Real-World Emissions From Mobile Sources

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Introduction

- Characterizing Real-world emissions is critical for EPA
  - Essential for program oversight and assessment
  - Results inform program direction
- Access to real-world data enables EPA to pinpoint excess emissions and respond
  - Research and emissions inventories
  - Robust and effective regulations
  - Targeted compliance oversight to ensure level playing field, maximize emissions reductions, and deliver public health benefits promised by regulations

PEMS History

EPA's ROVER Development

EPA's PEMS Patent

EPA issued regulations covering PEMS testing

EPA's PEMS SPOT (Nonroad) Development

1970 1980 1990 2000 2010 2015 Future

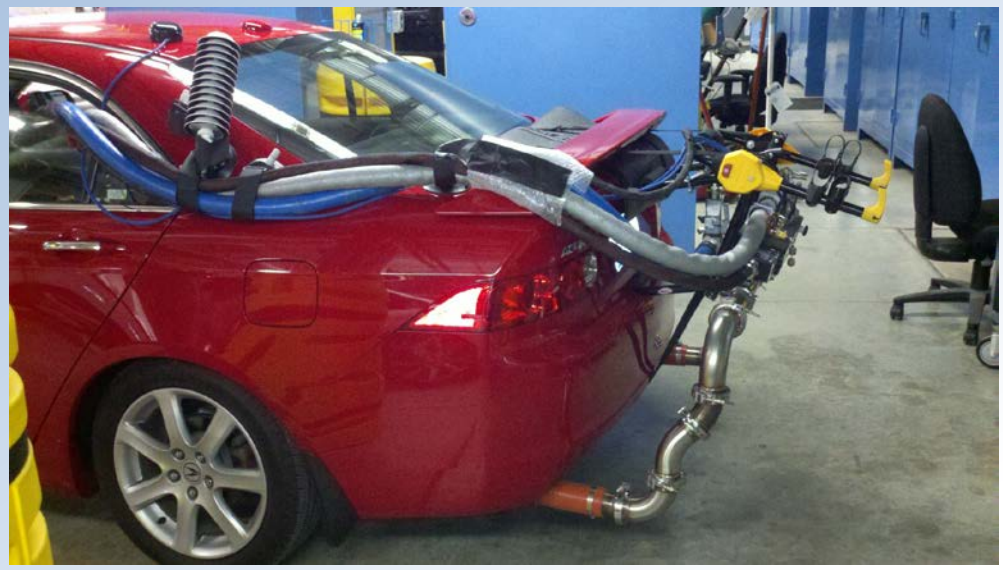
EPA Chase Car Testing

EPA PEMS Testing

EPA's HD In-use PEMS Program

PEMS/PAMS Research Programs Underway

- Heavy Duty Vehicles
- Non-Road Diesel Equipment
- Light Duty Vehicles
- We are pursuing partnerships to support these efforts

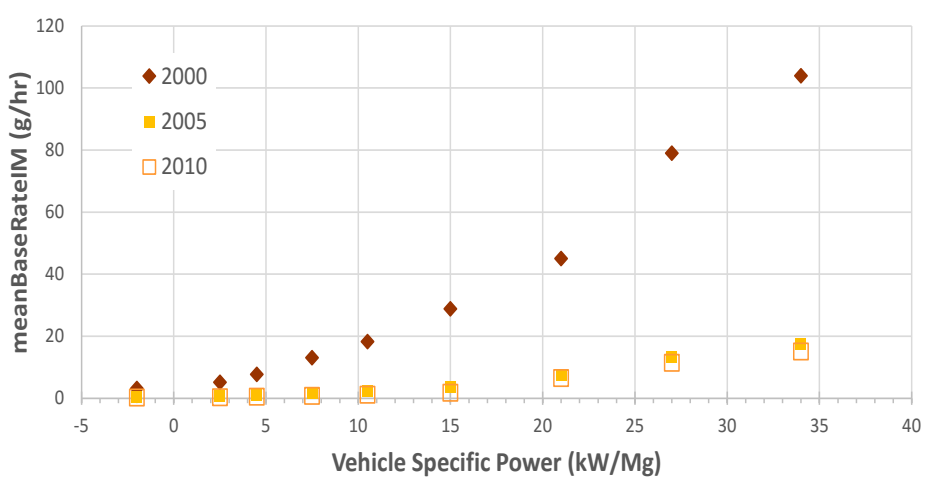


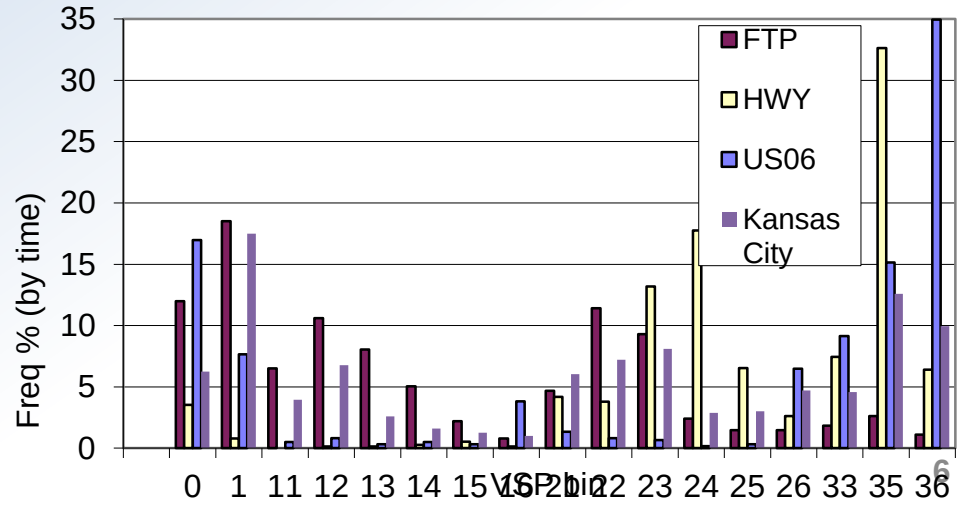
Research and Emission Inventories

- Forms the genesis for subsequent EPA actions
- EPA emissions inventories are primarily built from the “bottom up” using **data**
  - from vehicle and equipment usage
  - From real-world as well as laboratory measurements
- Much of our vehicle data is from dynamometers – how do we translate that to the real-world activity?
- Testing in the real-world is inherently variable and non-repeatable – how can we scientifically compare with standards and dyno testing?

Drive Cycle Comparisons

- MOVES is at its core a physics-based modal model
- Variability from real world tests can be reduced when the road load impacts and acceleration rates considered
- By splitting up emissions by VSP modes, can convert any driving to any other cycle for an apples to apples comparison*
  - Can also describe any driving as function of other cycles
  - Can help reduce uncertainty related to conformity factors
  - *As long as you have covered sufficient operating window





PEMS/PAMS Used in Regulations/Compliance Efforts

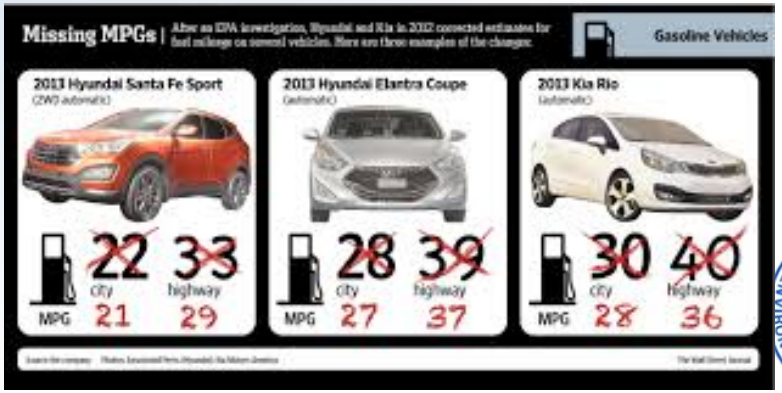
- Heavy Duty
  - In-Use testing requirements, including Not To Exceed provisions
- LDV: Fuel Economy Labeling Rule
  - Measured in-use fuel economy from Kansas City vehicles, including Hybrid Electric Vehicles
  - Important for any future labeling rule
- Ocean Going Vessel and Locomotive/Marine Rules
- Off-cycle emissions

Off-Cycle Emissions

- The Light-Duty GHG Rules made allowances for CO_2 credits from technologies not measured on the fuel economy test procedures
- Manufacturers not using the pre-determined table values or 5-cycle testing must conduct a scientific study to quantify the CO_2 impact
  - This includes consumer behavior
  - Driving patterns
  - Real-world emissions
- Our stakeholders will need your help

EPA Compliance Oversight

- Some fundamentals:
  - Regulations alone don't achieve emissions control. Vehicles and engines must comply if environmental benefits are to be realized
  - Strong EPA presence and oversight is needed to maximize compliance
- Recent events have reinforced these realities



Compliance Actions - Additional Examples

- In 2012/13 manufacturers recalled ~3.7 million cars and 340,000 heavy-duty engines with potential or actual emission problems
  - Consumers received free repairs, extended warranties or other remedies
- In 2013, EPA voided 153 certificates of conformity for engine families covering 170,000+ on- and off-highway motorcycles and all-terrain vehicles (model years 2005-12)

Importance of Compliance – Some Examples

Clean Air Benefits

- 1990 Clean Air Act Amendments
  - From 1990-2020, 4.2 million lives saved, benefit outweighs costs ~30:1
  - In 2030 alone, eliminate > 38,000 premature deaths; > $380 billion in health and welfare benefits
- Light duty vehicle greenhouse gas program is projected to result in:
  - $1.7 trillion dollars of fuel savings over the lifetime of vehicles produced between 2011 and 2025
  - 12 billion fewer barrels of oil consumed

Level Playing Field

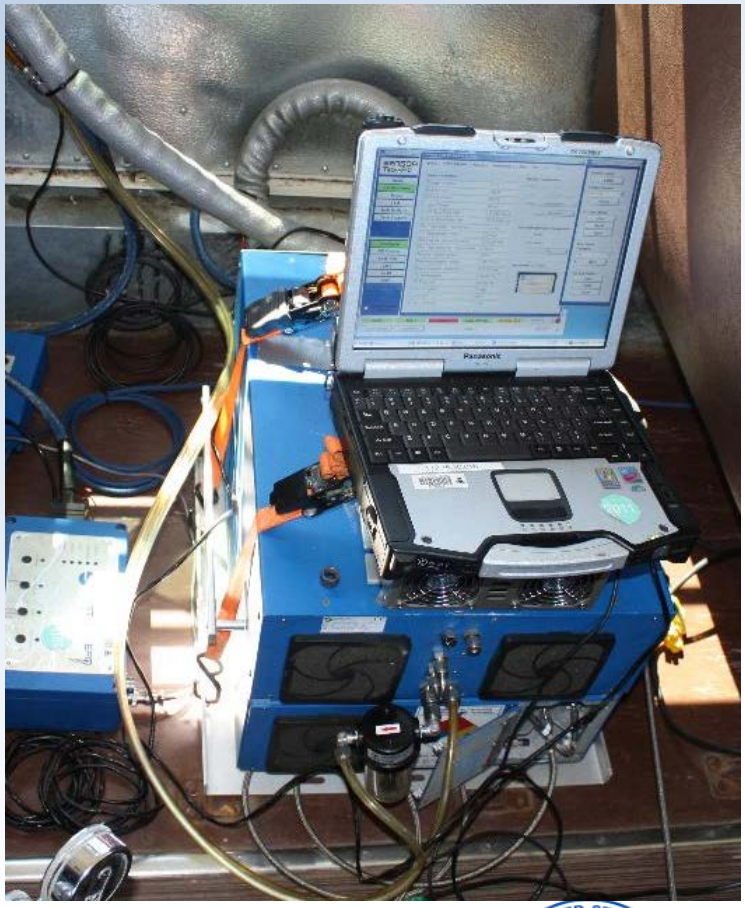
- Vehicle, engine, and fuels industries are highly competitive, especially in today's global environment
  - ➢ *Regulated industries expect and rely on EPA to protect their investment in emissions compliance*

Our Compliance Approach

- Our approach to compliance oversight is multi-dimensional and flexible
- We apply a flexible mix of testing, audits, manufacturer tracking/reporting review, and partnerships to collect and respond to compliance information
- We monitor emissions compliance throughout product lifecycle
  - Pre-production
  - Products coming off production lines
  - Vehicles and engines already in customer service
- PEMS and other real-world emissions monitoring technologies are important elements in our toolkit

EPA Has Been PEMS Compliance Testing for 15+ Years

- HD In-Use Compliance PEMS Testing evaluates emissions in real world operation, including:
  - Actual urban and highway routes, including road grade
  - Ambient conditions
  - Payloads
- PEMS measurements
  - CO_2, CO, HC, NO_x, & PM (g/hr basis)
  - Torque from engine controller
  - Combine to estimate g/bhp-hr emissions



Conclusions

- EPA-led research has led to significant advances in measurement as well as modeling techniques to capture real-world emissions
- Real-world monitoring technologies are increasingly important for EPA's vehicle emissions programs
- Regulatory programs help ensure cleaner air and health and welfare improvements
- Compliance programs
  - Maximize air quality benefits
  - Ensure that manufacturers compete on a level playing field
  - Protect consumers
  - Include "unpredictable" elements
- Partnerships are critical for advancement

We're In This Together

- You are on the leading edge of measurement technology
  - Smaller, lighter, lower power
  - NMOG Speciation
- While laboratories will always be needed, PEMS democratizes emissions testing
  - Lower cost, flexibility, portability
  - Opportunity for this to become "big data"
- There is an explosion of new vehicle technologies and fuels introduced into the fleet…
  - We need to understand the real world impact of these technologies
  - Continue working with policy makers to collect data

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APPENDIX

Example: Light-Duty Vehicle Compliance Program