



Legacy of CMEM Model Continues at Home and Abroad

The U.S. EPA released its official new mobile source inventory model MOVES (MOtor Vehicle Emissions Simulator) in early 2010 after nearly a decade of development. MOVES is a tool to help local and regional authorities meet clean air regulations, and its final shape owes something to the techniques and models that came before it. CE-CERT's 16-year-old Comprehensive Modal Emissions Model (CMEM), in particular, has played an influential role in the development of this technology.

Released in 1995, CMEM was one of the first traffic emissions models to account for variations in vehicle operation at a more fundamental level. The wide range of emission behaviors found under various driving conditions such as acceleration, deceleration, idling, steady-state cruising, and congestion makes in-use urban driving emissions difficult to estimate. Emissions under such conditions vary greatly and in such a way that "average speed" based emissions cannot easily express.

CMEM is distinct from most other models in at least two ways: it estimates emissions based on specific physical properties from each source vehicle; and it predicts second-by-second vehicle performance and emissions. One of the advantages of the CMEM model over conventional traffic emission models is that certain changes such as vehicle weight, aerodynamic characteristics, and additional accessory loads can be modeled without recalibration of vehicle categories.

The CMEM model has proven to be an exceptional research tool and was the basis for the simplified Physical Emission Rate Estimator (PERE) model which is part of EPA's new MOVES modeling suite. MOVES emission factors are based on Vehicle Specific Power (VSP), a quantity which generalizes many of the same physical principles characterized by the CMEM model.

PERE gives MOVES users the ability to expand EPA's emissions data model with customized local data from actual physical measurements. "The model is essentially an effort to simplify, improve, and implement the Comprehensive Modal Emissions Model (CMEM) developed at the University of California, Riverside," wrote Edward K. Nam, formerly of Ford Research and Advanced Engineering, in his Proof of Concept document.

According to Nam, the engineering advances over the past two decades in engine design, fuel formulation, control systems, and catalysts have made the use of generalized VSP calculations possible in the MOVES model. Modern vehicles simply perform more consistently at different speeds, loads and grades.

Over the years, the CMEM project has built an invaluable inventory of physical emission data for several hundred vehicles and traffic emission models for numerous automobile categories. As an open source model, CMEM has attracted more than a hundred registered users worldwide.

CMEM will continue as a research tool for those who have the need to view traffic emissions at the "microscopic" level. Researchers investigating transportation system design, intelligent transportation systems, emissions from traffic simulation models and many other areas where more precise localized measurements are essential will continue to need a physical model for fuel consumption estimation and pollutant emission prediction.