**assessment of a candidate metric for a new paradigm of real-world NOx emissions compliance for heavy-duty on-highway engines**

**Matthew W Spears, Truck and Engine Manufacturers Association (EMA)** [**mspears@emamail.org**](mailto:mspears@emamail.org)

This presentation examines the merits and limitations of a candidate metric that potentially could be used as part of a new paradigm for assessing real-world NOx emissions compliance for heavy-duty on-highway engines.

Throughout 2018, the California Air Resources Board (CARB) held a series of workgroup meetings to discuss potential changes to California’s heavy-duty on-highway (HDOH) NOx emissions control program ([CARB HDOH Low-NOx Web Link](https://www.arb.ca.gov/msprog/hdlownox/hdlownox.htm)). More recently, the U.S. Environmental Protection Agency (EPA) announced its Cleaner Trucks Initiative to consider revisions to its nationwide heavy-duty on-highway NOx emissions control program ([Cleaner Trucks Initiative](https://www.epa.gov/regulations-emissions-vehicles-and-engines/cleaner-truck-initiative)). In response, EMA has been collaborating with third-party researchers to develop the robust technical data needed to help inform the agencies’ assessments of a potential new HDOH Low-NOx program ([EMA HDOH Low-NOx Web Link](http://www.truckandenginemanufacturers.org/file.asp?A=Y&F=EMA+HDOH+Low-NOx+Standard+Press+Release.pdf&N=EMA+HDOH+Low-NOx+Standard+Press+Release.pdf&C=documents)).

Based on EMA’s research efforts to date, EMA recommends that EPA and CARB consider a new paradigm to modernize today’s heavy-duty NOx emissions compliance requirements. This paradigm would move emissions compliance assessments beyond the laboratory and beyond PEMS testing, and would, in effect, transform in-use HDOH vehicles into real-world emissions laboratories. EMA believes that advances in on-board NOx sensors and vehicle telematics could enable such a program to be implemented starting in the 2027 timeframe. Furthermore, that type of new regulatory paradigm could lead to EPA and CARB simplifying today’s laboratory-based engine certification procedures and eliminating the more costly and duplicative portions of CARB’s on-board diagnostics requirements.

A key element of this new in-use-focused regulatory paradigm would be a robust and effective metric that utilizes real-world “big data” from a large number of vehicles to determine an engine family’s degree of in-use NOx emissions compliance, on an on-going basis. This presentation examines the merits and limitations of one such candidate metric.

The desirable attributes of a candidate metric include its coverage of nearly all engine operation with minimal hardware and computational demands. The metric should properly weight emissions by their real-world impact, and the metric should be robust against false passes and false failures. Ideally, the metric also should separate characteristic modes of engine and after-treatment operation so that compliance assessments could be focused on modes of operation where cost-effective technology and calibrations can be applied to achieve the greatest degree of real-world NOx reductions. This presentation reports on the assessment of a metric for these attributes by applying the metric to nearly 100 months real-world in-use heavy-duty on-highway engine data. EMA sponsored West Virginia University to collect the real-world data in California via on-board NOx sensors and data-loggers over the course of 2018.

This presentation concludes with recommendations for future work to continue the development of a new paradigm of real-world NOx emissions compliance for heavy-duty on-highway engines.