



Lessons Learned from the Gateway Cities Fleet Modernization Program

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Reference: D0410

- 1** Overview of the Gateway Cities Program
- 2** Truck Replacement Element
- 3** Truck Retrofit Element
- 4** Summary / Lessons Learned

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The Gateway Fleet Modernization Program facilitated a 3-step process to reduce emissions from **in-use** heavy-duty diesel vehicles



Step 1: Scrap older truck



Step 2: Replace with newer truck

(Newer truck emits ~35% less NOx and ~80% less PM)



Step 3 (optional): Retrofit PM-control

(Reduces replacement truck's PM by ~85%, w/ option for 25% NOx reduction)

Retrofits may also be performed independently on qualified trucks

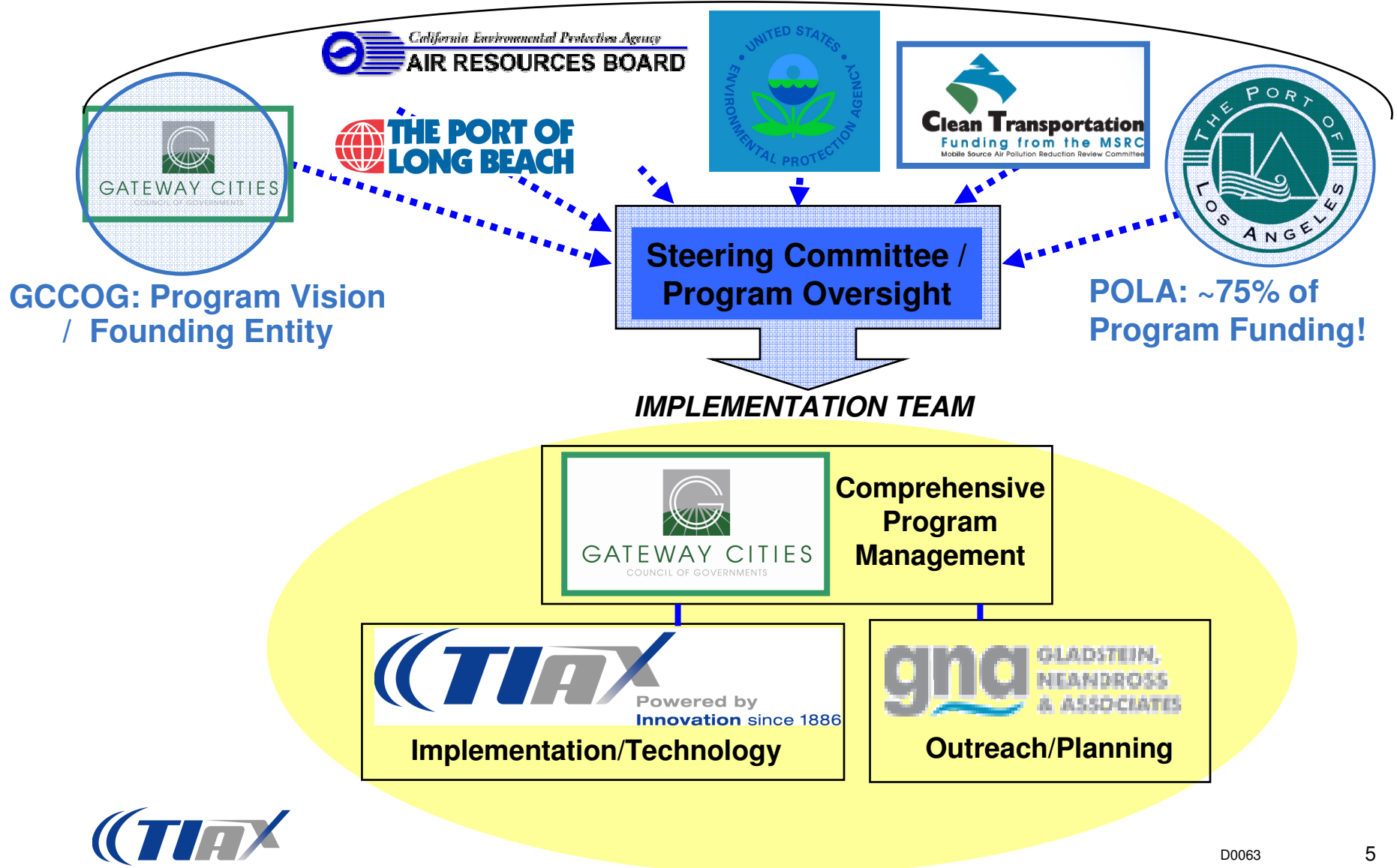


- **Key premise:** truckers with oldest vehicles can't afford newer, cleaner trucks
- Replaced pre-control trucks with more modern, electronic-controlled trucks
 - Incentive-based, voluntary program
 - Grant was about 2/3s the cost of replacement truck
 - Old truck's engine / chassis destroyed
- Allowed site- and vocation-specific targeting, e.g.
 - Drayage trucks
 - "Goods Movement" trucks
- Facilitated "capture" of replacement trucks for emissions upgrades and retrofitting
- **AQ benefits:** compelling and cost effective
- Other benefits were also realized, e.g.:
 - Improved reliability and safety
 - Reduced annual fuel costs (~35%)



A pre-1991 Gateway Cities truck undergoing scrappage process

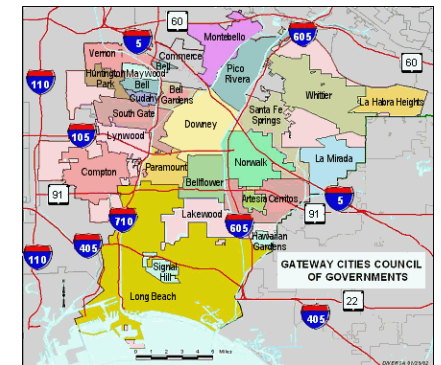
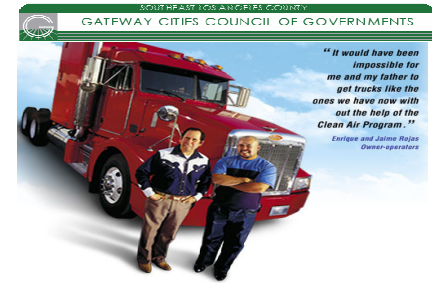
The Program included oversight and/or funding from 6 government entities . . .



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METRANS 2009: Gateway Cities Program *Snapshot*

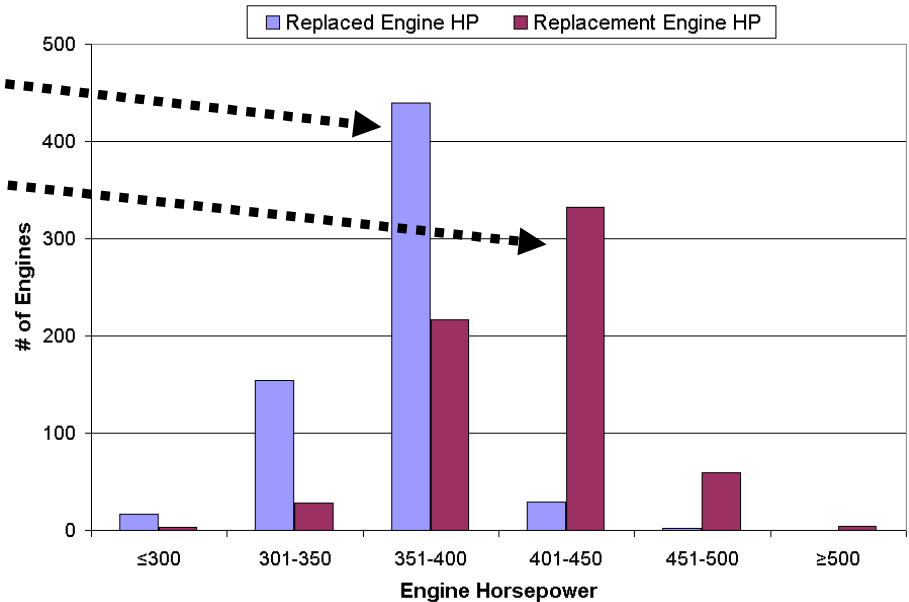
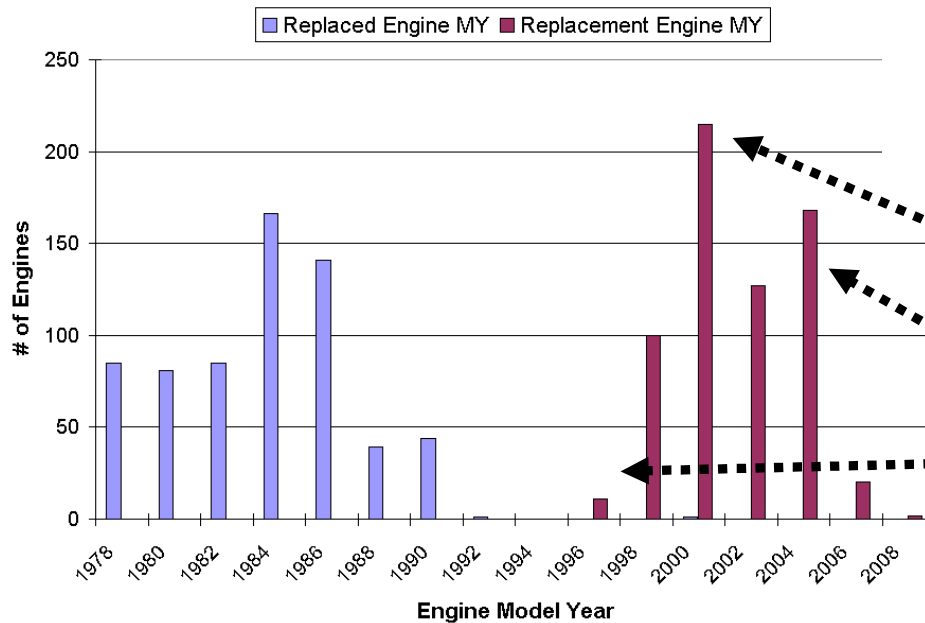
- Program began mid 2002 and ended early 2008 (~6 years)
- Approximately \$24.5 million in grant funds were expended to replace **643** older trucks (mostly pre-1987 MY)
 - **\$4.3 million / 153 trucks** – ARB, EPA and MSRC
 - **\$19.0 million / 473 trucks** – special POLA program
 - **\$1.24 million / 17 trucks** – special POLB program
- POLB also funded pilot retrofit program (Cleaire Longview LNC + DPF) - **\$630,000 / 22 trucks**
- Most trucks received installation of GPS-based “Automatic Vehicle Locator” (AVL) device
- Ongoing program changes and upgrades:
 - Progressively lower-emitting replacement trucks
 - Revisions to formula for calculating grants
 - Adoption of latest CARB emissions factors



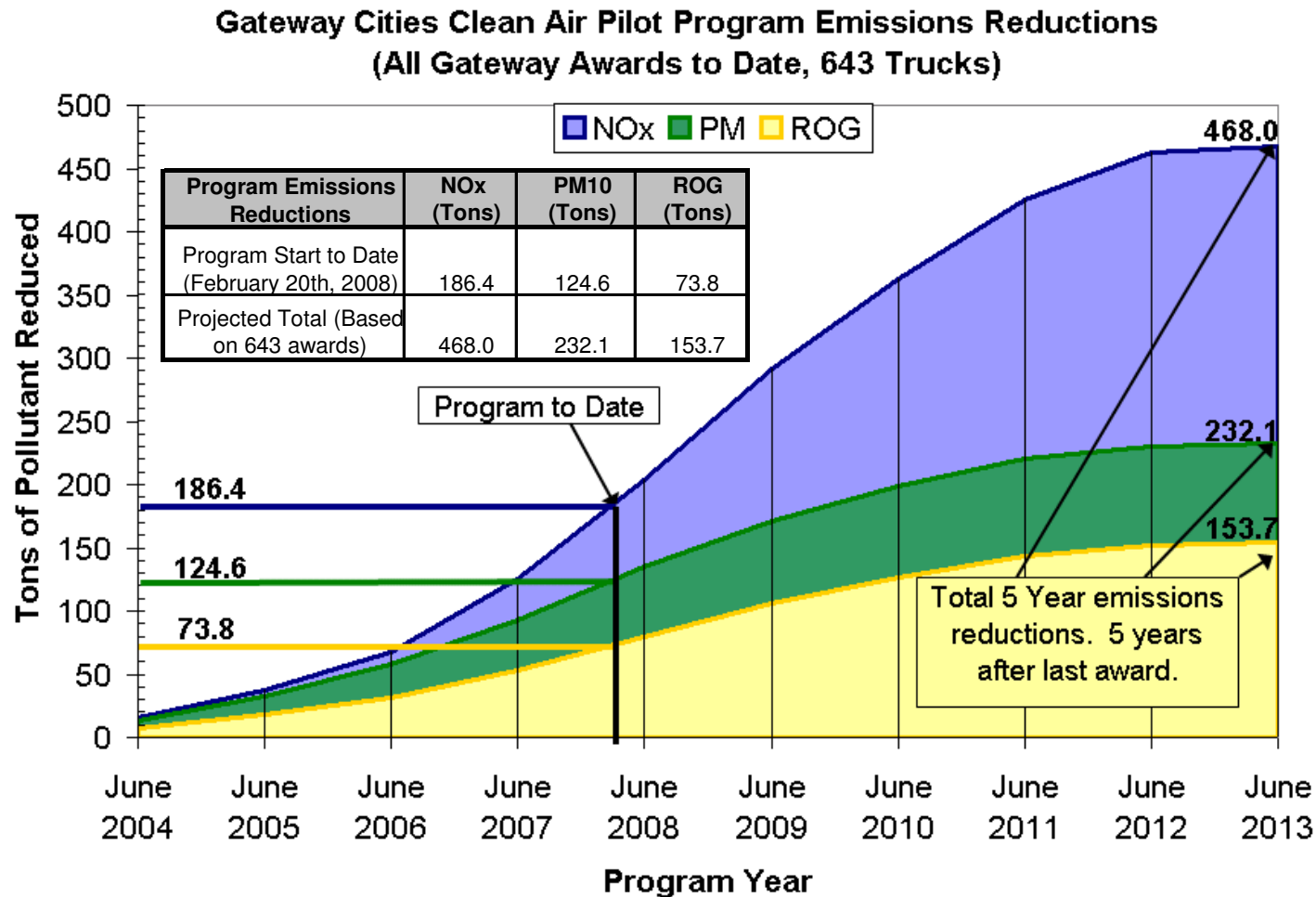
Gateway Program: harbinger to San Pedro Bay CTP

Fleet Mod Under Gateway Cities Program (643 Older Trucks Destroyed & Replaced)

- Most replaced trucks (pre-1991) had Cummins Big Cam engines at 350 to 400 HP
- Available replacement trucks mostly had 400 to 450 HP engines (e.g., DDC S60)
- **“De-rating” of replacement truck’s HP was frequently necessary (maintain AQ benefits)**



- Most common engines for replacement trucks were MYs 2000, 2001
- 2004+ MY replacement trucks deployed late in the program (EGR engines)
- **1994 to 1998 replacement engines were avoided (as the program progressed)**



- Estimates were based on mileage estimates for all replacement trucks using EMFAC '07
- The true air quality implications are **VERY COMPLEX** involving many unknown factors

Most Gateway Cities Replacement and Retrofitted Trucks Received an Automatic Vehicle Locator (AVL)

- Purpose:
 - Automatically monitor vehicle usage by air basin (SCAB) and Port boundaries
 - Help ensure emissions benefits were **Surplus, Quantifiable, Permanent**
 - Eliminate biannual self-reporting forms for participants
- Logistics:
 - Installed on replacement trucks at dealership by authorized entity
 - Truck usage data automatically transmitted to vendor
 - Vendor provided summarized data provided to GCCOG (TIAX)

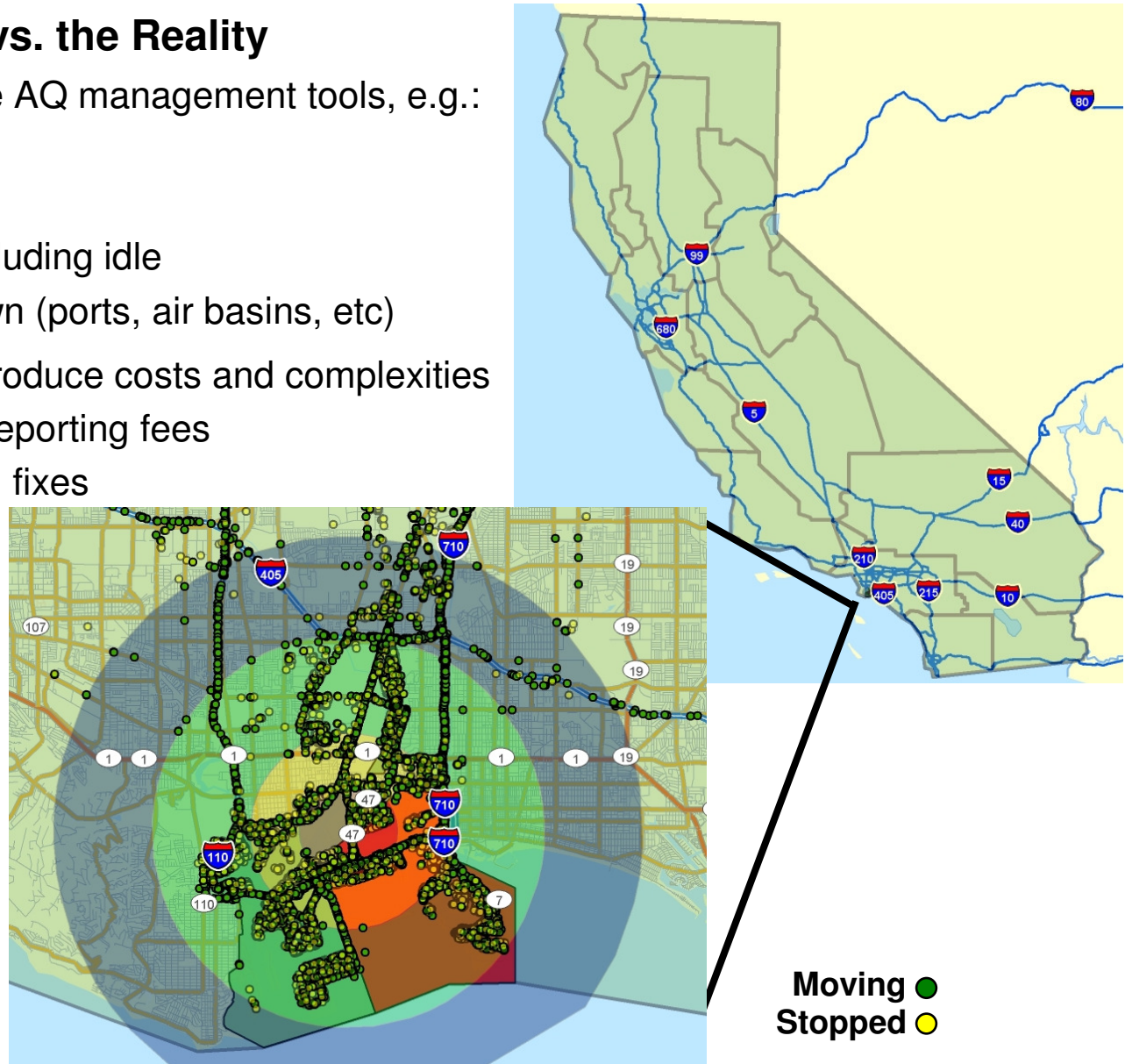
Privacy Protection:

- 1) Monitor only air quality related parameters
- 2) No “real-time” monitoring of trucks (unless vehicle theft or safety were involved).



AVLs: the Promise vs. the Reality

- AVLs can be valuable AQ management tools, e.g.:
 - Port trips
 - Mileage
 - Engine-on time including idle
 - Regional breakdown (ports, air basins, etc)
- But . . . AVLs also introduce costs and complexities
 - Capital costs and reporting fees
 - Field problems and fixes
 - Data management
 - Vendor issues
 - Human issues



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Retrofits are a Key Strategy for Reducing Emissions from Pre-2007 Trucks

- An option for trucks that aren't cost-effective to replace
- Ports' CAAP includes important elements for retrofitting port trucks
- ARB Fleet Rules seek to replace or retrofit all HDTs across the state
- **However, not all retrofit options are available/suitable to all trucks or vocations**
- **Retrofitting of port trucks can be particularly challenging**



Internal view of a DPF

General Suitability Tests for Retrofitting On-Road HDVs

- Considerations and selection criteria include:
 - Is there a CARB-verified device for the engine make/model year?
 - Are NOx reductions sought in addition to PM reductions?
 - Does engine have EGR?
 - Will a passive DPF work (sufficient exhaust temperatures)?
 - Is there an active DPF available that can be a better choice?
 - Are there horsepower restrictions? Does truck have dual exhaust?
 - Will the targeted trucker use and maintain the device properly?
 - Can the trucker afford higher operational costs (e.g., de-ashing of DPF)?
- Additional considerations for retrofits:
 - Infrastructure requirements (e.g., electric plugs?)
 - Failure mode of the device
 - Variability of driver workload and duty cycle



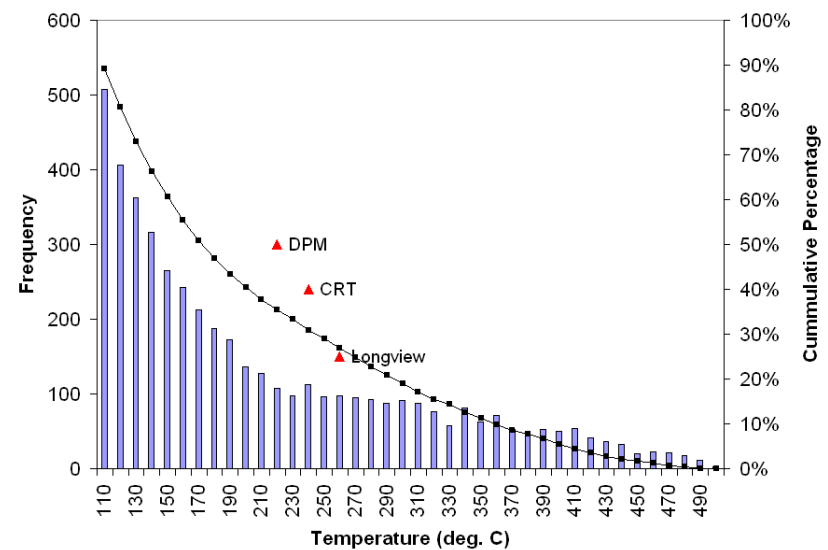
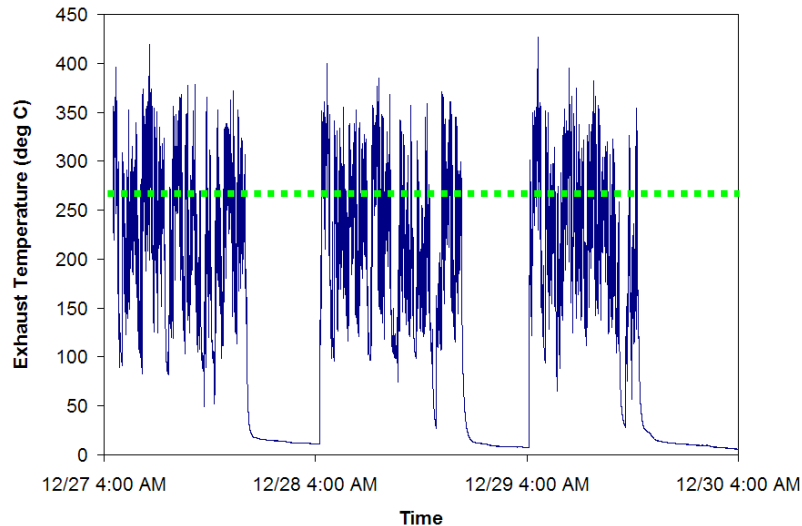
Internal view of a DPF

Specific challenges for retrofitting container port trucks include:

- Average daily mileage varies (from 50 to 300 miles per day)
- Driver's cargo and load constantly change (20,000 – 80,000 lbs GCVW)
 - 20' vs. 40' containers
 - Bobtailing (tractor with no trailer) or returning empty containers
- Workloads can change seasonally
- Drivers migrate into and out of trucking vocation
- Engines are not always properly maintained
- **These factors affect:**
 - **Average exhaust temperature and/or**
 - **PM generation rates of the engine**
- **Dictates viability of a given retrofit device**
- **Port truckers may not be able to afford higher O&M costs**



TIAX's exhaust temperature testing effort of port trucks for POLA / POLB



- **Preliminary Conclusion:** Passive DPF systems can work for a large percentage of port trucks, with screening to eliminate poor candidate vehicles



Example raw exhaust temperature data and histogram showing viability of verified DPFs

TIAX measured temp. losses along the exhaust pipe of one Class 8 Tractor

Turbo Outlet	1995 Freightliner w/DDC S60 Engine	Muffler Inlet
		
Temperature Range: 11 – 482 °C	Approx. 12 ft. of non-insulated exhaust piping.	Temperature Range: 10 – 430 °C



- Container trucks typically have sleeper cabs, resulting in extra-long exhaust piping
- On average, there was a 36 °C loss along the non-insulated exhaust pipe
- Turbo Outlet: 31% of time above 260 °C → Muffler Inlet: 26% of time above 260 °C
- **Finding**: sleeper cab trucks less likely to have sufficient exhaust temperatures

Program Commitments for Participants in Retrofit Program

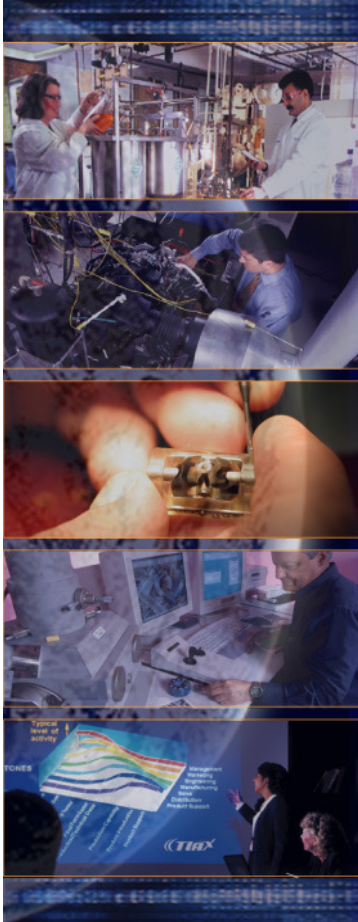
- Once installed, truck owners agree to the following obligations for **5** years:
 - Allow AVL (Automatic Vehicle Locator) installation
 - Apply clean air decals
 - Comply with applicable motor vehicle laws
 - Stay in port trucker vocation
 - Provide annual updates (insurance, registration, etc.)
 - Properly maintain retrofit device and truck



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- A national model for reducing emissions in-use heavy-duty trucks
 - ✓ 643 trucks replaced / 22 trucks retrofitted
 - ✓ Major reductions in NOx, PM, ROG and air toxics
- Thousands of trucks could have been completed, with more funding
- Harbinger of the San Pedro Bay Ports CTP
- Fleet modernization is conceptually simple with real-world challenges
 - ✓ IOOs are a unique trucking cohort
 - ✓ Managing individuals vs. fleets
- Retrofitting of port trucks brings **unique** challenges
- “Passive” DPFs can be viable, with application of:
 - ✓ Screening tools (duty cycle, engine condition, etc.)
 - ✓ Outreach programs for affected port truckers
- “Active” DPFs are emerging (currently expensive, limited uses)
- AVLs (GPS devices) can be a valuable program tool, but . . .
 - ✓ They come at a price (cost, complexity)
 - ✓ Not a panacea benefits vs. costs should be carefully assessed

Thank you for your attention!



TIAX wishes to thank the following key program supporters:

- Gateway Cities Council of Governments
- Port of Los Angeles
- Port of Long Beach
- U.S. EPA
- Cal EPA / CARB
- Mobile Source Air Pollution Reduction Review Committee

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