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Editorial

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Although public concern about vehicle emissions in the follow-up to Dieselgate has focused on ‘what else is the car industry doing wrong?’ much has been done in recent years to improve both our understanding of vehicle emissions and our ability to directly measure their real-world impacts. This work has been driven not just by the identification of a defeat device, but also a much wider range of factors that have acted *en masse* to amplify the divergence between regulatory (drive cycle) testing and on-road vehicle performance, and the need for new testing methods to complement evolving vehicle emissions management policies and regulatory standards. Using the Portable Emissions Measurement System (PEMS) Conference and Workshop (coordinated by the Bourns College of Engineer-Center for Environmental Research and Technology [CE-CERT] at the University of California at Riverside [UCR]) and associated research as its focus, this Special Issue provides a unique insight into both this issue and recent international sector-wide efforts to quantify and manage what has become known as the ‘off-cycle gap’. Rather than simply providing a collection of papers presented at the PEMS workshop itself, our intention here is to present papers that informed or reflected the conversations at the recent PEMS workshops. In this way, we aim to capture something of the atmosphere of the vehicle emissions measurement community post-Dieselgate.

The special edition begins with a forward by Alberto Ayala, now Air Pollution Control Officer and Executive Director at the Sacramento Metropolitan Air Quality Management District, but then Deputy Executive Officer at the California Air Resources Board (CARB), the authority that led the earliest legal actions. This forward provides both an overview of the Dieselgate investigation and a record of the critical role of the research community in all stages of the case.

The special issue then presents nine papers that illustrate on-going work to test in-use vehicle emissions and refine associated data collection strategies and develop next-generation monitoring equipment.

Many papers presented at the workshops and much of the work being undertaken by the wider research community focuses on improving our understanding of emissions under real-world driving condition. Here, we selected four papers that exemplify the breadth and quality of related passenger car research. Firstly, Triantafyllopoulos and colleagues present work that highlights the important message, often missed amongst all the ‘dirty diesel’ headlines, that, properly optimized for local driving conditions, modern diesel cars can meet and even beat their compliance test limits on-road. This is counter-pointed by work by O’Driscoll and colleagues that reports on real-world CO₂ and NO_x emissions from 149 diesel and gasoline passenger cars, representative of the current Euro 5 and 6 fleet, and indicates that many vehicles on the road today are unlikely to be achieving such targets. Although the two above mentioned studies, like many others, use Real Driving Emissions (RDE)

methods to standardize on-road measurements and reduce bias when comparing their findings with test-bed drive cycle regulatory standards, best practices in this area remain the subject of much discussion, and Khan and Frey add to that conversation with work which demonstrates a simple but elegant standardization method based on vehicle specific power data binning. Finally, in this section, in an example of leading edge work that incorporates the measurement of species likely to be of future regulatory interest (NH₃, N₂O and particle number), Mendoza-Villafuerte, Suarez-Bertoa and colleagues provide interesting insights into both the performance of current generation emission abatement technologies and the potential limitations of the RDE with respect to quantifying these species.

This work also employed new instrumentation, and although regulatory monitoring systems tend to be based on more established and therefore slow-to-evolve technologies, similar pushes for innovation are seen throughout the sector, driven by both a desire to reengineer our surveillance methods and a call for more robust data to inform emissions and air quality modeling activities. Method and instrument refinements are featured in several of the studies included here, but we selected two as examples of efforts to benchmark new technologies. Firstly, Ropkins, Pope and colleagues presented on international efforts to evaluate EDAR, a new-to-market passing vehicle (or remote sensing) vehicle emissions measurement system. Secondly, Yang, Johnson and colleagues present a comparison of a conventional industry standard (1065 Compliant) on-board PEMS vehicle exhaust sampling system and a mini-PEMS, one of a number of near-market-ready low-cost, weight and size alternatives.

In line with vehicle numbers, passenger car studies have traditionally dominated emissions research. However, in recent years both the volume and quality of other road vehicle and off-road vehicle studies have increased significantly, and here we select three papers as examples of this body of work. Firstly, in a study that demonstrates similar forward-thinking comparable to Mendoza-Villafuerte, Suarez-Bertoa and colleagues work on passenger cars, Vojtisek-Lom and colleagues present work that compares emissions from diesel and compressed natural gas (CNG) fueled light-duty vehicles. Next, in a study that highlights the drive to better manage the heavy-duty haulage vehicle fleet, Boriboonsomin and colleagues present work on the characterization of in-use exhaust temperatures, an issue directly linked with the poor real-world performance of some makes and models of heavy-duty diesel vehicles equipped with selective catalytic reduction (SCR) based emissions abatement technologies. We then close with off-road sector work by Cao and Colleagues on the assessment of the emissions impact of hybrid technology within the construction industry. This final paper, perhaps more than any other in this Special Issue,

demonstrates recognition within our research community that we now need to move to a position where we are routinely reassessing our emission standards to match the changing issues of a rapidly evolving vehicle fleet, and more regularly reviewing the metrics as well as the thresholds values that our regulatory practices are built upon.

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