

NEW METHODOLOGIES AND IMPROVED DATA GATHERING DEVELOPED FOR CARB'S HEAVY-DUTY VEHICLE (HDV) SELECTIVE CATALYTIC REDUCTION (SCR) TEST PROGRAM

Carl Fulper, Kent Johnson¹, Sandeep Kishan², and
Michael Sabisch²

United States Environmental Protection Agency, OTAQ

¹ CE-CERT, Riverside, CA; ² Eastern Research Group

PEMS Conference

UC-CERT

March 17-18, 2016

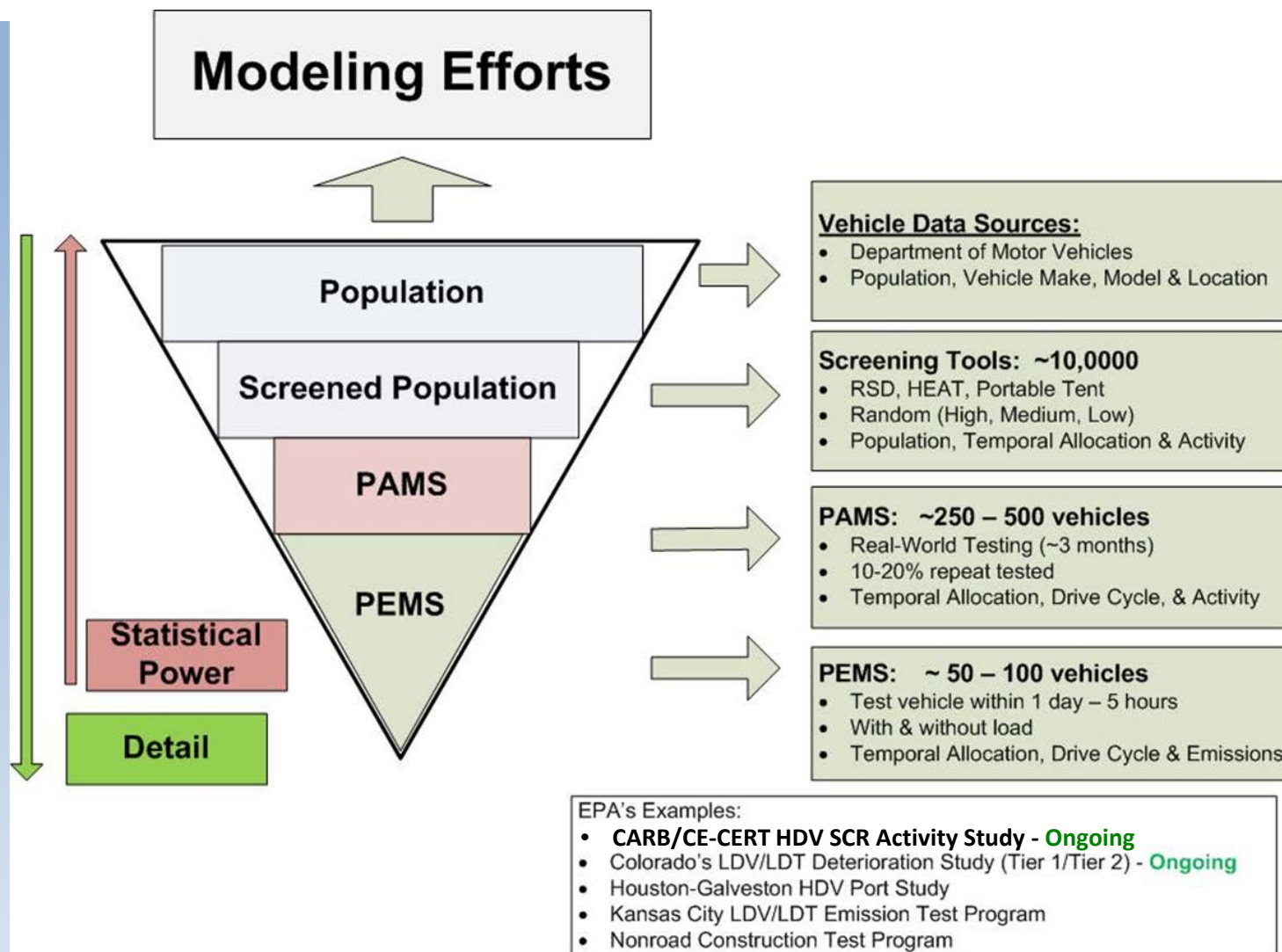


Outline

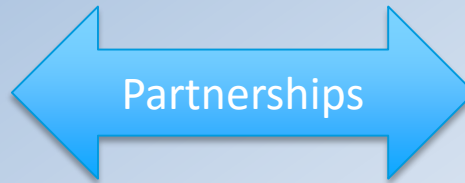
- Introduction of Sampling Methodology
- Overview of CARB's HDV SCR Test program
- Enhanced Support for CARB's HDV SCR Test Program
 - Sampling Methodology
 - Standardize Fleet Information
 - Standardize Vehicle Information
 - Data Gathering
 - Data Analysis



Integrated “Real-World” Testing Design



Working Together to Gather Data



<u>Laboratory</u> Chassis Dynos Engine Dynos Evap SHEDs	<u>"Real World"</u> PEMS PAMS Remote Sensing
--	---



Partnerships

- Partnerships allow for synergies:
 - Combining different experiences and knowledge between partners
 - Better use of facilities and equipment
 - Potential to expand test programs through cost sharing
 - Increase in understanding across the entire emissions community
 - Gain support from local entities



CARB's HDV SCR Test Program

Features

- Objective: to develop activity profiles for different types of heavy-duty vehicles
- CARB contracted with CE-CERT to gather activity data on 100 HD trucks with SCR (MY2010+)
 - Three months of activity data per vehicle
 - Different sizes of vehicles (MDV, HDVs, HHDVs)
 - Different geographic locations within California (North/Central/South)
 - Different truck vocations



Enhanced Support from EPA

- EPA and CE-CERT signed a Cooperative Research And Development Agreement (CRADA) to work together to gather HDV and non-road data
- EPA and CE-CERT partnered to help support CARB's HDV SCR data gathering effort
 - Technical support
 - Equipment support
 - Sampling Methodology support
 - Data Analysis support



Improvements to Sampling Methodology

- Sampling full fleet instead of just the vehicle being tested with PAMS and/or PEMS
- Provides a better understanding of how that tested vehicle fits into the rest of the fleet and to the overall vehicle population
- Developed a new standardized fleet survey form to capture fleet data **(details in a later presentation)**



CE-CERT SCR Study HD On-road Testing and Analysis, Establishment Interview

Form completed ☐ Database completed ☐

Name of establishment	Interview date
Interviewee name	Interviewer name
Telephone number of point of contact ()	
Address of company (main HQ or where interviewee is domiciled)	
Description of industry / services provided	
Establishment's North American Industry Classification (NAICS) code	
Types of delivery (local daily, in-state, interstate)	
Est of number of paid employees (including drivers)	
Est of number of contract personnel (including drivers)	
Number of sites / hubs / distribution centers from which operations are performed:	
Addresses of sites / hubs / distribution centers (only name of city if outside of HQ city)	
Estimated counts / types of trucks and trailers owned by company (i.e., 8 reefers, 32 Class 4 walk-in, etc.)	
Estimated counts / types of trucks leased to company and approximate lease duration	
Estimated counts / types of trucks and trailers contracted to company full-time / throughout the year	
Estimated counts / types of trucks and trailers contracted to company part-time / part of the year Addresses of sites / hubs / distribution centers (only name of city if outside of HQ city)	

WA 3-12 Establishment Interview Form_20160114.docx Page 1 of 2



Improvements to Sampling Methodology

- Developed new standardized vehicle profile documentation forms **(details in a later presentation)**
 - Saves “field” time by taking pictures of vehicle
 - Data fields can be completed later

CE-CERT SCR Study HD On-road Testing and Analysis, Establishment Inventory

Please collect the following information at each site where an inventory is conducted. Much of this information may be available remotely (i.e., information collected through e-mail transmission of inventory files maintained by the establishment). All local sites for each establishment will be inventoried. Inventories will only be performed for remote sites (in other cities or states) if the information can be obtained remotely (i.e., by e-mail, without on-site visits).

Establishment Information

Name of establishment	Interview date
Site location	Interviewer name
Representative phone ()	Site representative

Truck Information

License plate	Truck co. ID
VIN	VIN
Start time	End time

☐ 1 License plate ☐ 2 Full front ☐ 3 Front left angle side ☐ 4 Front right angle side ☐ 5 Truck Co. ID ☐ 6 Additional outside door information ☐ 7 Door jamb labels ☐ VIN ☐ Axle ratio ☐ OBD connection ☐ 9 HEM logger ID and CERT ID ☐ 10 Odometer ☐ 11 Inside cabin (middle section) ☐ 12 Tire and tire size ☐ 13 SCR tank cap ☐ 14 Back right angle side ☐ 15 Full back ☐ 16 Tailpipe ☐ 17 Back left angle side ☐ 18 Additional outside door information ☐ 19 Engine body ☐ 20 Engine labels ☐ Emissions control equipment ☐ Rated engine information	☐ 1 License plate ☐ 2 Full front ☐ 3 Front left angle side ☐ 4 Front right angle side ☐ 5 Truck Co. ID ☐ 6 Additional outside door information ☐ 7 Door jamb labels ☐ VIN ☐ Axle ratio ☐ OBD connection ☐ 9 HEM logger ID and CERT ID ☐ 10 Odometer ☐ 11 Inside cabin (middle section) ☐ 12 Tire and tire size ☐ 13 SCR tank cap ☐ 14 Back right angle side ☐ 15 Full back ☐ 16 Tailpipe ☐ 17 Back left angle side ☐ 18 Additional outside door information ☐ 19 Engine body ☐ 20 Engine labels ☐ Emissions control equipment ☐ Rated engine information
---	---

Comments:

Photo Establishment Inventory_Pages 1 and 2_20160114.docx Page 1 of 2

CE-CERT SCR Study HD On-road Testing and Analysis, Establishment Inventory

Form completed ☐ Database completed ☐

Please collect the following information at each site where an inventory is conducted. Much of this information may be available remotely (i.e., information collected through e-mail transmission of inventory files maintained by the establishment). All local sites for each establishment will be inventoried. Inventories will only be performed for remote sites (in other cities or states) if the information can be obtained remotely (i.e., by e-mail, without on-site visits).

Establishment Information

Name of establishment	Interview date
Site location Main ☐ Other ☐	Site representative
Representative phone ()	Interviewer name
Address where inventory was performed	
Attempt made to get establishment's fleet records (or service records) ☐	

Truck Information

License plate(s) (photo)	Photo taken & verified ☐
Truck company ID (usually on side of hood)	Photo taken & verified ☐
Truck Class (index) 1 4 5 6 7 8	Truck type (i.e., walk-in box truck, bus, etc.)
Truck ownership Company-owned ☐ Lease ☐ Other ☐	
Axle configuration (i.e., 2 axle four tire, 2 axle six tire, 3 axle, 3 axle combo, 4 axle, etc.)	Photo of entire truck taken & verified ☐
Truck Make	Model
Primary Fuel Type	Hybrid Yes ☐ No ☐
SCR tank picture taken (identify by blue cap)	Yes ☐ No tank ☐
Drive axle tire sidewall alpha numeric size	Photo taken & verified ☐
VIN	VIN plate photo taken & verified ☐
Odometer (if possible)	km ☐ miles ☐ Odo photo taken & verified ☐
CAN connector type	6-pin Deutsch (1587) ☐ 9-pin Deutsch (1599) ☐ 10 OBDII ☐
Axle ratio (front or rear axle)	Axle ratio label photo taken & verified ☐
Transmission Type	# of Gears
Ensure ALL door jamb labels photographed and & photos verified for legibility ☐	
Engine Mfr.	Engine Model
Engine Serial #	Engine Family
Engine Displacement	Configuration V-block ☐ Inline ☐
Rated Power	Units HP ☐ Other () ☐
Rated Torque	Units Ft-lbs ☐ Other () ☐
Rated Speed (for Power)	RPM
Rated Speed (for Torque)	RPM
Ensure ALL engine labels photographed and & photos verified for legibility ☐	
Emissions control equipment: TWC/OC/WU ☐ NAC ☐ SCR ☐ DPF ☐ PTOC ☐	
HDS/O2S ☐ EGR/EGRC ☐ Other ☐	
HEM Data Logger Installed: Yes ☐ No ☐ Logger ID (if installed)	
If leased and HEM Data installed, date truck to be returned to lease company?	
Comments:	

WA 9-12 Establishment Inventory_Pages 1 and 2_20160114.docx Page 1 of 2



Improvements to Data Gathering

- Standardizing HDV J1939 Data Files for Loggers **(details in a later presentation)**
 - Known database structure for quick data analysis
 - Gathering “key” vehicle parameter fields for present and future data analysis



Improvements to Data Gathering

- Standardizing Data Loggers (Non-cellular)
 - Quicker installation and setup
 - Problem: Did not know if worked for 3 months
- Cellular Data Loggers (details in a later presentation)
 - Create “Dashboard” to monitor data logger and vehicle
 - “Real-time” notification of issues on data logger and/or vehicle and resolve them (better data)
 - Allow “Real-time” data analysis



Improvements to Data Analysis

- Currently developing and implementing an open database and open data analysis structure with partners
 - Standard database structure: MySQL
 - Standard data analysis and QC/QA techniques: modular designed Scripts in Python and MySQL
 - Standard graphics: R
- Communicate through “Bit-Bucket” to share data analysis methods
 - Quicker QA/QC of data
 - Quicker data analysis  Quicker Results!



Conclusions

- Partnering together is allowing for:
 - Sharing the experience, knowledge and expertise of staffs;
 - Sharing equipment and costs to gather data; and
 - Better and consistent data to be gathered to address present and future research questions.



Thank You and Questions

