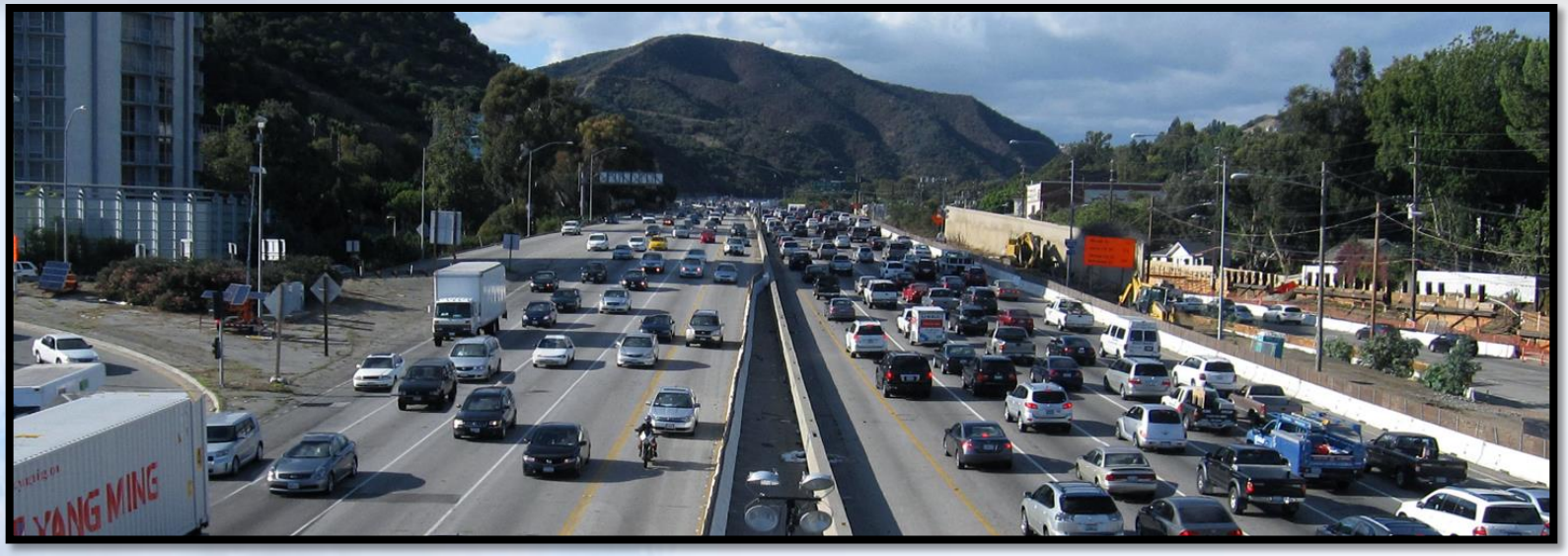
Mobile Source Measurements Showcase



California Air Resources Board

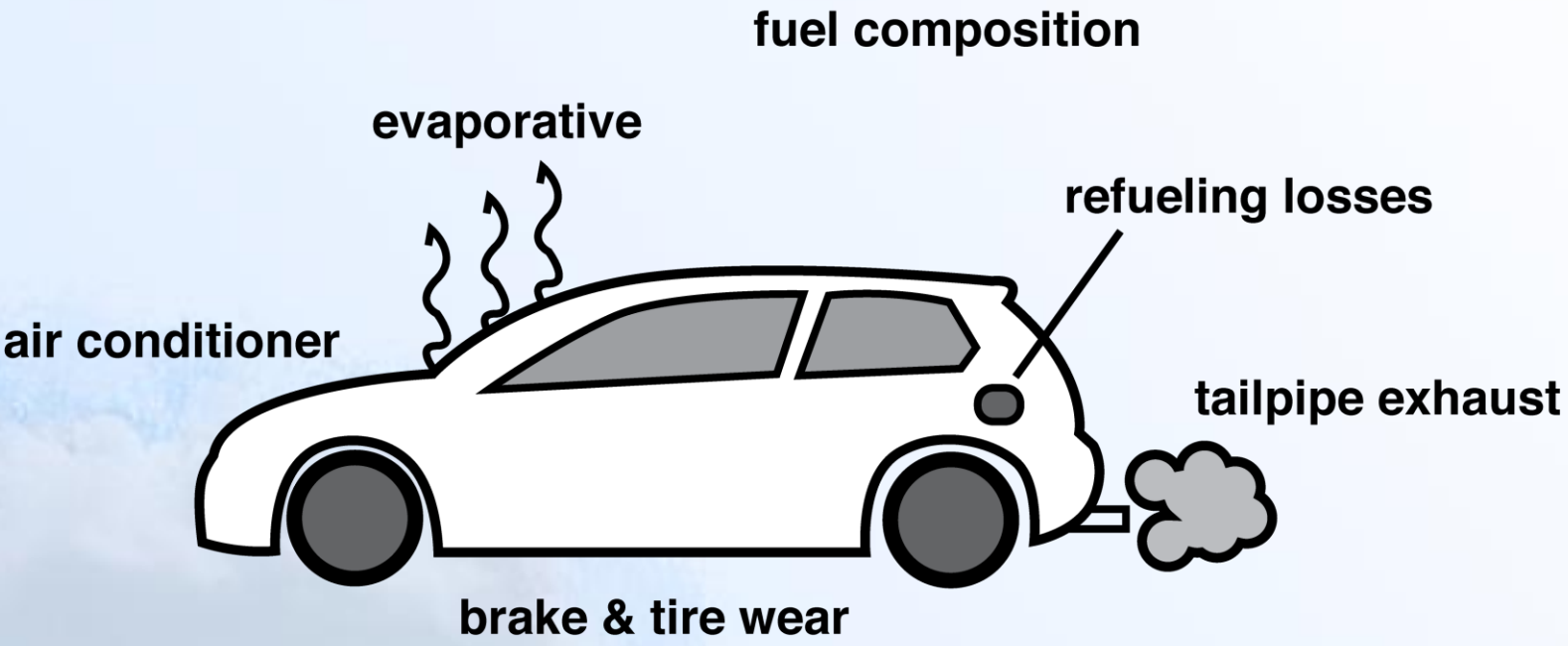
May 22, 2014

California Environmental Protection Agency
AIR RESOURCES BOARD

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

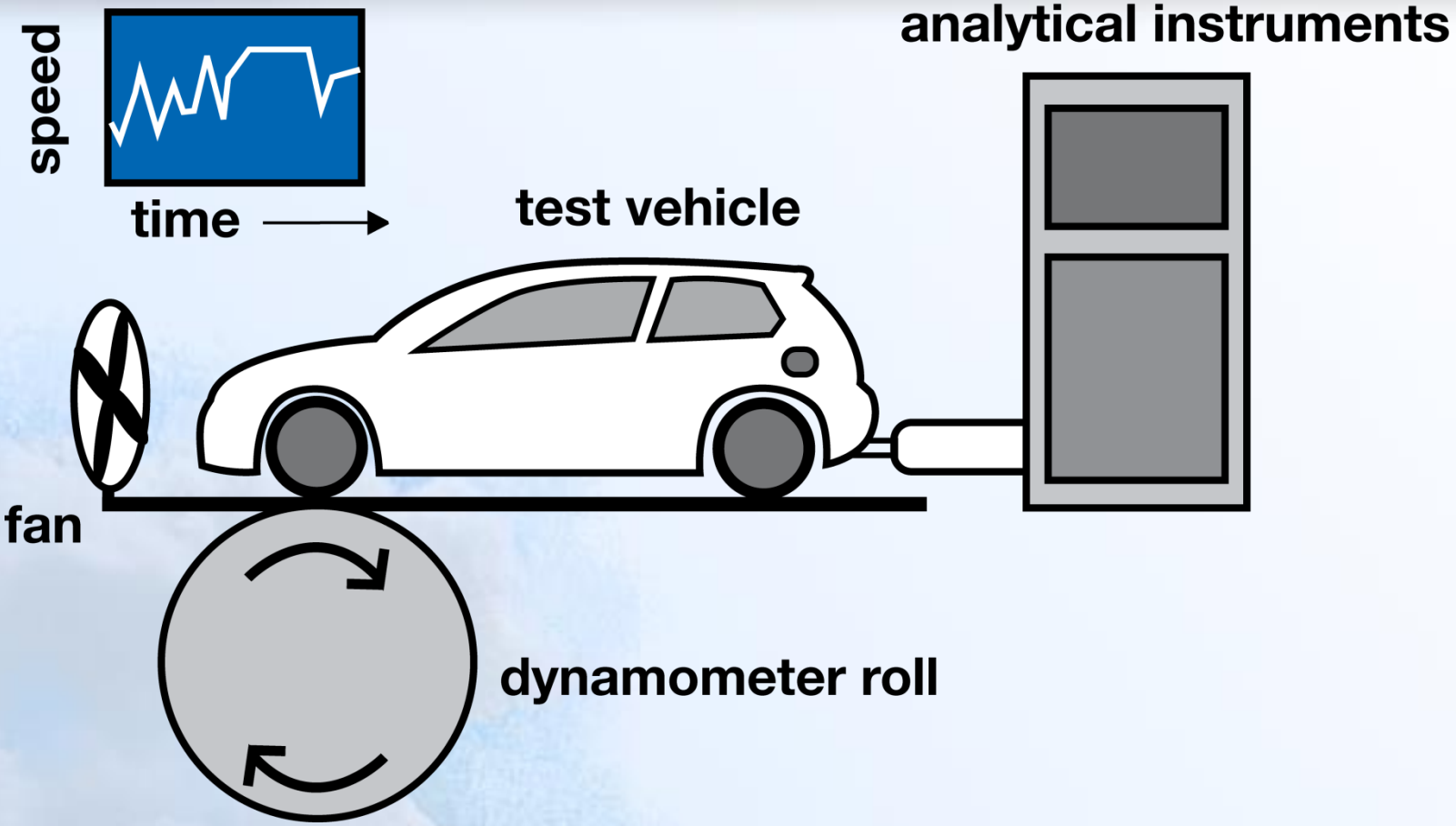
Sources of Vehicle Emissions



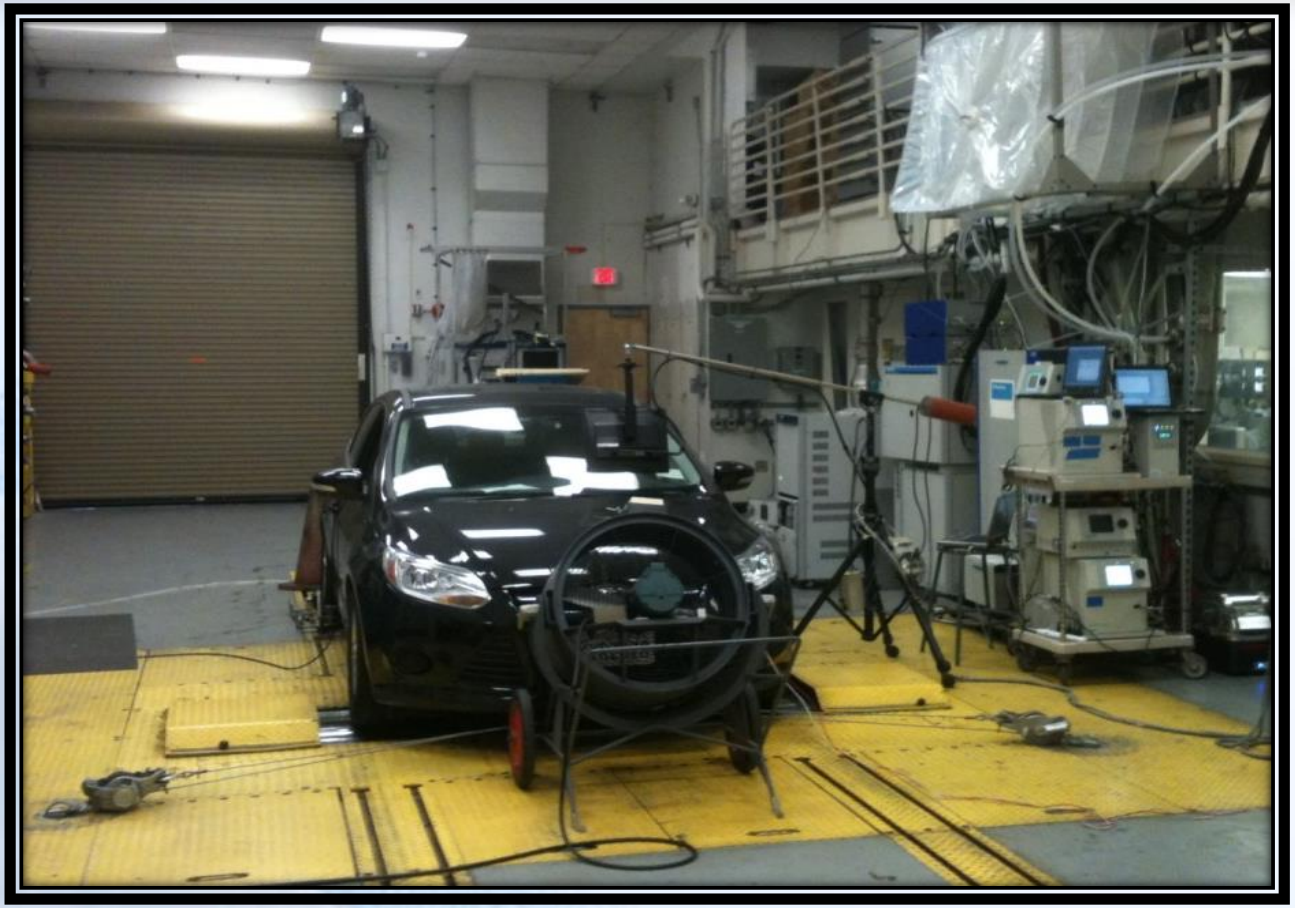
Engine and Chassis Dynamometers

- 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



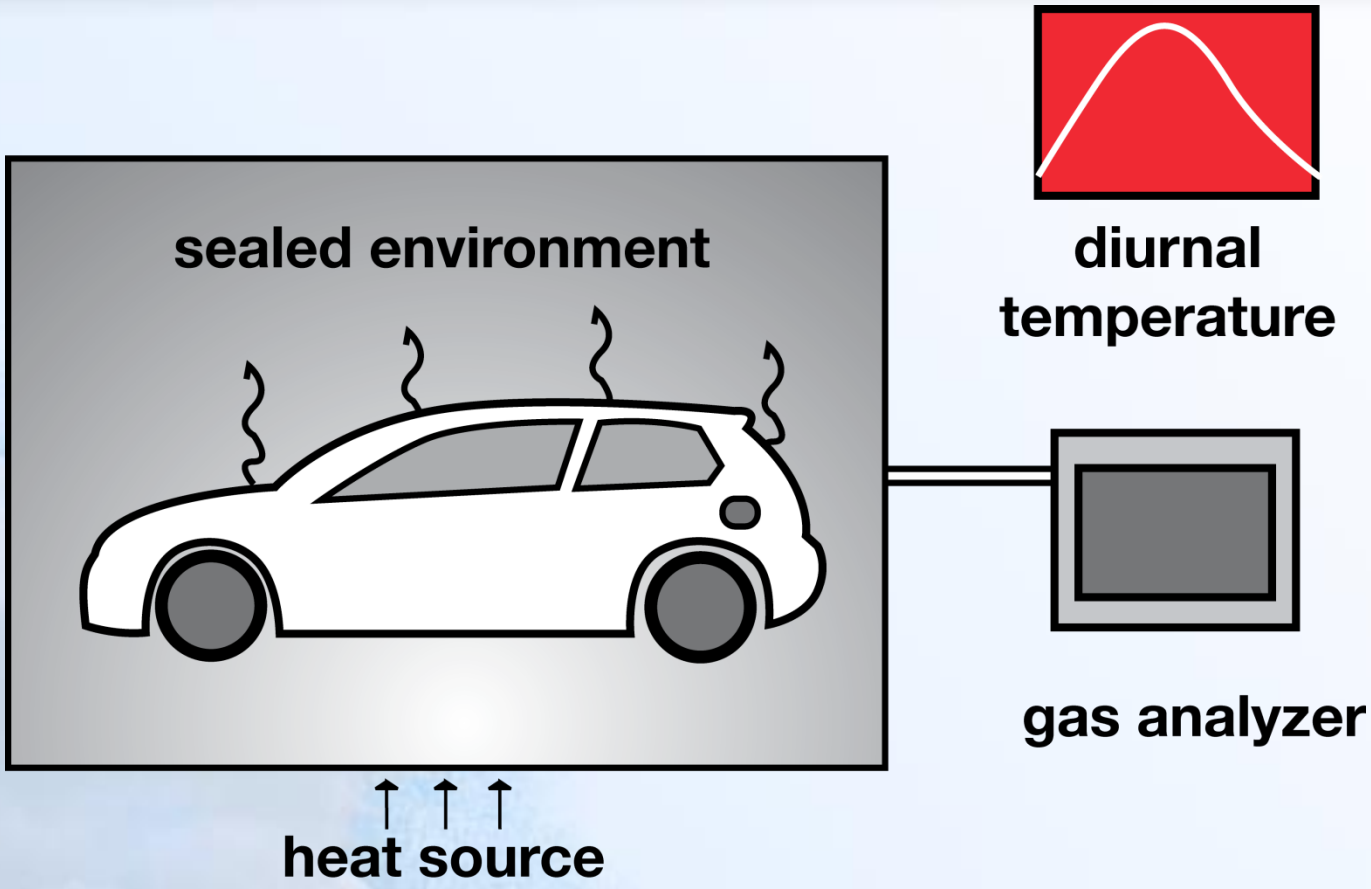
Chassis Dynamometer Testing



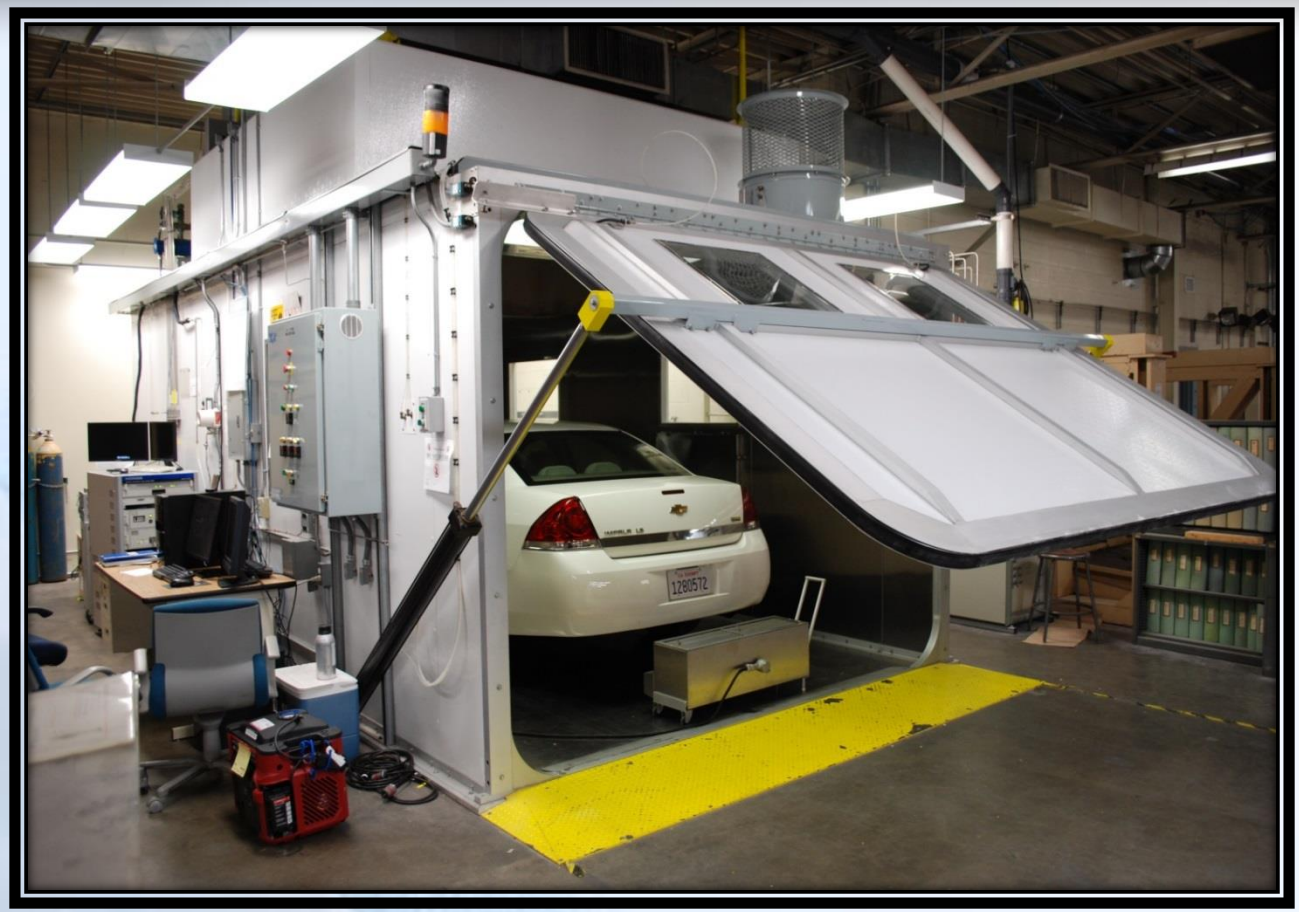
Evaporative Emissions

- 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



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

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

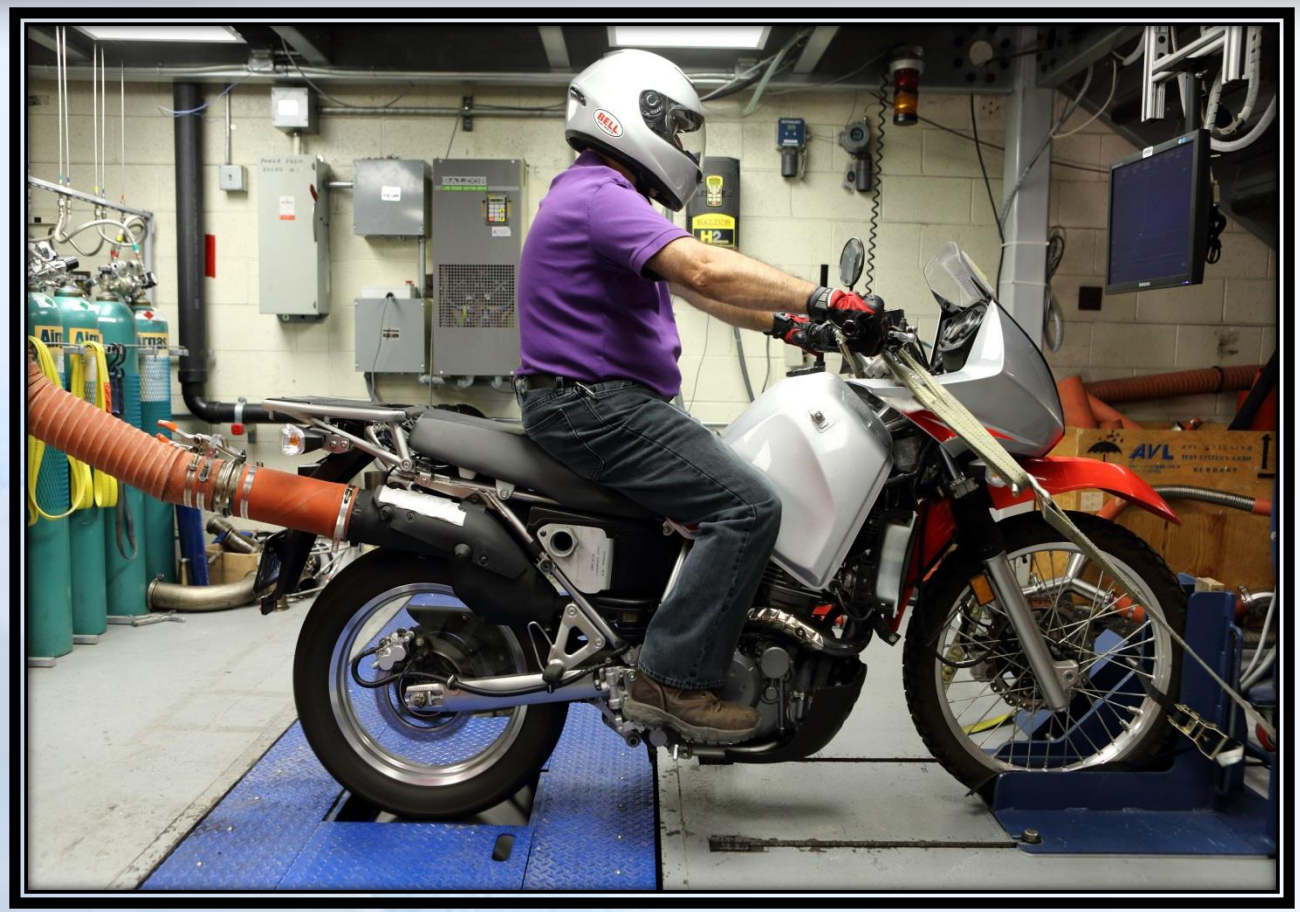
Heavy-Duty Chassis Dynamometer

Assessing Truck Aftertreatment Effectiveness

No Diesel Particulate Filter

With Diesel Particulate Filter

Motorcycle Dynamometer Testing



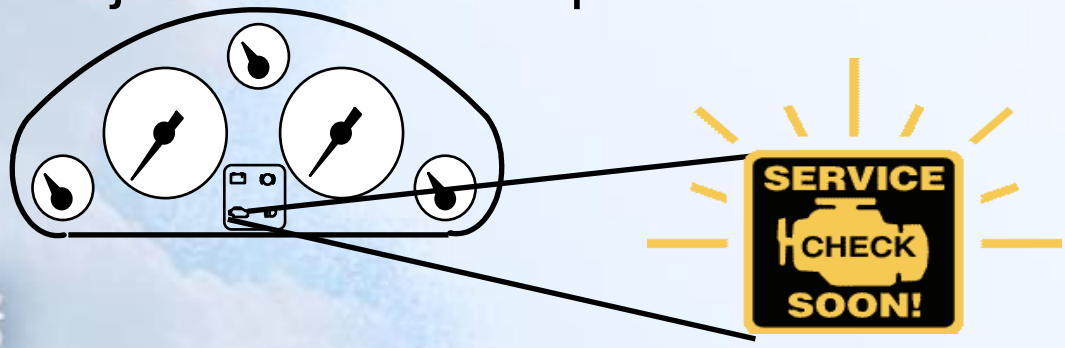
Taking the Laboratory to the Vehicle

- 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

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

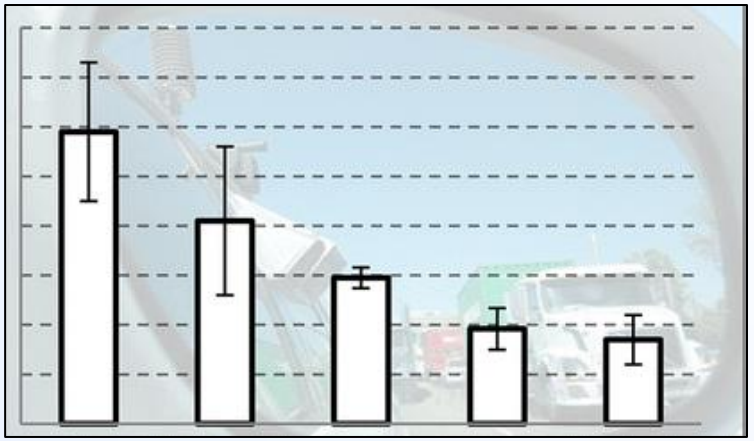


Tracking Fleet Emissions Trends

- 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 can include remote sensing, roadside, and on-road measurements
- Many studies are contracted or coordinated with academic institutions and government partners

Mobile Measurement Platform

Los Angeles, I-710 Freeway



<u>70%</u> reduction in black carbon from 2009-2011

Heavy-Duty Emissions Tunnel

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

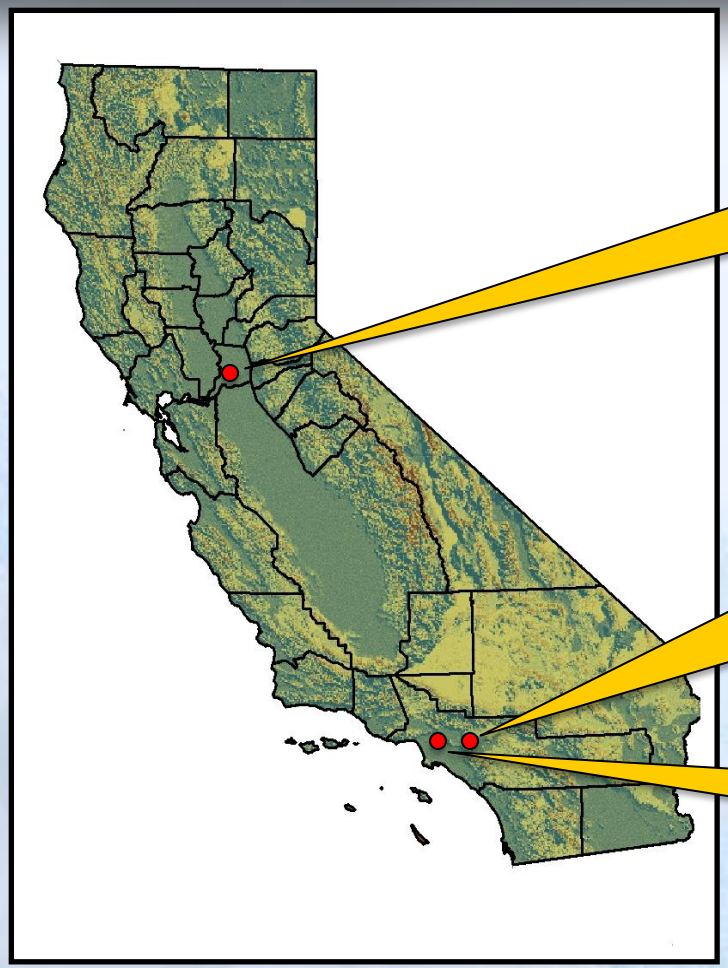
Measurements Support Rulemaking

- 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

- Haagen-Smit Lab and MTA facilities are aging
- Physical constraints limit ability to upgrade infrastructure and instruments
- Distance between facilities creates logistical issues
- Propose consolidation and relocation of labs and offices
- Will provide state-of-the-art testing in a more environmentally friendly and energy efficient facility
- Currently assessing program needs, developing siting criteria, and defining potential academic partnerships

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

Mobile Source Measurements Showcase

- Many of the tools discussed on display today
- Exhibit areas include second floor of CalEPA building and east of the building on 11th Street
- Indoor exhibits focus on informational items
- Outdoor exhibits include demonstration of selected emissions measurement tools
- All showcase items will remain open and available for public tour through 3:00 PM