

# Real World Emissions Workshop



## ***Workshop Co-sponsors***

**California Air Resources Board  
National Renewable Energy Laboratory  
US Environmental Protection Agency  
Truck and Engine Manufacturers Association**

## ***Workshop Organizers***

**Dominic DiCicco, Co-Chairman, Ford Motor Company  
Scott Mason, Co-Chairman, Phillips 66 Company  
Richard Baldauf, US Environmental Protection Agency NRMRL  
David Choi, US Environmental Protection Agency OTAQ  
Shaokai Gao, Phillips66  
Tao Huai, California Air Resources Board  
Joseph Impulitti, South Coast Air Quality Management District  
Yusuf Khan, Cummins, Inc.  
Rada Purushothaman, Caterpillar, Inc.  
Matthew Thornton, National Renewable Energy Laboratory  
Diep Vu, Marathon Petroleum Corporation  
Seungju Yoon, California Air Resources Board  
Amber Leland, Coordinating Research Council, Inc.**

**Virtual  
March 8-11, 2021**

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.

## DAY ONE MONDAY, MARCH 8, 2021

All times given in Eastern Time

**10:30 AM Welcome from the Chairs: Dominic DiCicco, Ford Motor Co., & Scott Mason, Phillips 66**

### 10:45 AM SESSION 1: PARTICULATE EMISSIONS AND MEASUREMENT

*Introduction by Yusuf Khan, Cummins, Inc.*

FAST NUMBER CONCENTRATION MEASUREMENT BASED ON REAL-TIME PARTICLE SIZE ESTIMATION WITH SINGLE-CHANNEL ELECTRICAL DETECTION

Erkka Saukko <sup>+</sup>

Pegasor Oy

FILTER-COLLECTED AND GAS-PHASE PAH EMISSIONS FROM A CGPF-EQUIPPED LIGHT DUTY TRUCK

Stanislav Bohac <sup>+</sup>

US EPA

REAL TIME ASH PARTICLE MEASUREMENTS

David Kittelson

University of Minnesota

### 11:35 AM 10 Minute Break

### 11:45 AM SESSION 2: BRAKE- AND TIRE-WEAR EMISSIONS

*Introduction by Yusuf Khan, Cummins, Inc.*

COMPARISON OF PARTICULATE EMISSIONS AND DISC TEMPERATURE PROFILES FROM A COMMERCIAL DISC-BRAKE SYSTEM TESTED ON TWO DYNAMOMETER SAMPLING SYSTEMS

Athanasios Mamakos <sup>+</sup>

AVL list GmbH

EVALUATION OF HEAVY-DUTY VEHICLE BRAKE-WEAR EMISSIONS USING A CHASSIS DYNAMOMETER

Eon Lee <sup>+</sup>

California Air Resources Board

REAL-WORLD TIRE AND BRAKE WEAR EMISSIONS

Heejung Jung <sup>+</sup>

University of California, Riverside

### 12:35 PM 25 Minute Break

### 1:00 PM SESSION 3: IN-USE EMISSIONS FOR HEAVY DUTY VEHICLES

*Introduction by Tao Huai, California Air Resources Board*

COMPARISON OF MANUFACTURERS IN-USE TESTING RESULTS USING EPA NOT-TO-EXCEED TEST PROCEDURES AND EU MOVING AVERAGING WINDOW METHOD

Fakhri Hamady

US EPA

HEAVY-DUTY IN-USE COMPLIANCE EMISSIONS AND A COMPARISON OF NEW METRICS

Stephen Berdahl <sup>+</sup>

California Air Resources Board

NOX EMISSIONS REDUCTION POTENTIAL FROM THE HYBRIDIZATION OF UTILITY WORK TRUCKS

Eric Miller

NREL

EVALUATING THE 3-BIN MOVING AVERAGE WINDOW METHOD USING REAL-WORLD EMISSION TESTING DATA

Yi Tan <sup>+</sup>

California Air Resources Board

### 2:00 PM 10 Minute Break

PEMS AND CHASSIS DYNAMOMETER EMISSIONS RATES OF HEAVY-DUTY DIESEL AND ALTERNATIVE FUELED VEHICLES OPERATING IN SOUTHERN CALIFORNIA

Arvind Thiruvengadam

West Virginia University

IN-USE EMISSIONS TESTING AND FUEL USAGE PROFILE OF ON-ROAD HEAVY-DUTY VEHICLES – PEMS AND CHASSIS TESTING

Cavan McCaffery <sup>\*\*</sup> & Hanwei Zhu<sup>\*</sup>

University of California, Riverside

EVALUATION OF IN-USE COMMERCIAL VEHICLE DATA TO DETERMINE EMISSIONS IMPACTS DUE TO ENGINE SOAK TIME, STARTS, AND WARM-UP DURATION

Chen Zhang

NREL

### 2:50 PM Conclusion of Day 1 Technical Sessions

### 3:00 PM Interactive Session for Day 1 on Fourwaves

\*Student Presenter

<sup>+</sup>Available for Interactive Session, refer to Interactive Session Schedule

## DAY TWO TUESDAY, MARCH 9, 2021

### 10:30 AM SESSION 4: FUEL EFFECTS ON EXHAUST EMISSIONS

*Introduction by Matthew Thornton, National Renewable Energy Laboratory*

IMMEDIATE AND LONG TERM EFFECTS OF FUEL VARIABILITY ON AFTERTREATMENT CATALYSTS AND PERFORMANCE	Alissa Recker <sup>+</sup>	Detroit Diesel
INFLUENCE OF SOME ISOMERS OF C2-C4 ALCOHOL ON THE FORMATION AND TOXICITY OF PAHSIN HIGH TEMPERATURE FLOW REACTOR	Zuhaib Khan <sup>+</sup> *	University College London
IMPACTS OF DISTILLATION ENDPOINT TEMPERATURE ON THE COMPOSITION AND PM INDEX OF GASOLINE	Aron Butler <sup>+</sup>	US EPA
INTERACTIVE EFFECTS OF ETHANOL AND AROMATICS ON GASOLINE PM EMISSIONS	Matthew A. Ratcliff <sup>+</sup>	NREL
LONG-TERM ACTIVITY DATA ANALYSIS OF A TRANSIT FLEET LEAPFROGGING FROM CONVENTIONAL TO ELECTRIC PROPULSION	Harikishan Perugu	California Air Resources Board

### 11:45 AM 15 Minute Break

### 12:00 PM KEYNOTE ADDRESS

**Bill Charmley**

Director Assessment and Standards Division  
Office of Transportation and Air Quality  
U.S. Environmental Protection Agency

### 12:35 PM 25 Minute Break

### 1:00 PM SESSION 5: OFF-ROAD/ NON-ROAD EMISSIONS

*Introduction by Rada Purushothaman, Caterpillar*

REAL WORLD EMISSION FROM TIER 4F OFF-ROAD CONSTRUCTION EQUIPMENT	Hanwei Zhu <sup>+</sup> *	University of California, Riverside
OBSERVED CHANGES IN CALIFORNIA'S AGRICULTURAL SECTOR, AS NOTED IN CALIFORNIA'S NEW AGRICULTURAL EQUIPMENT EMISSION INVENTORY	Julie Schiffman <sup>+</sup>	California Air Resources Board
EMISSIONS EVALUATION OF AN AUXILIARY BOILER ON A MODERN PANAMAX TANKER	Cavan McCaffery <sup>+</sup> *	University of California, Riverside
LOAD FACTORS FOR CONSTRUCTION OFF-ROAD DIESEL ENGINES EQUIPPED WITH AFTERTREATMENT CONTROLS AND THEIR IMPACTS ON EMISSION INVENTORY	Qi Yao	California Air Resources Board
DETERMINING BATTERY SIZE AND CHARGING POWER REQUIREMENTS FOR ELECTRIC CONSTRUCTION EQUIPMENT TO MEET REAL-WORLD OPERATION AND ENERGY DEMANDS	Fuad Un-Noor <sup>*</sup>	University of California, Riverside
OFF-ROAD GREENHOUSE GAS EMISSIONS	Jim Lindner <sup>+</sup>	ERG

### 2:30 PM Conclusion of Day 2 Technical Sessions

### 3:00 PM Interactive Session for Day 2

## DAY THREE WEDNESDAY, MARCH 10, 2021

### 9:00 AM Interactive Session for International Presenters

### 10:30 AM SESSION 6 : IN-USE EMISSIONS FROM LIGHT-DUTY VEHICLES

*Introduction by Joe Martin, Environmental Protection Agency*

E-23/E-106/E-123: THE COORDINATING RESEARCH COUNCILS LEGACY OF LONG-TERM ON-ROAD EMISSION MEASUREMENTS	Gary Bishop <sup>+</sup>	University of Denver
ON-ROAD EMISSIONS PERFORMANCE OF REPAIRED VOLKSWAGEN, AUDI AND PORSCHE DIESEL POWERED VEHICLES	Gary Bishop <sup>+</sup>	University of Denver
REAL WORLD GASEOUS AND PARTICLE NUMBER EMISSIONS FROM PLUG-IN HYBRID VEHICLES	Kieran Humphries <sup>+</sup>	Environment and Climate Change Canada
ARE GASOLINE VEHICLES BEING PROMOTED OVER DIESELS AS AN ARTEFACT OF THE POLLUTANTS MEASURED?	Nick Molden	Emissions Analytics
EVALUATION OF THE EFFECTS OF CONVENTIONAL CRUISE CONTROL ON LIGHT-DUTY GASOLINE VEHICLE FUEL USE AND EMISSION RATES	Weichang Yuan <sup>+</sup> *	North Carolina State University

### 11:45 AM 15 Minute Break

### 12:00 PM SESSION 7: AIR QUALITY IMPACTS AND EFFECTS OF COVID-19 ON AIR QUALITY

*Introduction by Shaokai Gao, Phillips66*

STAY AT HOME ORDER IMPACT ON OZONE CONCENTRATION IN THE PHOENIX NONATTAINMENT AREA	Rene Nsanzineza <sup>+</sup>	Arizona Dept. of Environmental Quality
ASSESSMENT OF PHOTOCHEMICAL MODELS ABILITY TO REPRODUCE OBSERVED OZONE CHANGES IN RESPONSE TO EMISSION CHANGES FROM THE COVID-19 PANDEMIC	Ralph Morris <sup>+</sup>	Ramboll
MEASURING THE AIR QUALITY IMPACT OF TRAFFIC FLEET INTERVENTIONS	Karl Ropkins <sup>+</sup>	University of Leeds

### 12:50 PM 25 Minute Break

### 1:15 PM SESSION 8: EMISSIONS MEASUREMENTS METHODS

*Introduction by Diep Vu, Marathon Petroleum Corporation*

IDENTIFICATION OF ON-ROAD HIGH-EMITTING HEAVY DUTY DIESEL VEHICLES USING THE PORTABLE EMISSIONS ACQUISITION SYSTEM (PEAQs)	Okjoo Park <sup>+</sup>	California Air Resources Board
MEASUREMENT OF NITROGEN OXIDES THROUGH ADVANCED NDUV	Jason Gaudet <sup>+</sup>	Sensors, Inc.
CALCULATING DRAG COEFFICIENTS FOR ROAD-TO-RIG APPLICATIONS	Adam Edwards <sup>+</sup>	California Air Resources Board
ON-ROAD MEASUREMENT OF RUNNING LOSSES BY REMOTE SENSING	Tim DeFries <sup>+</sup>	ERG
RDE PLUS – A ROAD TO RIG FRONTLOADING METHODOLOGY FOR WHOLE VEHICLE DEVELOPMENT, CALIBRATION AND VERIFICATION	Phil Roberts	Horiba

### 2:30 PM Conclusion of Day 3 Technical Sessions

### 3:00 PM Interactive Session for Day 3

## DAY FOUR THURSDAY, MARCH 11, 2021

### 10:30 AM SESSION 9: EMISSIONS CONTROL MEASURES: I/M, OBD, TECHNOLOGIES AND STRATEGIES

*Introduction by Seungju Yoon, California Air Resources Board*

NEXT-GENERATION HEAVY-DUTY VEHICLE ENFORCEMENT: A PILOT STUDY USING ROADSIDE EMISSIONS MONITORING SYSTEMS	Hang Liu <sup>+</sup>	California Air Resources Board
ANALYSIS OF HEAVY-DUTY DIESEL VEHICLE TELEMETRY DATA USING ARB'S "REAL-OBD" APPROACH	Arvind Thiruvengadam <sup>*</sup>	West Virginia University
DEVELOPMENT AND APPLICATION OF A MICRO-PEMS SYSTEM FOR ONBOARD SENSING, ANALYSIS, AND REPORTING	Kent Johnson	University of California, Riverside
ASSESSMENT OF THE CALIFORNIA SMOG CHECK PROGRAM	Philip Heirigs <sup>+</sup>	Bureau of Automotive Repair

#### 11:30 AM 15 Minute Break

### 11:45 AM SESSION 10: EMISSIONS MODELING

*Introduction by David Choi, Environmental Protection Agency*

UPDATES TO EPA'S MOTOR VEHICLE EMISSION SIMULATOR (MOVES)	Megan Beardsley <sup>+</sup>	US EPA
MODELING GASEOUS EMISSIONS FROM ADVANCED COMPRESSION IGNITION OPERATIONS IN A GASOLINE DIRECT INJECTION ENGINE	Joohan Kim	Argonne National Lab
MODELING EMISSIONS DETERIORATION IN LIGHT-DUTY GASOLINE VEHICLES WITH A 3-PIECE LOG-LINEAR SPLINE	James Warila <sup>+</sup>	US EPA
DEVELOPMENT OF A PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV) MODULE FOR EMFAC202X BASED ON REAL-WORLD EMISSION AND ACTIVITY DATA	Wan Jiao <sup>+</sup>	California Air Resources Board

#### 12:45 PM 15 Minute Break

### 1:00 PM SESSION 11: IMPROVING THE EMISSIONS INVENTORY

*Introduction by Joseph Impullitti, South Coast Air Quality Management District*

ANALYSIS OF IN-USE PERFORMANCE OF HEAVY-DUTY VEHICLES	Sara Forestieri	California Air Resources Board
ZERO EMISSIONS VEHICLE (ZEV) ENERGY CONSUMPTION	Sara Forestieri	California Air Resources Board
NEW HDV ANNUAL MILEAGE ACCRUAL RATES FOR THE EMFAC MODEL	Allison DenBleyker <sup>+</sup>	ERG
AN OVERVIEW OF EMFAC202X UPDATES	Fang Yan <sup>+</sup>	California Air Resources Board
DEVELOPMENT OF A NOVEL METHOD FOR PREDICTING TURNOVER AND RETIRING PATTERNS OF LINE-HAUL LOCOMOTIVES OPERATING IN CALIFORNIA	Junhyeong Park <sup>+</sup>	California Air Resources Board

#### 2:15 PM 5 Minute Break

**2:20 PM Closing Remarks from Workshop Co-Chairs:  
Dominic DiCicco, Ford Motor Co., Scott Mason, Phillips 66**

**2:30 PM Conclusion of Day 4 Technical Sessions**

**3:00 PM Interactive Session for Day 4**

DAY 1 INTERACTIVE SESSION: 3-4 PM Eastern Time at Fourwaves		
DEMONSTRATIONS		
TSI MODEL 3095 ENGINE EXHAUST PARTICLE MEASUREMENT SYSTEM WITH TWO-STAGE POROUS TUBE THERMODILUTER FOR RESEARCH ON PARTICLE EMISSIONS DURING TRANSIENT DRIVING CYCLES	Francisco Romay	TSI, INC.
DEMONSTRATION OF DEKATI AND PEGASOR INSTRUMENTS FOR PM SAMPLING, CONDITIONING, AND ANALYSIS	Tyler Beck	Particle Instrument: LLC
LOW NOx AND CPN DOWN TO 10	Rob Wilson	Sensors Inc.
3DATX parSYNC® iPEMS	Gurdas Sandhu	3DATX
PARTICULATE EMISSIONS AND MEASUREMENT (Session 1)		
POSTER PRESENTERS		
CHARACTERIZING EMISSION RATES OF GASEOUS AND PARTICULATE POLLUTANTS FROM TWO ULTRA-LOW NOX CNG HEAVY-DUTY VEHICLES	Hanwei Zhu*	University of California, Riverside
QUANTIFICATION OF PARTICULATE AND GASEOUS SEMI-VOLATILES IN CFR-COMPLIANT DYNAMOMETER TESTING OF GAS DIRECT INJECTION CONSUMER VEHICLES.	Joseph Martin	US EPA
DETERMINATION OF ORGANOSULFUR COMPOUNDS IN VEHICLE EMISSIONS BY THERMAL DESORPTION GAS CHROMATOGRAPHY TIME-OF-FLIGHT MASS SPECTROMETRY	Guenter Engling	California Air Resources Board
ORAL PRESENTERS		
FAST NUMBER CONCENTRATION MEASUREMENT BASED ON REAL-TIME PARTICLE SIZE ESTIMATION WITH SINGLE-CHANNEL ELECTRICAL DETECTION	Erkka Saukko	Pegasor Oy
FILTER-COLLECTED AND GAS-PHASE PAH EMISSIONS FROM A CGPF-EQUIPPED LIGHT DUTY TRUCK	Stanislav Bohac	US EPA
BRAKE AND TIRE WEAR EMISSIONS (Session 2)		
POSTER PRESENTERS		
NON-EXHAUST EMISSIONS: HOW DOES THE CONTRIBUTION OF TIRE WEAR TO AIR POLLUTION COMPARE TO TAILPIPE EMISSIONS?	Nick Molden	Emissions Analytics
BRAKE WEAR PARTICLE EMISSION RATES AND CHARACTERIZATION	Alan Stanard	ERG
REACTIVE OXYGENATE SPECIES GENERATION FROM PM2.5 AND ITS ASSOCIATION WITH CHEMICAL MEASUREMENTS FROM HIGHWAY EMISSIONS	Brian Hwang*	University of California, Irvine
ORAL PRESENTERS		
COMPARISON OF PARTICULATE EMISSIONS AND DISC TEMPERATURE PROFILES FROM A COMMERCIAL DISC-BRAKE SYSTEM TESTED ON TWO DYNAMOMETER SAMPLING SYSTEMS	Athanasios Mamakos	AVL list GmbH
EVALUATION OF HEAVY-DUTY VEHICLE BRAKE-WEAR EMISSIONS USING A CHASSIS DYNAMOMETER	Eon Lee	California Air Resources Board
REAL-WORLD TIRE AND BRAKE WEAR EMISSIONS	Heejung Jung	University of California, Riverside

\*Student Presenter

DAY 1 INTERACTIVE SESSION: 3-4 PM Eastern Time at Fourwaves		
IN-USE EMISSIONS FOR HEAVY DUTY VEHICLES (Session 3)		
POSTER PRESENTERS, Continued		
THE CANNONBALL EMISSIONS RUN–THE QUEST FOR RAPID VEHICLE EMISSIONS MEASUREMENTS DURING THE COVID-19 PANDEMIC	Michael Dio	3DATX
IN-USE COMPLIANCE METHODS OF CHASSIS CERTIFIED DIESEL VEHICLES	Jiacheng Yang	California Air Resources Board
EFFICACY OF MEASURING NOX MASS EMISSION RATES OF IN-USE TRUCKS USING HEAVY-DUTY ON-BOARD DIAGNOSTICS (HDOBD) SYSTEMS AND LABORATORY COMPARATIVE ANALYSIS	Laxmi Narasimha Yatavelli	California Air Resources Board
CHARACTERIZATION OF NITROGEN OXIDES IN ON-ROAD HEAVY HEAVY-DUTY DIESEL TRUCKS	Michael Milazzo	California Air Resources Board
MAPPING OF ON-ROAD HEAVY HEAVY DUTY DIESEL TRUCK EMISSIONS ON A CHASSIS DYNAMOMETER AT DIFFERENT TEMPORAL RESOLUTIONS <i>(Please find Michael at the title above)</i>	Michael Milazzo	California Air Resources Board
AN EMISSIONS EVALUATION OF TWO ADVANCED HEAVY-DUTY DIESEL VEHICLES:CANADA’S CONTRIBUTION TO THE IEA-AMF ANNEX 57	Jonathan Stokes	Environment and Climate Change Canada
OVERSIZE/OVERWEIGHT HEAVY-DUTY VEHICLE EMISSIONS IMPACTS STUDY	Chris Klaus	North Central Texas Council of Governments
TESTING OF ON-BOARD SENSORS FOR NOX EMISSIONS IN A CLASS 7 TRUCK	Kieran Humphries	Environment and Climate Change Canada
ASSESSING THE CORRELATION BETWEEN REAL-WORLD NOX EMISSIONS AND HEAVY-DUTY DIESEL VEHICLE AGE AND MILEAGE <i>(Please visit Yi at his other title below or on Wednesday afternoon)</i>	Yi Tan	California Air Resources Board
IMPACT OF EMISSION-RELATED MALFUNCTION AND DPF ACTIVE REGENERATION FOR HDDVS ON REAL-WORLD NOX AND GHG EMISSIONS <i>(Please visit Yi at his other title below or on Thursday afternoon)</i>	Yi Tan	California Air Resources Board
ORAL PRESENTERS		
EVALUATING THE 3-BIN MOVING AVERAGE WINDOW METHOD USING REAL-WORLD EMISSION TESTING DATA	Yi Tan	California Air Resources Board
HEAVY-DUTY IN-USE COMPLIANCE EMISSIONS AND A COMPARISON OF NEW METRICS	Stephen Berdahl	California Air Resources Board
IN-USE EMISSIONS TESTING AND FUEL USAGE PROFILE OF ON-ROAD HEAVY-DUTY VEHICLES – PEMS AND CHASSIS TESTING	Cavan McCaffery	University of California, Riverside
OTHER SESSIONS (CONFLICTS)		
FUEL EFFECTS ON EXHAUST EMISSIONS (Session 4)		
DETERMINING REAL WORLD EMISSIONS EFFECTS OF ETHANOL BLENDS THROUGH MEASUREMENT AND MODELING	Nigel Clark	Future Fuel Strategi
INFLUENCE OF SOME ISOMERS OF C2-C4 ALCOHOL ON THE FORMATION AND TOXICITY OF PAHSIN HIGH TEMPERATURE FLOW REACTOR (Hosting Chat Room on Day 1 & Day 4)	Zuhaib Khan*	University College London

\*Student Presenter



DAY 2 INTERACTIVE SESSION: 3-4 PM Eastern Time at Fourwaves		
DEMONSTRATIONS		
3DATX parSYNC® iPEMS	Mike Dio	3DATX
CALIBRATION OF ENGINE EXHAUST CPCS FOR UPCOMING 10NM REGULATIONS	Francisco Romay	TSI, INC.
DEMONSTRATION OF DEKATI AND PEGASOR INSTRUMENTS FOR PM SAMPLING, CONDITIONING, AND ANALYSIS	Tyler Beck	Particle Instrumentation LLC
LOW NOx AND CPN DOWN TO 10	Rob Wilson	Sensors Inc.
FUEL EFFECTS ON EXHAUST EMISSIONS (Session 4)		
POSTER PRESENTERS		
A SYSTEMATIC VIEW OF REAL-WORLD GASOLINE PROPERTIES	Robert Crawford	Rincon Ranch Consulting
FUEL BLENDING GUIDE FOR ETHANOL EMISSIONS EFFECT STUDIES	Nigel Clark	Future Fuel Strategies
APPLICATION OF GC-VUV TO PREDICTING GASOLINE PARTICULATE EMISSIONS	Dan Wispinski	VUV Analytics
EVALUATION OF MODERN OCEAN-GOING VESSELS ON TWO FUELS <i>(Please visit Cavan at his title in Session 5 Oral Presentation)</i>	Cavan McCaffery*	University of California, Riverside
ORAL PRESENTERS		
IMMEDIATE AND LONG TERM EFFECTS OF FUEL VARIABILITY ON AFTERTREATMENT CATALYSTS AND PERFORMANCE	Alissa Recker	Detroit Diesel
INFLUENCE OF SOME ISOMERS OF C2-C4 ALCOHOL ON THE FORMATION AND TOXICITY OF PAHSIN HIGH TEMPERATURE FLOW REACTOR (Hosting Chat Room on Day 1 & Day 4)	Zuhaib Khan*	University College London
IMPACTS OF DISTILLATION ENDPOINT TEMPERATURE ON THE COMPOSITION AND PM INDEX OF GASOLINE	Aron Butler	US EPA
INTERACTIVE EFFECTS OF ETHANOL AND AROMATICS ON GASOLINE PM EMISSIONS	Matthew A. Ratcliff	NREL
OFF ROAD/ NON-ROAD EMISSIONS (Session 5)		
POSTER PRESENTERS		
NORTH AMERICAN ROUND-ROBIN CORRELATION TEST PROJECT FOR OFF-HIGHWAY RECREATIONAL VEHICLES EXHAUST EMISSION RATES	Maryam Delavarrafiee	California Air Resources Board
CHARACTERIZING IN-USE ACTIVITY OF CONSTRUCTION EQUIPMENT IN CALIFORNIA	Kanok Boriboonsomsin	University of California, Riverside
ACTIVITY DATA OF ZERO AND NEAR-ZERO EMISSIONS VEHICLES AND EQUIPMENT	Chas Frederickson	University of California, Riverside
IN-USE TESTING IN THE OFF-ROAD SECTOR: TRANSPORT REFRIGERATION UNITS	Michael Milazzo	California Air Resources Board
COMPARATIVE ANALYSIS OF EMISSIONS, FUEL USE, ENERGY EFFICIENCY AND PERFORMANCE OF SELECTED TRANSPORT REFRIGERATION UNITS (TRU)	Ray Chang	US EPA
DEVELOPING UPDATED ACTIVITY INPUTS FOR EPA'S NONROAD MODEL	Sarah Roberts	US EPA
COMPARISON OF STEADY-STATE VERSUS TRANSIENTS FOR LOCOMOTIVE FUEL USE AND EMISSION RATES	Nikhil Rastogi*	North Carolina State University
EVALUATION OF ADVANCED PM AND/OR NOX AFTERTREATMENT FOR SMALL OFF ROAD DIESEL ENGINES <i>(Please visit Cavan at his title in Session 5 Oral Presentation)</i>	Cavan McCaffery*	University of California, Riverside

\*Student Presenter



DAY 2 INTERACTIVE SESSION: 3-4 PM Eastern Time at Fourwaves		
OFF ROAD/ NON-ROAD EMISSIONS (Session 5)		
ORAL PRESENTERS		
REAL WORLD EMISSION FROM TIER 4F OFF-ROAD CONSTRUCTION EQUIPMENT	Hanwei Zhu*	University of California, Riverside
OBSERVED CHANGES IN CALIFORNIA’S AGRICULTURAL SECTOR, AS NOTED IN CALIFORNIA’S NEW AGRICULTURAL EQUIPMENT EMISSION INVENTORY	Julie Schiffman	California Air Resources Board
EMISSIONS EVALUATION OF AN AUXILIARY BOILER ON A MODERN PANAMAX TANKER	Cavan McCaffery*	University of California, Riverside
OFF-ROAD GREENHOUSE GAS EMISSIONS	Jim Lindner	ERG
OTHER SESSIONS (CONFLICTS)		
EMISSIONS MODELING		
LOCAL SURVEY DATA IMPACT ON TEXAS NONROAD EMISSION INVENTORIES	Allison DenBleyker	ERG
IN-USE EMISSIONS FROM LIGHT-DUTY VEHICLES (Session 6)		
POSTER PRESENTERS		
VEHICULAR-DYNAMICS METRICS FOR REAL-WORLD IN-USE REGULATION	Adam Edwards	California Air Resources Board
DAY 3 INTERACTIVE SESSION A.M: 9-10 am Eastern Time at Fourwaves		
DEMONSTRATIONS		
DEMONSTRATION OF DEKATI AND PEGASOR INSTRUMENTS FOR PM SAMPLING, CONDITIONING, AND ANALYSIS	Tyler Beck	Particle Instrument: LLC
LOW NOx AND CPN DOWN TO 10	Rob Wilson	Sensors Inc.
TSI MODEL 3095 ENGINE EXHAUST PARTICLE MEASUREMENT SYSTEM WITH TWO-STAGE POROUS TUBE THERMODILUTER FOR RESEARCH ON PARTICLE EMISSIONS DURING TRANSIENT DRIVING CYCLES	Francisco Romay	TSI, INC.
3DATX parSYNC® iPEMS	Daisy Thomas and Matthew Berry	3DATX
PARTICULATE EMISSIONS AND MEASUREMENT		
NOVEL ELECTRICAL PARTICLE NUMBER COUNTER FOR PERIODIC TESTING AND INSPECTION (PTI)	Erkki Lamminen	Dekati Ltd.
FAST NUMBER CONCENTRATION MEASUREMENT BASED ON REAL-TIME PARTICLE SIZE ESTIMATION WITH SINGLE-CHANNEL ELECTRICAL DETECTION	Erkka Saukko	Pegasor Oy
AIR QUALITY IMPACTS AND EFFECTS OF COVID-19 ON AIR QUALITY		
THE IMPACT OF THE COVID-19 LOCKDOWN ON AIR QUALITY ACROSS THE UK	Karl Ropkins	University of Leeds

\*Student Presenter



DAY 3 INTERACTIVE SESSION P.M. : 3-4 P.M. Eastern Time at Fourwaves

DEMONSTRATIONS

TBD	Rob Wilson	Sensors Inc.
3DATX parSYNC® iPEMS	David Miller	3DATX
TSI MODEL 3095 ENGINE EXHAUST PARTICLE MEASUREMENT SYSTEM WITH TWO-STAGE POROUS TUBE THERMODILUTER FOR RESEARCH ON PARTICLE EMISSIONS DURING TRANSIENT DRIVING CYCLES	Noah Bock	TSI, INC.
DEMONSTRATION OF DEKATI AND PEGASOR INSTRUMENTS FOR PM SAMPLING, CONDITIONING, AND ANALYSIS	Tyler Beck	Particle Instrument: LLC

IN-USE EMISSIONS FROM LIGHT-DUTY VEHICLES (Session 6)

POSTER PRESENTERS

A CASE STUDY OF ADVANCED ENGINE TECHNOLOGIES AND THEIR EFFECTS ON EMISSIONS AND FUEL EFFICIENCY	Fadi Araj	Environment and Climate Change Canada
EVAPORATIVE EMISSIONS ASSESSMENT AT A REFUELING STATION	Connie Hart	US EPA
EVALUATION OF SPEED-DENSITY METHOD BASED ESTIMATES OF NATURALLY ASPIRATED LIGHT DUTY GASOLINE VEHICLE REAL-WORLD TAILPIPE EMISSION RATES	Tongchuan Wei*	North Carolina State University
REAL-WORLD EVALUATION OF POLLUTANT EMISSIONS FROM LIGHT-DUTY HYBRID ELECTRIC VEHICLE (HEV) USING PEMS	Chengguo Li*	University of California, Riverside
VEHICULAR-DYNAMICS METRICS FOR REAL-WORLD IN-USE REGULATION	Adam Edwards	California Air Resources Board
ON-ROAD PORTABLE EMISSION MEASUREMENT SYSTEMS TEST DATA ANALYSIS AND LIGHT-DUTY VEHICLEIN-USE EMISSIONS DEVELOPMENT	SoDuk Lee	US EPA
YARD TRACTOR ELECTRIFICATION: POTENTIAL FOR REDUCING EMISSIONS	Andrew Kotz	NREL

ORAL PRESENTERS

E-23/E-106/E-123: THE COORDINATING RESEARCH COUNCILS LEGACY OF LONG-TERM ON-ROAD EMISSION MEASUREMENTS <i>(Please visit Gary at the title below during the interactive session)</i>	Gary Bishop	University of Denve
ON-ROAD EMISSIONS PERFORMANCE OF REPAIRED VOLKSWAGEN, AUDI AND PORSCHE DIESEL POWERED VEHICLES	Gary Bishop	University of Denve
REAL WORLD GASEOUS AND PARTICLE NUMBER EMISSIONS FROM PLUG-IN HYBRID VEHICLES	Kieran Humphries	Environment and Climate Change Canada
EVALUATION OF THE EFFECTS OF CONVENTIONAL CRUISE CONTROL ON LIGHT-DUTY GASOLINE VEHICLE FUEL USE AND EMISSION RATES	Weichang Yuan*	North Carolina State University

AIR QUALITY IMPACTS AND EFFECTS OF COVID-19 ON AIR QUALITY (Session 7)

POSTER PRESENTERS

THE FEDERAL HIGHWAY ADMINISTRATION’S CONGESTION MITIGATION AND AIR QUALITY IMPROVEMENT (CMAQ) PROGRAM AND ITS ROLE IN REDUCING VEHICLE EMISSIONS	Kevin Black	KNM Consulting
MODELED HEALTH IMPACTS OF CHANGES IN TRANSPORTATION-RELATED FINE PARTICULATE MATTER EMISSIONS RESULTING FROM PROPOSED CLIMATE POLICY IN OREGON	Elizabeth Elbel*	Harvard Extension School

\*Student Presenter

DAY 3 INTERACTIVE SESSION P.M. : 3-4 P.M. Eastern Time at Fourwaves		
AIR QUALITY IMPACTS AND EFFECTS OF COVID-19 ON AIR QUALITY (Session 7)		
ORAL PRESENTERS		
STAY AT HOME ORDER IMPACT ON OZONE CONCENTRATION IN THE PHOENIX NONATTAINMENT AREA	Rene Nsanzineza	Arizona Dept. of Environmental Qua
ASSESSMENT OF PHOTOCHEMICAL MODELS ABILITY TO REPRODUCE OBSERVED OZONE CHANGES IN RESPONSE TO EMISSION CHANGES FROM THE COVID-19 PANDEMIC	Ralph Morris	Ramboll
EMISSIONS MEASUREMENT METHODS (Session 8)		
POSTER PRESENTERS		
DEVELOPMENT OF FIELD EVAPORATIVE TESTING IN HONG KONG	Sandeep Kishan	ERG
THE DYNAMICS OF CHALLENGE-BASED EQUIPMENT INNOVATION	Larry Mattison	3DATX
EMISSION SPECIATION AND FIRE SUPPRESSION OF LITHIUM ION BATTERY MODULES DURING OVERCHARGE INDUCED THERMAL RUNAWAY	Bapiraju Surampudi	Southwest Research Institute
ORAL PRESENTERS		
IDENTIFICATION OF ON-ROAD HIGH-EMITTING HEAVY DUTY DIESEL VEHICLES USING THE PORTABLE EMISSIONS ACQUISITION SYSTEM (PEAQS)	Okjoo Park	California Air Resources Board
MEASUREMENT OF NITROGEN OXIDES THROUGH ADVANCED NDUV	Jason Gaudet	Sensors, Inc.
CALCULATING DRAG COEFFICIENTS FOR ROAD-TO-RIG APPLICATIONS	Adam Edwards	California Air Resources Board
ON-ROAD MEASUREMENT OF RUNNING LOSSES BY REMOTE SENSING	Tim DeFries	ERG
OTHER SESSIONS		
IMPROVING THE EMISSIONS INVENTORY		
LICENSE PLATE SURVEY TO IMPROVE VEHICLE CLASSIFICATION IN CLARK COUNTY, NEVADA	Allison DenBleyker	ERG

\*Student Presenter

**DAY 4 INTERACTIVE SESSION P.M. : 3-4 P.M. Eastern Time at Fourwaves**

**DEMONSTRATIONS**

DEMONSTRATION OF DEKATI AND PEGASOR INSTRUMENTS FOR PM SAMPLING, CONDITIONING, AND ANALYSIS	Tyler Beck	Particle Instruments LLC
LOW NOx AND CPN DOWN TO 10	Rob Wilson	Sensors Inc.
3DATX parSYNC® iPEMS	Larry Mattison	3DATX
CALIBRATION OF ENGINE EXHAUST CPCS FOR UPCOMING 10NM REGULATIONS	Francisco Romay	TSI, INC.

**EMISSIONS CONTROL MEASURES: I/M, OBD, TECHNOLOGIES & STRATEGIES (Session 9)**

**POSTER PRESENTERS**

ENERGY CONSUMPTION AND DRIVING ACTIVITY OF LIGHT-DUTY VEHICLES IN CALIFORNIA	Chris Ruehl	California Air Resources board
INVESTIGATING “GET-HOT” AND “STAY-HOT” THERMAL MANAGEMENT STRATEGIES FOR A HEAVY-DUTY DIESEL ENGINE EMPLOYING CYLINDER DEACTIVATION AND EARLY EXHAUST VALVE OPENING	Christian Hushion*	West Virginia University

**ORAL PRESENTERS**

NEXT-GENERATION HEAVY-DUTY VEHICLE ENFORCEMENT: A PILOT STUDY USING ROADSIDE EMISSIONS MONITORING SYSTEMS	Hang Liu	California Air Resources Board
ASSESSMENT OF THE CALIFORNIA SMOG CHECK PROGRAM	Philip Heirigs	Bureau of Automot Repair

**EMISSIONS MODELING (Session10)**

**POSTER PRESENTERS**

DEVELOPING MOVES ACTIVITY INPUTS USING FLEET DNA AND CE-CERT DATA	Andrew Kotz	NREL
START EXHAUST EMISSIONS UPDATE FOR HEAVY-DUTY ON-ROAD VEHICLES IN EPA’S MOVES MODEL	Jaehoon Han	US EPA
CFD INVESTIGATION OF NOX EMISSION IN LEAN AND DILUTE MIXED-MODE ENGINE OPERATIONS	Chao Xu	Argonne National Lab
A FINE-SCALE ROADWAY EMISSIONS INVENTORY FOR THE WEST OAKLAND COMMUNITY USING TELEMATICS-BASED DATA	Yuan Du	Bay Area Air Quality Management District

**ORAL PRESENTERS**

UPDATES TO EPA'S MOTOR VEHICLE EMISSION SIMULATOR (MOVES)	Megan Beardsley	US EPA
MODELING EMISSIONS DETERIORATION IN LIGHT-DUTY GASOLINE VEHICLES WITH A 3-PIECE LOG-LINEAR SPLINE	James Warila	US EPA
DEVELOPMENT OF A PLUG-IN HYBRID ELECTRIC VEHICLE (PHEV) MODULE FOR EMFAC202X BASED ON REAL-WORLD EMISSION AND ACTIVITY DATA	Wan Jiao	California Air Resources Board

\*Student Presenter

DAY 4 INTERACTIVE SESSION P.M. : 3-4 P.M. Eastern Time at Fourwaves		
IMPROVING THE EMISSIONS INVENTORY (Session 11)		
POSTER PRESENTERS		
AMBIENT TEMPERATURE EFFECT ON NOX EMISSIONS FROM MODERN HEAVY-DUTY DIESEL VEHICLES	Evan Murray	US EPA
CRANKCASE EMISSIONS FROM MY 2010+ HEAVY-DUTY DIESEL TRUCKS	Darrell Sonntag	US EPA
INCREASE IN NH3 EMISSION INVENTORY FROM MODERN DIESEL FLEET <i>(Not available for chat)</i>	Guy Burke	Former US EPA Inte
NONROAD DIESEL ENGINE ACTIVITY AND TIER LEVEL DISTRIBUTION – IMPACT ON MODELED EMISSIONS	Rick Baker	ERG
INTEGRATING CONSUMER CHOICE-BASED ZEV MARKET SHARE FORECASTS INTO CALIFORNIA’S ON-ROAD EMISSIONS MODELING	Jiachen Zhang	California Air Resources Board
ORAL PRESENTERS		
NEW HDV ANNUAL MILEAGE ACCRUAL RATES FOR THE EMFAC MODEL	Allison DenBleyker	ERG
AN OVERVIEW OF EMFAC202X UPDATES	Fang Yan	California Air Resources Board
DEVELOPMENT OF A NOVEL METHOD FOR PREDICTING TURNOVER AND RETIRING PATTERNS OF LINE-HAUL LOCOMOTIVES OPERATING IN CALIFORNIA	Junhyeong Park	California Air Resources Board

\*Student Presenter