

# Monitoring and Reporting of truck CO2 emissions and fuel consumption

T&E's analysis of the Commission's proposal

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July 2017

## Executive Summary

Today heavy duty vehicles account for around 30% of EU road transport CO2. As cars decarbonise, truck emissions are expected to rise to c. 40% of such emissions by 2030. The Commission proposal on monitoring and reporting (MR) of truck CO2 emissions and fuel consumption seeks to collect certain truck data and make it available (with restrictions) to the Commission and stakeholders. The MR regulation will support the implementation of truck CO2 standards - a Commission proposal is due in early 2018.

One of the key lessons of the diesel emissions scandal is that emission tests are vulnerable to abuse, especially once they form the basis of regulations or taxation/tolling (as is expected for truck CO2). Dieselgate was uncovered thanks to independent third party scrutiny of official (lab) tests. Transparency and third party testing will be critical to avoiding another dieselgate.

While EU carmakers have been embroiled in the diesel emissions scandal, EU truckmakers were fined €2.93bn for their cartel activity – the EU's largest ever such fine. In 2016 the Commission ruled that EU OEMs colluded fix prices and delay the introduction of emission reduction technologies between 1997 and 2011. To prevent future cartel behaviour, the MR regulation must maximise transparency, knowing that this also stimulates competition between truckmakers and empowers truck buyers.

Under the current proposal, fleets and hauliers would not know how engines and transmission system perform. By obliging truckmakers to make that information available – to potential buyers and the Commission - purchasers get a better understanding of a truck's strengths and weaknesses (e.g. good aerodynamics, a very efficient engine). It will also enable buyers to specify the trucks exactly in accordance with their needs. For example, they could demand that a different, more efficient type of transmission system be fitted to the truck.

The VECTO test procedure that underpins the MR is based on computer simulation. Truck components such as engines, transmissions, axles, tyres and tractor aerodynamics – the so-called big five - are tested individually and then fed into the VECTO simulation tool. To reproduce, check or simply understand the truck CO2 test results, there needs to be access to all these five input parameters.

Truckmakers will likely seek to minimise the publication of data, claiming it would enable engineering possible. Such a claim would be false. An in-depth study commissioned by T&E notes that such information involves datasets, data points and names of component suppliers. It explains what efficiencies are being achieved - without saying how they are achieved - and should therefore be made public. <sup>i</sup> Transparency should be the starting point of the discussion, not secrecy.

In terms of access to data on HGVs, many Member States are still registering new trucks (and buses) using paper-based filing systems. This has to change. Digitisation must be embraced. T&E

proposes a dedicated online portal searchable by Vehicle Identification Number (VIN). This is also vital to toll newer trucks based on CO<sub>2</sub> (as envisaged under the proposed revision to the EuroVignette Directive), and to inform second hand sales. EU truck-making must embrace innovation, as European car-makers are doing: the PSA Group recently started publishing the real world fuel consumption of its cars online.<sup>ii</sup>

To summarise, T&E's three key asks are as follows:

### **1. The right data**

- In the current proposal 73 data inputs are to be reported to the EC by the truckmakers, of which 66 are to be publicly available. All of these should remain.

- On top of this, a number of other key input parameters – already recorded in VECTO, need to be made publicly available. These are engine efficiency (CO<sub>2</sub> and fuel use), axle efficiency and transmission efficiency and the name of the manufacturer of the axle and the transmission system.

- The same applies to conformity-of-production<sup>1</sup> test results - and the compliance verification testing<sup>2</sup> which needs to come.

This will allow for checks to validate the VECTO results and encourage competition at all levels.

### **2. Make the data available – and digitally**

- Access to the database shall be free of charge to ensure that everybody can consult this relevant data. So far this is not covered.

- VIN numbers: The European Environment Agency should operate a VIN portal where market surveillance authorities, the Commission and third parties can input the VIN and obtain all the publicly available information.

As part of the EU type approval framework, the Commission should ensure one central online database for all road transport vehicles, with all key vehicle, emission and testing data and parameters available in a digitally searchable format (i.e. a VIN portal). This VIN portal will give Member States, toll-road operators, research organisations and prospective second-hand buyers access to the above-described information without charge. The VIN portal is the simplest and most cost-effective solution.

### **3. Commit to the next steps**

- The MR regulation must set a deadline and essential parameters to introduce compliance verification testing.

- The MR Regulation must also set the deadline to integrate alternative powertrains to VECTO and

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<sup>1</sup> With conformity-of-production testing, approval authorities check that the results given by manufacturers for components, innovations and vehicles are accurate. These tests are lab-based. Under VECTO, agreed in May 2017, COP tests will be undertaken. But the reporting of the results is omitted under the MR proposal - as is making these results publicly available so they can be independently verified. T&E is calling for this to change.

<sup>2</sup> Under Compliance Verification Testing, complete vehicles are randomly selected and tested for compliance against the applicable standards. An EU system for compliance verification testing is being put in place for cars. A firm deadline for its application to trucks needs to be set in the MR regulation, together with commitments on reporting and public availability.

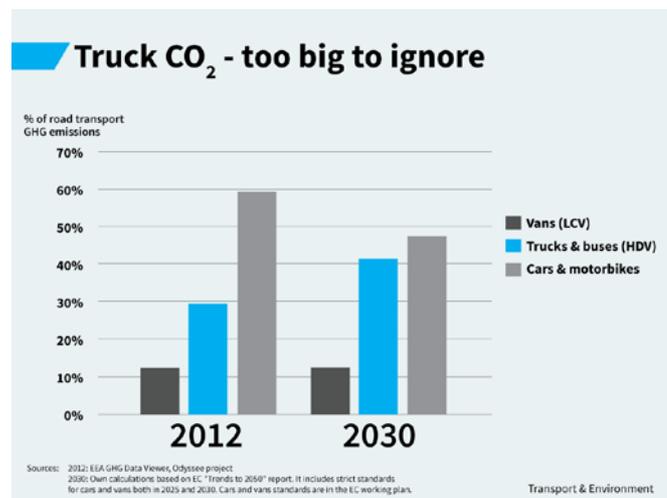
develop a VECTO test procedure for trailers. A CO2 test procedure for trailers – and a subsequent trailer CO2 regulation – should be in place by 2019.

- To check real-world performance the second VECTO package (due end 2017) should be enhanced with an on-road test and these results should be made publicly available.

Finally, there should be no more delay. The Commission started work on the VECTO test procedure in 2009/2010, the MR proposal was first announced in 2014 and member states have participated in a Commission editing board since 2015. That means all stakeholders have had ample time to prepare for the introduction of VECTO and the MR regulation and should be well placed to start reporting to the Commission from 2019 as proposed by the Commission.

## 1. Truck emissions should be tackled

Truck CO2 emissions are on the rise. According to European Commission (EC) projections, emissions from HGVs will increase 10% between 2010-2030 and 17% from 2010 to 2050<sup>iii</sup> – unless action is taken. HDVs currently make up around 30% of road transport CO2 emissions in the EU. In a business as usual scenario, truck CO2 emissions will grow to 40% by 2030.<sup>iv</sup> New Eurostat data also show that three-quarters of freight is still moved by road. At the same time the share of rail and inland waterways in EU freight transport has decreased.<sup>v</sup> Therefore road freight emissions need to be curbed as soon as possible.



To tackle this growing problem, the European Commission introduced the so-called VECTO certification test procedure in May 2017. This will oblige truckmakers (also termed OEMs) to measure the fuel consumption of new trucks in a standardised way as from 2019. However, the fuel consumption data would only be available to the individual purchasers of the vehicle via the consumer file and to the national authorities via the VIN number where the vehicle is registered.<sup>vi</sup> It will not be accessible by simple vehicle/model search from a central register.

With the current proposal for a *Regulation on the monitoring and reporting of CO2 emissions and fuel consumption of new heavy-duty vehicles*, the EC now wants to take steps to close this knowledge gap. This new Regulation will ensure that the fuel consumption data will be monitored and reported in a standardised way and made publicly available. In this way the EC wants to create more market transparency for the transport sector, the EU and its Member States and increase competition between truck OEMs.

# EU timeline for curbing truck CO<sub>2</sub> emissions



## 2. The proposal explained

### 2.1 How will this work?

The European Environment Agency (EEA) will be in charge of matching all the data, building a database and analysing the reported monitoring data as it is currently already doing for light-duty vehicles. On the basis of these data, the EEA will publish a yearly report which will outline the CO<sub>2</sub> emission trends from new trucks, allowing prospective purchasers to compare the performance of different manufacturers.

The legislative proposal outlines 3 options for monitoring and reporting to the EC via the EEA: i) Reporting by national authorities: here, national authorities would report the monitoring data and the registration data of the vehicles to the EC via the EEA. Many of the national authorities still use paper files to register trucks. This is why fully digitalising this data might take a lot of time for Member States and might be costly too.

ii) Reporting by truck manufacturers: under this option, the OEMs would be responsible for reporting the required data of each new vehicle to the EEA. The problem here is that the EC would only monitor the data based on the sales and not the registration data. In this case the CO<sub>2</sub> emissions could not be allocated to a particular Member State which would hamper introducing national taxation or specific road charging policies.

iii) Mixed reporting by national authorities and manufacturers (preferred option): in this scenario the national authorities would give the registration data to the EEA. The EEA would then request the relevant monitoring data from the OEMs. The two sets would be combined which will ensure that there will be data available at Member State level and also allow digitalisation of the data because OEMs will be responsible for monitoring the data.

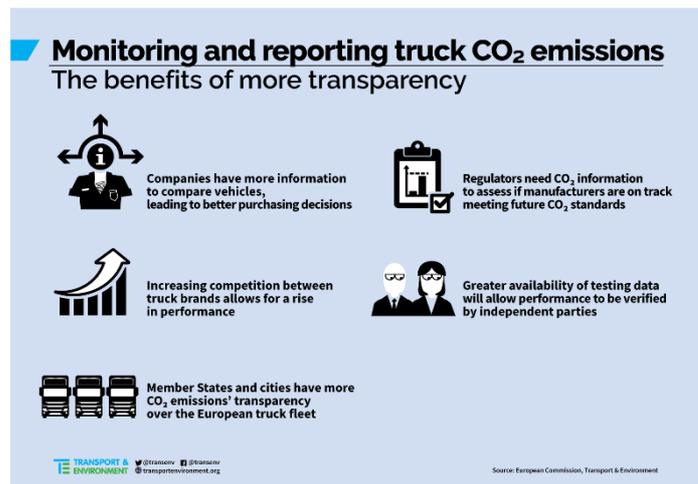
The third option is the one proposed by the European Commission. This option is the preferred one given that it guarantees digitalisation of data and monitoring of the data at EU and national level. This would mean less administrative burden and costs for the Member States who will now only be responsible for communicating the registration data to the EEA. The OEMs on the other hand will now have more

responsibility for guaranteeing the accuracy of the data. With this system, manufacturers cannot claim any more that the quality of the data is poor - something that they are doing in the light duty vehicle sector.

## 2.2 Why is this proposal so important?

Good, reliable and transparent monitoring and reporting of truck CO<sub>2</sub> emissions and fuel consumption could bring widespread benefits for the climate, transport sector, the trucking industry but also the Member States and the EU as a whole. Below we explain why:

- A monitoring database that is publicly available would allow transport operators and companies to compare many different vehicles and make better informed purchasing decisions. This is extremely important for these companies given that on average fuel consumption is between 20 and 30 percent of their operating costs.<sup>vii</sup> In some Member States such as Romania this goes up to 37%.<sup>viii</sup> But this requires transport operators to have access to a detailed set of technical parameters to better understand *why* one truck is performing better than the other.



- More transparency might also help to overcome the current lack of competition between the main trucking brands. The fact that truck OEMs were recently fined 2.93 billion euros for price-fixing and delaying the introduction of certain technologies shows that the market cannot be trusted.<sup>ix</sup> The ruling in the case shows how collusive the manufacturers were, for example, by sharing their pricing strategies.<sup>x</sup> Apart from this, several data also confirm that the average fuel efficiency of the truck fleet in Europe has stagnated for the past two decades which shows the market is not delivering improved fuel economy by itself.<sup>xi</sup> Also the recent episode on the Weights and Dimensions proposal for trucks where truck OEMs delayed the **voluntary** introduction of safer and more fuel efficient lorry designs confirms this image.<sup>xii</sup> A good monitoring and reporting proposal would increase competition between different truck OEMs, allowing performance to be compared in a standardised way.
- With this monitoring and reporting data, Member States would get a complete overview of the CO<sub>2</sub> emissions of new trucks. Without this Regulation, national authorities would only get the fuel consumption data of trucks registered in their Member State which is incomplete. Trucks move across borders, and national authorities need the flexibility to reform taxes and tolls in a way that rewards more fuel efficient vehicles. This is very relevant given that in the recent EC proposal for the Eurovignette Directive, Member States which have distance-based tolls will need to take account of CO<sub>2</sub> emissions from 2022.<sup>xiii</sup>
- In its Mobility Package of May this year, the European Commission has announced it will make a proposal for a truck CO<sub>2</sub> standard in the beginning 2018.<sup>xiv</sup> This is an important step forward given that fuel efficiency standards are the most effective tool in reducing Europe's fast-growing truck emissions. The data coming from monitoring and reporting (i.e. this proposal) will be used to analyse the trends of different OEMs and allow the EC to assess if truck manufacturers are on track

meeting the upcoming fuel efficiency standards. This is already happening in the yearly EEA reports on cars and vans.<sup>xv</sup>

- Finally, having key vehicle, emissions and testing data parameters publicly available allows for meaningful and effective third party verification tests to check compliance of the original results demonstrated at type approval. Data such as individual vehicle configurations, emission values, aerodynamic drag and tyre rolling resistance is needed to repeat the original test in a reliable and correct manner, in order to compare the results, establish discrepancies and their possible cause, including test manipulation. This is already the case in the US, where the US EPA runs a centralised register of key testing specifications, empowering third parties to carry out independent tests. VW cheating was found thanks to this type of activity.

### **3. The proposal – what is still missing?**

In the current proposal the European Commission specifies which data manufacturers have to report (Annex 1B). In total 73 data regarding new trucks have to be monitored by the OEMs and reported to the European Commission. Nearly all of these data, except for seven, will be publicly available. Below we explain why this is not sufficient and which other data need to be reported to the Commission and publicly available.

#### **3.1 The proposal should not be weakened and data should be easy accessible**

It is very important that all of the 73 data stay in the proposal and will need to be reported to the EC, and that the 66 are made publicly available and easy accessible. Many of these parameters such as the aerodynamic performance of the tractor (data entry 23) and the rolling resistance of the tyres (e.g. data entry 42 and 45) will give transport operators a very good insight into the performance and strength of different trucks. By consulting the monitoring database and data inputs on rolling resistance and aerodynamic performance, operators can compare different vehicles and assess why one is performing better than the other. And, as also noted above, this would be very useful information for their next purchase.

Apart from this, encouraging competition regarding the aerodynamic performance and the tyre rolling resistance will bring long term benefits. However trucks are powered in the future (hybrid, electric, hydrogen etc.), further improving these components will have a major influence on the efficiency of the truck.

The legislation should also clearly guarantee that access to the database will be free of charge to ensure that everybody can have access to this relevant data. So far this is not covered.

### 3.2 Engine transparency matters

The current proposal does not allow 3rd parties or the Commission to get a better insight into the fuel efficiency of the engine, and how this is developing over time. This is worrying and of great importance given that the engine accounts for approximately 58% of the fuel energy losses of the average long-haul truck in Europe.<sup>xvi</sup> Studies show that engine efficiency could be improved around 10% with currently available technologies and even up to 18% in the long-term – meaning by 2030.<sup>xvii</sup>

The table below gives an overview of the test runs engines need to perform to measure CO2 and fuel consumption as part of the VECTO certification procedure. During the recent discussions on VECTO, OEMs claimed that the data of the fuel consumption of the engine, the so-called fuel consumption map, could not be shared because it could reveal innovative steps undertaken by the truck-maker. This is actually not the case. The fuel consumption map will not reveal *how* OEMs managed to achieve the engine efficiency so there is no possibility of reverse engineering.

Apart from the fuel consumption mapping cycle, the results the other tests, the WHSC and WHTC, should be monitored, reported and publicly available. During this test, the engines are tested in 13 different modes with a weighted average calculated to give the result. The values from the WHSC and WHTC test runs are not business confidential; they only give an average value of the engine map, do not reveal *how* the truckmaker achieved enhanced performance, and should be made available. Earlier research commissioned by T&E clearly outlines why sharing the input parameters of the engine but also all the other VECTO input parameters such as the axle, tyres, aerodynamics and transmission is not confidential.<sup>xviii</sup>

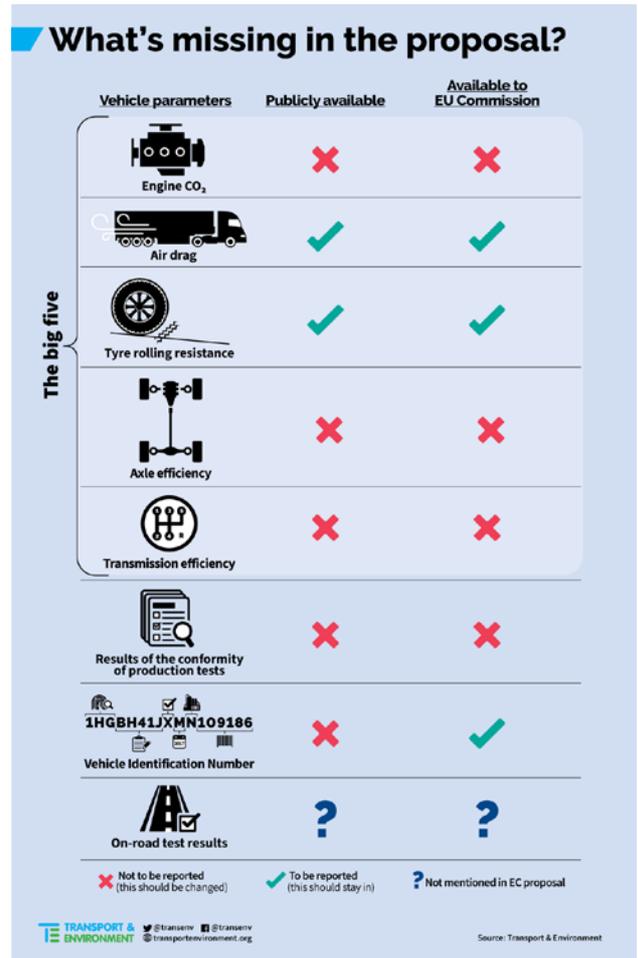


Table 3: Overview of testruns to be performed

Testrun	Reference to paragraph of this Annex	Required to be run for CO <sub>2</sub> -parent engine	Required to be run for other engines within CO <sub>2</sub> -family
Engine full-load curve	4.3.1	yes	yes
Engine motoring curve	4.3.2	yes	no
WHTC test	4.3.3	yes	yes
WHSC test	4.3.4	yes	yes
Fuel consumption mapping cycle	4.3.5	yes	no

4.2 Allowed changes to the engine system

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For these reasons all the values of these two tests (the so-called ‘parent’ engine and all the ‘family’ members) should be reported to the Commission and also publicly available. Making these values public is

very important for the following reasons:

- The proposal on truck CO<sub>2</sub> standards is due from the Commission early next year. A number of options are open to the Commission, e.g. an engine standard only - or a vehicle standard with a separate engine standard, as is the case in the US phase I regulation. In short, the EU must ensure it can regulate engine performance in the future, and for this it needs data on CO<sub>2</sub> from the engine.<sup>3</sup> It's vital not to severely limit the ambition of EU truck CO<sub>2</sub> standards, meaning they could not be as comprehensive as US standards – even before they are published. Making the results of the fuel efficiency maps and the results of the WHSC and WHTC tests public would solve this problem.
- Second, engine data would allow 3<sup>rd</sup> parties to do targeted testing. Research institutes and other independent parties could do their own engine testing and check if the engines *in-service* are as efficient as OEMs claim in the tests. In other words, the more data is hidden, the more the system is open to abuse. It would also create more competition between manufacturers and encourage them to make the most efficient engine possible.
- Third, making engine fuel efficiency numbers public would allow transport operators and research organisation to distinguish worst and best in class performers in terms of engine fuel consumption. For transport companies it would be very useful to get a better understanding what the “strength” of the truck is (engine, aerodynamics, tyres).

To give more detail, transport operators who mainly do highway driving might be more interested in the aerodynamic performance while others who are operating in hilly areas might look for more efficient engines. Conclusions on truck performance must be based on data – not speculation or hearsay. Overall, just as for tyres and aerodynamics, more reporting would create more competition between different OEMs, which would be a big incentive for further improving efficiency.

### 3.3 Transmission and axle data need to be public too

As well as engine data, the efficiency of the transmission and axles – the so-called torque loss maps - should be reported, monitored by the Commission and made publicly available. This should also include the name of the manufacturer in order to encourage competition between different suppliers. Transmission efficiency can be improved by 2 to 4 percent so more progress is still to be made.<sup>xx</sup> Making all these data transparent would give 3<sup>rd</sup> parties, the Commission and transport operators a better understanding how the efficiency of these components is developing. It would also enable a purchaser to demand a more efficient transmission be fitted to the truck.

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<sup>3</sup> A US-style engine standard needs to be considered by the EU because it will oblige OEMs to improve the efficiency of the tractor ‘structure’ and the engine at the same time. Improving engine efficiency is more challenging for manufacturers but should be encouraged by legislators because it brings forward innovations such as waste-heat recovery and hybridisation. A separate engine standard in combination with a whole vehicle standard (i.e. tractor (overall) plus engine) would ensure that OEMs start investing in these technologies more rapidly.

### 3.4 Vehicle registration numbers (VIN) - Member States should have real-time access to the CO2 values of registered trucks

In the recent Eurovignette Directive proposal by the EC, truck tolls shall also take into account CO2 emissions (no later than 2022). However, in order for Member States to do this, they need to get a good understanding of the CO2 emissions of trucks to set up an effective and well-functioning road charging or taxing system. However, in the current scenario, Member States only get the vehicle registration numbers (VIN) and the Conformity of Certification (COC) file which does not include the CO2 value of the trucks.

The MR proposal goes some way to redress this by giving information on the CO2 emission from all newly-registered trucks in Europe once per year. But for effective tolling, Member States need access to a live EU-wide database. Such an initiative will also tie in with the EU's digital agenda.

T&E proposes that the EEA operates a VIN portal, namely an online facility in which type-approval authorities, market surveillance authorities, the Commission and third parties can input the VIN and obtain all the publicly available information (i.e. the data described in the Annex).

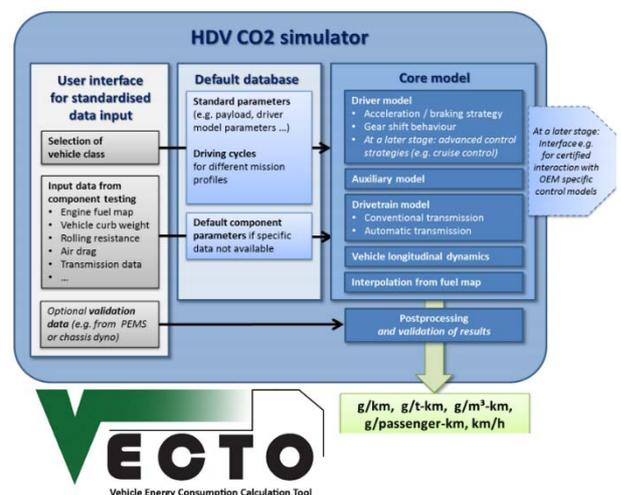
Certificates of Conformity, and other data the inclusion of which T&E has requested in this briefing, should also be available through this portal. The portal should be free to access, digitally searchable, machine readable, and well maintained.<sup>4</sup>

### 3.5 Conformity of production test results should be reported and publicly available, and the MR package must also include a commitment to on-road testing

The CO2 emissions that will be monitored and reported will be the results of the VECTO test procedure. Unlike cars, this test is a simulation procedure because of the many different truck types, the size of the vehicles etc. While on-road tests performed by the European Commission's Joint Research Centre already show that the results of the test procedure on trucks can be fairly close to real-world performance,<sup>xxi</sup> the Dieselgate scandal has taught us that as manufacturers get more familiar with test procedures, they might start exploiting loopholes.

VECTO and data reported under MR will be used to sell trucks, inform fiscal policies (including tolls), and help keep truck-makers on track to meet the upcoming truck CO2 standards. So there will be very strong incentives for truck makers to game the system.

The VECTO proposal that was adopted on the 11<sup>th</sup> of May also entails conformity-of-production testing.<sup>xxii</sup> During such tests the main truck components of VECTO (e.g. the engine, transmission, axle, tyre rolling resistance and aerodynamic drag) are tested by the local type approval authorities to see if the results of the tests match those submitted by the manufacturer when the component was approved. However, in the



<sup>4</sup> Existing portals, such as the EU Rapid Warning System (RAPEX) and the Information and Communication System on Market Surveillance (ICSMS) may offer precedent in designing the VIN portal.

current monitoring and reporting proposal, the approval authorities are not obliged to report the results of these tests to the Commission – or make them publicly available. This is not acceptable and needs to be changed. The results of conformity-of-production testing need to both be reported to the Commission and made publicly available.

Conformity-of-production testing is a good start– but not sufficient on its own. The next step is compliance verification testing. Here, the EU’s Joint Research Centre tests a portion of all newly-built trucks to confirm compliance and verify the accuracy of the results submitted by the manufacturer. While precise details can be worked out subsequently, the MR proposal needs to include a firm commitment to compliance verification testing. Such tests, and indeed more comprehensive on-road and in-use performance testing, is already in place for light duty vehicles, where the EC has developed a Real Driving Emission (RDE) test for NOx and PN emissions - and a publicly available report.<sup>xxiii</sup>

Trucks need to follow this same direction. To summarise, the first step is providing within the MR proposal that conformity-of-production tests will be reported and made available. The next step is a clear commitment, also within the MR proposal, that compliance verification testing will be put in place. The monitoring and reporting proposal should set the parameters for such testing, outline the type approval authorities which are to perform it and how the results will be reported to the Commission and made publicly available.

Monitoring and reporting test results has several advantages:

- Transport operators would get a better understanding of the real-world fuel efficiency performance of the trucks on the market;
- Third parties could more easily find out if there are discrepancies between VECTO and on-road performance. This would allow them to do more targeted 3<sup>rd</sup> party testing. It would give the EC and other stakeholders a better understanding if OEMs are potentially optimising their components for testing as was the case in the Diesel scandal;
- The EC and 3<sup>rd</sup> parties will be in a position to understand to what extent OEMs are using the flexibilities in the current VECTO proposal, e.g. the 7.5% tolerance for the aerodynamic test. This will inform future reforms to VECTO, for example, the aerodynamic tolerance could be further strengthened to with a more accurate test procedure.

## 4. Conclusion

### **T&E’s key asks for amendments to ensure transparency and efficiency**

- **1. The right data**
- In the current proposal 73 data inputs are to be reported to the EC by the truckmakers, of which 66 are to be publicly available. All of these should remain.
- On top of this, the big five key input parameters – already recorded in VECTO but not public, need to be made publicly available. These are: engine efficiency (CO2 and fuel use); aerodynamic efficiency; tyre rolling resistance; axle efficiency; and transmission efficiency. Including the name of the manufacturer of the axle and the transmission system.
- The conformity-of-production test results and the compliance verification testing - which needs to come – need to be made publicly available.

This will allow for checks to validate the VECTO results and encourage competition at all levels.

- **2. Make the data available – and digitally**

- Access to the database shall be free of charge to ensure that everybody can consult this relevant data. So far this is not covered.
- VIN numbers: The EEA should operate a VIN portal where market surveillance authorities, the Commission and third parties can input the VIN and obtain all the publicly available information.

As part of the EU type approval framework, the Commission should ensure one central online database for all road transport vehicles, with all key vehicle, emission and testing data and parameters available in a digitally searchable format (i.e. a VIN portal). This VIN portal will give Member States, toll-road operators, research organisations and prospective second-hand buyers access to the above-described information without charge. The VIN portal is the simplest and most cost-effective solution.

- **3. Commit to the next steps**

- The MR regulation must set a deadline and essential parameters to introduce compliance verification testing.
- The MR Regulation must also set the deadline to integrate alternative powertrains to VECTO and develop a VECTO test procedure for trailers.

This briefing shows that we all have an interest in adopting an ambitious regulation on monitoring and reporting of truck CO<sub>2</sub> emissions. The proposal is a unique opportunity to create more transparency, competition and scrutiny for the EU, Member States, transport sector, the manufacturers and other independent parties.

## Further information

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## Endnotes

<sup>i</sup> <https://www.transportenvironment.org/publications/why-vecto-black-box-needs-be-opened>

<sup>ii</sup> <https://www.transportenvironment.org/press/psa-publishes-real-world-fuel-consumption-data-1000-peugeot-citro%C3%ABn-and-ds-cars>

<sup>iii</sup> <https://ec.europa.eu/transport/sites/transport/files/swd20170180-ia-part1-eurovignette-infrastructure.pdf> p. 19

<sup>iv</sup> [https://www.transportenvironment.org/sites/te/files/publications/2015%2009%20TE%20Briefing%20Truck%20CO2%20Too%20big%20to%20ignore\\_FINAL.pdf](https://www.transportenvironment.org/sites/te/files/publications/2015%2009%20TE%20Briefing%20Truck%20CO2%20Too%20big%20to%20ignore_FINAL.pdf)

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<sup>vi</sup> <https://ec.europa.eu/transport/sites/transport/files/com20170279-regulation-hdv.pdf> p. 3

<sup>vii</sup> <https://www.iea.org/publications/freepublications/publication/TheFutureofTrucksImplicationsforEnergyandtheEnvironment.pdf> p. 39

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- xxi See the presentation by the JRC during the Editing Board meeting on 26 April 2016, titled “SICO and VECTO validation exercise”
- xxii [https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-1900557\\_en](https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-1900557_en)
- xxiii <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0646&from=LV>