

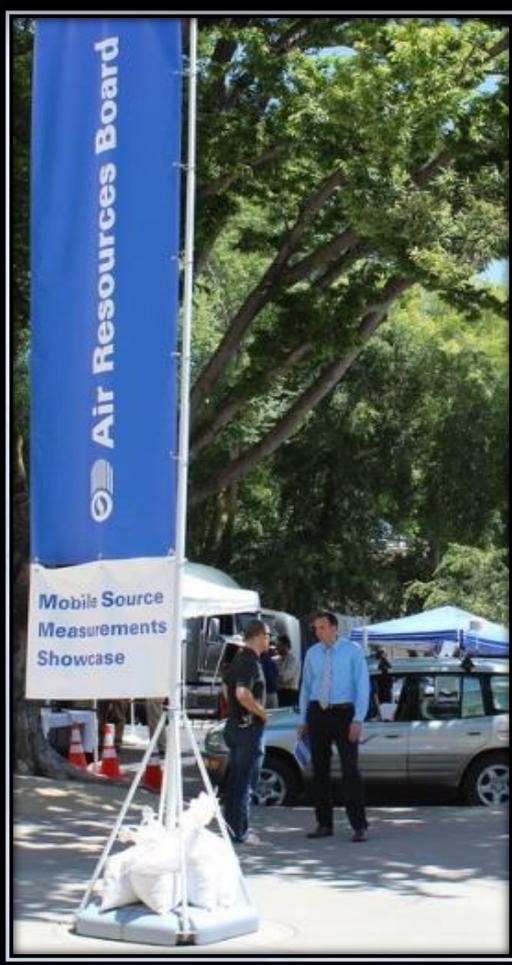
ARB's Mobile Source Measurement Capabilities



California Air Resources Board

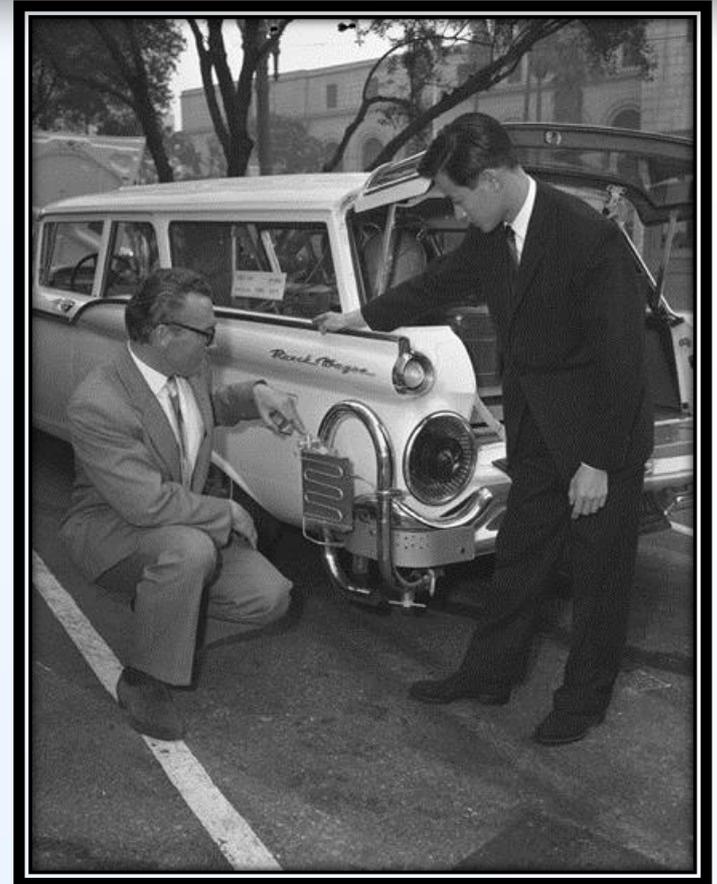
June 26, 2014

Mobile Source Measurements Showcase

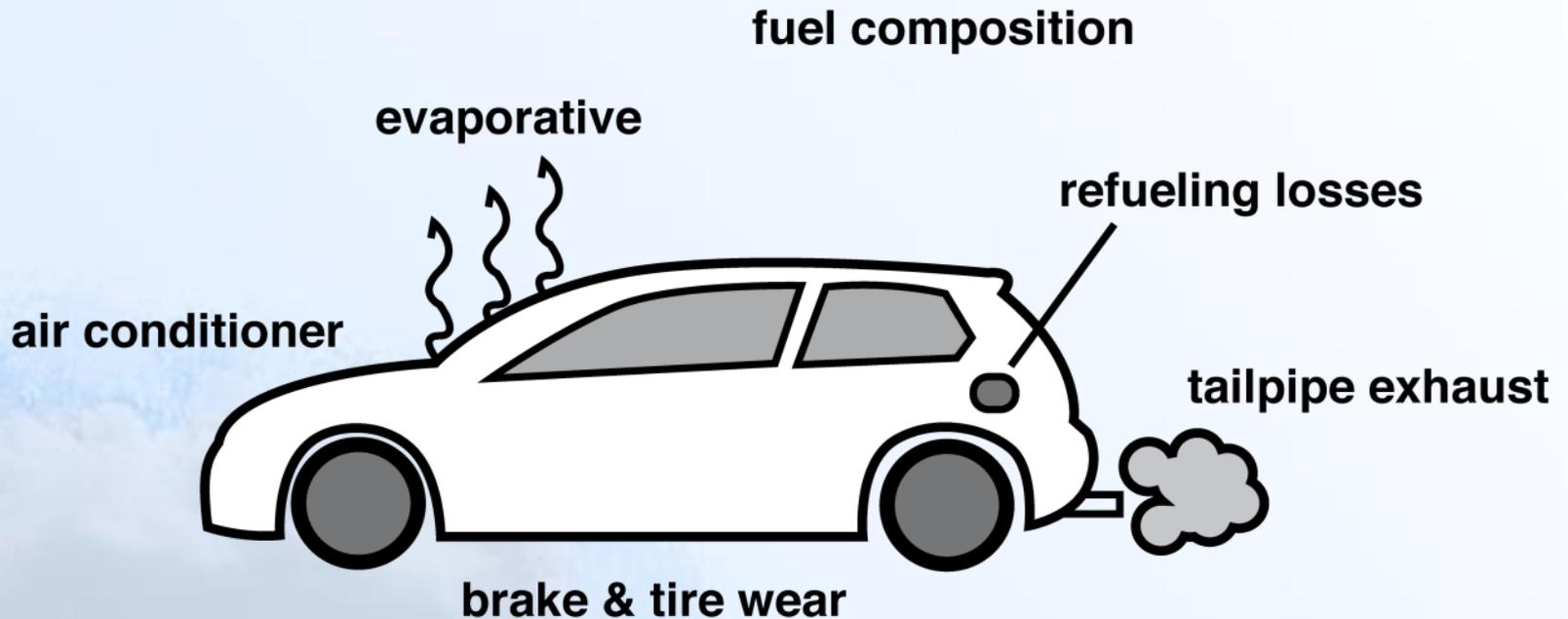


The Need for a Measurement Program

- In the 1950s, Arie Haagen-Smit linked vehicle emissions to photochemical smog formation
- ARB recognized the need for a robust vehicle emissions measurement program to support rulemaking
- Initial focus was passenger cars



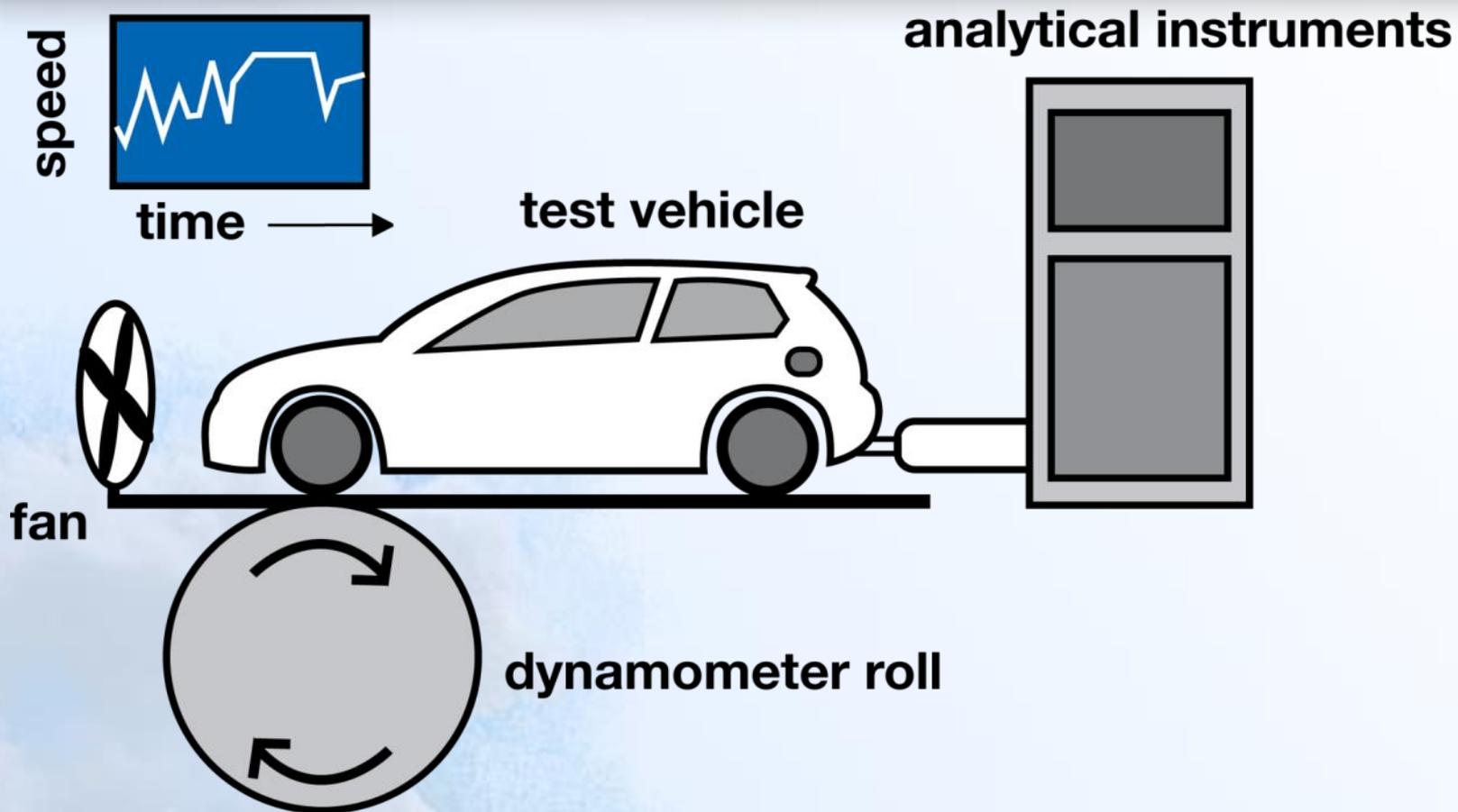
Sources of Vehicle Emissions



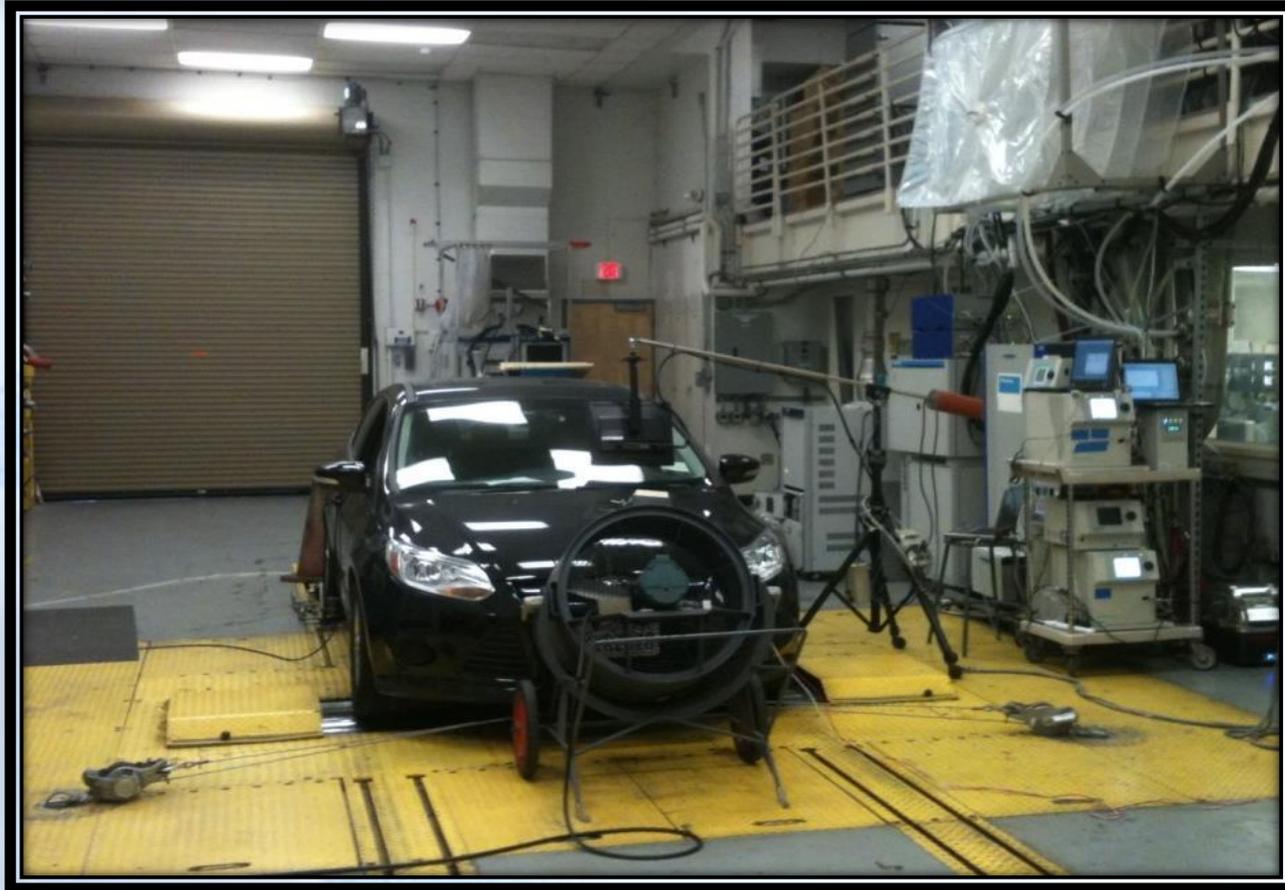
Engine and Chassis Dynamometers

- Used for emissions testing beginning in the 1960s
- Engine and chassis dynamometer testing is a key tool for measuring tailpipe emissions
- Engines tested over representative load and driving cycles
- Enabled evaluation of key technologies over past decades, including the three-way catalyst and diesel particulate filter

Laboratory Chassis Dynamometer



Chassis Dynamometer Testing

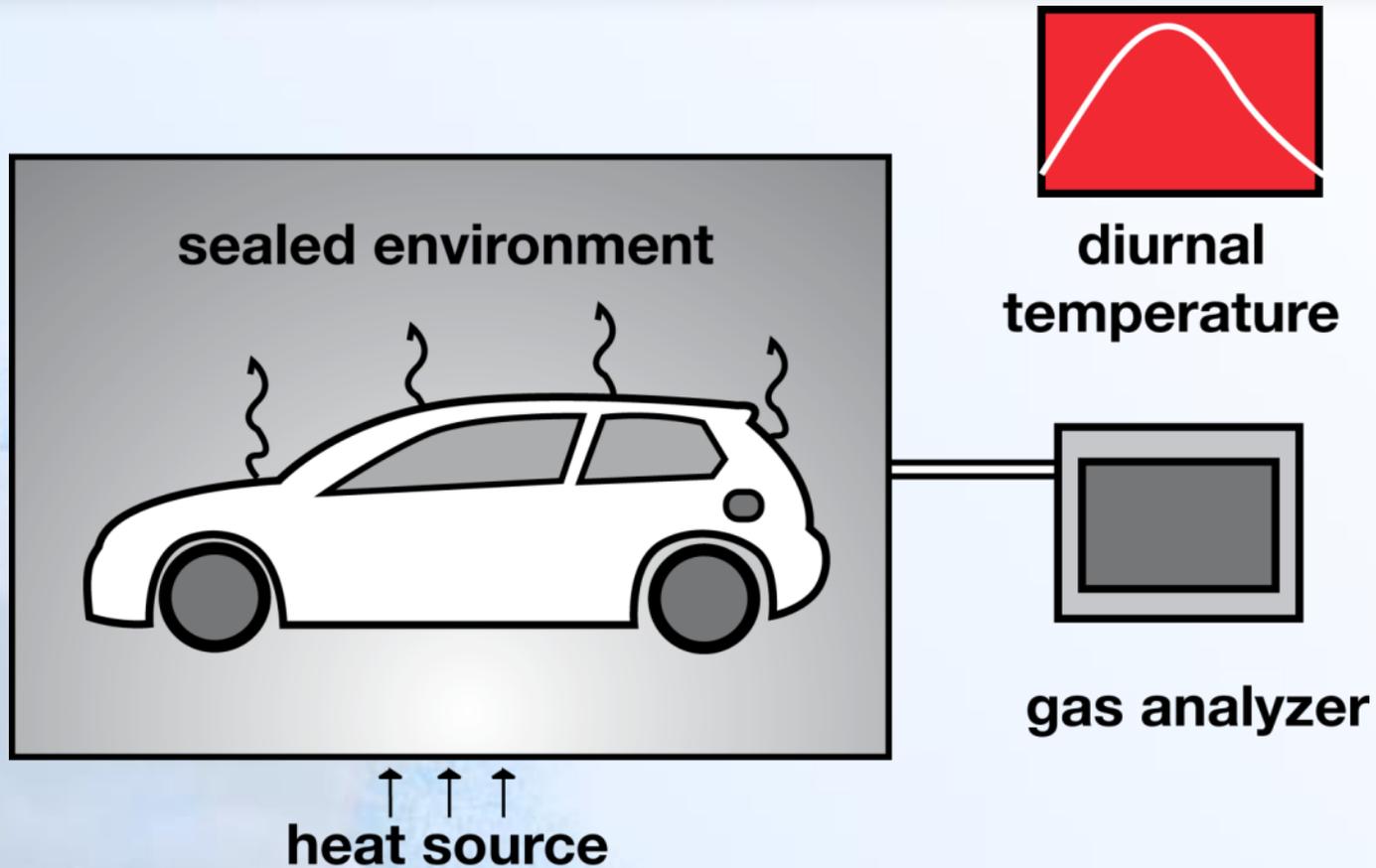


Haagen-Smit Laboratory, *El Monte, CA*

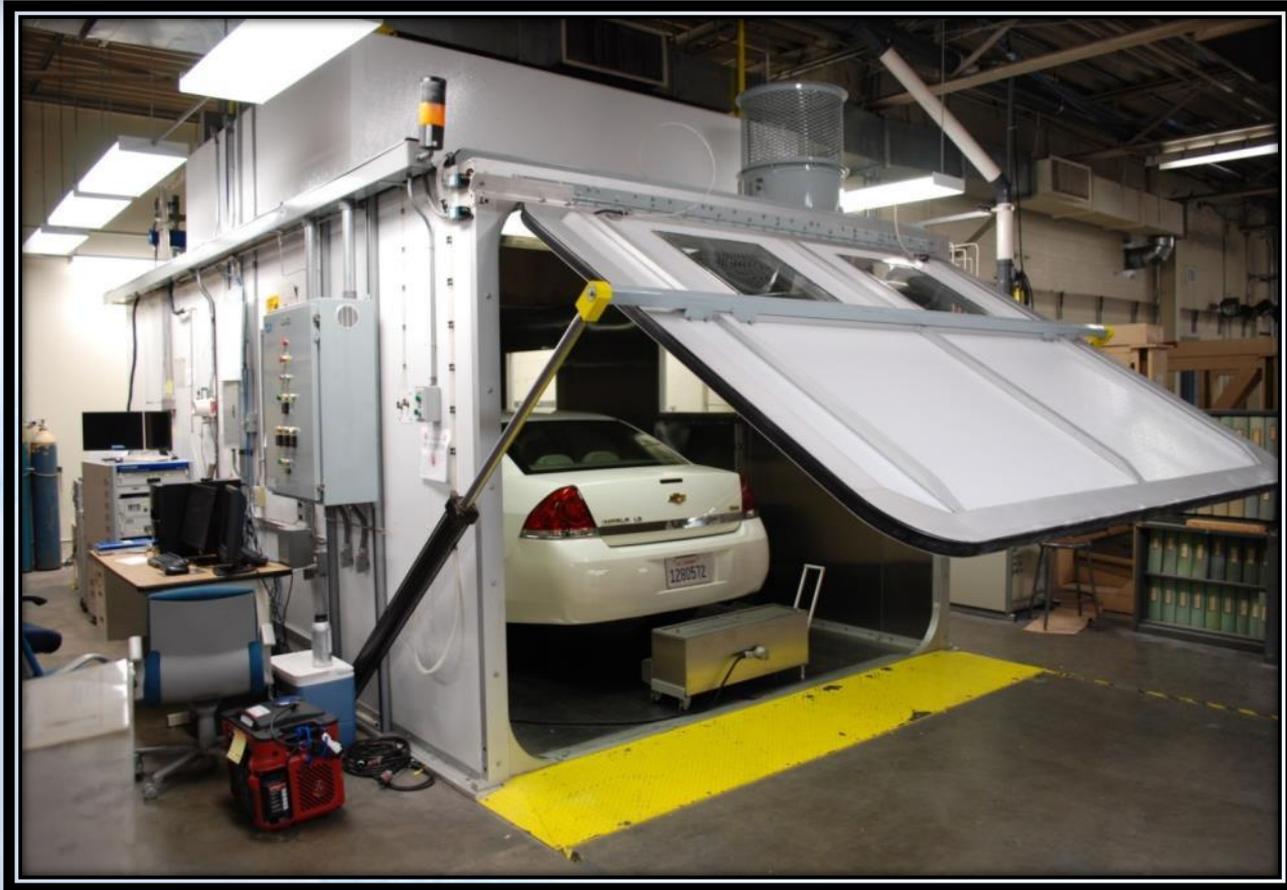
Evaporative Emissions

- Evaporative emissions are an important source of hydrocarbons
- Sealed Housing for Evaporative Determination (SHED) testing was developed in the late 1960s to measure evaporative emissions from passenger vehicles
- Multi-day tests reflecting typical diurnal temperatures
- Testing is applied to other vehicles including off-road recreational vehicles, watercraft, and lawn and garden equipment

Sealed Housing for Evaporative Determination (SHED)



Evaporative Testing



Haagen-Smit Laboratory, *El Monte, CA*

Stringent Fuel Standards

- Fuel reformulation recognized as a critical control strategy
- Includes the phase-out of lead, as well as setting limits on sulfur and aromatic hydrocarbons
- Enabled aftertreatment devices to more effectively control tailpipe emissions and provides immediate emissions benefits
- Analytical laboratories with latest methods are needed to develop, support, and enforce fuel standards

Mobile Fuels Enforcement Laboratory



Operates Statewide

Moving Beyond Passenger Cars

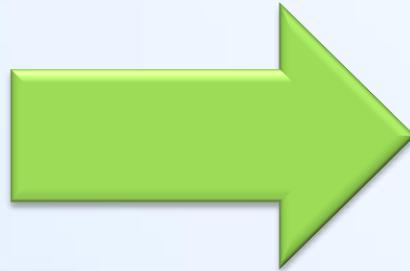
- In the 1980s, understanding that emissions from more sources of air pollution needed to be controlled
- Heavy-duty vehicles were identified as major sources of nitrogen oxides and particulate matter
- Standards followed later for categories such as watercraft, recreational vehicles, and motorcycles
- ARB's measurement capabilities have evolved to meet these needs

Heavy-Duty Chassis Dynamometer



MTA Laboratory, *Downtown Los Angeles, CA*

Assessing Truck Aftertreatment Effectiveness



No Diesel Particulate Filter



With Diesel Particulate Filter

Motorcycle Dynamometer Testing



Haagen-Smit Laboratory, *El Monte, CA*

Taking the Laboratory to the Vehicle

- Need to move measurement capabilities out of the lab:
 - to measure off-road and other large vehicles
 - to better reflect real-world operating conditions
- Previously bulky laboratory tools packaged into compact portable emissions measurement systems (PEMS)
- Made possible real-world measurements of particulate matter and other pollutants from many sources

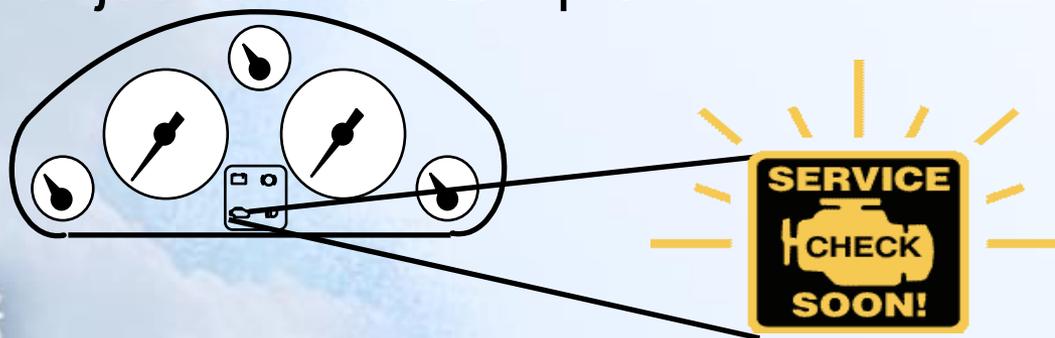
Deploying PEMS in the Field



In-Use Research, *Riverside, CA*

Monitoring with OBD

- On-Board Diagnostics (OBD) enables detection of faulty emissions control components, such as catalyst sensors, which may result in elevated emissions
- Required for passenger cars in the late 1980s, and heavy-duty trucks and buses beginning in 2010
- Allows monitoring of all vehicles during in-use operation, not just a small sample



Tracking Fleet Emissions Trends

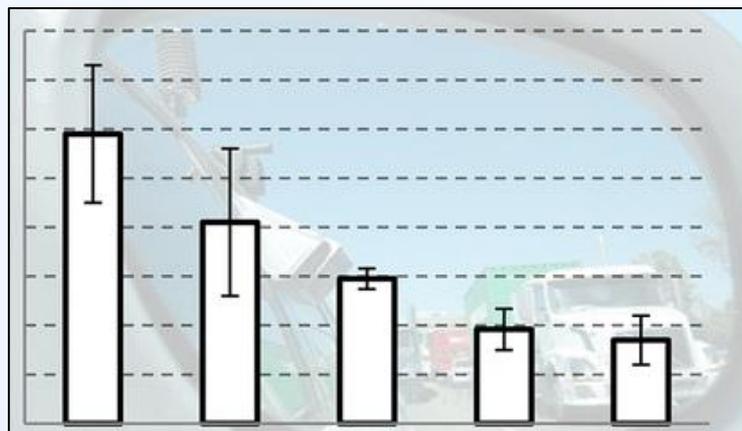
- Measuring fleet-level emissions is critical for tracking vehicle technology turnover, verifying the benefits of rules, and improving emission factors to support air quality modeling
- Approaches include laboratory surveillance testing and field studies by remote sensing, roadside, or on-road measurements.
- Many studies are contracted or coordinated with academic institutions and government partners

Mobile Measurement Platform



In-Use Research, I-710 Freeway

Los Angeles, I-710 Freeway



70% reduction in black carbon from 2009-2011

Heavy-Duty Emissions Tunnel



In-Use Research, Port of Long Beach

The Importance of Research

- Research helps guide emissions testing and regulatory program priorities
- ARB-funded extramural research complements in-house expertise and tools
- More than 200 mobile source related contracts funded since 1970
- ARB staff collaborate with leading academic researchers and also conduct in-house research
- Results peer-reviewed and published in leading scientific journals

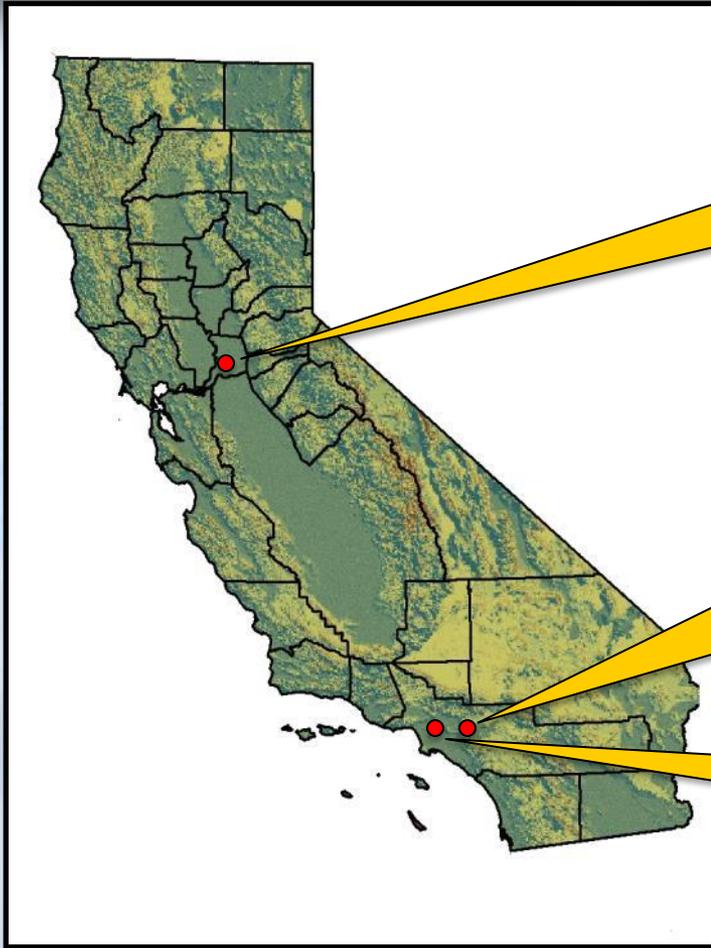
Measurements Support Rulemaking

- Sound science, rigorous test methods, and open public process support ARB's rulemaking
- Typically use multiple independent emissions measurement approaches
- Work with US EPA and industry in developing appropriate test methods
- Share methods and results through public workshops
- Solicit expert review through working groups and the peer-review publication process

Future Measurement Priorities

- Light-duty:
 - LEV III Midterm Review
- Heavy-duty:
 - Tighter NOx emissions standard
 - New Phase II greenhouse gas standards
- Assessment of advanced near-zero technology cars and trucks
- Consideration of new pollutants and sources of emissions

Current ARB Testing Facilities



Depot Park (2010)

- Heavy-Duty Dynamometer
- PEMS

Haagen-Smit Lab (1973)

- Light-Duty Dynamometers
- Evaporative Testing SHEDs
- PEMS
- Chemical Analysis Lab

MTA (1998)

- Heavy-Duty Dynamometer

A New Southern California Facility

- Advanced testing needed to meet future needs
- Limited ability to upgrade HSL and MTA
- Proposed new state-of-the-art testing facility
- Contract awarded to complete feasibility study
- Working with control agencies to complete approval process

Looking Forward

- ARB has a solid scientific foundation to support future mobile source rulemaking
- Development of advanced new vehicle testing facilities in Northern and Southern California
- Leveraging in-house expertise with academic and government partnerships
- Recognition that new measurement tools will be needed to meet changing program needs and critical air quality and climate goals