

AGENDA

34th CRC REAL WORLD EMISSIONS WORKSHOP

Co-Sponsors

California Air Resources Board
Truck and Engine Manufacturers Association
US Environmental Protection Agency
South Coast Air Quality Management District
National Renewable Energy Laboratory

Workshop Organizers

Paul Loeper, Chevron (Co-Chair)
Michael Moore, Stellantis (Co-Chair)
Steven McConnell, Marathon Petroleum (Co-Chair)
Michael Aldridge, US Environmental Protection Agency
Sam Cao, South Coast Air Quality Management District
Yusuf Khan, Cummins Inc.
Andrew Kotz, National Renewable Energy Laboratory
Joseph Martin, US Environmental Protection Agency
Rada Purushothaman, Caterpillar
Heidi Vreeland, US Environmental Protection Agency
Laxmi Reddy Yatavelli, California Air Resources Board
Seungju Yoon, California Air Resources Board

Hyatt Regency Mission Bay
March 10-13, 2024

The purpose of this workshop is free exchange of ideas, research, data, etc. Please do not record or take photos of presentations. All submitted presentation content will be available to participants in the Workshop Proceedings. Sponsorship of or participation in the workshop by CRC or others does not reflect any endorsement of information.

Keynote Speakers

Matt Spears

Executive Director, Global Regulatory Affairs
Cummins Inc.

In March of 2020 Matt Spears joined Cummins, as Executive Director for Global Regulatory Affairs, within Cummins' Product Compliance and Regulatory Affairs (PCRA). Matt leads emissions regulatory affairs strategy; outreach; and activities to ensure that Cummins plans for, executes, and complies with global emissions, materials, and cybersecurity standards. Before coming to Cummins, Matt was a Vice President at the Truck & Engine Manufacturers Association (EMA), where he focused on advocacy regarding emissions regulation development and implementation, both in the U.S. and worldwide. Prior to that, he spent nearly 20 years at the U.S. Environmental Protection Agency's Office of Transportation and Air Quality (OTAQ), where he led regulatory teams that developed some of EPA's most far-reaching heavy-duty on-highway and nonroad emissions regulations. Matt also has held leadership positions at the International Civil Aviation Organization and at the International Maritime Organization, where he supported the development of new worldwide emissions standards for aircraft and ocean-going ships. Matt's other work experience includes over two years at sea & on the Great Lakes as a licensed watch-standing engineer on steam and diesel-powered merchant ships. Matt also achieved the rank of Lieutenant during his 12 years in the U.S. Naval Reserve.

David Kittelson

University of Minnesota

Professor Kittelson has worked for more than 45 years on measurements and control of emissions from engines. Current research interests include sampling, characterization, and control of ultrafine and nanoparticles from engines - both ground based and aircraft; measurement and control of crankcase particle emissions; characterization of advanced engine exhaust aftertreatment systems; measurement of vehicle emissions using mobile platforms; and reducing both local and global greenhouse emissions from transportation.

He is a Fellow of the Society of Automotive Engineers.

He received the 2020-2021 Haagen-Smit Clean Air Award for outstanding contributions to air quality science/technology

Workshop Co-Chairs

Michael Moore

Stellantis

Michael Moore is a Senior Regulatory Development Engineer of the Environmental and Energy Regulatory Development Group for Stellantis N.V. In his current role, Michael is the global fuels and evaporative emissions regulatory lead for Stellantis. In addition, Michael and the Regulatory Development Group responds to all North American environmental rulemakings. This includes interaction with government, industry, and third-party entities to develop and promote rational market-based regulations. Michael received his Bachelor of Science from Michigan State University and holds a Master of Science from Eastern Michigan University.

Paul Loeper

Chevron

Paul Loeper is a Fuels Engineer for Chevron, conducting fuels and additive research within the Fuel Products & Technology group at the Richmond Technical Center (RTC) within the Downstream Technology and Services (DT&S) organization. Paul participates in multiple industry groups working to develop and lead joint research between energy and automotive companies. Currently, Paul serves as co-chair of the Emissions Committee within the Coordinating Research Council (CRC) investigating fuel effects and engine hardware impacts on vehicle emissions. Paul received both his MS (2005) and PhD (2013) in mechanical engineering from the University of Wisconsin-Madison's Engine Research Center (ERC); and his BS in mechanical engineering from Marquette University (2003). Prior to returning to Madison for his doctoral studies in 2008, Paul worked as a thermofluids analyst for the Rocket Systems Launch Program (RSLP) at Northrop Grumman. Outside work, Paul enjoys biking and winter recreation in the Sierra Nevada mountains with his family.

Steven McConnell

Marathon Petroleum

Steve McConnell received a BSME from WVU in 1993 and a MSME from WVU in 1995. Steve liked WVU so much he ran the mobile lab until 1997. Steve recently worked as the Principal Fuels Engineer at Argonne National Lab where he worked to facilitate communication between the Department of Energy's national laboratories and USCAR, and helping to rewrite DoE's Research Roadmap and Goals for engine and vehicle level research. Steve McConnell is currently the Senior Engine Technologist at Marathon Petroleum, where he is Marathons internal expert on current and future engine technology (SI and Diesel) including: Octane/Cetane requirements, impact of physical properties of fuel, interaction between fuels and engines on emissions, emissions control technology, engine efficiency and fuel economy improvement technologies. Steve represents Marathon Petroleum Corporation on the following committees: American Petroleum Institute Vehicle Emissions Group and in Coordinating Research Council's Advanced Vehicles Fuels and Lubricants, Fuels for Advanced Combustion Engines, Atmospheric Impacts Committees and the US DoE's USDRIVE Fuels Working Group.

Session Chairs

Michael Aldridge

US Environmental Protection Agency

Dr. Michael Aldridge is a scientist in the Assessment and Standards Division of EPA's Office of Transportation and Air Quality. His work focuses on emissions inventory modeling of mobile sources which includes development of EPA's MOVES model, Nonroad model, and Marine Emissions Tools. Michael holds a B.A. in Physics from New College of Florida and PhD in Materials Science and Engineering from the University of Michigan.

Sam Cao

South Coast Air Quality Management District

Dr. Sam Cao is a Program Supervisor at the Technology Demonstration group at South Coast AQMD. He has a Ph.D. in Chemical and Environmental Engineering University of California, Riverside, specializing in in-use emissions measurement from off-road construction equipment and a MBA from Indiana University. Sam currently manages various low-emissions and zero emission technology demonstration and research projects. Prior to joining South Coast AQMD, he worked at Cummins Inc. in Advanced Emissions Development group for 5 years.

Yusuf Khan

Cummins Inc.

Dr. Yusuf Khan is a Global Emissions Testing & Regulatory Affairs Technical Advisor in the department of Product Compliance & Regulatory Affairs at Cummins Inc. He joined Cummins in 2013 after obtaining his Ph.D. in Chemical & Environmental Engineering from the University of California, Riverside. At Cummins, he is an emissions measurement and test procedures expert supporting global sites. He is the owner of Cummins global emissions & GHG post-processing tool, emissions & GHG database, and retrieval programs. He is also responsible for ensuring correct implementation of new test procedures at various global test sites. He is currently a co-chair of the Truck & Engine Manufacturer Associations - Emissions Measurement & Testing Committee, represents Cummins in European Automobile Manufacturers' Association, SAE Emission Standard Committee, and represents the US for ISO Technical Committee.

Session Chairs

Andrew Kotz

National Renewable Energy Lab

Dr. Andrew Kotz is a Senior Research Engineer at the U.S. Department of Energy National Renewable Energy Lab where he is part of the Center for Integrated Mobility Science's Commercial Vehicle Technology team. Andrew received his Ph.D. in Mechanical Engineering from the University of Minnesota where he researched real-world transit bus NOx emissions and vehicle big data. At NREL, Andrew's work focuses on heavy duty electrification, vehicle emissions and big data that help advance energy efficient and renewable transportation.

Joseph Martin

US Environmental Protection Agency

Dr. Joseph Martin is a researcher with the USEPA's Office of Research and Development, in the Surface and Fine Scale Branch of the Center for Environmental Modeling and Measurement. He received an MPH in Environmental Quality and Health from the University of Michigan's School of Public Health and a Ph.D. in Soil Chemistry from Purdue University. At EPA, Joseph's work is centered on characterization of IVOC/SVOC emissions from multiple sources, supporting method development, emissions inventories, and regulatory action.

Rada Purushothamon

Caterpillar, Inc.

Dr. Rada Purushothaman is a Senior Engineering Specialist, Global Engine Development at Caterpillar. Rada joined Caterpillar as an intern in Advanced Materials Technology in 2006. He worked as an engineer for Heat Treatment and Furnace Atmosphere Monitoring Systems. Rada later joined the Engine Emissions Measurement team in 2009 to support the Non-Road Tier IV engine development. His team is responsible for gaseous, particulate and particle emissions measurement for testing and compliance to various global emissions regulations. Rada is currently Chairman of the Truck and Engine Manufacturers Associations' (EMA's) Emissions Measurement and Testing Committee (EMTC) and has been a member of that committee for over 10 years. The EMTC meets regularly with US EPA and CARB to draft and amend emissions test procedures. The EMTC also sponsors and funds projects to improve emissions measurement and testing issues. Rada is also a member in SAE Emissions Standards Committee. Rada's research interests include Particulate and Particle Measurement and Emissions Measurement Uncertainty. He holds a M.S. and Ph.D. from Worcester Polytechnic Institute, Massachusetts in Manufacturing Engineering.

Session Chairs

Heidi Vreeland

US Environmental Protection Agency

Dr. Heidi Vreeland is a researcher at the U.S. Environmental Protection Agency in the Office of Research and Development. Her work at EPA includes investigating air quality impacts from combustion source emissions, and managing light-duty and heavy-duty dynamometer research. Heidi holds a M.S. from the Georgia Institute of Technology and Ph.D. from Duke University in Environmental Engineering.

Laxmi Reddy Yatavelli

California Air Resources Board

Dr. Reddy Yatavelli is a manager in the Mobile Source Laboratory Division of CARB. His work focuses on advanced technology and emissions evaluation of small handle-held to large on- and off-road engines. Prior to joining CARB, Reddy was a research faculty at Desert Research Institute, Reno, NV, and before that a post-doctoral researcher in Cooperative Institute for Research in the Environmental Sciences (CIRES), University of Colorado, Boulder. Reddy holds a B.S. in Mechanical Engineering from Bangalore University, India, a M.S. in Mechanical Engineering from Ohio University, Athens, OH, and a M.S. and Ph.D. in Atmospheric Sciences from the University of Washington, Seattle, WA.

Seungju Yoon

California Air Resources Board

Dr. Seungju Yoon is a manager with California Air Resources Board, Research Division. He oversees on-road and off-road mobile source research programs of mitigating greenhouse gas emissions from mobile air conditioners (MVAC), characterizing in-use vehicle emissions and activity and their impact on air quality, investigating emissions reduction opportunities using laboratory, remote-sensing, and engine and activity data-logging technologies, and understanding non-tailpipe emissions such as brake and tire wear. Seungju holds a master's degree in environmental engineering – air pollution control and a Ph. D degree in civil engineering – transportation systems from the Georgia Institute of Technology. He has over 20 years of experience in transportation and air quality research and policy development.

Sunday, March 10, 2024

4:30-6:00 PM Registration in the Bayview Foyer and Poster Setup in the Regatta Pavilion

6:00-7:00 PM Welcome Reception in Banyan Court and Lawn

Monday, March 11, 2024

All sessions take place in Bayview Ballroom, unless otherwise noted

7:00 AM **Registration in Bayview Foyer and Continental Breakfast in Regatta Pavilion**

8:00 AM **Welcome from the Chairs: Steve McConnell, Marathon Petroleum & Michael Moore, Stellantis**

Keynote Address: Matthew Spears

8:15 AM **Executive Director for Global Regulatory Affairs
Cummins, Inc.**

SESSION 1

9:00 AM **In-Use Heavy Duty and Low Carbon Vehicle Technologies**

Introduction by Session Leader: Andrew Kotz, National Renewable Energy Laboratory

9:05 AM EXAMINATION OF N₂O EMISSIONS FROM IN-USE HEAVY-DUTY TRUCKS Hee Je Seong California Air Resources Board

9:20 AM H₂ ICE AFTERTREATMENT CATALYST CHARACTERIZATION Bryan Zavala Southwest Research Institute

9:35 AM ANALYSIS OF ONBOARD CARBON CAPTURE AND STORAGE FOR HEAVY DUTY TRUCKS, RAIL, AND MARINE Mike Kass Oak Ridge National Laboratory

9:50 AM DEVELOPING TOOLS TO QUICKLY FIND POTENTIALLY HIGH EMITTING HEAVY-DUTY VEHICLES Carl Fulper US Environmental Protection Agency

10:05 AM General Discussion and Open Q & A

10:20 AM **Poster Session and Demonstrations in Regatta Pavilion**

SESSION 2

10:55 AM **Non-Exhaust Emissions**

Introduction by Session Leader: Seungju Yoon, California Air Resources Board

11:00 AM NON-EXHAUST EMISSIONS RESEARCH IN CALIFORNIA: RESEARCH GOALS AND STATUS UPDATE Seungju Yoon California Air Resources Board

11:15 AM REAL-WORLD MEASUREMENTS OF PARTICLE EMISSIONS FROM BRAKE AND TIRE WEAR Louisa Kramer Ricardo

11:30 AM ASSESSING REAL-WORLD BRAKE WEAR PARTICLE EMISSIONS ON PUBLIC ROADS Michael Peter Huber Institute of Automotive Engineering of the Technical University of Graz

11:45 AM CHARACTERISTIC OF TIRE WEAR AND TIRE-ROAD WEAR PARTICLES FROM VEHICLES DRIVING ON REAL ROADS Hwansoo Chong National Institute of Environmental Research

12:00 PM RECONSTRUCTION OF PM SPECIATION PROFILES FROM HEAVY-DUTY VEHICLE BRAKE WEAR PARTICULATE MATTER EMISSION Chia-Li Chen California Air Resources Board

12:15 PM General Discussion and Open Q & A

12:30 PM **Lunch Break in Banyan Court and Lawn**

Monday, March 11, 2024

SESSION 3

2:00 PM Emissions Measurement Methods

Introduction by Session Leaders: Rada Purushothaman, Caterpillar, and Joseph Martin, US Environmental Protection Agency

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| 2:05 PM | FIRST LOOK AT ETHYLENE OXIDE EMISSION FROM MOBILE SOURCES | Aiko Matsunaga | California Air Resources Board |
| 2:20 PM | EVALUATION OF ANALYZER ACCURACY, NOISE, AND REPEATABILITY AT LOW NOX CONCENTRATIONS | Benjamin Shade | AVL Test Systems, Inc. |
| 2:35 PM | PRACTICAL ANALYSIS OF MINI-PEMS DATA TO SCORE IN-USE EMISSIONS | Gregory Banish | Calibrated Success |
| 2:50 PM | General Discussion and Open Q & A | | |

3:05 PM Poster Session and Demonstrations in Regatta Pavilion

SESSION 3

3:35 PM Emissions Measurement Methods (Continued)

Welcome Back by Session Leaders: Rada Purushothaman, Caterpillar, and Joseph Martin, US Environmental Protection Agency

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| 3:40 PM | ENHANCING REAL-WORLD EMISSION FACTOR MEASUREMENTS FOR HEAVY-DUTY VEHICLES USING ADVANCED TECHNOLOGY | Okjoo Park | California Air Resources Board |
| 3:55 PM | FUTURE CHALLENGES FOR PEMS FT-IR MEASUREMENT OF CARBON/NON-CARBON BASED EXHAUST | Philipp Jakubec | IAG Test Cell Technology |
| 4:10 PM | REAL WORLD LASER SPECTROSCOPY-BASED EMISSIONS TESTING ON A DIESEL CARGO VAN | Ritobrata Sur | Indrio Technologies |
| 4:25 PM | General Discussion and Open Q & A | | |

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| 4:40 PM | Logistics for Dinner Event | Jan Tucker | Coordinating Research Council, Inc. |
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4:45 PM END OF DAY

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| 5:45 PM | Meet in Lobby to Leave for Networking Dinner, Last Bus Leaving at 6:00 PM | | |
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Tuesday, March 12, 2024

7:00 AM Registration in Bayview Foyer and Continental Breakfast in Regatta Pavilion

8:00 AM Keynote Introduction by Workshop Co-Chair, Michael Moore, Stellantis

Keynote Address: "Memories of Workshops Past"

8:05 AM Dr. David Kittelson
University of Minnesota

SESSION 4

8:50 AM Improving the Emissions Inventory

Introduction by Session Leader: Sam Cao, South Coast Air Quality Management District

8:55 AM INVESTIGATING THE IMPACT OF PORT CONGESTION ON AIR POLLUTANT AND GREENHOUSE GAS EMISSIONS FROM OPERATIONS AT THE PORTS OF LONG BEACH AND LOS ANGELES: INSIGHTS FROM THE COVID-19 ERA AND THE INFLUENCE OF CLEAN TRANSPORTATION POLICIES Sara Forestieri California Air Resources Board

9:10 AM DEVELOPMENT OF A STATEWIDE AIRCRAFT EMISSIONS INVENTORY IN CALIFORNIA Kaishan Zhang California Air Resources Board

9:25 AM APPROACHES FOR USING PORTABLE EMISSIONS MEASUREMENT SYSTEM (PEMS) DATA FOR INVENTORY DEVELOPMENT Mo Chen California Air Resources Board

9:40 AM ADVANCEMENTS IN LATIN AMERICAN EMISSION INVENTORIES USING MOVES: A FRAMEWORK FOR INTERNATIONAL APPLICATION John Koupal ERG

9:55 AM General Discussion and Open Q & A

10:05 AM Poster Session and Demonstrations in Regatta Pavilion

SESSION 5

10:30 AM Emissions Modeling

Introduction by Session Leader: Michael Aldridge, US Environmental Protection Agency

10:35 AM APPLICABILITY OF MICROSCALE SPATIALLY RESOLVED ONROAD EMISSIONS FOR EVALUATING ENVIRONMENTAL JUSTICE IMPLICATIONS Tongchuan Wei North Carolina State University

10:50 AM DEVELOPMENT OF NEW HEAVY-DUTY VEHICLE BRAKE WEAR EMISSION RATES FOR EPA'S MOVES MODEL Jaehoon Han US Environmental Protection Agency

11:05 AM MODELING ELECTRIC VEHICLE IMPACTS ON AIR QUALITY – AN ANALYSIS OF EMISSION CHANGES DUE TO ADOPTION OF PLUG-IN ELECTRIC VEHICLE IN DALLAS-FORT WORTH METROPOLITAN AREA Madhusudhan Venugopal Texas A&M Transportation Institute

11:20 AM ACCOUNTING FOR LOCAL PROFILE VARIATION WHEN SOURCE APPORTIONING AIRBORNE PARTICULATE MATTER DATA USING THE US EPA'S SPECIATE Karl Ropkins University of Leeds

11:35 AM COMPREHENSIVE SIMULATION PLATFORM FOR ENABLING LOW EMISSION MD/HD VEHICLES Andrea Strzelec USCAR

11:50 AM General Discussion and Open Q & A

12:05 PM Lunch Break in Banyan Court and Lawn

Tuesday, March 12, 2024

SESSION 6

1:35 PM Electric and Hybrid Vehicles

Introduction by Session Leader: Laxmi Reddy Yataveli, California Air Resources Board

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| 1:40 PM | DISTINGUISHING BRAKING ACTIVITY PATTERNS: A STUDY OF DIFFERENCES BETWEEN HEAVY-DUTY BATTERY ELECTRIC AND CONVENTIONAL VEHICLES | Georges Saliba | California Air Resources Board |
| 1:55 PM | VEHICLE ACTIVITY AND ENERGY USE PROFILES: A STUDY OF DIFFERENCES BETWEEN HEAVY-DUTY BATTERY ELECTRIC AND CONVENTIONAL VEHICLES | Hanwei Zhu | California Air Resources Board |
| 2:10 PM | IMPROVING ESTIMATION OF ENERGY CONSUMPTION RATES FOR ZERO-EMISSION VEHICLES IN EMFAC 202Y | Lucas Algrim | California Air Resources Board |
| 2:25 PM | ACTIVITY DATA OF ZERO AND NEAR-ZERO EMISSIONS VEHICLES AND EQUIPMENT | Tom Durbin | University of California, Riverside |
| 2:40 PM | ENERGY-EFFICIENT ADAPTIVE CRUISE CONTROL | Piyush Bhagdikar | Southwest Research Institute |
| 2:55 PM | General Discussion and Open Q & A | | |

3:05 PM Poster Session and Demonstrations in Regatta Pavilion

SESSION 7

3:35 PM Alternate Fuel and Zero-Emissions Vehicles (Hydrogen, Non-Carbon Fuels, Battery-Electric fuel cells)

Introduction by Session Leader: Andrew Kotz, National Renewable Energy Laboratory

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| 3:40 PM | UNDERSTANDING DC POWER TRANSFER WITH ELECTRIC VEHICLES | Sandesh Rao | Southwest Research Institute |
| 3:55 PM | IMPACT OF HYDROGEN BLENDING ON EMISSIONS OF NATURAL GAS UTILITY ENGINE | John Sparrow | Intertek |
| 4:10 PM | NITROGEN SPECIES EMISSIONS FROM GREEN AMMONIA-FUELED YARD TRACTORS | Will Northrop | University of Minnesota |
| 4:25 PM | SOLUTIONS TO MAKE GREEN METHANOL AN EASY LOW CARBON FUEL WITH REDUCED EMISSIONS IN COMPRESSION IGNITION ENGINES | Anne-Gaëlle Morin | VeryOne |
| 4:40 PM | General Discussion and Open Q & A | | |

4:50 PM END OF DAY

5:30 PM Evening Poster and Demonstration Reception in Regatta Pavilion

Wednesday, March 13, 2024

7:00 AM Registration in Bayview Foyer and Continental Breakfast in Regatta Pavilion

SESSION 8

8:00 AM **Conventional and Alternative Fuel Effects on Emissions (Low-Carbon Fuels, etc.)**

Introduction by Session Leader: Yusuf Khan, Cummins Inc.

8:05 AM LOW NOX EMISSIONS IMPACT OF HIGH BIODIESEL BLENDS - EVALUATION AND ENGINE RECALIBRATION Christopher Sharp Southwest Research Institute

8:20 AM IMPACT OF ULSD FUEL ANALYSES VARIATION ON BSCO₂ BASED ON SIX INTER-LAB STUDY Atharva Desai Cummins

8:35 AM EMISSIONS AND EFFICIENCY IMPACTS OF BIO-OIL/VERY LOW SULFUR FUEL OIL BLENDS IN THE ENTERPRISE 2-STROKE MARINE DIESEL RESEARCH ENGINE Brian Kaul Oak Ridge National Laboratory

8:50 AM COMPARING REGULATED AND UNREGULATED REAL DRIVING EMISSIONS FROM EURO 6D VEHICLES RUNNING ON E0 AND E10 GASOLINE BLENDS Nick Molden Emissions Analytics

9:05 AM General Discussion and Open Q & A

9:20 AM **Poster Session and Demonstrations in Regatta Pavilion**

SESSION 9

9:50 AM **Off-Road / Non-Road Emissions**

Introduction by Session Leader: Rada Purushothaman, Caterpillar

9:55 AM NEW NOX EMISSION FACTORS FOR OFF-ROAD ENGINES Julie Schiffman California Air Resources Board

10:10 AM MOBILE HYDRAULIC ENGINE DYNAMOMETER Axel Freund California Air Resources Board

10:25 AM EMISSIONS MEASUREMENT FROM OCEAN GOING CONTAINER AND ROLL ON/ROLL OFF VESSELS USING A CAPTURE AND CONTROL SYSTEM Tianbo Tang* University of California, Riverside

10:40 AM EMISSION RESULTS FROM TRANSPORT REFRIGERATION UNIT (TRU) ENGINES USING PEMS IN A SIMULATED IN-USE TEST CONDITION Shaohua Hu California Air Resources Board

10:55 AM General Discussion and Open Q & A

11:10 AM **Lunch Break in Banyan Court and Lawn**

Wednesday, March 13, 2024

SESSION 10

12:30 PM Emissions Control Measures: I/M, OBD, Technologies and Strategies

Introduction by Session Leader: Seungju Yoon, California Air Resources Board

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| 12:35 PM | CLEANING THE AIR IN NIGERIA - LESSONS FROM AN I/M CAMPAIGN | Daisy Thomas | 3DATX |
| 12:50 PM | PRELIMINARY RESULTS OF SENSOR BASED ONBOARD SENSING ANALYSIS AND REPORTING FROM FLEETS DURING A TWO MONTH TIMEFRAME | Grace Johnson* | University of California, Riverside |
| 1:05 PM | HEAVY-DUTY VEHICLE ENFORCEMENT WITH ROADSIDE EMISSIONS MONITORING DEVICES FOR CARB'S CLEAN TRUCK CHECK PROGRAM: CURRENT STATUS AND FUTURE PLANS | Hang Liu | California Air Resources Board |
| 1:20 PM | HEAVY-DUTY VEHICLE INSPECTION AND MAINTENANCE PROGRAM IN CALIFORNIA – THE CLEAN TRUCK CHECK, CARBTEST REFEREE PROGRAM | Tom Durbin | University of California, Riverside |
| 1:35 PM | General Discussion and Open Q & A | | |

SESSION 11

1:50 PM Air Quality and Impact of Regional Emissions Changes on Environmental Justice

Introduction by Session Leader: Heidi Vreeland, US Environmental Protection Agency

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| 1:55 PM | WORKER EXPOSURE TO DIESEL EXHAUST FROM NON-ROAD MOBILE MACHINERY USED IN THE UK CONSTRUCTION SECTOR | Carl Desouza | Imperial College London |
| 2:10 PM | AIR QUALITY IMPACTS AND NOX EMISSIONS EXPOSURES IN DISADVANTAGED COMMUNITIES FROM HEAVY-DUTY VOCATIONAL VEHICLES | Troy Hurren* | University of California, Riverside |
| 2:25 PM | PEMS MEASUREMENTS OF TAILPIPE EMISSIONS FOR BUILDING A VOLUNTARY MOBILE SOURCE CARBON OFFSET PROGRAM – A CASE STUDY FROM AFRICA | Alberto Ayala | South Coast Air Quality Management District |
| 2:40 PM | QUANTIFYING THE OCCUPATIONAL EXPOSURE TO PM2.5 AND STAFF SICKNESS ABSENCE ON THE LONDON UNDERGROUND | Justie Mak | Imperial College London |
| 2:55 PM | REAL-WORLD EMISSIONS APPLICATIONS IN FRA'S NEW CLIMATE AND SUSTAINABILITY PROGRAM | William Chupp | U.S. Department of Transportation |
| 3:10 PM | General Discussion and Open Q & A | | |

3:25 PM **Closing Remarks from Workshop Chairs**
Steven McConnell, Marathon Petroleum
Michael Moore, Stellantis

3:35 PM **END OF WORKSHOP**

POSTERS

IN-USE HEAVY DUTY AND LOW CARBON VEHICLE TECHNOLOGIES

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| CHARACTERIZING THE GASEOUS TOXIC POLLUTANTS, PARTICULATE EMISSIONS AND THEIR TOXICITY FROM A PHEV OPERATING WITH ETHANOL BLENDS | Troy Hurren* | University of California, Riverside |
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| CURRENT HEAVY-DUTY DIESEL AND NATURAL GAS VEHICLE TECHNOLOGY CAN MEET FUTURE EPA IN-USE NOX EMISSIONS STANDARDS | Troy Hurren* | University of California, Riverside |
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| HOW GHG REGULATIONS AND VARIOUS VEHICLE TECHNOLOGIES IMPACT IN-USE CO2 EMISSIONS IN THE HEAVY-DUTY TRANSPORTATION SECTOR | Troy Hurren* | University of California, Riverside |
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| MEASUREMENT OF NOX EMISSIONS FROM HEAVY DUTY VEHICLES UNDER REAL-WORLD DRIVING CONDITIONS | Louisa Kramer | Ricardo |
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NON-EXHAUST EMISSIONS

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| QUANTIFYING TYRE EMISSIONS IN ENVIRONMENTAL SAMPLES | Nick Molden | Emissions Analytics |
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| STUDY OF EMISSION CHARACTERISTICS OF NON-EXHAUST PARTICULATE MATTER AS A FUNCTION OF SEPARATION DISTANCE ON AUTOMOBILE ROADS | Yunsung Lim | National Institute of Environmental Research |
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| BRAKE WEAR PARTICLE EMISSION MEASUREMENTS BASED ON SEVERAL REAL URBAN DRIVING CYCLES ON LABORATORY EXPERIMENTS | Hiroyuki Hagino | Japan Automobile Research Institute |
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EMISSIONS MEASUREMENT METHODS

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| PERFORMANCE EVALUATION OF THE AVL M.O.V.E FT - A NEW PORTABLE FTIR FOR IN-VEHICLE MEASUREMENTS | Benjamin Shade | AVL Test Systems, Inc. |
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| FUEL COMPOSITION EFFECTS OF SPECIATED EMISSIONS FROM GASOLINE ENGINES | Justine Geidosch | US Environmental Protection Agency |
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| VEHICLE EMISSIONS AND FUEL CONSUMPTION IN LABORATORY AND ON-ROAD: A CASE STUDY FOR THE QUITO METROPOLITAN AREA | Luis Tipanluisa | Escuela Superior Politécnica de Chimborazo |
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| EVALUATION OF AN FT-IR/TDLAS MEASUREMENT SYSTEM DESIGNED FOR SIMULTANEOUS MEASUREMENT OF LOW NOX AND AMMONIA | Richard Frazee | EigenValue Emission Solutions, Inc. |
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| TESTING OF PEMS | Stephan Newl | AVL |
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| RESULTS FROM SENSOR BASED ON-BOARD SENSING ANALYSIS AND REPORTING (OSAR) PHASE 2 DEPLOYMENT | Zisimos Toumasatos | University of California, Riverside |
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ALTERNATE FUEL AND ZERO-EMISSIONS VEHICLES (HYDROGEN, NON-CARBON FUELS, BATTERY-ELECTRIC FUEL CELLS)

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| UTILISING AN INTEGRATED PORTABLE EMISSIONS MEASUREMENT SYSTEM (IPEMS) TO MEASURE EMISSIONS FROM A MULTI-GAS FUELLED GENERATOR | Carl Desouza | Imperial College London |
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POSTERS

AIR QUALITY AND IMPACT OF REGIONAL EMISSIONS CHANGES ON ENVIRONMENTAL JUSTICE

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| THE PROBLEM WITH PUBLIC TRANSPORT: POLLUTION EXPOSURE FOR TRAVELLERS, AND WHAT TO DO ABOUT IT | Nick Molden | Emissions Analytics |
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| INFLUENCE OF LONDON'S CLEAN AIR ZONES FOR CONSTRUCTION SITES | Carl Desouza | Imperial College London |
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CONVENTIONAL AND ALTERNATIVE FUEL EFFECTS ON EMISSIONS (LOW-CARBON FUELS, ETC.)

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| EFFECT OF TEST TEMPERATURE AND FUEL PROPERTIES ON PM EMISSIONS FROM A 2018 TOYOTA CAMRY | Aron Butler | US Environmental Protection Agency |
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DECARBONIZATION: TECHNOLOGIES, COMPLICATIONS, AND MITIGATION STRATEGIES

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| ROUTE MAP TO DECARBONISATION AND ACHIEVING NET-ZERO CONSTRUCTION IN THE UK | Carl Desouza | Imperial College London |
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PARTICULATE EMISSIONS AND MEASUREMENT

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| ULTRAFINE PARTICLE MEASUREMENT CAMPAIGN IN THE CITY OF GRAZ USING AN AVL CPC | | AVL |
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DEMONSTRATIONS

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