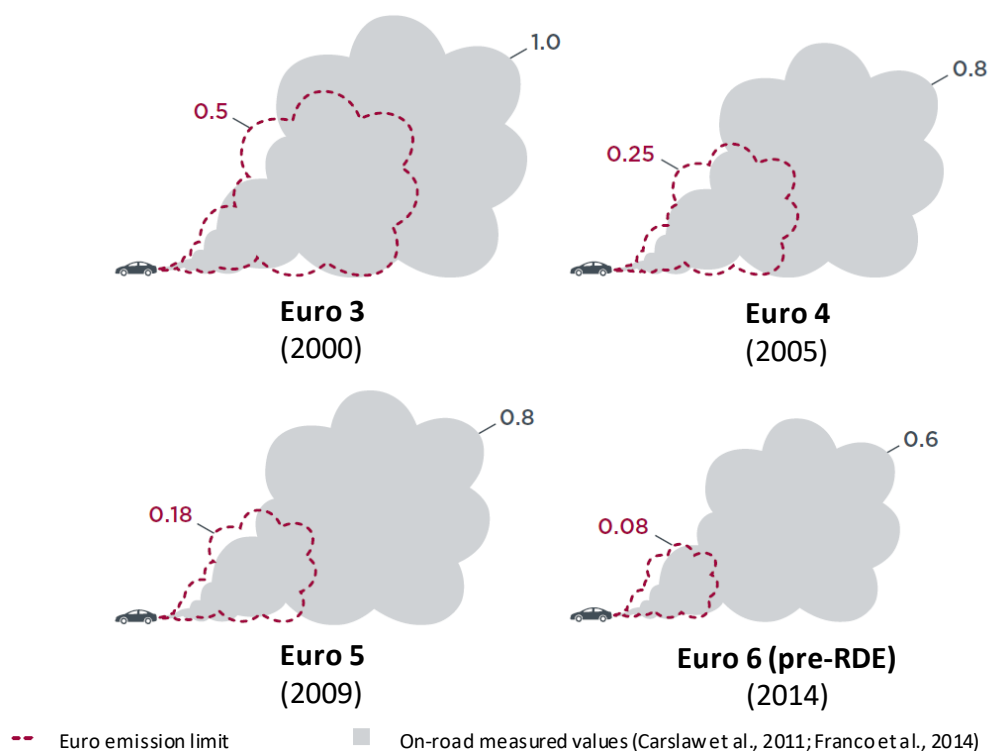
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<sup>15</sup> EPA website “Learn About Volkswagen Violations”.

<sup>16</sup> Statement by Volkswagen, 22.9.2015.

<sup>17</sup> Transport & Environment, *Dieseldgate: Who? What? How?*, 2016, p. 7

**Figure 4 – Evolution of NO<sub>x</sub> emissions on the road (in g/km) from European diesel passenger cars and of regulated emission limits.**

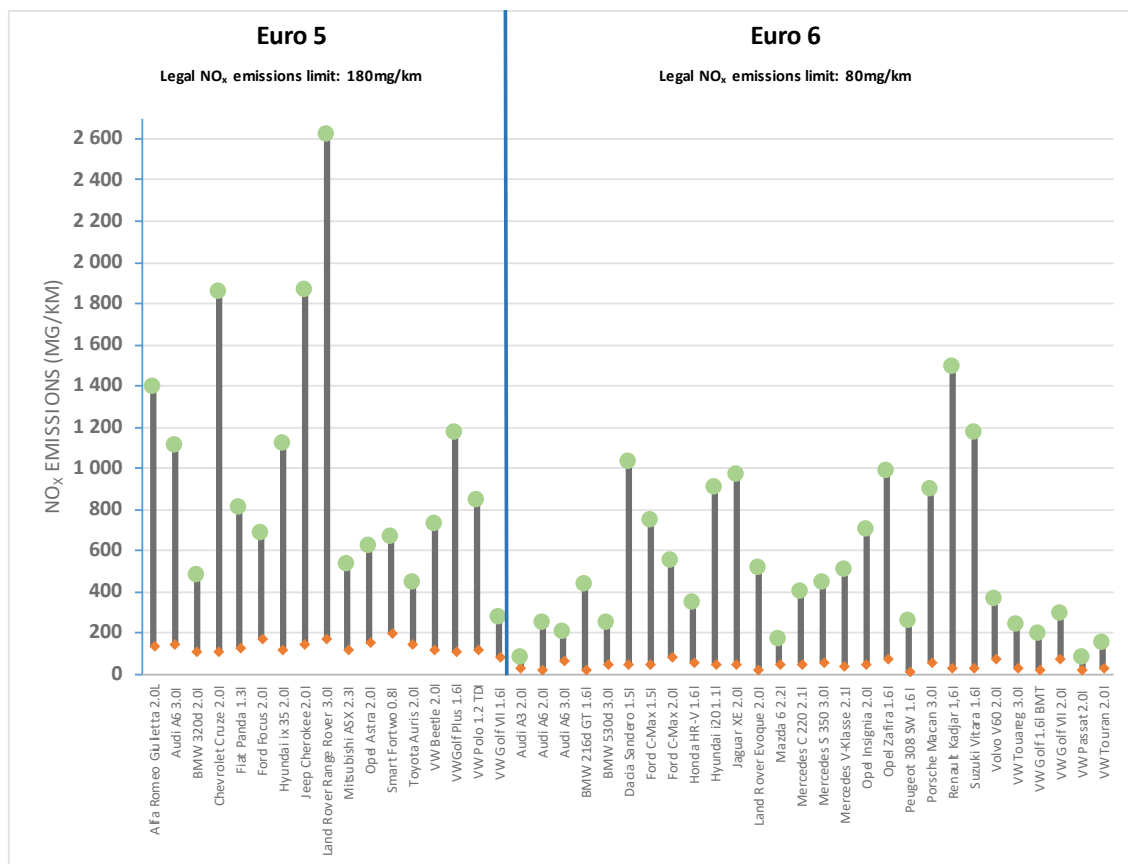


Source: ICCT, Impact of improved regulation of real world NO<sub>x</sub> emissions from diesel passenger cars in the EU, 2015-2030, p. 1.

**15** As **Figure 5** shows, divergences between type-approved emissions and those on the road are a significant problem for most diesel cars. We used data on diesel car models from the German government based on laboratory and on-road tests taken in 2015-16. The chart shows the highest and the lowest NO<sub>x</sub> emission measured for each car model tested. It does not show the full range of results.



**Figure 5 – Highest and lowest NO<sub>x</sub> emissions figures registered in laboratory and on-road vehicle emissions testing of selected diesel car models by the German transport ministry**



Source: ECA, based on data from the German government consolidated by the ICCT<sup>18</sup>. Figures and lines may have been approximated and are illustrative only.

## Objective and approach of this briefing paper

**16** This briefing paper sets out the actions taken, at the level of the EU and Member States, and describes changes made to the system for measuring vehicle emissions after September 2015. It does not seek to assess whether the actions taken and proposed have solved the problem. We focus on the measurement of NO<sub>x</sub> emissions from diesel cars and also consider the measurement of CO<sub>2</sub> emissions.

**17** The objective of this briefing paper is to inform the public about the EU's response to the dieselgate scandal. As the legislative changes made will not have a

<sup>18</sup> The original test results have been published online by the German Federal Ministry of Transport, Building and Urban Development (BMVI). The ICCT has published a brief analysis of the results.

measurable impact in the near future, we have carried out a review rather than an audit.

**18** The information presented in this briefing paper has been obtained from:

- reviews of external reports, studies, papers and articles;
- reviews of EU legislation proposed and adopted between 2015 and 2018;
- interviews with relevant Commission Directorates-General (DG GROW, DG CLIMA and DG JUST), including a visit to the Joint Research Centre in Italy;
- consultations with stakeholders, such as the International Council on Clean Transportation; Transport & Environment and the European Automobile Manufacturers' Association;
- an expert panel meeting involving representatives of environmental organizations, type-approval authorities, technical services and research engineers;
- information visits to two Member States where we held meetings with representatives of TAAs, of a research institute and of two environmental agencies;
- a survey of all type-approval authorities in Member States (15 replies received).

**19** We have discussed this paper with the Commission throughout the process, and taken account of its feedback when drafting.

# Review of the EU's response to the “dieselgate” scandal

## Summary of the response

### EU's institutional response

**20** Some years before the dieselgate scandal erupted, the European Commission's Joint Research Centre (JRC) signalled in 2011 that there was a significant discrepancy between car NO<sub>x</sub> emissions under laboratory conditions and those observed on the road<sup>19</sup>. Consequently, Commission's services started to look into ways to address the issue.

**21** On 17 December 2015, the European Parliament set up a committee of inquiry into Emissions Measurements in the Automotive Sector (EMIS) to investigate alleged contraventions and maladministration in the application of EU law in relation to emissions measurements in the automotive sector. On 4 April 2017, the European Parliament adopted the final report and recommendations<sup>20</sup>.

**22** As a result of the dieselgate scandal, the legislative process accelerated and several new pieces of legislation were approved (see *Annex I*). Part of this legislation will only enter into force in September 2020. The Commission will need to adopt a significant number of implementing regulations.

**23** The Commission submitted a follow-up report to the ENVI Committee of the EU Parliament on 17 October 2018<sup>21</sup>. *Table 1* lists the key weaknesses of the EU's system for measuring vehicle emissions, as identified by the European Parliament, and how the Commission intends to address them. It also indicates where we address these points in this paper.

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<sup>19</sup> Commission (JRC), “Analyzing on-road emissions of light-duty vehicles with Portable mission Measurement Systems (PEMS)”, 2011.

<sup>20</sup> Report on the inquiry into emission measurements in the automotive sector.

<sup>21</sup> Commission replies to the EP recommendations.

**Table 1 – Key weaknesses identified by the European Parliament’s EMIS inquiry, together with the Commission’s response**

Description of the weaknesses	Commission’s steps to address them	See paragraph in our paper
NEDC laboratory test does not reflect current driving conditions and allows flexibilities that increase the gap between laboratory figures and CO <sub>2</sub> emissions on the road	New laboratory test introduced: the Worldwide harmonised Light vehicles Test Procedure (WLTP)	30 to 35
Real NO <sub>x</sub> emissions significantly exceed the legal limits	New Real-Driving Emissions (RDE) test introduced	36 to 39
Defeat devices used by the majority of car manufactures; no checks to detect them carried out by type-approval authorities	Methodology developed to help detect defeat devices, including modified RDE testing cars in circulation and surprise testing	40 to 41
No requirement for manufacturers to disclose emissions strategies	Compulsory requirement for a manufacturer to declare all base and auxiliary emissions strategies	41
Lack of checks on vehicles after type-approval granted	New rules for in-service conformity checks; market surveillance activities to be introduced in 2020	46 to 52
No specific EU oversight of vehicle type-approval and weak enforcement of the legislation	Commission will be able to suspend and withdraw type-approval, and impose penalties on manufacturers; Forum introduced to promote best practices and harmonise implementation in MSs	53 to 55
Lack of data transparency on vehicles tested	Manufacturers are obliged to disclose data necessary for third party testing	56 to 58
Insufficient information on how Member States dealt with vehicles containing defeat devices	Commission launched a central Recall Information Platform	63 to 64
No unified EU legal framework to compensate consumers	Commission proposal on consumer collective redress	70 to 72

Source: European Parliament (EMIS report and recommendations) and the Commission’s reply to it.

**24** In November 2015, the European Anti-Fraud Office (OLAF) opened an investigation into a €400 million loan made to Volkswagen by the European Investment Bank (EIB). While the loan was dedicated for the development of greener and more fuel-efficient engine components for passenger cars and utility vehicles,

allegations were made that the development of defeat devices was encompassed in the scope of the EIB project. OLAF finalised its investigation in July 2017 and recommended actions to be taken by the EIB. The EIB has said that it is currently implementing measures in line with the recommendations. In 2018, the Commission also opened a formal in-depth investigation to assess whether BMW, Daimler and the VW group agreed not to compete against each other in developing and rolling out systems to reduce emissions from petrol and diesel cars<sup>22</sup>.

### Member States' reactions to the scandal

**25** Type-approval authorities in certain Member States<sup>23</sup> reacted to the Volkswagen emissions scandal by retesting diesel passenger vehicles, mainly those for which they had granted type-approval certificates. These tests showed that the exhaust emissions on the road of almost all Euro 5 and Euro 6 light-duty diesel vehicles significantly exceeded applicable NO<sub>x</sub> limits, sometimes by a factor of more than 10<sup>24</sup>.

**26** These tests and further investigations carried out by type-approval authorities, coupled with increased pressure from the public and from the Commission, resulted in almost all car manufacturers organising extensive recalls of diesel-fuelled cars.

**27** In the United States, the Volkswagen group was obliged to set aside over US\$ 9.7 billion for settlements (see **Box 1**).

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<sup>22</sup> European Commission - Press release "Antitrust: Commission opens formal investigation into possible collusion between BMW, Daimler and the VW group on clean emission technology".

<sup>23</sup> Germany, Spain, France, Italy, the Netherlands, Finland, Sweden, the UK.

<sup>24</sup> ICCT used results from British, Dutch, French and German government reports, [Road tested: Comparative overview of real world versus type-approval NO<sub>x</sub> and CO<sub>2</sub> emissions from diesel cars in Europe](#), 2017, p. 7.



**Box 1****Enforcement actions related to dieselgate in the US**

In the US, the VW group agreed in three civil settlements to: (a) remove from the market or apply retrofits to most of its diesel engine cars; (b) pay US\$ 2.925 billion to a national NO<sub>x</sub> emissions mitigation trust fund; (c) invest US\$ 2 billion in electric vehicle charging infrastructure and promotion; and (d) pay a US\$ 1.45 billion civil penalty<sup>25</sup>.

Additionally, in a criminal settlement with the US Department of Justice, the VW group pleaded guilty to the crimes of conspiracy, obstruction of justice, and entry of goods by false statement<sup>26</sup>. The settlement resulted in a US\$ 2.8 billion criminal fine.

**28** In the European Union, the Commission opened infringement procedures against:

- (a) Czechia, Greece, and Lithuania, for lacking a system of penalties on manufacturers;
- (b) Spain, Germany, Luxembourg, and the United Kingdom, for not imposing penalties to VW for using illegal defeat device software; and
- (c) Italy, for failing to address concerns raised by the Fiat Chrysler group emissions control strategies<sup>27</sup>.

**29** The Member States have not imposed any penalties on manufacturers for breaches of type-approval regulation. So far, at least three Member States have imposed fines for breaches of commercial or consumer law. In Germany, VW agreed to pay €1 billion to the State of Lower Saxony and Audi €800 million to the State of Bavaria for obtaining unfair economic advantages and for not taking appropriate supervisory measures. In the Netherlands, the Consumer and Market authority (ACM)

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<sup>25</sup> The VW group includes the VW, Audi, and Porsche brands. The group entered in the civil settlements with the EPA, the California Air Resources Board (CARB), and the US Customs and Border Protection. See [EPA website "Volkswagen Clean Air Act Civil Settlement"](#) and [U.S. Customs and Border Protection webpage "CBP Joins DOJ, FBI, and EPA in Announcing a Settlement Against Volkswagen as a Result of Their Scheme to Cheat U.S. Emissions Test"](#).

<sup>26</sup> [The United States Department of Justice webpage](#).

<sup>27</sup> [European Commission Press Releases "Car emissions: Commission opens infringement procedures against 7 Member States for breach of EU rules"](#) and ["Car emissions: Commission opens infringement procedure against Italy for breach of EU rules on car type-approval"](#).

has imposed a €450 000 fine against Volkswagen, the highest amount in the Dutch national law for unfair commercial practices<sup>28</sup>. In Italy, the Volkswagen group was fined €5 million by the country's antitrust authority<sup>29</sup>. In Spain, there are ongoing administrative and criminal procedures against SEAT.

## The new system for vehicle emissions checks

### The new test cycles

#### New laboratory test cycle

**30** In 2007, the Commission and Japan sponsored a United Nations technical working group to develop a new laboratory test cycle for measuring vehicle emissions, the Worldwide Harmonised Light-Duty Vehicle Test (WLTP). The test was intended to replace the outdated New European Driving Cycle (NEDC) and was adopted on 1 June 2017<sup>30</sup>.

**31** The WLTP became compulsory in the EU for new car models introduced from September 2017, and for all new registrations from September 2018 onwards. The WLTP measures all air pollutants and greenhouse gas emissions already regulated by the NEDC. **Figure 6** shows the main differences between the NEDC and WLTP test cycles. The aim was that the WLTP cycle should better reflect on the road driving conditions.















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<sup>28</sup> Autoriteit Consument & Markt webpage "ACM beboet Volkswagen voor misleiding bij diesellaaffaire".

<sup>29</sup> "PS10211 - Antitrust sanziona il gruppo Volkswagen per 5 milioni di euro per manipolazione del sistema di controllo delle emissioni inquinanti".

<sup>30</sup> Commission Regulation (EU) No 2017/1151 of 1 June 2017 (OJ L 175, 7.7.2017, p. 1).

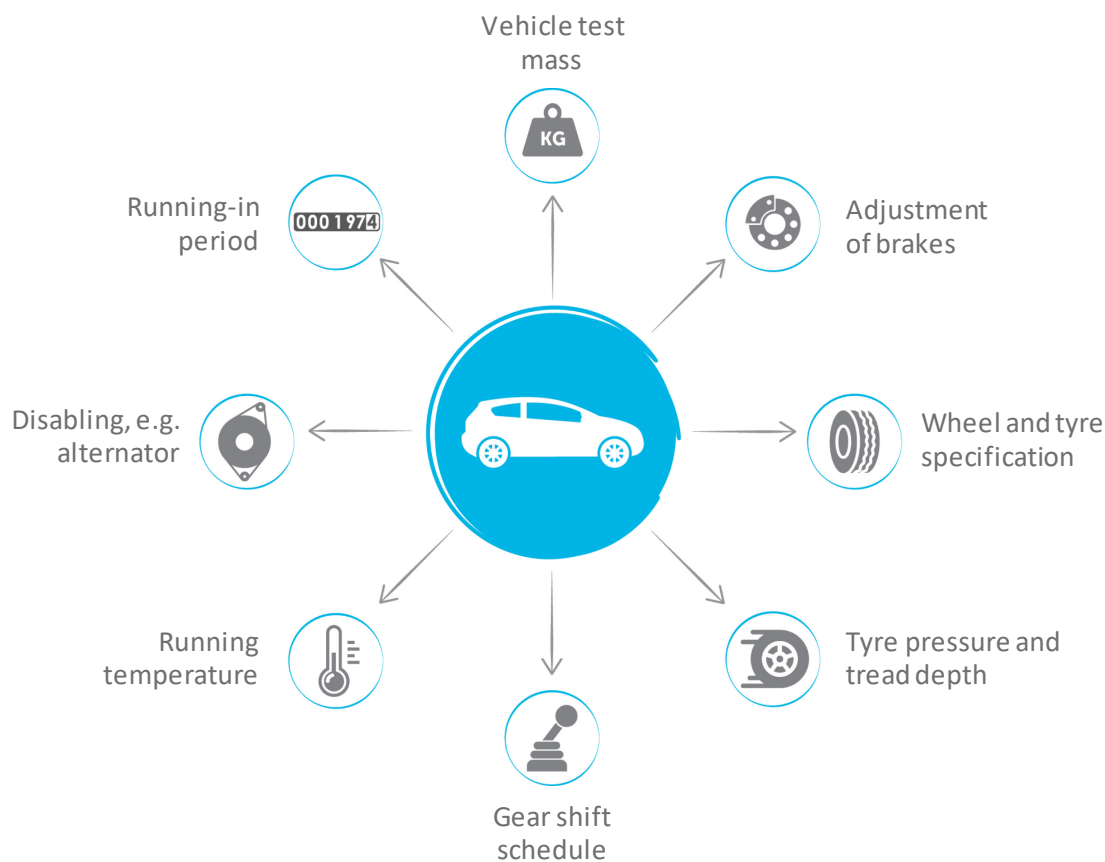
**Figure 6 – Main differences between the NEDC and WLTP test cycles**

NEDC	Test cycle	WLTP
Single test cycle 		▶ Dynamic cycle more representative of real driving
20 minutes 		▶ 30 minutes
11 kilometre 		▶ 23.25 kilometre
2 phases, 66 % urban and 34 % non-urban driving 		▶ 4 more dynamic phases, 52 % urban and 48 % non-urban driving
34 kilometre per hour 		▶ 46.5 kilometre per hour
120 kilometre per hour 		▶ 131 kilometre per hour
Impact on CO <sub>2</sub> and fuel performance not considered under NEDC 		▶ Additional features (which can differ per car) are taken into account

Source: ECA based on ACEA.

**32** One of the main purposes of WLTP is to serve as an industrial standard for CO<sub>2</sub> emissions and fuel consumption. The new test cycle also aims at eliminating certain flexibilities that were present in the former testing regime. **Figure 7** shows some known flexibilities exploited by certain manufacturers in the NEDC test cycle:

**Figure 7 – Examples of known flexibilities exploited by some manufacturers under NEDC test cycle**



Source: ECA based on EEA, “Explaining road transport emissions”, 2016, pp. 32-37.

**33** A 2016 report produced for the Commission provides data showing that the CO<sub>2</sub> emissions gap between type-approval figures and those registered on the road could be greater than 50 % in certain cases<sup>31</sup>. A JRC report from 2018<sup>32</sup> concludes that the new WLTP test cycle will significantly reduce this gap but that it is necessary to continuously monitor this gap, and to incentivise technologies that reduce CO<sub>2</sub> emissions in driving conditions. Article 1 of Regulation (EU) 2018/1832 requires the installation of fuel consumption monitoring devices in new vehicle models.

<sup>31</sup> European Commission (Scientific Advisory Mechanism), “Closing the gap between light duty vehicle real world CO<sub>2</sub> emissions and laboratory testing”, 2016, p. 27.

<sup>32</sup> J. Pavlovic, B. Ciuffo, G. Fontaras, V. Valverde, A. Marotta; “How much difference in type-approval CO<sub>2</sub> emissions from passenger cars in Europe can be expected from changing to the new test procedure (NEDC vs. WLTP)?”; European Commission – Joint Research Centre, 2018, Section 5 – Conclusions and policy implementations.

**34** The Netherlands Organisation for Applied Scientific Research (TNO) stated in a 2016 report<sup>33</sup> that CO<sub>2</sub> type-approved emissions values were, on average, 20 g/km lower than the values obtained in independent tests. The TNO pointed out that these differences were not fully investigated during the development of the WLTP test cycle. While the report suggests that the WLTP test cycle could reduce this gap by 7 g/km, some loopholes remain. The report also points out that a manufacturer, which is on track to meet the 2021 CO<sub>2</sub> fleet target, could postpone the exploitation of WLTP flexibilities for later by keeping a “buffer” for future CO<sub>2</sub> reductions.

**35** In July 2018, Commissioners Bienkowska and Arias Canete addressed a letter to the European Parliament and the Council informing them about the Commission’s findings that WLTP CO<sub>2</sub> type-approval emissions values could be inflated, thus increasing the potential “buffer” for CO<sub>2</sub> reductions after 2021 (see [paragraph 12](#)). The test results of 114 vehicles type-approved from September 2017 show an increase of around 4.5 % on average between the measured and the declared WLTP values, the highest deviation being 15 %. The letter outlined three measures that will be taken to address the issue<sup>34</sup>. They are now in the process of being implemented.

#### **Real-driving emissions (RDE) test**

**36** The New European Driving Cycle (NEDC) has been used since 1990 to certify exhaust emissions of cars and light commercial vehicles, including NO<sub>x</sub>. It is a strictly defined laboratory test, using a chassis dynamometer, with well-defined ambient parameters for temperature and humidity (see [Picture 2](#)). In 2011, the Commission set up a working group to develop a new test cycle for measuring mainly NO<sub>x</sub> emissions. In October 2012, the working group decided to develop on-road testing with Portable Emissions Measurement System (PEMS). Four regulatory packages have been prepared for this new real driving emissions (RDE) testing (see [Annex I](#)).

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<sup>33</sup> TNO, “NEDC – WLTP comparative testing”, 2016, p. 26.

<sup>34</sup> Using the WLTP measured values for the purpose of determining the starting point for the new post-2020 target calculation, clarifying WLTP testing conditions and ensuring a robust implementation of the WLTP.



## Picture 2 – Vehicle exhaust emissions laboratory testing



Source: European Commission, EU Science Hub webpage.

**37** The RDE test is conducted on public roads in real traffic and covers a wide range of driving conditions experienced by drivers in the EU (see **Picture 3**). It has three parts (urban, rural and motorway) defined by the speed of the car as it is being driven. For a vehicle to pass the RDE test, average NO<sub>x</sub> emissions must be below the limit for the test as a whole and for the urban part. As driving styles, altitude, ambient temperature, idle time, and other variables, have an impact on NO<sub>x</sub> emissions, the Commission has defined conditions for a valid RDE test (see **Annex II**).

### Picture 3 – Example of RDE testing using a Portable Emissions Measurement System (PEMS)



Source: European Commission, EU Science Hub webpage.

**38** Some researchers have argued that the EU legislative adoption process has weakened the effect of the introduction of the RDE test<sup>35</sup>, as the Commission’s initially proposed limit of 128 mg/km for diesel cars has been increased to 168 mg/km until 31 December 2020. This contrasts with the US where NO<sub>x</sub> limit is 40 mg/km<sup>36</sup>. **Table 2** shows the implementation of the WLTP and RDE test cycles for type-approval, together with applicable NO<sub>x</sub> limits both for diesel and petrol engines.

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<sup>35</sup> Hooftman, N., Messagie, M., Van Mierlo, J., Coosemans, T., “A review of the European passenger car regulations – Real driving emissions vs local air quality”, 2018; pp. 9-10.

<sup>36</sup> The EPA uses a margin for evaluating real driving emission tests but this is not written in the regulation. European Parliament, “Comparative study on the differences between the EU and US legislation on emissions in the automotive sector”, 2016, p. 15.

**Table 2 – Euro 6 standards: differences and implementation**

	Euro 6b	Euro 6c	Euro 6d (temp)	Euro 6d
Applicable to new type-approvals (models) from	01/09/2014	N/A	01/09/2018	01/01/2020
Applicable to all new cars from	01/09/2015	01/09/2018	01/09/2019	01/01/2021
Laboratory test <sup>37</sup>	NEDC	WLTP	WLTP	WLTP
Applicable RDE NO <sub>x</sub> limit for diesel vehicles	no RDE test required	no RDE test required	168 mg/km	114.4 mg/km <sup>38</sup>
Applicable RDE NO <sub>x</sub> limit for petrol vehicles	no RDE test required	no RDE test required	126 mg/km	85.8 mg/km

Source: ECA, based on EU legislation.

**39** According to the German auto-club ADAC<sup>39</sup>, 463 diesel fuelled vehicle types of 28 brands met the Euro 6d-temp standard in November 2018. This means that vehicle types available in Germany had passed the RDE test and their NO<sub>x</sub> emissions did not exceed 168 mg/km. This illustrates a positive impact of RDE, especially if compared to Euro 5 and Euro 6 diesel vehicle NO<sub>x</sub> emissions (average emissions around 800 mg/km and 450 mg/km, respectively<sup>40</sup>). The main reason for this is the use of more effective after-treatment technologies, such as selective catalytic reduction (SCR), without which it would be impossible to meet the NO<sub>x</sub> emissions limits during RDE testing.

<sup>37</sup> The applicable laboratory NO<sub>x</sub> emission limits for laboratory tests (NEDC or WLTP) are always the same: 80 mg/km for diesel fuelled passenger cars and 60 mg/km for petrol fuelled passenger cars.

<sup>38</sup> Value based on a conformity factor of 1.43, which was adopted in the RDE 4 legislation. The conformity factor stems from a different accuracy of the PEMS tool compared to the laboratory equipment. The same is applicable for petrol vehicles.

<sup>39</sup> Allgemeiner Deutscher Automobil-Club e.V. (ADAC) [website](#).

<sup>40</sup> ICCT, “Impact of improved regulation of real world NO<sub>x</sub> emissions from diesel passenger cars in the EU, 2015-2030”, 2016, p. iv.

**40** The RDE test aims at covering normal driving conditions. This means that, for example, driving in temperatures lower than minus 7 °C or driving in an aggressive manner is not covered by the test. Manufacturers may also attempt to employ emissions technologies and strategies to fit the RDE test parameters, i.e. optimising cars for RDE tests rather than attempting to reduce overall NO<sub>x</sub> vehicle emissions. NGOs argue that the RDE test parameters are too narrow<sup>41</sup> and call for vehicle emissions to be tested beyond the RDE test parameters, in order to provide a better picture of the level of NO<sub>x</sub> emitted<sup>42</sup>.

**41** Since May 2016, car manufacturers must provide an extended documentation package at the type-approval test, in which they declare their base (BES) and auxiliary emissions strategies (AES)<sup>43</sup>. This additional step, together with the introduction of the RDE test, should make it more difficult for manufacturers to use illegal defeat devices to change the behaviour of an emissions control system. First, type-approval authorities will be able to evaluate AES strategies. Second, the RDE testing of vehicles in circulation under various conditions will make it possible to assess the impact of these strategies, and possibly identify further strategies that have not been declared. If any undeclared AES is detected later, this will be considered as a breach of the manufacturer's obligations in the type-approval procedure.

## New compulsory emissions checks on vehicles in circulation

### Focus on type-approval testing has been maintained

**42** **Figure 8** below shows the main elements of the old and new EU systems for ensuring that vehicles meet emissions limits. The old and the new systems rely substantially on type-approval checks of new car models. The newly proposed system requires more checks on vehicles in circulation.

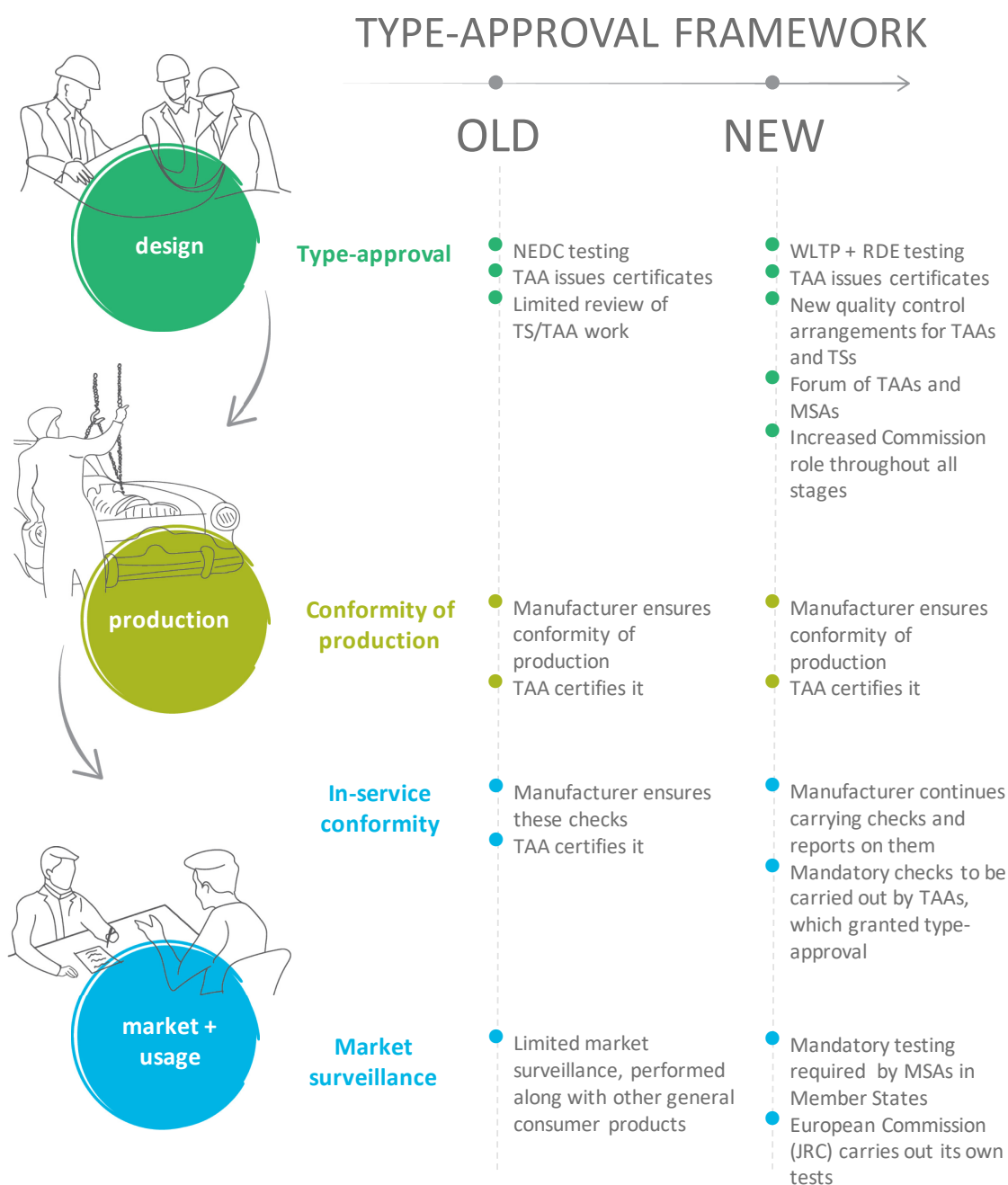
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<sup>41</sup> T&E, "Cars with engines: can they ever be clean?", 2018, p. 16.

<sup>42</sup> ICCT, "Real-driving emission test procedure for exhaust gas pollutant emissions of cars and light commercial vehicles in Europe", 2017, p. 8.

<sup>43</sup> BES - an emission strategy that is active throughout the speed and load operating range of the vehicle unless an auxiliary emission strategy is activated. AES – an emission strategy that becomes active and replaces or modifies a BES for a specific purpose and in response to a specific set of ambient or operating conditions and only remains operational as long as those conditions exist.

**Figure 8 – Overview of the old and new EU systems for ensuring that vehicles meet emissions limits**



Source: ECA.

**43** The European Parliament's Inquiry found<sup>44</sup> that the type-approval authorities, and the technical services designated by them, carried out only the minimum checks required by the legislation and that the fees these bodies charged make up a

<sup>44</sup> European Parliament, "Report on the inquiry into emission measurements in the automotive sector", 2.3.2017, p. 47.



significant source of revenue for them. The inquiry pointed out that car manufacturers were free to select technical services and that most testing took place in their own laboratories. They had the opportunity to test new vehicle models many times before inviting technical services to carry out the final test.

**44** Vehicle emissions compliance and enforcement systems exist outside the EU. According to the ICCT<sup>45</sup>, the US, Canada and South Korea allow type-approval tests to be carried out by the manufacturers themselves, without the presence of technical services to witness the test (as is the case in the EU). The results of these tests are then submitted to the type-approval authority, which may re-perform them. In the US, 15 % of tests are re-performed by type-approval authorities; some of these are selected at random, and some on the basis of risk criteria. The ICCT also notes that post-production compliance checks, backed up by strong enforcement measures, provide a strong incentive for manufacturers to carry out thorough checks to avoid fines and reputational damage.

**45** German environmental NGOs have called for a new type-approval procedure to be put in place. It should be based on self-declarations by manufacturers and complemented by tests on the road of cars in circulation by independent authorities, which should not be involved in the type-approval process (ideally an environment agency) to verify the manufacturer's self-declaration<sup>46</sup>.

#### **In-service conformity checks reinforced**

**46** The aim of in-service conformity checks, which are performed by both manufacturers and granting type-approval authorities, is to verify whether a type-approved car remains compliant with legal emissions requirements during its lifetime. The Commission has significantly reinforced the system by requiring type-approval authorities to perform RDE tests on a minimum number of vehicles in addition to reviewing manufacturers' reports on checks they have carried out.

**47** The information needed to calculate the number of vehicles, which will be subjected to in-service conformity checks in 2019, is not publicly available. Type-approval authorities that have not granted any type-approvals will not have to check any vehicles for in service conformity. The Commission indicated that, for example,

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<sup>45</sup> ICCT, "Global baseline assessment of compliance and enforcement programs for vehicle emissions and energy efficiency", pp. 22-32 and 45.

<sup>46</sup> VCD website "Lehren aus dem Abgasskandal: Typzulassung von Pkw reformieren und reale Emissionen messen".

authorities in France, Spain and Luxembourg will have to check around five vehicle models each year. For checking each vehicle model, it is necessary to perform tests on three to ten different vehicles.

**48** It will only be possible to assess the benefits of the compulsory conformity tests by type-approval authorities from 2021 onwards, when at least two full years of these checks will have been completed.

#### **Minimum market surveillance activities required from 2020**

**49** Article 8 of Regulation (EU) No 2018/858 introduced an obligation for the Commission (JRC) and the Member States to carry out market surveillance activities. These activities will involve analysing the available data on vehicles' compliance with the standards in order to select a sample of vehicles in circulation for emissions testing. The Commission has been working on the implementing regulations to the new type-approval framework.

**50** Member States must ensure that the roles and responsibilities of their own market surveillance and type-approval authorities are strictly separated. Many NGOs would prefer emissions testing to be carried out by independent environmental authorities<sup>47</sup> as in the United States, where the Environmental Protection Agency conducts market surveillance and enforcement activities at federal level. Only two environmental authorities have this role in the EU: in the Netherlands and Spain (in the autonomous city of Melilla).

**51** Article 8 of Regulation (EU) No 2018/858 requires market surveillance authorities to test one vehicle for every 40 000 registered, with a minimum number of five tests per year. Of the selected cars, at least 20 % should be tested for exhaust emissions. This means that in some Member States, only a small number of cars might be selected for emissions testing (for example three in the Netherlands<sup>48</sup>). In the past, some Member States carried out vehicle testing as part of their market surveillance. With the exception of Sweden, these member States have all terminated their

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<sup>47</sup> For example see [VCD website "Lehren aus dem Abgasskandal: Typzulassung von Pkw reformieren und reale Emissionen messen"](#).

<sup>48</sup> The number of light-duty vehicles registered in the Netherlands in 2016 was 455 158, meaning that the minimum cars selected for market surveillance would be 11 ( $11.38 = 455\,158 / 40\,000$ ) but the minimum number of cars checked for emissions will be only three cars ( $2.28 = 0.2 \times 11.38$ ).

activities<sup>49</sup>. The effectiveness of the market surveillance checks will depend on how they are set-up and implemented by the Member States.

**52** However, in addition to the vehicles tested in Member States, the JRC plans to test between 40 and 50 models each year<sup>50</sup>. If achieved, this would exceed the average annual number of models tested by the EPA in the USA (40) between 2009 and 2013<sup>51</sup>.

## New enforcement powers for the Commission

**53** The new legislative framework has granted to the Commission new enforcement powers, such as the possibility to suspend or withdraw vehicle type-approvals, launch recalls of non-compliant vehicles and apply penalties. It also requires an advisory body to be formed, the Forum for Exchange of Information on Enforcement, composed of representatives from Member State type-approval and market surveillance authorities. The Forum should create a platform for the exchange of best practices, and work towards a uniform implementation of the applicable legislation across the EU.

**54** The Commission will also assess the procedures of the type-approval authorities for granting type-approvals, carrying out conformity of production, and for designating and monitoring technical services. In addition, the type-approval authorities may also be subject to peer evaluations of their procedures for assessing and monitoring technical services. These will be carried out by teams composed of two type-approval authorities from other Member States and, optionally, the Commission<sup>52</sup>.

**55** Like the Member States, the Commission will be allowed to impose fines on economic operators who fail to comply with the Regulation. However, issuing such fines will only be possible if Member State authorities have not already imposed fines themselves. No detailed guidance on the fines is included in the legislation, except a

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<sup>49</sup> ICCT, Global baseline assessment of compliance and enforcement programs for vehicle emissions and energy efficiency, p. 31.

<sup>50</sup> The JRC has been enlarging its laboratory facilities for such tests, and hiring and training staff.

<sup>51</sup> ICCT, A historical review of the U.S. vehicle emission compliance program and emission recall cases, 2017, p. 29.

<sup>52</sup> If a national accreditation body assesses and monitors the work of technical services, peer review is not required. The Commission may decide to participate in the peer evaluation team on the basis of a risk assessment analysis (Article 67 of Regulation (EU) No 2018/858).

mandatory cap of €30 000 per vehicle and a requirement that they be effective, proportionate and dissuasive. Since type-approval authorities have no history of imposing fines on car manufacturers, and the regulation does not provide detailed guidance, it is not possible to assess whether any penalties they ultimately impose will meet these criteria.

## Data transparency

**56** Data on car type-approval testing in the EU, such as the results of the emission tests, are fragmented. Neither the Commission nor the Member States have a comprehensive view of it. In general, existing data are kept at Member State level<sup>53</sup>.

**57** In the United States, car testing data are made publicly available by the Environmental Protection Agency (EPA)<sup>54</sup>. In the EU, the lack of data transparency and public availability make the situation harder for interested parties to follow the issue and to contribute to the monitoring of vehicle emissions. Articles 61 to 66 of Regulation (EU) No 2018/858 applicable from 2020, lay out the basis for the standardisation and future use of data collected by on-board emissions-measurement systems, which may increase the availability of data on car emissions in the EU. The new in-service conformity rules in the RDE legislation (fourth package – see ***Annex I***) allow access to all data necessary for testing vehicles that are type approved from January 2019. The Commission is developing a tool to facilitate access to such data by manufacturers, type-approval authorities or independent testers. All reports of the in-service conformity checks will be publicly available.

**58** The US EPA also operates a user-friendly online tool that allows users to compare instantly CO<sub>2</sub> emissions across different car models available on the US market<sup>55</sup>. In the EU, easily comparable information on type-approved vehicle fuel consumption, CO<sub>2</sub> and NO<sub>x</sub> emissions is not available from a central database. This makes it more difficult for citizens to take informed decisions when purchasing vehicles.

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<sup>53</sup> For instance, the German TAA, KBA, publishes data related to its emissions testing. See [Kraftfahrt-Bundesamt website](#). The British TAA, VCA, published data on vehicle emissions for the models on sale in the British market, accessible through an online search system (See [Vehicle Certification Agency's webpage](#)), or by downloading a comma-separated values (CSV) file (See [Vehicle Certification Agency's webpage](#)).

<sup>54</sup> [EPA webpage "Data on Cars used for Testing Fuel Economy"](#).

<sup>55</sup> [U.S. Department of Energy webpage](#).

Nevertheless, vehicle dealers must make the information on consumption of the cars they sell available in their showrooms, as well as in advertising media<sup>56</sup>. CO<sub>2</sub> emissions of newly registered vehicles are monitored and made annually available to the public by the European Environment Agency. The Commission also intends to make information on NO<sub>x</sub> emissions available in a central database.

### Third-party testing becomes a part of enforcement

**59** Articles 8, 9 and 13 of Regulation (EU) No 2018/858 provide for third-party testing by “*recognised third parties [...] with a legitimate interest in the fields of public safety or environmental protection*”. The Commission has yet to adopt implementing acts containing rules governing the recognition of these third parties, which may face barriers to entry as the WLTP and RDE tests are expensive to carry out<sup>57</sup>.

**60** Less costly options of measuring vehicle emissions are available, such as exhaust emissions measurement using remote sensing equipment or real driving tests with SEMS<sup>58</sup> units. While these measurements can be less accurate, they are usually sufficient to identify vehicles significantly exceeding the legal emission limits and thus needing further testing.

## Highly polluting cars in the existing fleet

### Information on cars in circulation

**61** According to the European Automobile Manufacturers’ Association (ACEA), the EU had around 257 million passenger cars and 31 million light commercial vehicles in circulation in 2016<sup>59</sup>. About 42 % of the passenger cars, and almost 90 % of light

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<sup>56</sup> Directive 1999/94/EC - [Car Labelling Directive](#).

<sup>57</sup> PEMS equipment can cost around €80 000 plus additional variable costs to each test (expert fees, vehicle hire costs, etc.). WLTP test is more expensive as there are a limited number of independent laboratories.

<sup>58</sup> Smart Emissions Measurement System (SEMS) has been developed by TNO. It is a compact sensor-based system that measures emissions and can be easily built into a vehicle, which can be then used in a normal way.

<sup>59</sup> [ACEA webpage "Report: Vehicles in Use"](#).

commercial vehicles, are diesel-powered. Over 93 million of these diesel vehicles in circulation may not be fitted with diesel particulate filters<sup>60</sup>.

**62** The different Euro emissions standards (from Euro 1 to Euro 6) are not a reliable proxy for determining car NO<sub>x</sub> emissions on the road<sup>61</sup>, as shown by the dieselgate scandal. Although data for some diesel vehicles (mostly Euro 5 and 6) is available from various sources, comprehensive data on emissions on the road is not readily available at EU level. This hampers any potential initiative aimed at removing the more polluting cars from circulation.

### Millions of vehicles have been recalled but the impact on emissions is unclear

**63** Since 2015, the Volkswagen group has recalled over 8 million cars in the EU. Other car manufacturers have also recalled significant numbers of vehicles. The Commission has created a platform giving figures on the number of vehicles recalled (see [Figure 9](#)), in most cases to update software controlling the vehicles' exhaust systems. We have found only very few publicly available test results of recalled vehicles, indicating that the impact on the NO<sub>x</sub> emissions reduction has been rather small. For example, Austrian, German and Swiss automobile clubs tested nine vehicles over a highway cycle<sup>62</sup> and found an average emission reduction of 25 %<sup>63</sup>. Average NO<sub>x</sub> emissions of these vehicles over the highway cycle was 590 mg/km<sup>64</sup>.

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<sup>60</sup> From total number of diesel cars (circa 136.4 million) is deducted 43 million of Euro 5 and 6 diesel cars stated in the report by Transport & Environment (2018). *Cars with engines: can they ever be clean?* [online] Brussels: Transport & Environment, p. 10. [Accessed 22 October 2018].

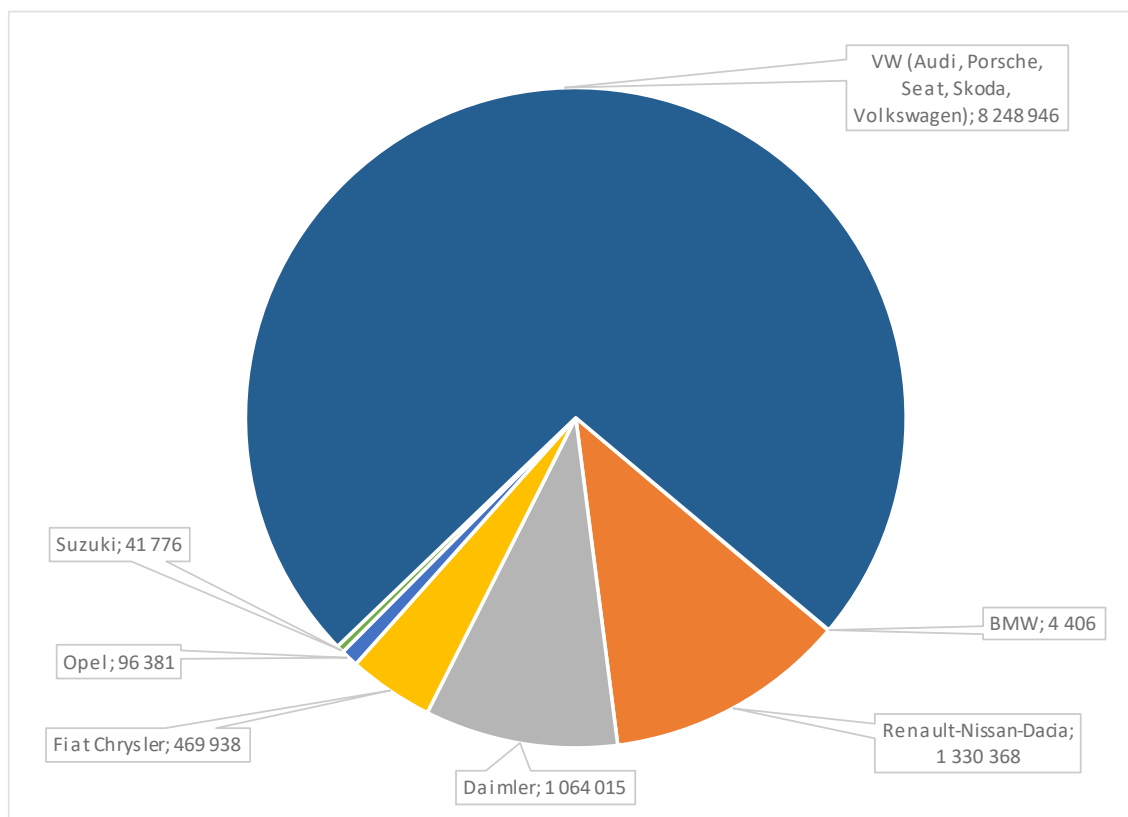
<sup>61</sup> T&E, *Cars with engines: can they ever be clean?*, 2018, p. 3.

<sup>62</sup> The laboratory (chassis dynamometer) highway cycle is a part of Eco Test cycle developed by ADAC. It represents driving on a German motorway with a maximum speed of 130 km/h.

<sup>63</sup> More thorough retrofits can reach reductions of 60-95 %, as shown in Giechaskiel, B., Suarez-Bertoa, R., Lähde, T., Clairotte, M., Carriero, M., Bonnel, P. and Maggiore, M., Evaluation of NO<sub>x</sub> emissions of a retrofitted Euro 5 passenger car for the Horizon prize "Engine retrofit", *Environmental Research*, 2018, pp. 298-309.

<sup>64</sup> Source: ICCT, "VW defeat devices: A comparison of U.S. and EU required fixes", 2017, p. 6 (averages for eight vehicles only).

**Figure 9 – Overview of vehicles to be recalled due to issues with NO<sub>x</sub> emissions (as of 14 September 2018)**



Source: ECA, based on data supplied by Member States and consolidated by the Commission. Data may contain inconsistencies and is for illustrative purposes only.

**64** Additional hardware retrofits<sup>65</sup> could be an alternative to only software fixes. Indeed, such retrofits have already been applied to heavy-duty vehicles. Preliminary tests by the JRC have shown positive results, with emissions of NO<sub>x</sub> being significantly lower after the retrofit<sup>66</sup>. The main disadvantage of hardware retrofits is their cost. In the US, Volkswagen was obliged either to retrofit vehicles to lower the NO<sub>x</sub> emissions below the limit, or to scrap them. The EPA has tested and certified the effectiveness of these retrofits.

<sup>65</sup> Retrofit is the addition of new technology or features to an existing system, such as a car engine. A hardware retrofit entails the addition of a new device, or a physical modification of the engine.

<sup>66</sup> Giechaskiel, B., Suarez-Bertoa, R., Lähde, T., Clairotte, M., Carriero, M., Bonnel, P. and Maggiore, M. (2018). Evaluation of NO<sub>x</sub> emissions of a retrofitted Euro 5 passenger car for the Horizon prize “Engine retrofit”. *Environmental Research*, 166, pp. 298-309.



## Tampering with vehicle emission systems

**65** Car drivers wishing to improve their car's performance, to reduce consumption or to avoid expensive maintenance costs can tamper with their vehicles' emissions after-treatment systems, similar to heavy-duty vehicle operators<sup>67</sup>. This can cause the cars to emit various pollutants at levels many times above the legal limit, greatly affecting urban air quality. For instance, cars whose diesel particulate filters (DPFs) have been removed can emit between 20 and 50 times as much PM as cars whose DPFs are working as intended<sup>68</sup>. As the problem with tampering does not fall within the remit of type-approval, in-service conformity, or market surveillance, it is for Member States to deal with it under national law.

**66** Tampering can be detected through the use of emerging technologies to measure vehicle emissions, such as remote sensing and the use of "sniffing cars" (see **Picture 4**). This could be combined with a procedure in which the worst emitters are called in for further testing. Another way is through periodical technical inspections (PTI)<sup>69</sup>, which however still do not require the authorities to measure NO<sub>x</sub> and PM. Furthermore, their effectiveness needs to be increased in order to be able to detect tampered vehicles<sup>70</sup>.

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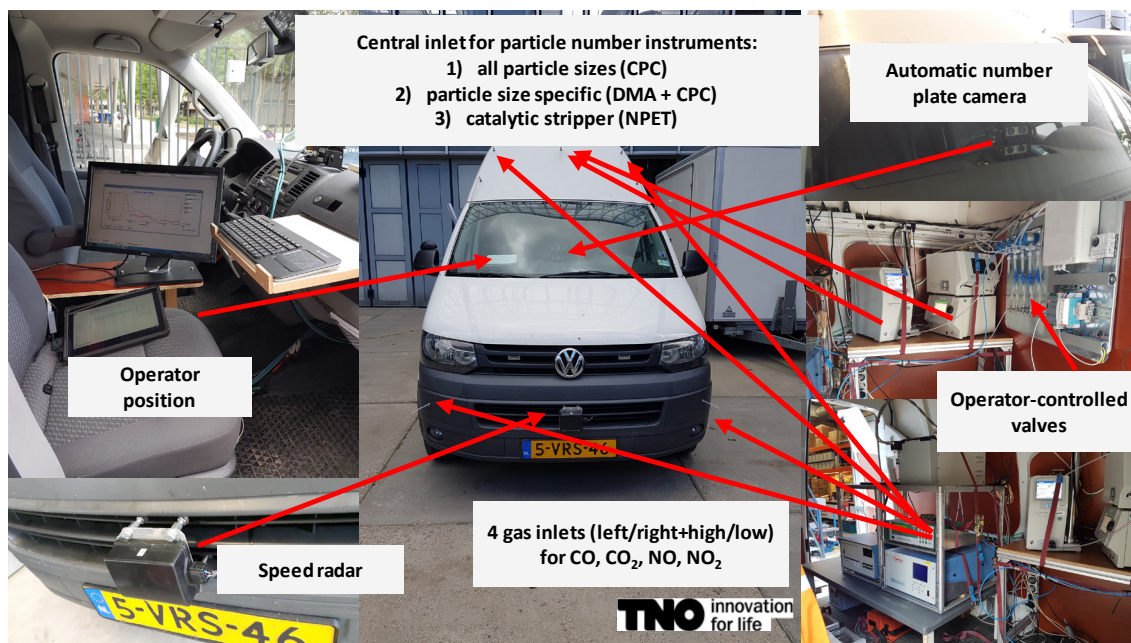
<sup>67</sup> See T&E, Cars with engines: can they ever be clean?, 2018, p. 21.

<sup>68</sup> Spreen, J., Kadijk, G. and van der Mark, P., *Diesel particulate filters for light-duty vehicles: operation, maintenance, repair, and inspection (TNO 2016-R10958)*, 2016, p. 13.

<sup>69</sup> Directive 2014/45/EU of the European Parliament and of the Council on periodic roadworthiness tests for motor vehicles and their trailers and repealing Directive 2009/40/EC (OJ L 127, 29.4.2014, p. 51).

<sup>70</sup> Hooftman, N., Messagie, M., Van Mierlo, J. and Coosemans, T. (2018). A review of the European passenger car regulations – Real driving emissions vs local air quality. *Renewable and Sustainable Energy Reviews*, 86, p. 14.

Picture 4 – “Sniffing car” developed by TNO



Source: TNO.

## Initiatives in Member States for cities suffering from air pollution

**67** Another result of the emissions scandal is an increased willingness in several Member States to introduce restrictions on car circulation in order to improve air quality. For example, several European cities with high levels of air pollution have created low-emissions zones where cars are banned. Local authorities can also impose traffic restrictions during pollution peaks. Such measures tend to rely on the use of the Euro standards, which may not represent vehicle NO<sub>x</sub> emissions on the road and thus make these measures less effective<sup>71</sup>. As an example, we have found that at least four local low emission zones in the EU rely simply on a given Euro standard, without differentiation between petrol and diesel, for establishing vehicle circulation restrictions<sup>72</sup>.

<sup>71</sup> Giorgiev, P., *How to get rid of dirty diesels on city roads: Analysis of diesel restriction measures in European cities to date*. [online] Transport and Environment, 2018 [Accessed 13 Nov. 2018], pp. 8-9.

<sup>72</sup> An overview of low-emissions zones in Europe is available at the [Urban Access Regulations in Europe website](#).

**68** A patchwork of vehicle restrictions of this kind has emerged across the EU. As a result, drivers who wish to travel across several Member States must comply with an increasing number of local regulations to avoid fines. Drivers must often demonstrate compliance with these local regulations by putting stickers on their vehicle's windscreen. To help drivers navigate these local regulations, the Commission has created a website that contains information on circulation restrictions across the EU<sup>73</sup> and is developing a guidance document, which aims to help the drivers to understand local rules.

**69** According to the NGO Transport & Environment<sup>74</sup>, the emissions scandal and car use restrictions have had an impact on the prices of second-hand diesel cars. There has also been a recorded increase in the number of such cars exported to eastern European countries. This will have an impact on air quality improvements in these countries, depending on whether second hand vehicles replace older or newer vehicles.

### **Compensation to consumers as a result of the “dieseldate” scandal**

**70** The dieseldate emissions scandal also showed that the single type-approval system in place in the EU is not complemented by a single consumer-compensation system. Consumer redress systems vary between Member States. As a response to this situation, the Commission has presented a proposal for a Directive on “*representative actions for the protection of the collective interests of consumers*”<sup>75</sup>. The text includes a set of harmonised requirements for the establishment of collective consumer redress systems in EU Member States<sup>76</sup>. However, this will not be available to the consumers affected by the dieseldate scandal.

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<sup>73</sup> [Webpage Urban Access Regulations In Europe.](#)

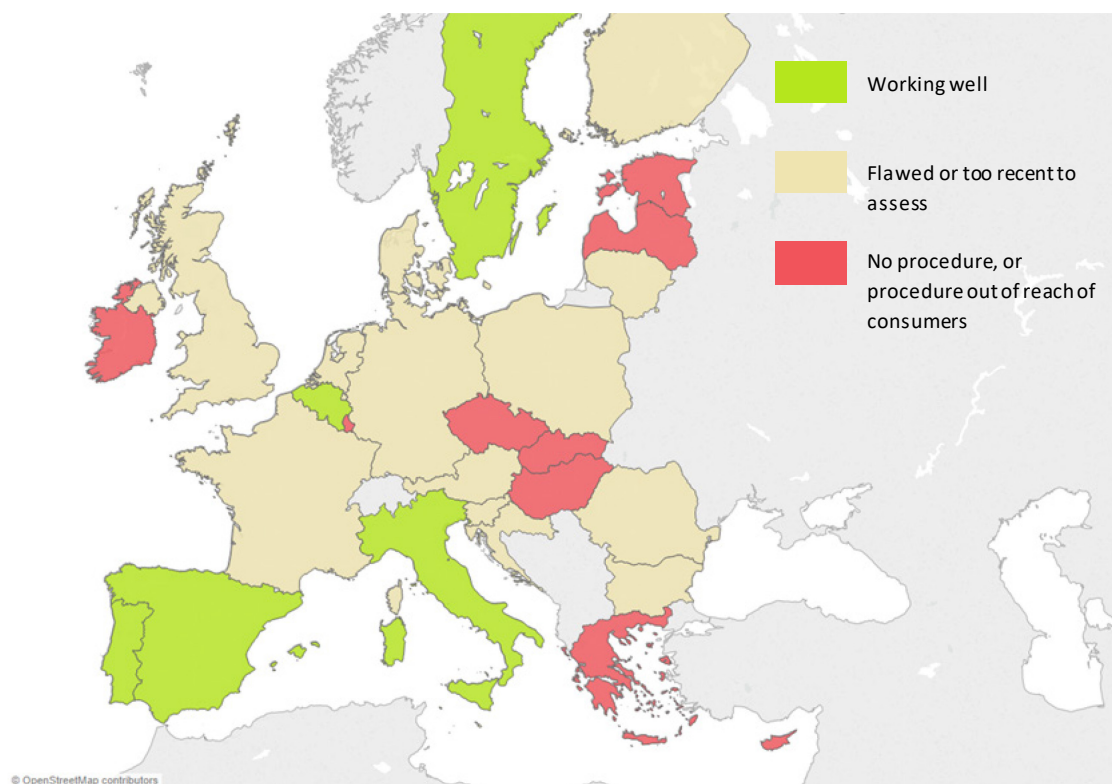
<sup>74</sup> T&E, *Dirty diesels heading East*, 2018, pp. 2-3.

<sup>75</sup> [COM\(2018\) 184 final of 11.4.2018.](#)

<sup>76</sup> A collective redress system is a mechanism that allows a group of consumers affected by a similar problem to file a single action (a lawsuit or an administrative procedure) against an economic operator. If such a system does not exist, consumers must file individual actions, which may be beyond an individual's economic capacity, or may cost more than the amount of potential compensation received.

**71** According to a study conducted by the European Consumer Organisation (BEUC), nine EU Member States have no collective consumer redress system in place. Fourteen Member States either have systems with serious flaws or their systems are too new to be assessed. This means that only five Member States have fully functioning systems in place for collective consumer redress (see **Figure 10**).

**Figure 10 – State of consumer redress systems in the EU**



*Note:* Third-countries' borders have been omitted.

*Source:* ECA, based on data from BEUC.

**72** The proposed rules will strengthen consumer rights but will not result in the same compensation to citizens across the EU. The compensation provided to consumers will remain governed by national law.

## Concluding remarks

**73** The emissions scandal has accelerated many legislative changes to the EU system of vehicle emissions checks:

- The Commission is now empowered to review the work of national type-approval authorities, test vehicles, withdraw or suspend type-approvals, and impose penalties.
- Testing vehicles in circulation is now mandatory in Member States, either by means of in-service conformity checks or in the framework of market surveillance activities.
- A new laboratory test, the Worldwide Harmonized Light Vehicle Test Procedure (WLTP), has been introduced to tackle the large gap between CO<sub>2</sub> emission levels as measured in the laboratory and on the road.
- A Real-Driving Emissions test (RDE) has been introduced to measure NO<sub>x</sub> emissions.
- Interested third parties may now conduct emission tests.

**74** The Commission plans to improve the current situation in which data on vehicle emissions testing is limited, fragmented, and not easy to access. Despite the recent legislative actions:

- It may take many years to improve city air quality, given the large number of highly-polluting cars already on the roads.
- While over 10 million vehicles of different brands have been recalled, the limited data available indicates that the impact on NO<sub>x</sub> emissions has been small.
- While the RDE test introduction has led to a significant reduction of NO<sub>x</sub> emissions of diesel cars, the impact could have been even greater if the initially proposed temporary NO<sub>x</sub> limit of 128 mg/km was adopted instead of 168 mg/km.

**75** For the legislative changes introduced, it will take some time for improvements to become apparent. The following challenges may impact the effective implementation of these changes:

- The effectiveness of the market surveillance checks will depend on the set-up and implementation by the Member States.

- While the scope for car optimization has been narrowed and the Commission's recent legislation provides for better monitoring of the gap between laboratory figures and CO<sub>2</sub> emissions on the road, manufacturers may find new flexibilities in the WLTP laboratory test to lower their CO<sub>2</sub> emissions.
- There is a risk that manufacturers optimise vehicles for the RDE test and that NO<sub>x</sub> emissions outside the RDE boundaries remain high. Testing cars in circulation beyond RDE parameters may address this risk.
- The newly introduced independent third-party testing may be limited due to the high costs of performing WLTP and RDE emissions tests.

# Acronyms and abbreviations

**ACEA:** European Automobile Manufacturers Association

**BEUC:** The European Consumer Organisation (in French, *Bureau Européen des Unions de Consommateurs*)

**CO<sub>2</sub>:** Carbon dioxide

**DG CLIMA:** European Commission's Directorate-General for Climate Action

**DG GROW:** European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs

**DG JUST:** European Commission's Directorate-General for Justice and Consumers

**EEA:** European Environment Agency

**EMIS:** Committee of Inquiry into Emissions Measurements in the Automotive Sector

**EPA:** United States Environmental Protection Agency

**ICCT:** International Council on Clean Transportation

**JRC:** European Commission's Directorate-General Joint Research Centre

**NEDC:** New European Driving Cycle

**NO<sub>x</sub>:** Nitrogen oxides

**PEMS:** Portable Emissions Measurement System

**PM:** Particulate Matter

**RDE:** Real Driving Emissions

**T&E:** Transport and Environment

**TAA:** Type-approval authority

**TS:** Technical Services

**WLTP:** Worldwide harmonized Light vehicles Test Procedure

# Glossary

**Euro “x” standards:** European light vehicle emissions standards defined through a series of EU legislative acts. They are typically referred to as Euro 1, Euro 2, Euro 3, Euro 4, Euro 5, and Euro 6, based on the stage at which they were implemented.

**Market surveillance authority:** Member State authority responsible for verifying that products already available on the market are safe and not harmful to the environment, and for checking that the products being sold are the same which were initially tested and approved.

**New European Driving Cycle (NEDC):** A test-driving cycle to assess the exhaust emissions of cars during their type-approval process. It measures emissions of CO<sub>2</sub>, NO<sub>x</sub>, PM, PN, and THC, in standardised laboratory conditions.

**Nitrogen oxides (NO<sub>x</sub>):** Generic term for various kinds of gases composed of nitrogen and oxygen atoms, such as nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>). They are considered pollutants and are different from the nitrogen gas (N<sub>2</sub>) that occurs naturally in the air. The nitrogen oxides contribute to the formation of smog, acid rain, as well as of tropospheric ozone.

**Particles (particulates):** Mixture of solid particles and liquid droplets found in the air. They vary in sizes and shapes. They may be visible to the naked eye (such as dust, dirt, soot, or smoke), but may also be microscopic in size. The term “particle” is conventionally used for the matter in the airborne phase (suspended matter), and the term “particulate” for the deposited matter.

**Particle number emissions (PN):** Corresponds to the total number of solid particles emitted from the vehicle exhaust.

**Particulate matter emissions (PM):** Corresponds to the mass of any particulate material emitted from the vehicle exhaust

**Real Driving Emissions (RDE) testing:** Testing procedure, which complements laboratory emissions testing, which aims to confirm the laboratory readings for NO<sub>x</sub> and PN under real driving conditions.

**Technical services (TS):** Test bodies and laboratories specifically designated by the Members States’ type-approval authorities to carry out the type-approval tests in accordance with EU legislation.



**Type-approval:** Process applied by Member State authorities, before authorizing the placement of a new vehicle model on the market, to certify that it meets all EU safety, environmental, and conformity of production standards.

**Type-approval authorities (TAA):** Member State public authorities in charge of certifying vehicles before they are placed on the EU market.

**Worldwide harmonized Light vehicle Test Procedure (WLTP):** A test-driving cycle to assess the exhaust emissions of cars during their type-approval process. It measures emissions of CO<sub>2</sub>, NO<sub>x</sub>, PM, PN, and THC, in standardised laboratory conditions.

# Annexes

## Annex I — Key legislation on EU vehicle type-approval and emissions testing

### Legislation on vehicle type-approval in the EU

The main legal basis for vehicle type-approval in the EU was Directive 2007/46/EC (Framework Directive). This Directive currently coexists with Regulation (EU) 2018/858, which will apply in full from 1 September 2020. The new framework provides enforcement powers to the Commission, as well as mandating compulsory vehicle testing.

### The Worldwide Harmonised Light Vehicle Test Procedure (WLTP)

The WLTP was incorporated into EU law in 2017, through Commission Regulation No 2017/1151 of 1 June 2017. It measures emissions of pollutants such as CO<sub>2</sub>, NO<sub>x</sub>, PM, PN, and THC in standardised laboratory conditions.

### Real-Driving Emissions (RDE) legislative packages

**The first package**<sup>77</sup> includes the basic features of the RDE test, such as the specification of the RDE test route, the “vehicle family” concept, a specification of the data-evaluation tools to be used, the technical requirements of the PEMS equipment, and reporting obligations.

**The second package**<sup>78</sup> includes issues such as a specification of the conformity factors and the timetable for RDE implementation, as well as the introduction of dynamic parameters and a limit for altitude gain.

**The third package**<sup>79</sup> includes the introduction of the particulate number (PN) measurement. The package also features specific legislative provisions for hybrids and a procedure for including cold starts and regeneration events in the RDE test.

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<sup>77</sup> Commission Regulation (EU) 2016/427 of 10 March 2016 (OJ L 82, 31.3.2016, p. 1).

<sup>78</sup> Commission Regulation (EU) 2016/646 of 20 April 2016 (OJ L 109, 26.4.2016, p. 1).

<sup>79</sup> Commission Regulation (EU) 2017/1151 of 7 June 2017 (OJ L 175, 7.7.2017, p. 1).

The fourth package<sup>80</sup>, covers in-service compliance and surveillance tests, independent third party testing and a methodology for evaluating real driving emissions. It also mandates a reduction of the conformity factor, which accommodates technical and statistical variations in RDE measurements, from 1.50 to 1.43.

## Annex II — Specifications and boundaries of the RDE test

The RDE test must conform to a set of specifications and boundaries established in legislation, summarized in **Table 3**.

**Table 3 – Specifications and boundaries of the RDE test**

Specifications/parameters		Provisions
Total trip duration		Between 90 and 120 minutes
Distance	Urban	Greater than 16 km
	Rural	Greater than 16 km
	Motorway	Greater than 16 km
Trip composition	Urban	29-44 % of the distance
	Rural	23-43 % of the distance
	Motorway	23-43 % of the distance
Average speeds	Urban	15-40 km/h
	Rural	60-90 km/h
	Motorway	Greater than 90 km/h (greater than 100 km/h for at least 5 minutes)
Payload		≤90 % of maximum vehicle weight
Altitude	Moderate	0-700 meters above sea level
	Extended	700-1 300 meters above sea level
Altitude difference		No more than 100 meters difference in altitude between the start and the end of the test
Cumulative altitude gain		1 200 meters per 100 km
Ambient temperature	Moderate	0 to 30 °C
	Extended	-7 to 0 °C and 30 to 35 °C
Stop percentage		6-30 % of urban time

<sup>80</sup> Commission Regulation (EU) 2018/1832 of 5 November 2018 (OJ L 301, 27.11.2018, p. 1).

Maximum speed	145 km/h (160 km/h for 3 % of motorway driving)
Use of auxiliary systems	Free to use as on the road (this includes, for example, automatic stop-start systems)

Source: ECA, based on legislation and on work by the [ICCT](#).

## ECA team

This briefing paper was adopted by Chamber I Sustainable use of natural resources, headed by ECA Member Nikolaos Milionis. The task was led by ECA Member Samo Jereb, supported by Kathrine Henderson, Head of Private Office and Jerneja Vrabic, Private Office Attaché; Michael Bain, Principal Manager; Jindrich Dolezal, Head of Task; Ernesto Roessing, João Nuno Coelho Dos Santos, Radostina Simeonova and Joachim Otto. Richard Moore provided linguistic support.



*From left to right: João Nuno Coelho Dos Santos, Ernesto Roessing, Michael Bain, Jindrich Dolezal, Samo Jereb, Jerneja Vrabic.*

The question of discrepancies between laboratory figures and vehicle emissions on the road was brought into sharp focus with the discovery of the manipulation of vehicle emissions systems by the Volkswagen group, the so-called "dieselgate" scandal, which came to light in September 2015.

This briefing paper sets out the actions taken, at the level of the European Union and Member States, and describes changes made to the system for measuring vehicle emissions after September 2015. The paper does not seek to assess whether the actions taken and proposed have solved the problem.



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