

BOARD MEETING DATE: October 2, 2026

AGENDA NO. 8

PROPOSAL: Execute Contract to Characterize Brake Wear Emissions

SYNOPSIS: Non-tailpipe emissions from brake wear are an important source of particulate matter that is not well understood. The University of California, Irvine (UCI) proposes a research project to characterize gaseous and particulate brake wear emissions, identify chemical fingerprints for source attribution, and develop emission profiles for use in emissions inventories and air quality modeling. The project will build on prior research and support improvements to Emission FACTor and South Coast AQMD's MATES modeling framework. This action is to execute a contract with UCI in an amount not to exceed \$997,063 to conduct the proposed research from the Clean Fuels Program Fund (31).

COMMITTEE: Technology, September 18, 2026; Recommended for Approval

RECOMMENDED ACTION:

Authorize the Executive Officer to execute a contract with the Regents of the University of California, on behalf of the University of California, Irvine (UCI), for a two-year research project to characterize brake-wear emissions, develop chemical source fingerprints and emission parameterizations, and evaluate their application to emissions inventories and air quality modeling in an amount not to exceed \$997,063 from the Clean Fuels Program Fund (31).

Wayne Natri
Executive Officer

AK:MW:VP:HL

Background

As tailpipe emissions decline in response to regulatory efforts, non-tailpipe emissions from brake and tire wear are becoming increasingly important sources of particulate matter. Brake wear is estimated to account for approximately half of non-tailpipe particulate emissions, however the gaseous and particulate composition and contribution to ambient air pollution are not well known. A gap exists in the characterization of organic gases and particles across operating conditions that can

be used to extrapolate emissions across vehicle classes and real-world operating conditions.

Building on prior research supported by the California Department of Justice, the U.S. National Science Foundation, and South Coast AQMD, UCI has demonstrated that brake wear produces a broad range of gaseous and particulate emissions, with brake rotor temperature as an important driver. Further research is needed to better characterize these emissions under representative braking conditions, studying different brake pad compositions, identifying chemical source markers, and improving the incorporation of these measurements into emissions inventories and air quality models.

Proposal

UCI proposes a two-year project to characterize brake-wear emissions and develop model-ready emissions profiles for air quality applications. Using a portable brake dynamometer, UCI will measure gaseous and particulate emissions from hydraulic disc brakes representative of light-duty vehicles and Class 4 and 5 medium-duty vehicles (14,001–19,500 lb GVWR), including delivery and step vans. The project will evaluate approximately six to seven brake-pad formulations across three vehicle/brake categories: a well-characterized reference system, light-duty vehicles, and Class 4 and 5 medium-duty vehicles. For each formulation, emissions will be characterized under approximately eight to ten controlled combinations of rotational speed, applied braking torque, and braking duty cycle, with three replicate test sessions per operating condition, resulting in approximately 300 to 500 hours of controlled dynamometer testing. The range reflects initial development of the braking cycle protocol and characterization of operating conditions, which will inform the number of test conditions required for subsequent measurements.

UCI will also analyze brake-pad composition and thermal-degradation emissions to inform estimates and identify data gaps for heavier-duty vehicles that cannot be directly tested with the current dynamometer. Laboratory results will be used to identify unique markers or combinations of compounds that provide chemical fingerprints for brake wear and will be compared with existing roadway field measurements.

Finally, UCI will evaluate how the laboratory-derived brake wear emission factors, chemical profiles and operating condition relationships can better inform emissions data used in Emission FACtor (EMFAC)-based inventories and South Coast AQMD MATES modeling. The analysis will identify potential inventory implications, data gaps and recommendations for future refinement of brake wear emissions estimates.

Sole Source Justification

Section VIII.B.2 of the Procurement Policy and Procedure identifies four major provisions under which a sole source award may be justified. The request for a sole source award with UCI is made under provision B.2.d.(8): Research and development efforts with educational institutions or nonprofit organizations. UCI is an educational institution and a research center with multidisciplinary resources to engage in diverse environmental and transportation research programs including advanced vehicle technologies and systems; emission measurements, analyses and control technologies; atmospheric measurements and modeling; and renewable energy. The proposed project builds on UCI's prior California Department of Justice- and U.S. National Science Foundation-funded brake emissions research to expand testing and develop emissions dataset for inventories and air quality modeling.

Benefits to South Coast AQMD

Projects supporting the characterization of non-exhaust emissions are included in the Technology Advancement Office Clean Fuels Program 2026 Plan Update under "Fuel and Emission Studies." The project will improve South Coast AQMD's understanding and quantification of brake-wear emissions which are becoming a more substantial source of particulate emissions. The resulting emission profiles and chemical fingerprints will support improved source attribution, emissions inventories, and MATES air quality modeling, while identifying areas where additional real-world validation may be needed.

The research will characterize more than 100 gaseous compounds, including air toxics, as well as particle size and chemical composition, including ultrafine particles. This data will help identify chemical fingerprints of brake wear, improve source attribution, and better inform future EMFAC/MATES applications, research priorities and potential emission control strategies to reduce particulate matter.

Resource Impacts

South Coast AQMD shall fund the total cost of UCI's research to characterize brake-wear emissions, identify chemical source fingerprints, and develop emission profiles for emissions inventory and air quality modeling applications which shall not exceed a total of \$997,063 from the Clean Fuels Program Fund (31).

Sufficient funds are available from the Clean Fuels Program Fund (31), established as a special revenue fund resulting from the state-mandated Clean Fuels Program. The Clean Fuels Program, under Health and Safety Code Sections 40448.5 and 40512 and Vehicle Code Section 9250.11, establishes mechanisms to collect revenues from mobile sources to support projects to increase the utilization of clean fuels, including the development of the necessary advanced enabling technologies. Funds collected from motor vehicles are restricted, by statute, to be used for projects and program activities related to mobile sources that support the objectives of the Clean Fuels Program.