

Euro VI trucks still don't meet emission limits on the road

A new Euro VII emission standard is needed to clean up toxic pollution from trucks and buses

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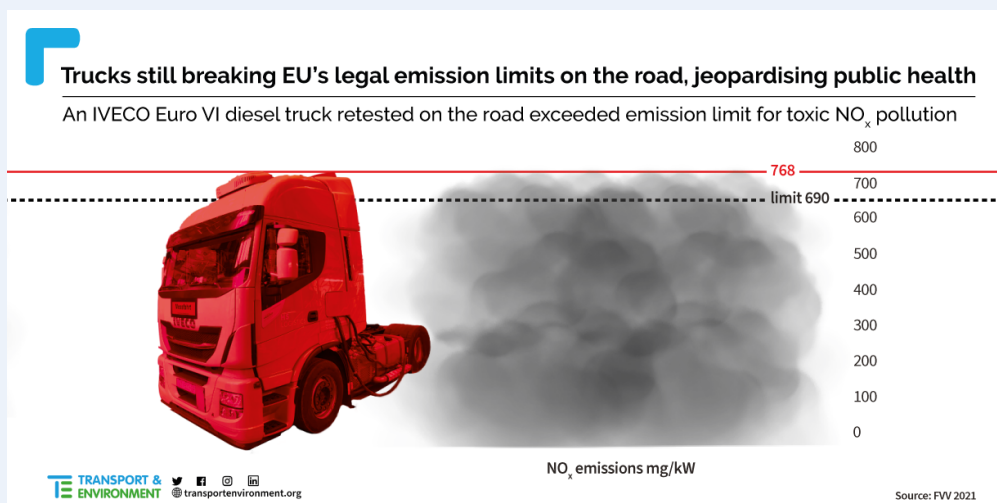
Summary

This position paper reports new test results which show that even Euro VI D trucks can exceed EU pollution limits on the road and provides policy recommendations for a new Euro VII pollutant emission standard to slash toxic pollution from trucks and buses.

Results of on-road testing of a IVECO Euro VI D diesel truck

On road testing of an IVECO Euro VI D diesel long-haul truck shows that even new Euro VI trucks still fail to comply with legal emission limits on the road. The testing, undertaken in 2021 by the Technical University of Graz on behalf of T&E found that:

- 1. The IVECO truck tested does not comply with the Euro VI nitrogen oxide (NO_x) emission limit during official on-road tests used for verifying emissions compliance in the EU.** The truck exceeded the on-road NO_x emission limit (690 mg/kWh) by 11%, emitting 768 mg/kWh on the test. The high NO_x emissions measured during this test mean that the truck is non-compliant with the Euro VI D regulation.



- 2. The truck had particularly high urban NOx emissions on tests replicating a typical supermarket delivery trip and low speed driving typical in towns and cities.** Emissions during the urban part of the test were at least double the Euro VI NOx emission limit. This indicates that even Euro VI D trucks can emit large amounts of toxic NOx pollution when driving in towns or cities.
- 3. On one of the city driving tests the NOx emission control system malfunctioned resulting in huge NOx emissions on the road.** The Adblue dosing system critical for NOx control failed. While a fault light did show up on the dashboard, the malfunction resulted in NOx emissions which were 11 times higher than the Euro VI limit during urban driving.

The Commission and the Italian Type-Approval Authority which approved the truck for sale should investigate the incidence rate and the cause of the failure in the emission control of the IVECO truck further as well as the high NOx emissions during the official test.

Polluting trucks drive air pollution crisis

Overall, the results of the test are highly concerning for air quality and public health as every year 50,000 people in Europe die prematurely due to nitrogen dioxide (NO₂) pollution- a component of NOx¹. Particularly in cities, high traffic volumes result in poor air quality. In Europe's biggest cities trucks and buses alone account for 20 to 36% of transport NOx² emissions. Trucks which fail to meet emission limits on the road such as the IVECO diesel truck tested directly contribute to the air pollution crisis.

Sadly, road transport overall remains the largest source of NOx and in 2019 eighteen EU Member States registered NO₂ air concentrations above EU air quality limits. While this decreased to 8 Member States and the UK in 2020³, the improvement is likely short lived and down to lockdown measures imposed across Europe rather than due to long term reductions in NO₂ pollution. Alongside this, the World Health Organisation's (WHO) new guidelines for NO₂ are 75% lower than current EU limits meaning that current EU air quality guidelines are inadequate for protecting EU citizens from air pollution and road transport emissions must be further reduced to reach the new WHO guidelines.

Failures of the Euro VI regulation

The poor NOx performance of the IVECO truck highlights that the Euro VI D emissions regulation is insufficient to ensure adequate emissions performance of all heavy-duty trucks on the road. Regular in-use testing of trucks for emissions compliance is required by Euro VI. However, this is run by truck manufacturers and as such cannot be impartial, unlike for cars and vans where independent testing by Member State Type-Approval Authorities is required. Relying on truck

¹ EEA. (2020) [Air quality in Europe](#).

² Air Quality Consultant. (2021) [Covid-19, Air Quality and Mobility Policies: Six European Cities](#).

³ EEA. (2021). [Europe's air quality status 2021](#).

manufacturers to perform in service compliance testing is ineffective, in this case it has failed to ensure that the IVECO truck complies with all limits on the road. In addition, Member States which are required to run market surveillance activities, rarely test heavy-duty trucks, further compounding the problem.

Alongside lack of in-use oversight by type-approval authorities, a lack of limits which apply specifically to urban driving, along with exclusion of cold start (i.e. emissions when the engine is first turned on) and low load, low speed driving - typical driving which occurs in cities- from conditions covered by on road tests means that trucks still emit more than the Euro VI limits when driving in cities. The new Euro VI E standard, which fully enters into force for diesel trucks this year, only adds minor improvements to the on-road testing procedure with cold start still not fully covered and no improvements to low speed, low load driving. Therefore, drastic improvements in the emissions performance of heavy-duty vehicles are unlikely.

A new emission standard for trucks and buses is needed

While the transition to zero-emission mobility will eliminate pollution from trucks and buses in the longer term, based on truckmaker announcements just 7% of newly sold trucks are expected to be zero-emission in 2025⁴. As such, pollution from internal combustion engines needs to be urgently reduced. **Crucially, a new EU emission standard for heavy-duty vehicles needs to be implemented by 2025**, to replace the outdated Euro VI standard agreed more than a decade ago.

By the end of 2021 the Commission is expected to publish a proposal for a new Euro VII emission standard for heavy-duty vehicles. Euro VII is Europe's last chance to cut toxic pollution from engines and it cannot be missed. Otherwise Europe will fall behind other major automotive markets such as California which has already set stricter standards for trucks. An ambitious Euro VII could reduce total EU NOx emissions by 4.2 million tonnes by 2050 and avoid 35,000 premature deaths⁵. To achieve this, the proposal put forward by the Commission at the end of the year must be **a comprehensive revision of the outdated Euro VI standard, reducing pollution under all driving conditions to the lowest levels.**

To assist, the European Commission assigned a cross European consortium of vehicle emission experts known as CLOVE to investigate how the EU heavy-duty emissions regulation could be improved. For over two years CLOVE investigated air pollution issues in the latest vehicles, assessed the effectiveness of Euro VI and explored the potential and feasibility of new exhaust emission control technologies to enable the introduction of new emission limits and test conditions to further reduce emissions. This resulted in Euro VII proposals put forward in April by CLOVE which include **lower emission limits for all regulated pollutants, extension of driving**

⁴ T&E. (2021) [Easy Ride: why the EU truck CO2 targets are unfit for the 2020s](#).

⁵ ICCT. (2021) [Comments to the European Commission on the development of Euro 7/VII pollutant emissions standards for cars, trucks and buses](#).

conditions covered by on road tests, enhanced durability requirements, regulation of additional pollutants including small particles and on-board emissions monitoring (OBM)⁶.

T&E recommendations for a new Euro VII standard

For Euro VII to be successful in reducing heavy-duty emissions to the lowest possible levels **all aspects proposed by CLOVE need to be introduced together as a comprehensive package of measures**. Anything less, such as a limited revision of Euro VII which, for example, only reduces pollutant emission limits while disregarding improvements to durability or testing conditions will do little to improve vehicle’s real world emissions performance. In its upcoming Euro VII proposal the Commission should prioritise the following key aspects and further build on the ambition set by CLOVE to ensure that Euro VII delivers the cleaner air that Europe deserves:

- 1. Reduce emission limits to the lowest levels technically possible.** Only the lowest emission limits will ensure that the best available emission control technology such as double AdBlue dosing and exhaust pre-heating is fitted to new trucks and buses to reduce emissions to the lowest technically possible levels.

a) As a minimum the new Euro VII limits put forward by the Commission should be aligned with the most ambitious limits proposed by CLOVE (table below)⁷.

Pollutant	Nitrogen oxides (NOx)	Particle number (PN)	Particulate Mass (PM)	Carbon dioxide (CO)	Non-methane organic gases (NMOG)	Ammonia (NH3)
Euro VI	460 mg/kWh	6x10 ¹¹ /kWh inc. all >23 nm PN	10 mg/kWh	4000 mg/kWh	160 mg/kWh ⁸	10 ppm
Euro VII	90 mg/kWh	1x10¹¹ /kWh inc. all >10nm PN	8 mg/kWh	200 mg/kWh	50 mg/kWh	65 mg/kWh

b) Cold start NOx emissions requirements (i.e. emissions when the engine is first started) need to be strengthened in order to reduce emissions to the lowest technically feasible

⁶ As presented to the Advisory Group on Vehicle Emission Standards (AGVES) on the 8th and 27th of April 2021. Proposals put forward by CLOVE can be accessed within the library of AGVES on the European Commission’s [CIRCABC](#) website.

⁷ 90th percentile, hot engine emission limits for diesel. Separate limits have been proposed for cold start and low load, low speed operation (100th percentile limit). As presented by CLOVE to the Advisory Group on Vehicle Emission Standards (AGVES) on the 27th of April 2021. Proposals put forward by CLOVE can be accessed within the library of AGVES on the European Commission’s [CIRCABC](#) website.

levels, especially since high cold start emissions can often occur in urban areas. A further reduction of the diesel NO_x cold start (100th percentile) limit from the 175 mg/kWh currently proposed closer to 100 mg/kWh should be considered.

c) The Commission must ensure that the cold start NO_x emission requirements for gas trucks (LNG/CNG) are aligned with the most ambitious proposals for diesel and based on what is achievable with the best available technology including exhaust pre-heating. Technology neutral limits will ensure that gas trucks do not receive an unfair license to pollute.

2. Regulate all pollutants which are harmful to human health and the environment and can be effectively regulated at the tailpipe. These include small particles and the potent greenhouse gas nitrous oxide (N₂O).

3. Improve testing, approval and certification of vehicles to make sure buses and trucks meet emission limits whenever and wherever they are driven.

a) As a priority this must ensure limits must be met when driving in towns and cities.

b) 'Normal' on-road test boundary conditions, during which normal emission limits apply, must include all driving conditions which occur normally and regularly in EU Member States. In the Commission's upcoming proposals 'normal' on-road test temperature boundaries should be extended to include all temperatures regularly experienced in the EU, between -10 to 40 °C.

c) Loopholes which allow heavy-duty vehicles to emit more than the emission limits on the road cannot have a place in the upcoming proposal. This includes the so-called 'reference power correction' proposed by CLOVE's which would allow trucks to emit more than the limits during low load, low speed driving which typically occurs in cities and urban areas.

4. Ensure that emission limits are met throughout the lifetime of the vehicle. As a minimum this should require new large trucks (>16 tonnes) to meet the emission limits for the first 1.3 million km instead of the currently proposed 1.2 million km. This would align EU requirements with the ambitious new truck standards in California.

The technology needed for heavy-duty vehicles to meet the CLOVE proposed Euro VII standard is already available and is affordable. New emissions standards for trucks already set in California require more ambitious NO_x emission and durability improvements, the technical feasibility of which have been extensively exhibited with demonstrator vehicles. In terms of cost, the estimated increase in the total cost of ownership of a 40 tonne diesel truck in Germany, in 2025, due to Euro

VII will be limited to between 0.4-0.8% over a five year period⁸ indicating that the cost of cleaner trucks is not prohibitive.

Without an ambitious and comprehensive Euro VII standard in 2025, unnecessarily polluting buses and trucks will continue to be sold and remain on the EU's roads for at least another quarter of a century. For the sake of its citizen's health and the environment, the EU cannot afford to miss its last opportunity to clean up toxic pollution from internal combustion engines. It is now in the Commission's hands to bring forward an ambitious proposal at the end of the year and prove that the EU is committed to the zero pollution promises made in the Green Deal.

⁸ Analysis based on T&E's heavy-duty TCO model as detailed in T&E. (2020) [How to decarbonise long-haul trucking in Germany](#) with assumed additional Euro VII aftertreatment costs as detailed in ICCT. (2021) [Estimated cost of diesel emissions control technology to meet future Euro VII standards](#): €1,400-€4,300, a durability requirement increase to 1.3 million kilometers is assumed for all scenarios with an additional cost of €1,000.

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1. Introduction

Air pollution is the largest environmental health risk in Europe causing a wide range of health issues including respiratory diseases, increased asthma attacks and premature deaths - disproportionately affecting those who are vulnerable including children, the elderly as well as those who are economically disadvantaged. Despite decades of tailpipe pollution limits, heavy-duty vehicles i.e. trucks and buses are still a large contributor to the air pollution crisis. In Europe's big cities, trucks today contribute to between 12-26% of transport nitrogen oxide (NOx) emissions - the pollutant at the heart of the dieselgate scandal. Buses and coaches contribute another 9-14%⁹. In total heavy-duty vehicles represent just 2.4% of EU road vehicles¹⁰ but together contribute up to 40% of total NOx emissions¹¹.

Road transport overall, remains the main source of toxic NO₂ (nitrogen dioxide) emissions and the third largest source of PM_{2.5} (particulate matter smaller than 2.5 microns)¹². Air pollution is particularly bad in traffic choked cities with many EU cities still exceeding the previous World Health Organisation's (WHO) Air Quality Guidelines. New WHO guidelines, published in September 2021, further recommended reductions in NO₂ and PM_{2.5} air concentrations of 70% and 80% respectively, compared to today's EU Air Quality limits¹³. As one of air pollutants biggest contributors, reductions of pollutant emissions from road transport will be required for the EU's towns and cities to meet the new WHO limits.

The first regulation to reduce toxic pollution from heavy-duty vehicles, known as Euro I, came into force in 1992. Since then there have been 5, progressively more stringent, emission standards for trucks and buses. The latest, Euro VI, first entered into force in 2013 and on-paper was a significant improvement on the previous Euro V standard largely due to the introduction of on-road testing, more representative laboratory based tests, introduction of particle number emission¹⁴ and ammonia limits as well as the extension of durability requirements.

However, while emissions from individual trucks have decreased with the introduction of the Euro VI, loopholes still present in the regulation mean that Euro VI trucks still do not always meet emission limits on the road. Remote sensing conducted in Spain between 2017-2019 found that around a third of Euro VI trucks could be exceeding the nitrogen oxide (NOx) emission limit when driving on the road¹⁵. Current tests (laboratory and on the road) fail to fully cover many normal on-road driving conditions including cold-start (when the engine is first turned on) or low-load, low speed driving - typical driving conditions in many towns and cities. Recent on-road testing of Euro VI trucks has shown that this can lead to NOx

⁹ Based on Berlin, Budapest, Madrid, Paris and Brussels. Air Quality Consultants. (2021) [Covid-19, Air Quality and Mobility policies: Six European Cities](#).

¹⁰ ICCT. (2021) [ICCT's Roadmap Model Documentation \(version 1.6\)](#).

¹¹ European Commission. (2018, 05, 17) Impact Assessment: Proposal for the Regulation of the European Parliament and of the Council setting CO₂ emission performance standards for new heavy-duty vehicles.

¹² EEA. (2020) [Air quality in Europe](#).

¹³ WHO. (21st of September 2021). [Ambient \(outdoor\) air pollution](#).

¹⁴ Known as PM number in the heavy-duty regulation.

¹⁵ T&E. (2021) [A third of Euro VI trucks are still high emitters](#).

emission which are up to eight times higher than the Euro VI limits¹⁶. Such results indicate that the emission control systems fitted to trucks are designed to meet emission limits under conditions covered by official tests and not for delivering good overall emissions performance under all driving conditions. These loopholes remain present even in the latest Step (E) of the Euro VI regulation which fully enters into force in 2021. Step E only requires slight improvements in the cold start performance of Euro VI trucks and enforces the on-road particle number (PN) limit.

In addition, Euro VI fails to ensure lifetime emissions durability. Even the biggest long-haul trucks only need to comply with emissions limits for the first 700,000km of the vehicle's life. In reality the average lifetime of this type of truck is more than double that at 1.47 million km¹⁷. It also fails to prevent tampering with emission critical systems such as the disablement of AdBlue dosing for selective catalytic reduction (SCR) systems. A recent remote sensing campaign in Denmark found that 61% of high emitting trucks had been tampered¹⁸ resulting in huge NOx emission on the road. Euro VI also fails to regulate many pollutants which are dangerous to human health or the environment such as toxic small particles or the greenhouse gas nitrous oxide.

The shortfalls of the Euro VI regulation combined with the negative impact that heavy-duty vehicles continue to have on air quality in Europe means that another Euro standard which reduces emissions from trucks and buses is urgently needed. Such a standard should ensure compliance wherever and whenever a vehicle is driven, throughout its lifetime. Technological progress since Euro VI was agreed upon more than a decade ago means that lower emission limits are feasible. Already a much lower, than Euro VI, heavy-duty emission standard has been agreed upon in California which slashes NOx emissions from trucks by up to 90%, including reducing their emissions during urban driving. This is possible due to new technology such as cylinder deactivation or dual Adblue dosing for selective catalytic reduction (SCR) dosing.

In 2020, T&E published its position paper¹⁹ outlining key principles and recommendations for a new vehicle emission standard known as post-Euro VI or 'Euro VII'. This new policy brief is an update on T&E's position. It includes new emissions results of a Euro VI D IVECO diesel truck tested on-road under a range of driving conditions, including city driving. The results highlight why a new Euro standard for heavy-duty vehicles is needed. The briefing also zooms in on aspects of CLOVE's (Consortium for ultra Low Vehicle Emissions working on Euro 7 on behalf of the Commission) Euro 7 proposal for cars and vans that should be strengthened in the upcoming Commission proposal expected by the end of this year to deliver the clean air benefits that Europe needs.

¹⁶ ICCT. (2020, 11, 26) Findings from recent ICCT research on vehicle emission standards. Presentation to the Advisory Group on Vehicle Emission Standards.

¹⁷ ICCT. (2018) [European heavy-duty vehicles: cost-effectiveness of fuel efficiency technologies for long-haul tractor-trailers in the 2025-2030 timeframe.](#)

¹⁸ Danish center for Environment and Energy. (2020) [Control of SCR-systems using roadside remote sensing.](#)

¹⁹ T&E. (2020) [Road to Zero: the last EU emission standard for cars, Vans, buses and trucks.](#)

2. The tests

At the beginning of 2021, T&E commissioned TU Graz to undertake on-road testing of the latest IVECO Euro VI D long-haul diesel truck (Figure 1). The aim was to measure its pollutant emissions under a range of different driving conditions including those not currently covered by official tests.



Figure 1: The IVECO Euro VI D diesel truck tested by T&E.

The truck was tested on 3 different tests:

1. Official test: A route fully compliant with Euro VI D in-service conformity testing requirements used for checking the legal compliance of trucks with European emission standards on the road.
2. Supermarket delivery test: This test mimics regional deliveries for supermarket re-supply operations.
3. City driving test: Covers low speed, low load driving typical in cities and towns that is not covered by official EU tests. A similar test has been introduced in California for ensuring low emissions in urban areas.

The following regulated pollutant emissions were measured: nitrogen oxides (NO_x), carbon monoxide (CO), hydrocarbons (HC), methane (CH₄) and particle number (PM number) emissions of particles larger than 23 nm. Currently unregulated emissions of 10-23 nm particle number emissions were also measured.

All tests started with a cold engine after the vehicle was left parked outside overnight. Further details on the truck and the tests are available in Annex 1.

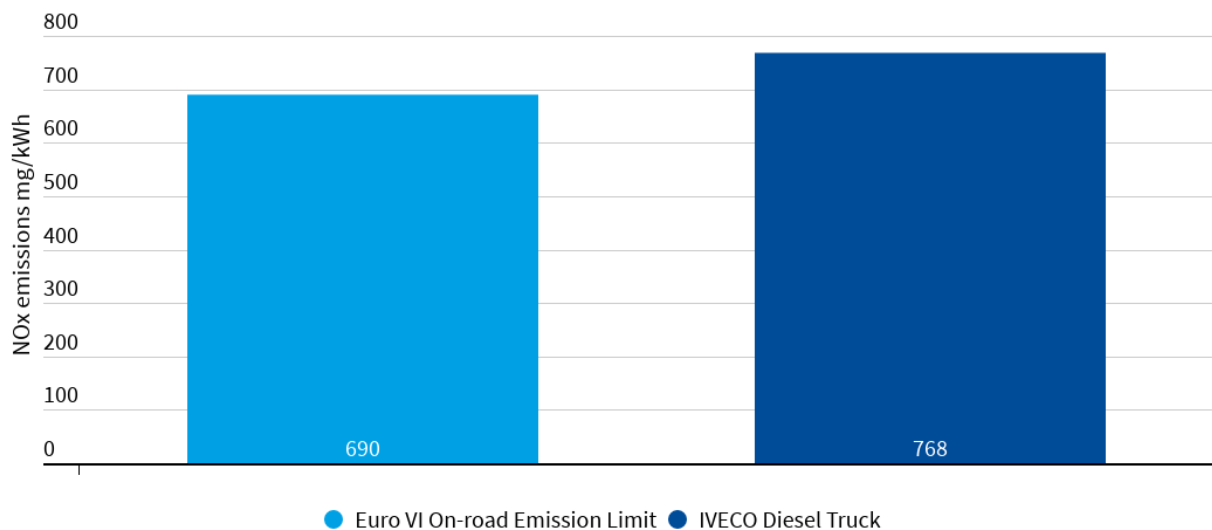
3. The truck was non-compliant with EU NO_x emission limits

The official test was fully compliant with the Euro VI D regulation. This means that the emissions measured during this test can be directly checked for compliance with Euro VI limits. The emissions measured were post-processing using the official EU EMROAD moving average window tool as required by

the Euro VI D regulation²⁰. This tool excludes emissions measured when the truck is driving in conditions not covered by the Euro VI D standard such as cold start emission i.e. emissions released when the engine is first turned on²¹ or when the engine is working at less than 10% of its rated power. This often means that the official emissions used to check compliance with Euro emission limits is often less than what the truck actually emits on the road.

Despite the Euro VI D regulation excluding many of the highest on-road emissions from inclusion in the final test, such as cold start, **the NOx emissions of the diesel truck were above the Euro VI on-road emission limit of 690 mg/kWh²²**. Overall, the IVECO truck emitted 768 mg/kWh, exceeding the limit by 11% (figure. 2), meaning that this truck is **non-compliant with the Euro VI D regulation**. Emissions of the other regulated pollutants (CO, HC, PN and CH4) were within the Euro 6 limits.

Official on-road compliance test NOx emissions



Source: FVT (2021)



Figure 2: NOx emissions results of the official compliance test. The truck is non-compliant with Euro VI limits on the road.

These results highlight that even trucks that are certified to the Euro VI D emission can still be highly polluting with this particular truck failing to comply with the NOx emissions limits on the road. Non-compliance with NOx limits is highly concerning for air quality as nitrogen dioxide (NO₂, a

²⁰ (EU) 2018/932

²¹ Emissions measured before the coolant temperature reaches 70 °C are excluded for Euro VI D, 30 °C for Euro VI E.

²² The 460 mg/kWh World Harmonised Transient Cycle (WHTC) multiplied by a 1.5 conformity factor.

component of NO_x²³) causes a range of serious health effects including inflammation of the airways, reduced lung function and worsened asthma²⁴. Across the EU NO₂ pollution is responsible for over 50,000 premature deaths every year²⁵. Trucks which still fail to comply with emission limits on the road are actively contributing to the health crisis caused by air pollution.

4. Results of the supermarket delivery test.

The supermarket delivery test represents a typical supermarket re-supply operation. The test is not compliant with the in-service conformity testing requirements of Euro VI D due to the trip composition. However, while non-compliant, the test does represent typical supermarket delivery trips undertaken by these trucks in the EU as the test was designed by FVT based on the VECTO regional delivery cycle developed by the Commission for certification of EU regional delivery trucks for CO₂ emissions. The results of the supermarket delivery test presented in this section are raw emission results only, as what actually matters for air quality are the emissions of the truck on the road and not on-paper compliance. As such, the results presented in this section include all pollution emitted from the truck on the road and includes emissions excluded in ISC tests such as those emitted during cold start..

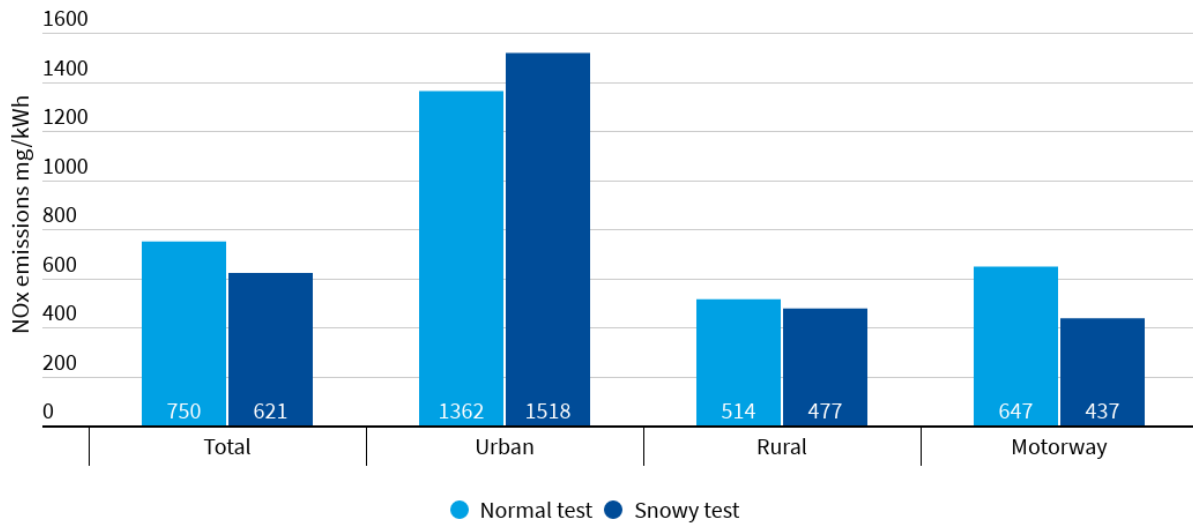
Due to snow on the road during the test, the average speed of the first supermarket delivery test attempted was lower than planned (for more details see Annex 1). Therefore, the test was repeated again when road conditions improved. Overall, CO, HC, CH₄ and PM number emissions were below the Euro VI limits during both tests including when the emissions were divided into urban, rural and motorway driving . However, the NO_x emissions performance of the truck was much worse (Figure 3).

²³ NO, also emitted from truck exhausts, is also converted to NO₂ in ambient air.

²⁴ American Lung Association. <https://www.lung.org/clean-air/outdoors/what-makes-air-unhealthy/nitrogen-dioxide>
Accessed 21/08/2021

²⁵ EEA. (2020) [Air quality in Europe](#). EU 27 + UK

Supermarket delivery NOx emissions



Source: FVT (2021)

Figure 3: Raw NOx emission results of the two on-road supermarket delivery tests.

NOx emissions during rural and motorway driving were below the Euro VI emission limit. However, urban NOx emissions were much higher at 1,362 - 1,518 mg/kWh, exceeding the Euro VI limit on both tests by at least double. The high urban NOx emissions during the normal supermarket delivery test resulted in average on-road emissions on this test exceeding the Euro VI emission limit²⁶. These results indicate that while the performance of this diesel truck is adequate during rural and motorway driving, the truck still has very high emissions during urban operation.

5. Results of the city driving test

The city driving test assesses the trucks performance during challenging city driving conditions like low speed driving, idling and some short motorway driving which can take place when the truck is driving on higher speed roads in cities such as ring roads. This style of driving is not covered by official on-road tests, but occurs in normal use and previous tests have shown that emissions of Euro VI trucks can be high during such operation²⁷. As per the supermarket delivery test, the emission results presented for the city driving test are raw emission results.

²⁶ However, this does not mean that, based on this test, the truck was non-compliant with Euro VI regulation as this was not an official in-service conformity test and the results were not post-processed as required by Euro VI (to exclude conditions such as cold start).

²⁷ ICCT. (26th of November 2020) Findings from recent ICCT research on vehicle emission standards. Presentation to the Advisory Group on Vehicle Emission Standards.

5.1. Failure of the NOx emission control system

During the first attempt at the city driving test the Adblue dosing for the selective catalytic reduction (SCR) system - critical for NOx emission control - failed, indicated by a light (activated MIL) on the dashboard. The test was stopped and the truck was driven on the motorway, this purged the Adblue system and fixed the issue.

Emissions measured prior to the termination of the test show that the lack of AdBlue dosing lead to incredibly high on-road NOx emissions. Average urban emissions were 7,585 mg/kWh, 11 times higher than the on-road NOx limit and motorway emissions were even higher at 9,454 mg/kWh or 14 times higher than the limit. IVECO Euro VI diesel engines are not fitted with exhaust gas recirculation (EGR) technology, the truck solely relies on the SCR to reduce NOx emissions²⁸. When this fails, as it did on this test, the NOx emissions coming out of the tailpipe are untreated and not reduced in combustion through EGR.

Such poor NOx emissions performance from a Euro VI D truck is alarming, especially since there was no obvious cause for the malfunction. While the ambient temperature on that day was low (-1 °C)²⁹, Euro VI D requires trucks to meet on-road emission limits down to -7 °C so the truck emission control system should be designed to cope with such temperatures. On top of that the truck had reached only one third of its Euro VI emissions durability requirement of 700,000km, meaning that the emission control system should be functioning well.

Overall, the failure indicates poor emission control system design and potential durability issues which fail to reduce emissions to below legal limits under all driving conditions, which is what is required to minimise the impact of truck pollution on air quality in Europe. Given the large emissions impact of such failures, the Commission and the Italian Type-Approval Authority which approved the truck for sale should investigate the incidence rate and cause of the failure in IVECO diesel trucks further. Alongside this a activated MIL light on the dashboard should prompt every driver to a repair garage as soon as possible in order for the issue to be fixed quickly and minimise its impact on air quality.

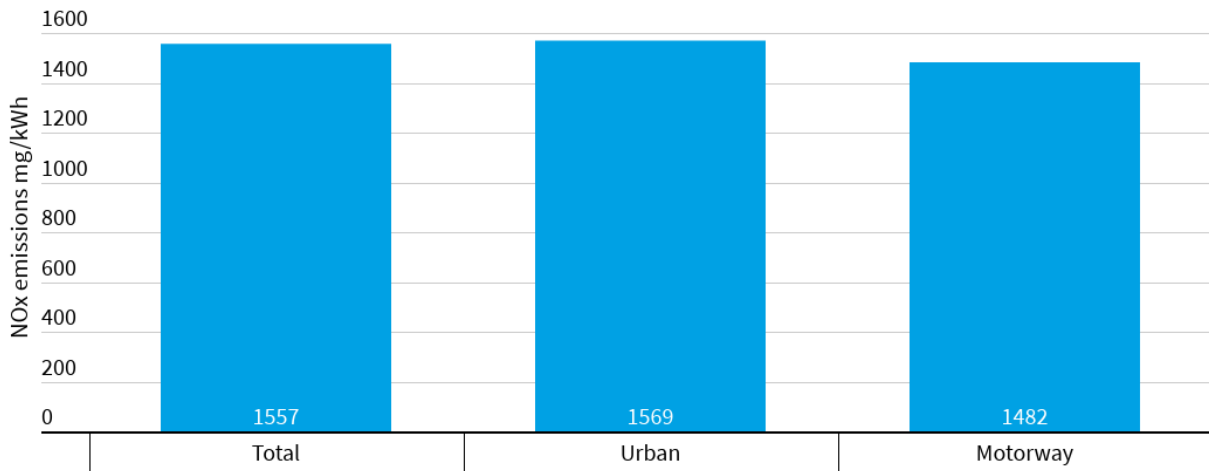
5.2. Poor NOx emissions in city driving

The city driving test was repeated the following day with no further problems, however the NOx emissions measured during this test were still more than double the NOx emission limit, indicating that the truck generally has poor emission's performance in city driving (Figure 4). The truck emitted on average 1,557 mg/kWh during the entire test and 1,569 mg/kWh, when driving on city roads. This indicates that the Euro VI emission limits fail to ensure low emissions when driving in cities.

²⁸ IVECO. (2016, 04, 26) [IVECO HI-SCR system-the most efficient Euro VI technology](#).

²⁹ The overnight temperature was above 11.5 °C and consequently a frozen Adblue tank could not be the reason for the malfunction as AdBlue freezes at -11°C.

City driving test NOx emissions



Source: FVT (2021)

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Figure 4: Raw NOx emission results of city driving test.

6. Summary of emission test results and discussion

Despite the Euro VI requirements to check on road emissions compliance both at type-approval and of in use trucks, the results show that Euro VI D trucks can still be non-compliant with emissions limits on the road. T&E's tests show that the IVECO Euro VI D diesel truck tested does not comply with the nitrogen oxide (NOx) emission limit on the road, as checked on an EU on-road test. A failure of the emission control system on another test, led to NOx emissions of up to 14 times the legal limit, indicating that the truck may have design or durability flaws. High NOx emissions, of more than double the Euro VI limit, measured during urban driving on two other in-use tests, demonstrates that the Euro VI emission standard is inadequate at ensuring that trucks comply with the Euro VI emission limits wherever and whenever they are driven.

Unlike the Euro 6 emissions regulation for cars and vans which requires independent in-service conformity testing by the Commission and Member States, truck in service compliance testing is in the hands of truck manufacturers. Such a system is not objective and fails to provide independent scrutiny of how trucks actually perform on the road, resulting in trucks -such as the IVECO truck tested- which do not comply with emission limits. In addition, Member States which are required to run market surveillance activities, rarely test heavy-duty trucks further compounding the problem.

Shortcoming of the on-road testing procedure such as a failure to apply emission limits to urban operation (as is applicable to cars and vans), to fully cover cold start (i.e. emissions when the engine is first turned on) or low, load low speed operation, typical of city driving, due to a minimum engine load requirement of 10% on tests, mean that trucks can exceed emission limits when driving in towns and

cities. A recent study showed that in cities trucks can exceed the emission limit by up to eight times³⁰. While the final step of the Euro VI regulation, known as Step E entered into force in 2020/21 for diesel trucks, it is not expected to significantly improve their on-road emissions performance as Step E only introduces the requirement for particle number emissions to be regulated on the road and slightly increases the coverage of cold start emissions. Yet even then cold start is still not fully covered and other loopholes such as the minimum load requirement remain.

The failures of the Euro VI regulation mean that another emission standard for heavy-duty vehicles is urgently needed to ensure trucks actually meet on road emission limits and to further reduce the negative impact trucks and buses have on air quality in the EU. Such a standard, known as post Euro VI or Euro VII has been under development since 2018 by the European Commission. The new regulation is an integral part of the EU's Green Deal, Sustainable and Smart Mobility Strategy and Zero Pollution Action Plan. The draft regulation is expected to be published by the Commission by the end of 2021.

The next section of the policy brief provides recommendation for the new emissions standard and zooms in on aspects of CLOVE's (Consortium for ultra Low Vehicle Emissions working on Euro VII on behalf of the Commission) Euro VII proposal for trucks and buses, presented in April this year, that should be strengthened in the upcoming Commission proposal to deliver the clean air benefits that Europe needs.

7. Summary of CLOVE Euro VII proposals

As part of the Euro VII policy development process, the Commission assigned a cross-European consortium of vehicle emission experts known as CLOVE to investigate how the EU vehicle emissions regulation could be improved. For over two years CLOVE has been investigating air pollution issues in Euro VI trucks and buses, assessing the effectiveness of the Euro VI regulation including on-road Portable Emissions Measurement System (PEMS) testing and exploring the potential, costs and feasibility of new exhaust emission control technologies to set new emission limits and test conditions to further reduce emissions from road transport.

In April of this year CLOVE presented to the Commission's Advisory Group on Vehicle Emissions Standards (AGVES) the results of their work. This included proposals for a wide range of changes to the truck and bus emissions regulations, among many suggested improvements:

- **Lower emission limits** with separate provisions for cold start (i.e. when the engine is first started) and low speed, low load driving.

³⁰ ICCT. (26th of November 2020) Findings from recent ICCT research on vehicle emission standards. Presentation to the Advisory Group on Vehicle Emission Standards.

Table 1: Euro VI and proposed CLOVE Euro VII (90th percentile) currently regulated pollutant emission limits which would apply once the engine is hot.

Pollutant	NOx (mg/kWh)	PN (#/kWh)	PM (mg/kWh)	CO (mg/kWh)	NMOG (mg/kWh)	NH3
Euro VI	460	6x10 ¹¹ inc. all >23 nm PN	10	4000	160 ³¹	10 ppm
CLOVE Diesel Scenario 1	90	1x10 ¹¹ inc. all >10nm PN	8	200	50	65 mg/ kWh
CLOVE Diesel Scenario 2	90	1x10 ¹¹ inc. all >10nm PN	8	200	50	50 mg/kWh

- **Regulation of additional pollutants** including very small 10-23nm particle number emissions, the greenhouse gas nitrous oxide (N2O) as well as the introduction of the non-methane organic gases (NMOG) limit instead of the current non-methane hydrocarbon limit in order to cover a wider range of organic pollutants.
- **New testing requirements** which cover a wider range of on-road driving conditions as part of PEMS testing than required for the latest Euro VI vehicles including during urban driving. (table 2).

Table 2: Summarised Euro VI and CLOVE Euro VII proposed on road test boundaries.

Parameter	Euro VI boundaries	Euro VII normal boundaries	Euro VII extended boundaries
Temperature (°C)	-7 to 35 °C	-7 to 35 °C	-10 to +45 °C
Maximum altitude (m)	1600	1600	2200
Auxiliaries	None	As per normal use	As per normal use
Min trip (kWh)	4x laboratory WHTC test	No restriction	No restriction

³¹ Regulated as non-methane hydrocarbons for Euro VI. New non-methane organic gases (NMOG) will cover a wider range of organic pollutants.

Payload	10-100%	0-100%	0-100%
Engine load (kW/kW_{rated})	>10% per window	All	All
Windows which comply with limits	90%	90% (lower limit) 100% (higher limit)	As per normal conditions but limits x2

- **Enhanced durability requirements** increase the period during which emission limits must be met and in-service conformity testing can be performed. For large long-haul trucks this will increase from 700,000km to 1.2 million km.
- **Introduction of on-board monitoring (OBM) of pollutants** to constantly monitor tailpipe concentrations of pollutants using sensors and models to verify compliance with limits and detect tampering thus aiding emissions compliance monitoring.

Based on CLOVE’s research and proposals as well as the work of the Commission’s Joint Research center and independent studies, the Commission is expected to publish a draft Euro VII regulation along with an Impact Assessment at the end of this year.

8. A strong emission standard is at risk

While CLOVE’s proposals are a significant improvement on the current Euro VI regulation, the biggest risk for cleaner air remains that, pushed by the automotive industry which has been vocal in their opposition to Euro VII³², the European Commission decides to not proceed with a new Euro standard. This would be bad news for air quality as the transition to zero emission mobility is simply not happening fast enough to make a new Euro standard obsolete. T&E forecasts, based on truck maker announcements that in 2025 (when Euro VII should enter into force) 93% of trucks sold in the EU will still have a polluting internal combustion (ICE) engine. Even in 2030 more than half of newly registered trucks will have an ICE³³.

With such high continuing ICE truck sales, more needs to be done to reduce their emissions. The latest research shows that an ambitious Euro VII³⁴ could reduce total NOx emissions by 4.2 million tonnes by 2050, in total avoiding 35,000 premature deaths and 568,000 years of life lost across the EU³⁵. If the Commission fails to bring forward a proposal, the EU would miss the last opportunity to reduce ICE emissions and make improvements to air quality, human and environmental health. If the EU is serious about its commitment to the recently published Zero Pollution Action Plan, which includes reducing pollution from transport, it should not allow this to happen.

³² ACEA. (2020) [Views on proposals for Euro 7 emission standard](#).

³³ T&E. (2021) [Easy Ride: why the EU truck CO2 targets are unfit for the 2020s](#).

³⁴ For both heavy and light-duty.

³⁵ ICCT. (2021) [Comments to the European Commission on the development of Euro 7/VII pollutant emissions standards for cars, trucks and buses](#).

Another risk is that the Commission decides to make minimal cosmetic changes to Euro VI, such as proposing only small reductions to emission limits. These changes would appear to be an improvement on paper but in reality, would result in minimal real world emissions reductions. The Commission could also choose to only implement some of the improvements proposed by CLOVE for example by reducing limits but not improving durability or testing requirements. This would result in a new regulation riddled with the same loopholes as Euro VI again bringing about only very limited improvements to truck emissions.

To be effective in driving large reductions in emissions from trucks that the EU needs, Euro VI must include a wide range of measures that tackle the emission issues faced by Euro VI trucks today. Since the Commission plans for Euro VII to be the last emission standard for internal combustion engines it must ensure that the standard tackles all loopholes left behind by Euro VI and reduces pollution from trucks and buses to lowest feasible levels. There is no more time to bring in small incremental changes as with previous Euro standards. Euro VII needs to be a full overhaul of the current regulation and must bring in all of the most ambitious aspects proposed by CLOVE. As already covered in T&E's Euro VII position paper published last year³⁶ this requires Euro VII to:

- 1. Set the truck and bus emission limits to the lowest levels technically possible.**
- 2. Regulate all pollutants which are harmful to human health and the environment and can be effectively regulated at the tailpipe.** This includes smaller than 23nm particles, formaldehyde, non-methane organic gases and the greenhouse gas nitrous oxide.
- 3. Improve testing, approval and certification of vehicles to make sure buses and trucks meet emission limits whenever and wherever they are driven.** This should be achieved by extension of on-road testing to all possible driving conditions that can be encountered on the EU's roads including, critically, more effective control of urban emissions.
- 4. Ensure that emission limits are met throughout the lifetime of the vehicle.** This must include independent in-service conformity testing throughout the lifetime of the truck and should include an extension of the emissions durability to a minimum 1.3 million km. On-board emissions monitoring (OBM) technology should also be introduced to aid with compliance monitoring. Remote sensing for fleet emissions monitoring should also be considered.

Implemented together with a new Euro 7 emission standard for cars and vans, this will ensure that pollution from road transport is reduced to the lowest feasible levels.

Overall, T&E welcomes CLOVE's proposals for Euro VII which are an improvement on Euro VI and tackle many of the standard's loopholes and shortfalls such as emission limits only applying under a narrow range of driving conditions or for less than half of a typical truck's lifetime³⁷. If all of the most ambitious

³⁶ T&E. (2020) [Road to Zero: the last EU emission standard for cars, vans, buses and trucks](#).

³⁷ Average lifetime mileage of a long-haul truck is 1.47 million km in the EU. Source: ICCT. (2018) [European heavy-duty vehicles: cost effectiveness of fuel efficiency technology for long-haul tractor trailers in the 2025-2030 timeframe](#). Euro VI requires emissions durability for 700,000 km.

aspects of CLOVE's proposals are included as a combined package within the Commission's upcoming Euro VII proposal there would be a significant reduction in pollutant emissions from internal combustion engines. However, despite the improvements, some areas still lack the necessary ambition required to bring emissions from internal combustion engines down to the lowest technologically feasible levels and thus the greatest air quality benefits. The next part of the briefing provides recommendations on how CLOVE's proposals can be further strengthened to provide the most robust Euro VII regulation.

9. Emission limits

More stringent pollutant emission limits than in force today are required for all pollutants emitted from internal combustion engines, which are harmful to human health or the environment, and can be effectively regulated at the tailpipe in order to improve air quality and reduce the impact that heavy-duty vehicles have on human and environmental health. In order to drive the largest air quality improvements the lowest technically feasible emission limits should be introduced for Euro VII.

As part of the Euro VII, CLOVE proposed to introduce 3 separate heavy-duty emission limits for each regulated pollutant as opposed to just one emission limit applicable to Euro VI. This includes a cold start 100th percentile emission limit which would control emissions when the engine is first turned on, a lower 90th percentile emission limit which would apply once the engine is hot (as shown in table 1) and a 3 x WHTC limit, which would apply over the distance equivalent to the engine work done over the three World Harmonised Transient Cycle (WHTC) tests regulating cold start and low load, low speed driving.

9.1 Cold start (100th percentile) emission limit

Ensuring low emissions during the cold start period, i.e. when the engine is first started and exhaust treatment technologies are still warming up, is very important for air quality as ineffective regulation can lead to very high emission during this period. CLOVE proposes to predominantly regulate cold start emissions through a separate 100th percentile emission limit. Per current proposals, this would allow heavy-duty vehicles to emit more than during hot driving (90th percentile limits).

9.1.1 100th percentile diesel limit

For diesel vehicles CLOVE have proposed two potential emission limit scenario's 1 and 2 with scenario two being the most ambitious for all pollutants (table 3), apart from PM emissions, limits under both scenarios are a reduction compared to Euro VI limits.

Table 3: Euro VI and proposed CLOVE Euro VII cold start (100th percentile) currently regulated pollutant emission limits.

Pollutant	NOx (mg/kWh)	PM number (#/kWh)	PM (mg/kWh)	CO (mg/kWh)	NMOG (mg/kWh)	CH4 (mg/kWh)	NH3
Euro VI ³⁸	460	6x10 ¹¹	10	4000	160 ³⁹	500	10ppm
Euro VII CLOVE diesel scenario 1 ⁴⁰	350	5x10 ¹¹	12	3500	200	100	65 mg/kWh
Euro VII CLOVE diesel scenario 2 ⁴¹	175	5x10 ¹¹	12	1500	75	85	65 mg/kWh

While the reduction in emission limits under both scenarios is welcome, scenario 1 does not go far enough to reduce emissions from internal combustion engines because it does not bring emissions down to the lowest levels technically feasible. At best it is only a minor improvement on the limits that Euro VI heavy-duty vehicles should already have met on the road. For example, for NOx, the Association for Emission Control by Catalysts (AECC) have already shown that a truck fitted with Euro VII emission control technology can emit almost three times less NOx (~130 mg/kWh) during the cold start period⁴². While the test does not cover all possible conditions that the vehicle can encounter on the road it does show that emissions can be reduced much further in normal driving than the CLOVE proposed scenario 1 limits would deliver.

As the Commission expects Euro VII to be the last pollutant emission standard for trucks the minimal pollution emission reduction that should be considered is scenario 2. However, for NOx, the proposed

³⁸ WHTC emission limits, additional conformity factors apply for on-road tests.

³⁹ Regulated as non-methane hydrocarbons for Euro VI. New non-methane organic gases (NMOG) will cover a wider range of organic pollutants.

⁴⁰ Denoted as HD 2 in CLOVE. (27th April 2021) Presentation to the Advisory Group on Vehicle Emission standards. HDV. Available from [CIRCABC](#).

⁴¹ Denoted as HD 3 in CLOVE. (27th April 2021) Presentation to the Advisory Group on Vehicle Emission standards:HDV. Available from [CIRCABC](#).

⁴² AECC. (2021, 02, 24) [AECC contribution to the Euro 7/VII process](#). Presentation to the Advisory Group on Vehicle Emission standards.

scenario 2 emission limit of 175 mg/kWh is still above the new California heavy-duty on road emission limit of 100 mg/kWh which includes cold start emissions even under the most challenging low load, low speed driving conditions. The technical feasibility of the California limit has been extensively demonstrated including by demonstrator vehicles. As such, the Commission should consider a further reduction of the 100th percentile emission limit, closer to 100 mg/kWh in order to drive the adoption and use of best available emission control technologies to their full potential, such as exhaust pre-heating to reduce emissions to the lowest technically feasible.

For Euro VII to drive large improvements in diesel truck and bus cold start emissions the minimum reduction in the 100th percentile emission limit which should be considered is CLOVE scenario 2. For NOx, a further reduction closer to 100 mg/kWh should also be considered.

9.1.2 100th percentile gas limit

To achieve the largest air quality benefit, Euro VII must include the lowest powertrain neutral emission limits, which drive the adoption of the best available technology for all powertrains. In the design of the proposed Euro VII emissions limits CLOVE have considered three different emission control technology packages for diesel heavy-duty vehicles resulting in two different emission limit proposals (CLOVE scenario 1 and 2). The most advanced package for diesel includes a pre-heating system i.e. a diesel burner which allows for the exhaust emission control system to be heated up quickly when the vehicle first starts, resulting in a large reduction in the cold start NOx emissions and therefore a large reduction of the cold start NOx 100 percentile limit (CLOVE scenario 2) compared to an exhaust without the pre-heating technology (CLOVE scenario 1).

However for gas vehicles i.e. LNG or CNG, only one Euro VII technology package was considered by CLOVE for each, without any exhaust pre-heating included. This resulted in only one NOx 100th percentile emission scenario being proposed for LNG and CNG vehicles. Disappointingly set at 350 mg/kWh, this is aligned with the least ambitious proposed diesel limit. It is not clear why no preheating technology has been considered by CLOVE for gas vehicles to further reduce their cold start emissions in line with the most ambitious reductions proposed for diesel. This is especially the case for the high pressure direct injection (HPDI) LNG engine which uses diesel for ignition and for which the proposed Euro VII emission control system is similar to that proposed for diesel under the scenario 1 emission limit.

Table 4: Proposed CLOVE Euro VII cold start (100th percentile) NOx limit for LNG high pressure direct injection (HPDI) and CNG spark ignition (SI) engines.

Pollutant	NOx (mg/kWh)
CLOVE LNG scenario	350
CLOVE CNG scenario	175

A Euro VII which sets different limits for different powertrains is unfair and does not make sense for air quality. Placing more stringent emission requirements on diesel than gas trucks or buses is not consistent with the EU principle of technology neutrality.

Euro VII must require large reductions in emission from both diesel and gas trucks. The Commission must ensure that the gas 100th percentile cold start limit is aligned with the most ambitious limit for diesel and based on what is achievable with the best available technology.

10. Better tests

Despite the introduction of on-road PEMS testing with Euro VI, there are still many normal driving conditions which are not adequately covered by the EU on-road test procedure such as cold start, low load, low speed driving which typically occurs in towns and cities or when the vehicle is empty (i.e. when the vehicle load is less than 10 %). To ensure low emissions wherever and whenever a vehicle is driven, it's important that all possible driving conditions are included in on-road testing as part of Euro VII.

CLOVE's proposal to extend the range of driving conditions covered by the RDE test procedure compared to those applicable to the latest Euro VI Step E vehicles is a big step in the right direction. Under the proposals more driving conditions would be covered under 'normal' RDE driving conditions. This includes improvements such as the removal of a minimum vehicle load requirement of 10%, a minimum test window requirement of 10% engine load and the inclusion of cold start emissions from the first start of the engine and not from when the coolant temperature reached a minimum of 30 °C as is required under Euro VI Step E. However, despite the improvements some tightening adjustments to the proposal are needed.

10.1 Reference power correction

Euro VI trucks struggle with low load, low speed operation which typically occurs in cities and urban areas, independent emissions testing has shown that under such conditions trucks can emit up to 8 times more NOx than the Euro VI limits⁴³. In T&E's test of the IVECO truck, the emissions were even higher at 11 times the limit. The reason for such high emissions during urban operation is partly due to Euro VI on-road testing not requiring emission limits to be met when the engine is at less than 10% of its maximum power⁴⁴. During post-processing of the measures test emissions such results are simply not included, in effect meaning that such driving conditions are excluded from on-road testing.

CLOVE's proposal to regulate pollutant emissions under these previously excluded conditions for Euro VII is welcome. However, the CLOVE proposal also includes plans to artificially lower official pollutant emissions results during low load driving through a so-called 'reference power correction' - which would automatically assume that the truck operates at a minimum 10% of rated power. This would introduce a loophole which allows trucks to emit more when driving in cities under low speed and low load conditions than the emission limits demand.

Removal of the 'reference power correction' would force truck makers to respect the emission limits in city driving. ICCT estimates that this would result in around a third higher NOx emissions performance improvement under cold start conditions and bring the required emissions reduction closer to that required by California's new heavy-duty emission limits⁴⁵.

The Commission should not include the reference power correction in its upcoming Euro VII proposal as this would introduce a loophole which would allow trucks to emit more than the limits during low load and low speed driving allow .

10.2 Temperature boundaries

Under the CLOVE proposals, on road driving conditions which occur frequently in some Member States would fall into the 'extended' on-road test category, allowing heavy-duty vehicles to emit two times the legal pollutant emission limits. Of particular concern are the proposed temperature boundaries.

Table 5: Euro VI and CLOVE Euro VII proposed on road temperature boundaries.

Euro VI	CLOVE proposal
Normal: -7 to 35 °C	Normal: -7 to 35 °C Extended: -10 to 45 °C

⁴³ ICCT. (26th of November 2020) Findings from recent ICCT research on vehicle emission standards. Presentation to the Advisory Group on Vehicle Emission Standards.

⁴⁴ For Euro VI STEP A, B and C this was set at below 20%.

⁴⁵ ICCT. (27th April 2021) Presentation to the Advisory Group on Vehicle emission standards: HDV.

The CLOVE proposed ‘normal’ temperature boundaries fail to cover all temperatures regularly experienced in Member States and are not an improvement on the EURO VI temperature boundaries. In Finland temperatures down to -10 °C are common⁴⁶, as are temperatures in excess of 35°C in Southern Europe during the summer months. These now occur more frequently and are more and more prevalent in the rest of Europe as a result of climate change. Allowing cars to emit double pollution under conditions which are regularly experienced in Europe will be bad for air quality in affected Member States when it’s cold or hot outside.

Trucks and buses should meet the emission limits under all driving conditions in which they are designed to operate and which occur normally and regularly in EU Member States. Only driving conditions which are very rare and extreme should fall in the ‘extended’ on road test category. In the Commission’s upcoming proposals ‘normal’ on-road test temperature boundaries should be extended to include all temperatures regularly experienced in the EU.

11. Durability

For air quality it is important that heavy-duty vehicles respect the emissions limits throughout their entire lifetime and not just during the first few years of use. For as long as a vehicle remains on the road it should obey the emission limits regardless of age or mileage. Lifetime emission durability, market surveillance and in use testing requirements are needed to ensure this. However, at present, the EU has around half the durability requirement for trucks compared to California- who is currently the world leader in regulating truck emissions. The 700,000km required for long-haul trucks under Euro VI covers, on average, less than 7 years of truck use⁴⁷. This falls far short of the average age of a truck in the EU of 12.4 years which rises to as much as 20.9 years in Southern Europe⁴⁸. Low emissions durability requirement disproportionately affects central, eastern and southern Member States which generally have the oldest truck fleets which, generally, fall outside of the Euro VI durability requirements. However, it should be noted that those older trucks can drive and pollute all over Europe.

Table 6: Euro VI and CLOVE Euro VII proposed emission durability requirements.

Euro VI	CLOVE proposal
<p><16 tonnes as well as buses 300,000 km >16 tonnes 700,000 km</p>	<p><16 tonnes as well as buses 700,000 km >16 tonnes 1.2 million km</p>

T&E supports the extension of durability requirements for both small and large heavy-duty vehicles proposed by CLOVE. However, the Euro VII durability requirements proposed for larger trucks (i.e those larger than 16 tonnes) of 1.2 million km still falls short of the average lifetime mileage of long-haul trucks

⁴⁶ CLOVE. (8th of April 2021) Presentation to the Advisory Group on Vehicle emission standards: HDV.

⁴⁷ Based on a 2010 average annual mileage of 103,000km for heavy-duty articulated 24-40t trucks. Source: [TRACCS](#).

⁴⁸ ACEA. (2020) [Automobile industry pocket guide](#).

in the EU which is 1.47 million km⁴⁹ and is not the maximum durability technically feasible. In California the durability requirement for long haul trucks has been extended to 1.3 million km. Durability requirements which fail to cover the full vehicle lifetime, risk exporting the problem of toxic vehicle pollution to less affluent countries, which have older vehicle fleets. Such a regulation would be discriminatory as everyone across the European Union has the same right to breathe clean air and contradicts the EU's Zero Pollution Ambition of reducing pollution at its source.

T&E recommends that the Commission include lifetime emission durability requirements in its upcoming proposal in order to ensure that trucks meet the emission limits throughout their lifetime. As a minimum this should require new large trucks (>16 tonnes) to meet the emission limits for the first 1.3 million km.

12. Costs

The Euro VII proposals put forward by CLOVE are technically feasible and are expected to be affordable. For trucks, compliance would result in a 2-5% purchase price increase compared to the current price of new Euro VI trucks⁵⁰. However, purchase decisions for trucks are primarily driven by the total cost of ownership (TCO) and the purchase price represents only a fraction of the TCO in the truck sector. T&E estimates that the increase in the TCO of a 40 tonne diesel truck in 2025 due to Euro VII in Germany will be limited to between 0.4-0.8% over a five year period⁵¹.

In contrast air pollution from road transport costs EU citizens dearly. In 2016, pollution from trucks alone amounted to over €13 billion in health and other costs⁵². Aside from the monetary costs, it also causes tens of thousands of avoidable, premature deaths a year⁵³. Low emission vehicles - equipped with technology to reduce pollution to lowest technologically possible levels - are urgently needed to reduce these health costs.

13. Conclusion and policy recommendations

A new EU emission standard is urgently needed to reduce pollution from trucks and buses as the Euro VI standard is now outdated and full of loopholes. T&E testing of a Euro VI IVECO truck shows that even Euro VI D trucks still fail to comply with nitrogen oxide (NOx) emission limits on the road and emit large amounts of toxic pollution when driving in cities. The findings highlight that the Euro VI standard is

⁴⁹ ICCT. (2018) [European heavy-duty vehicles: cost-effectiveness of fuel efficiency technologies for long-haul tractor-trailers in the 2025-2030 timeframe.](#)

⁵⁰ ICCT. (2021) [Estimated cost of diesel emissions control technology to meet future Euro VII standards.](#)

⁵¹ Analysis based on T&E's heavy-duty TCO model as detailed in T&E. (2020) [How to decarbonise long-haul trucking in Germany](#) with assumed additional Euro VII aftertreatment costs as detailed in ICCT. (2021) [Estimated cost of diesel emissions control technology to meet future Euro VII standards](#): €1,400-€4,300, a durability requirement increase to 1.3 million kilometers is assumed for all scenarios with an additional cost of €1000.

⁵² EPHA. (2018) [Health impacts and costs of diesel emissions in the EU.](#)

⁵³ EPHA. (2018) [Health impacts and costs of diesel emissions in the EU.](#)

inadequate to control pollution from heavy-duty vehicles and that more needs to be done by the EU to improve on-road performance of these vehicles.

Over a decade of technological progress means that less polluting trucks are already technically feasible. California, for example, has already agreed to much more ambitious emission standards, with tougher tests and required emissions reductions of up to 90%. Now the EU needs to do the same. While truck makers have made commitments to transition to zero emission mobility, the simple fact remains that the transition is not happening fast enough to make a new emission standard obsolete. As of yet there is no proposed phase out date for heavy-duty internal combustion engines and based on truckmaker commitments just 7% of truck sales are expected to be zero emission by 2025⁵⁴.

To bring about a much needed improvement in air quality across Europe and reduce its negative effects on human and environmental health it is critical that the European Commission puts forward an ambitious Euro VII proposal at the end of this year. To be effective in reducing on-road pollution from trucks and buses, the proposal must be a comprehensive revision of the Euro VI standard, closing all loopholes which allow heavy-duty vehicles to exceed emission limits on the road. As a priority the proposals need to:

- 1. Reduce emission limits to the lowest levels technically possible.**
- 2. Regulate all pollutants which are harmful to human health and the environment and can be effectively regulated at the tailpipe.** This includes smaller than 23nm particles, formaldehyde, non-methane organic gases and the greenhouse gas nitrous oxide.
- 3. Improve testing, approval and certification of vehicles to make sure buses and trucks meet emission limits whenever and wherever they are driven.** This should be achieved by extension of on-road testing to all possible driving conditions that can be encountered on the EU's roads including, critically, more effective control of urban emissions.
- 4. Ensure that emission limits are met throughout the lifetime of the vehicle.** This must include independent in-service conformity testing throughout the lifetime of the truck and should include an extension of the emissions durability to a minimum 1.3 million km. On-board emissions monitoring (OBM) technology should also be introduced to aid with compliance monitoring. Remote sensing for fleet emissions monitoring should also be considered.

Anything less, such as only a limited revision of the Euro VI standard focusing, for example, on reducing pollutant emission limits while disregarding improvements to other critical aspects of the regulation such as durability requirements or testing conditions will only bring about marginal emission reductions and will fail to bring about the air quality improvements that Europe needs.

New Euro VII proposals put forward in April by the consortium of emissions experts from across Europe known as CLOVE, working on Euro VII on behalf of the Commission, tackle the many shortfalls of the Euro VI regulation. The proposed lower emission limits, extension of driving conditions covered by on-road

⁵⁴ T&E. (2021) [Easy Ride: why the EU truck CO2 targets are unfit for the 2020s](#).

tests, enhanced durability requirements, regulation of additional pollutants including small particles and on-board emission monitoring (OBM) incorporated together will significantly improve the emissions performance of new vehicles. However, to reduce emissions of all pollutants to the lowest technically feasible levels and to ensure the adoption of the best available emission control technology, such as exhaust pre-heating, further tightening of the requirements is needed. In particular:

- 1. The minimum reduction of pollutant emission limits that should be considered for Euro VII must be the most ambitious pollutant emission limits proposed for Euro VII by CLOVE.** Only the lowest limits proposed, will ensure that the best available emission control technology such as double AdBlue dosing for Selective Catalytic Reduction (SCR) needed for NO_x control is fitted to new trucks and buses and toxic pollution is reduced to the lowest possible levels. For regulated pollutants the proposed minimum Euro VII limits are shown in the table below.
- 2. Cold start NO_x emissions requirements (i.e. emissions when the engine is first started) need to be strengthened in order to reduce emissions to the lowest technically feasible levels. , especially since high cold start emissions can often occur in urban areas.**
 - a) A further reduction of the diesel cold start limit closer to 100 mg/kWh should be considered.
 - b) The Commission must ensure that the cold start NO_x emission requirements for gas trucks (LNG/CNG) are aligned with the most ambitious limit for diesel and based on what is achievable with the best available technology including exhaust pre-heating.
- 3. The on road test requirements must be strengthened to ensure emission limits are met under all driving conditions.**
 - a) 'Normal' on-road test conditions, during which normal emission limits apply, must include all driving conditions which occur normally and regularly in EU Member States. Only driving conditions which are very rare and extreme should fall in the 'extended' on road test category which under current proposals would allow trucks to emit double the emission limits. In the Commission's upcoming proposals 'normal' on-road test temperature boundaries should be extended to include all temperatures regularly experienced in the EU, between -10 to 40 °C
 - b) Loopholes which allow heavy-duty vehicles to emit more than the emission limits on the road must not be included in the upcoming proposal. This includes the so-called 'reference power correction' included in CLOVE's proposal which would allow trucks to emit more than the limits during low load, low speed driving which typically occurs in cities and urban areas.
- 4. Durability requirements must be extended to ensure that emission limits are met throughout the entire vehicle lifetime.** As a minimum this should require new large trucks (>16 tonnes) to meet the emission limits for the first 1.3 million km and increase on the currently proposed 1.2 million km. This would align EU requirements with ambitious new truck standards in California.

The Euro VII proposals for trucks put forward by CLOVE are both economically and technically feasible. Emission control technology has progressed significantly since 2009 - when the current Euro VII limits

were agreed upon. New better emission control and engine technology such as cylinder deactivation, exhaust pre-heating with a diesel burner can deliver lower emissions, especially for NOx. For example, new emissions standards for trucks set in California require much lower NOx emissions and higher durability requirements than Euro VI, the technical feasibility of which have been extensively exhibited with demonstrator vehicles.

In terms of cost, for trucks, compliance with new Euro VII limits is estimated to result in a 2-5% purchase price increase compared to the current price of new Euro VI trucks⁵⁵. However, purchase decisions for trucks are primarily driven by the total cost of ownership (TCO) and the purchase price represents only a fraction of the TCO in the truck sector. T&E estimates that the increase in the TCO of a 40 tonne diesel truck in 2025 due to Euro VII in Germany will be limited to between 0.4-0.8% over a five year period⁵⁶. In contrast, air pollution from road transport costs EU citizens tens of billions of euros in health costs⁵⁷.

The Commission's Euro VI proposal expected at the end of this year is the EU's last chance to reduce pollution from internal combustion engines. For the sake of EU citizen's health the Commission cannot afford to be complacent and put forward a weak proposal. Based on truckmaker announcements just 7% of trucks sold in 2025 are expected to be zero emission⁵⁸. For the sake of EU citizen's health the EU needs to ensure that internal combustion engined trucks sold until the full transition to zero emission mobility are as low pollution as technically feasible. Without any action, unnecessarily polluting trucks will remain on the EU's roads for at least another quarter of a century damaging both EU citizens' health and the environment.

Further information

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⁵⁵ ICCT. (2021) [Estimated cost of diesel emissions control technology to meet future Euro VII standards](#).

⁵⁶ Analysis based on T&E's heavy-duty TCO model as detailed in T&E. (2020) [How to decarbonise long-haul trucking in Germany](#) with assumed additional Euro VII aftertreatment costs as detailed in ICCT. (2021) Estimated cost of diesel emissions control technology to meet Euro VII standards: €1,400- €4,300, a durability requirement to increase to 1.3 million kilometers is assumed for all scenarios with an additional cost of €1000.

⁵⁷ EPA. (2020) [Health costs of air pollution in European cities and the linkage with transport](#).

⁵⁸ T&E. (2020) [Easy Ride: why the EU truck CO2 targets are unfit for the 2020s](#).

Annex 1

Truck details

The IVECO truck tested was a N3 tractor trailer with a maximum GVW of 40 tonnes, typically used for regional delivery and long-haul haulage. The vehicle chosen for the testing project was sourced independently of T&E by FVT. In addition to the vehicle specifications detailed in table 7 the truck was equipped with a 12-gear AMT transmission system. Gross vehicle weight was kept constant between tests at a total of 28 tonnes, equal to around 50% of the maximum possible payload.

Table 7: Specification of the IVECO diesel truck tested.

Vehicle	Year of registration	GVW (t)	Payload (t)	Engine (L)	Rated power (kW)	Mileage (km)	Axle and body configuration
IVECO Stralis EURO VI- D	2019	28.0	12.5	11.1	353	216,224	4x2 tractor (Diesel)

On-road tests

Table 8: On-road test specifications.

Test	Distance (km)	Duration (min)	Ambient temperature (°C)	% urban driving	% of rural driving	% of motorway driving	Average engine power (%)
Supermarket delivery test (snowy)	130.3	162.8	3	8.7	22.9	68.4	20
Official test	194.4	211.7	3	14.7	23.8	61.5	21
Supermarket delivery test	130.3	142.2	3	8.7	22.9	68.4	21
City driving test (No Adblue dosing)	25.4	77.6	-1	81.1	0	18.9	12
City driving test	33.5	114.8	-6	85.7	0	14.3	10

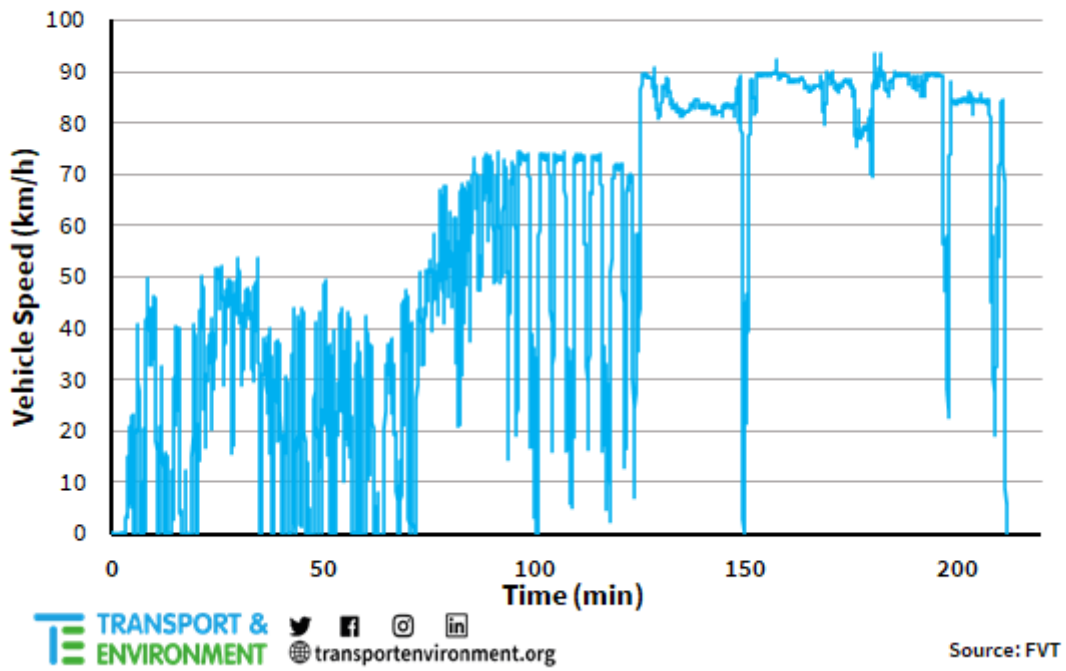


Figure 5: Official on-road test route.

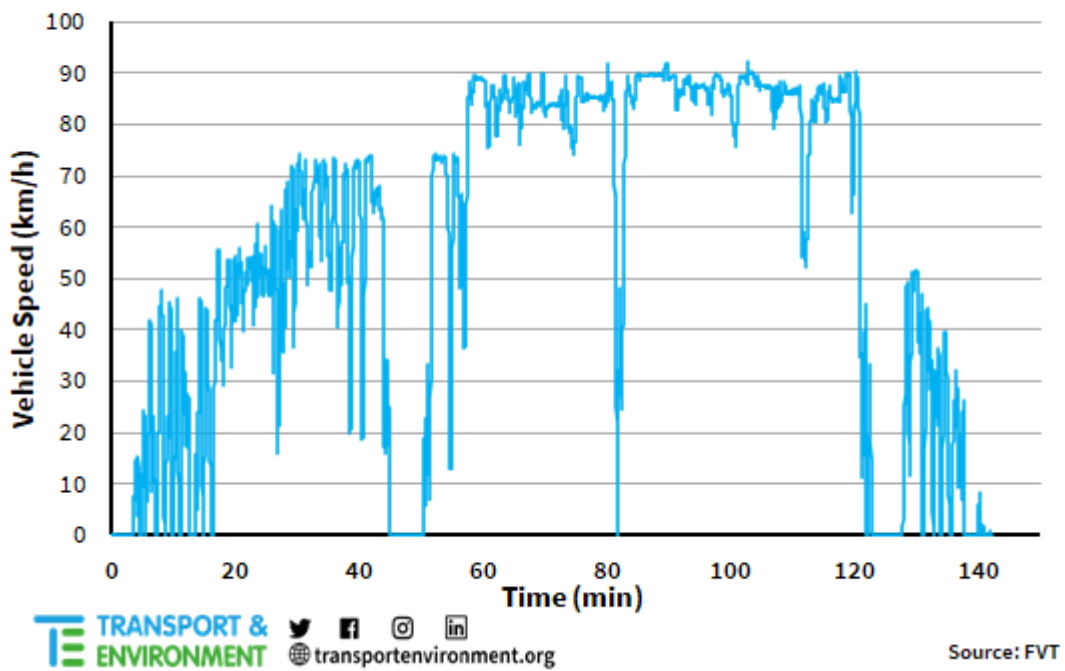


Figure 6: Supermarket delivery on-road test route.

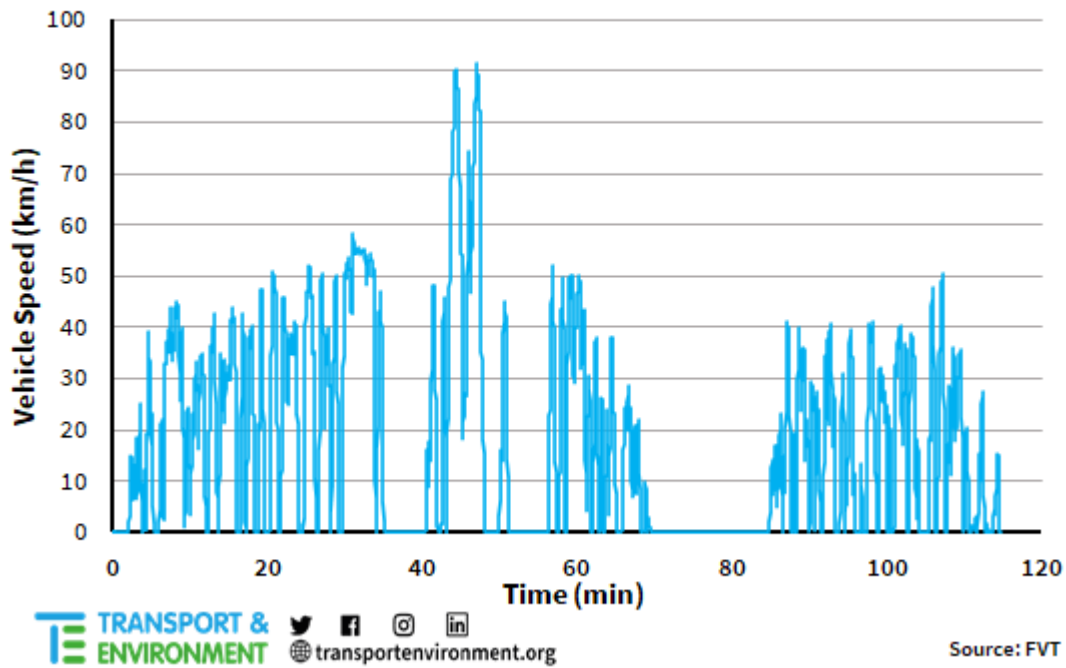


Figure 7: City driving on-road test route.

Pollutant emissions measurement

Regulated gaseous emissions were measured using the AVL MOVE Portable Emissions Measurement System (PEMS) and include carbon dioxide (CO₂), carbon monoxide (CO), hydrocarbons (HC), methane (CH₄), nitrogen oxide (NO), nitrogen dioxide (NO₂) and nitrogen oxides (NO_x). >23nm and >10nm particle number emissions were measured using a condensation particle counter (CPC) and the Downt-To-Ten dilution system. Exhaust mass flow and available CAN bus signals were also measured. All measurements were made at a 1Hz frequency.