# Questionnaire to car manufacturers

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<th>No</th>
<th>Question</th>
<th>Answer</th>
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<td>Q1</td>
<td>In previous hearings we have heard that the exhaust systems are vulnerable to clogging and corrosion. Can you describe how you as a producer adapted the materials used in order to fulfil warranty requirements, leak-free assembly requirements and customer demands for long service life?</td>
<td>Avoiding clogging or corrosion issues impacting the exhaust systems is indeed a major concern for OEMs. Exhaust systems have to meet many requirements relating to performance, safety and durability. As regards durability, customer demand for long service life is a requirement, but current European regulations on emissions also require OEMs to ensure and demonstrate durability of the Emission Control System, including the after treatment system in the exhaust line, during 160,000 Km. Such a requirement is a condition to obtain homologation. Meeting these requirements is not only a matter of materials. The design and Engine Control System also play a key role to avoid critical conditions that may induce durability or safety issues.</td>
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<td>Q2</td>
<td>What is the effect of the higher temperatures that SCR needs to properly function with the materials used?</td>
<td>Temperature is not a challenge for Renault regarding the chemical reactions of the SCR's urea with the materials used. The existing exhaust system is made to allow DPF regeneration, at a temperature which is much higher than that required by SCR.</td>
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<td>Q3</td>
<td>On average, how much does a diesel emissions reduction system cost when purchased and built in? Could you please specify these prices for an exhaust gas recirculation (EGR) system, a NOx storage catalytic converter (NOx trap) and a Selective Catalytic Reduction (SCR) system? And how much would a combination of multiple systems like these costs? In your experience: How many of these costs can be passed on to the buyer?</td>
<td>Renault may not provide an estimated cost for an &quot;average&quot; diesel emission system when purchased and built in, given the significant number of variables which come into play, such as the layout, the configuration of the system, the number and type of components, the raw materials etc. In addition, the total costs to be incurred to meet one particular emission standard do not only relate to the &quot;emissions reduction system&quot; insofar as it is quite often a matter of reducing the so-called &quot;engine-out emissions&quot;, which trigger extra costs linked for example to the injection system</td>
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itself (involving higher injection pressure and more complex injectors). Insofar as these improvements on base engine often bring performance improvements as well, defining the baseline as a reference to assess the cost of an "emissions reduction system" is very difficult.

A way to provide a relevant indication in the current context is to consider what will be the extra cost for Euro 6d regulation with RDE test, compared to current Euro 6b. At Renault, we use the following technology for Diesel Euro 6b: DPF (already as a standard since Euro 5), EGR and LNT for NOx after treatment (for Passenger Cars) plus some additional features in the combustion itself (mainly on the injection system).

For Euro 6d with RDE, we consider SCR as necessary, sometimes combined with LNT to better manage city driving. The extra cost of an Emission Control System between Euro 6b (w/o RDE) and Euro 6d (w RDE) is in the range of €1,000 (to reflect the enhanced EGR technology and refined cooling, SCR instead of LNT, or for some application in combination with LNT). Additionally, several hundreds of millions Euros have to be spent to engineer the system and fit it in the vehicle platform.

From our experience as a high volume non premium OEM, such an extra cost cannot be passed on to the buyer.

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**Q4** Why did car manufacturers focus mostly on the legal testing cycle NEDC if they knew that it was far from reality and had nothing in common with real emissions? Was it not possible to orientate yourself towards real driving emissions (RDE) -like values from the beginning to generate more trust from the customer? Why did the automobile industry not take the initiative on its own and communicated more realistic exhaust values of their products?

**A4** The automobile industry operates in a highly regulated and competitive market, and we believe it is to regulation authorities to take the lead to improve regulations, taking into account the inputs from the different stakeholders, including of course OEMs. The legal NEDC testing cycle is the test currently applicable under Regulation (EU) 715/2007. This test did reflect the vehicle technology and testing regime and related measurement technology available when this regulation was drafted and came into force, i.e. in a laboratory under controlled conditions. The purpose of the NEDC testing cycle was to allow for comparisons between the various vehicles' performance on a like-for-like basis.

The European Commission, OEMs and other stakeholders had acknowledged that the NEDC testing cycle was more and more far from reality and they have been working together for several years to develop future regulations which would be closer to real usage, based on 2 key features: new worldwide testing cycle (WLTC and the related WLTP procedure) and RDE, both coming soon into force now.

The on-road testing of vehicle emissions performance has recently been made possible thanks to the technology improvements. In particular, RDE testing has been made possible due to progress achieved in PEMS adapted to Passenger Cars, especially over the last three years, while such a technology was not widely available for industrial scale tuning activity when the main part of the vehicles fleet currently on the road was still under development.
The automobile industry had to strictly follow the rules applicable to the communication of vehicle emissions data to consumers under the European Regulations and the advertising requirements in force in the Member States.

In this respect, it is essential to note that the testing regime, however close to real usage, has to be defined at European level. In the absence of a precise standard, the data provided by one OEM cannot be compared to data from another OEM without creating confusion amongst the market and customers. From that perspective, the coming RDE protocol is the right "not to exceed" approach for pollutant emissions.

For fuel economy and CO2 emissions, further study would be needed to allow for fair comparisons between vehicles, as the RDE “not to exceed” approach has in essence a high degree of variability. The WLTP procedure will however bring a very significant improvement and reduce the gap between homologation values and real life as experienced by customers.

**Q5**

Article 5(2) of Regulation 715/2007/EC allows for certain derogations to the prohibition of defeat devices that reduce the effectiveness of emission control systems. Do the vehicles you produce make use of the derogation, and if so could you please describe in detail under what conditions do you employ the derogation?

Have you indicated and justified the conditions of the operation of such defeat devices to the type approval authority when applying to type approval? If not, why not? Were you ever requested by the technical services or type-approval authorities to provide clarifications on the use of derogations under article 5(2)?

**A5**

Regarding Renault Euro 6b vehicles, at the moment, the EGR flow is reduced (not cut) below 17°C and above 35°C of engine inlet air temperature. This "temperature window" was set by Renault in the years 2000-2005 to avoid the severe reliability and safety issues faced then, which triggered a high rate of incidents for customers.

In order to better take into account various driving conditions and to prepare for the future "Real Driving Emissions" protocol coming with Euro 6d, Renault launched in July 2015 technical analysis and actions aiming at expanding this temperature window for vehicles already launched in production and for future products.

After a specific validation process that we have carried out since July 2015, we can expand the EGR temperature window to 10-45°C for current models and up to 5-60°C for new products that will be launched from now on.

For current models, this improvement will also be proposed to all our customers in the field driving a Diesel Euro 6b vehicle, as communicated in the media in April 2016.

For new products with 5-60°C temperature window, this further improvement on NOx emissions leads however to some oil drain interval shortening, which is a penalty for the customer.

Up to now, manufacturers were not requested by type-approval authorities to provide clarifications on the use of derogations under article 5(2). As from May 2016, a complete description of Emission System Control strategies, including temperature windows, is included in the AES/BES dossier submitted to type-approval authorities.
**Q6** During recent investigations (e.g. in Germany) manufacturers admitted to using so called “thermo windows” to switch off emission control systems under certain ambient temperatures in order to protect the engine. It has become clear that there is a broad range of temperatures used for lower switch-off limits (e.g. below 10°C or 17°C). This suggests that the setting of these temperature limits are rather arbitrary. Please explain the discrepancy in temperature limits used by car manufacturers to justify switching off emission control systems (including EGR). Are these limits really needed to protect the engine and at which ambient temperatures?

**A6** As far as Renault is concerned, temperature limits have been set based on thorough testing conducted on our vehicles, on the review of the evaluation data obtained during the development phase study and on market problems analysis. Each OEM has set a temperature window adapted to its engine and components characteristics and layout. The thermal conditions in the engine bay are key to several issues encountered with EGR systems insofar as the physical and chemical phenomena are strongly depending on temperature. Temperature in the engine bay and at engine inlet for a given ambient temperature depends on many parameters (engine and engine bay layout and driving conditions). As a whole, we believe that this explains the discrepancy in temperature limits amongst OEMs.

**Q7** Do you use emissions control systems with different operational limits (e.g. ambient temperature or engine loads) or quality (design, components or materials used), or of different durability when producing vehicles for US and EU markets? Are you aware of such discrepancy between OEMs on the EU market?

**A7** Renault is not present on the US market. We are, therefore, not able to answer that question.

**Q8** At a meeting of transport ministers in Luxembourg on 7 June 2016, the following wording on when the ban on defeat devices should not apply was proposed: “even if the best available technologies are included, no other technology is available to protect the engine against damage or accident and for safe operation of the vehicle”. In this regard, what is your understanding of “the best available technologies”? Can you provide us with a list of currently “best available technologies” for lowering NOx and CO2 emissions?

**A8** Renault believes that the best technology for lowering NOx emissions for Diesel cars is EGR for engine-out emissions. Further lowering of the remaining NOx emissions can be achieved through an additional after treatment system: either SCR or LNT. To meet Euro 6d, Renault believes that SCR will be necessary. A combination of both SCR and LNT could also be required on some applications for low temperature conditions.

Lowering CO2 emissions is achieved through several actions at both vehicle (lowering energy demand: mass, frictions, aerodynamics, efficient electric equipment) and powertrain (increasing efficiency and/or going for electro-mobility with BEV, PHEV) levels.
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<th>Q9</th>
<th>With emissions norms progressively tightening, the introduction of the WLTP testing in 2017 and new emissions measurement procedures better reflecting real-driving conditions (RDE), what is, according to your own research and experience, the optimal combination of the best available technologies in order to comply with NOx and CO2 standards? Are the required technologies currently available for mass production or do they need more research and development before they can deliver the expected results? Do certain best available technologies damage the engine? If yes, why?</th>
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<td>A9</td>
<td>Renault considers that, for Diesel cars under the Euro 6d regulation (with WLTP and RDE testing), EGR will remain the best engine-out NOx reducer, with a wider temperature range, and additional NOx after treatment. SCR will be necessary, likely combined with LNT to better manage city driving. Diesel will remain one of the main technologies to meet the ambitious 95 g CO2 target in 2021 and beyond, even if we foresee a decrease in its market share, because of its increased complexity and cost to comply with emission regulations In order to cope with CO2 regulations, we will have to develop other technologies, less versatile than Diesel and inducing other constraints such as charging infrastructure for EVs (BEVs and PHEVs).</td>
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<td>Q10</td>
<td>Do you agree with the statement that the engine control unit (ECU) is a black box, without type-approval obligation and without external supervision on how it is configured or how it functions? Would you be in favour of the introduction of a type-approving provision for this unit with, for instance, the possibility for the certifying authority of accessing the software and its code, and request detailed information on the use of the software, in order to avoid any unwanted software modifications, including unwanted modifications after type approval and before true production? What benefits or risks would you identify in such a procedure?</td>
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<td>A10</td>
<td>Software should not remain excluded from type-approval, inspections, COP, etc. However, because of the complexity of current softwares, Renault believes that an efficient way to address this is by describing and checking strategies. Indeed, this is now part of the RDE regulation, which provides that an AES/BES (Auxiliary Emission Strategy/base Emission Strategy) dossier has to be submitted to type-approval authorities, describing emission control strategies. We do not identify any risks in such a procedure. However, it will require that specific skills and resources be developed within type-approval authorities in order for them to manage the high volume of complex information to be analysed.</td>
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<td>Q11</td>
<td>From the manufacturers point of view, what kind of role other aspects such as increase engine efficiency play in the emission reduction? What kind of research is carried out, other than the pipe-end technologies, to reduce the emissions?</td>
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<td>A11</td>
<td>There is a continuous improvement of engine efficiency, through for instance multi-injection, friction reduction, nozzle improvement for spray, rail pressure up to 2500 bar for Diesel, combustion chamber shape and internal aerodynamics, etc.</td>
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This is, however, a very complex issue insofar as, while emissions reduction generally goes together with the improvement of engine efficiency, it is not the case regarding NOx: for Internal Combustion Engines, high efficiency combustion indeed leads to high combustion temperature, which favours the combination of oxygen and nitrogen contained in the inlet air (= NOx).

Q12 According to the JRC, exemption for the use of devices interfering with pollution control systems, as provided for in Article 5(2) of Regulation (EC)715/2007, are not justified from a technical point of view as the same results (i.e. protecting the engine from damages) can be obtained in many different ways. Do you agree with this assumption? If not can you explain in detail why?

A12 Additional data would be needed from JRC to allow for a detailed discussion of such a general statement.

Renault, however, reminds that ensuring reliability and safety for the customer is always a matter of existing technology and knowledge at a particular point in time, bearing in mind the necessary lead time needed to modify and develop the engine, including potential impact on the vehicle platform.

Q13 The EU law (Regulation 715/2007/EC Article 5(1)) requires manufacturers to equip vehicles so as to enable the vehicle to comply with the emission limit values contained in the Regulation “in normal use”. How do you explain the conclusions of the German Federal Motor Transport Authority (Kraftfahrt-Bundesamt) investigation that on average the Emission Control Technologies are off or turned down around 75-80% of the time? Please describe in detail for which “normal use” conditions (temperature, altitude, engine load, etc.) your engines are designed to operate in Europe?

A13 All Renault vehicles meet regulations 715/2007 (co-decision regulation) and 692/2008 (comitology). In these regulations, the "normal use" is not clearly defined. Emission limits are to be met within a detailed test protocol, including conditions on atmospheric pressure, ambient temperature (20 to 30°C) etc. In addition, some requests are defined for -7°C ambient temperature (NOx after treatment function) but not much more.

The Emission Control System is designed and managed to comply with emission limits or functional request provided for by regulation and is operated in customer use, except for driving conditions putting at risk the reliability of the engine and of the vehicle. In addition, all safety issues must be avoided.

"Normal use conditions" were not defined before RDE. Describing how the Emission Control System operates is quite complex and such a description is now available in the "AES/BES" dossier in line with the RDE regulation and the so-called "boundary conditions".

See also A5 above.