No Escape from Diesel Exhaust – Findings

NOTE: This page contains videos which may take a while to load over slow connections

Findings

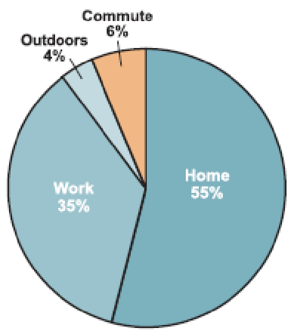
Exposure to Fine Particles has Deadly Consequences

Particulate matter is a potent pollutant. In fact, medical researchers believe that fine particulate matter pollution in the air is responsible for at least 70,000 deaths a year. [34], [35] Two analyses by Abt Associates for the Clean Air Task Force, following EPA Science Advisory Board-approved methodologies, have estimated that approximately 45,000 American lives are lost prematurely each year from exposure to particulate matter pollution from two sources of particles—21,000 from diesel engines and 24,000 from power plants.[36] This is roughly equivalent to the 44,000 motor vehicle deaths per year in the U.S. each year.[37]

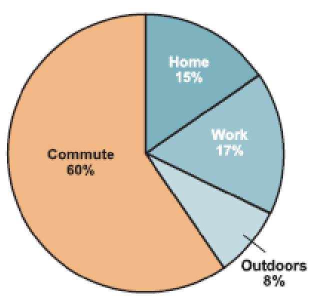
For the average risk from diesel pollution in your community go to the CATF website at: www.catf.us/projects/diesel/dieselhealth/. Our study suggests that your exposure may be considerably higher if you commute.

Our Daily Commute: Over Half of Our Exposure to Diesel Particles

Studies throughout the world show that people who live or work around diesel engines are at highest risk.[38] But what about the rest of us? Exposure studies, including this study, suggest that commuters on busy roadways, on diesel transit buses, and on commuter trains receive above-average exposures to fine particles. Studies by California Air Resources Board (CARB) researchers estimate that during the relatively small part of the day when we are in our vehicles, we experience over half of our exposures to ultrafine particles and black carbon.[39], [40], [41]



Percent of Day Commuting

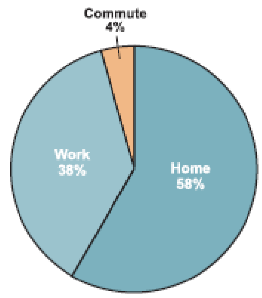


Percent of Daily Exposure to Harmful Particles

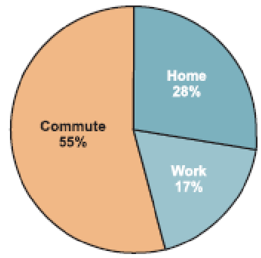
(SOURCE: CARB)

CATF researchers wanted to determine whether the California studies are applicable to other areas of the country. We chose Columbus, Ohio, whose particulate air pollution is commonly thought to come largely from coal-fired power plants. CATF completed approximately two dozen runs and ten commuter "profiles" investigating particle exposures at home, in traffic, and at work, to estimate the relative proportion of ultra-fine particles experienced during different times of a commuter's day. The researchers found that, as in California, Columbus commuters experience the majority of their exposures to particles during their trips to and from work.

Columbus, Ohio

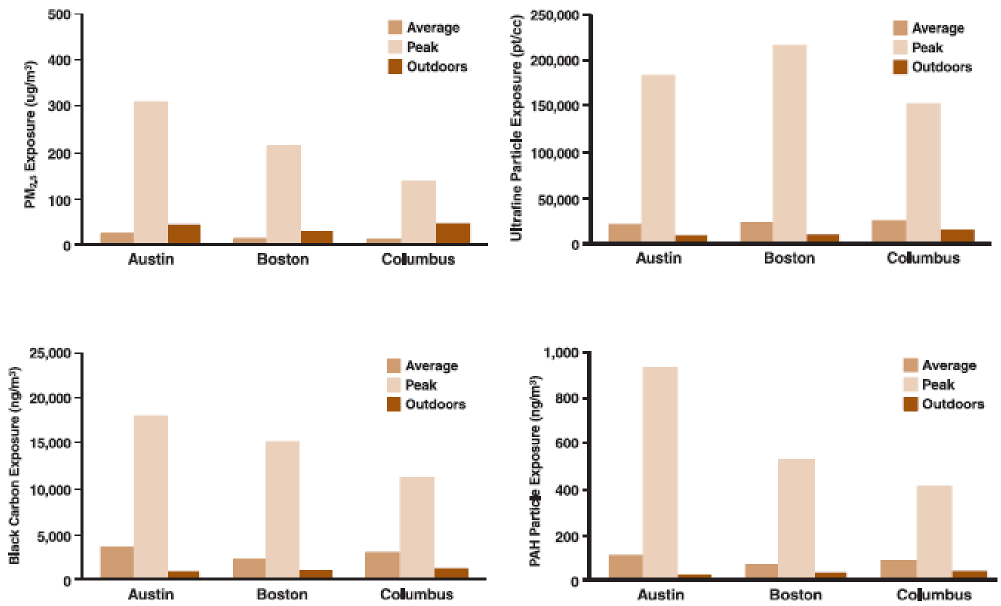


Percent of Day Commuting



Percent of Daily Exposure to Harmful Particles

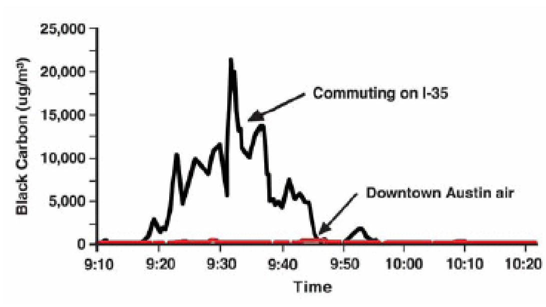
Cars

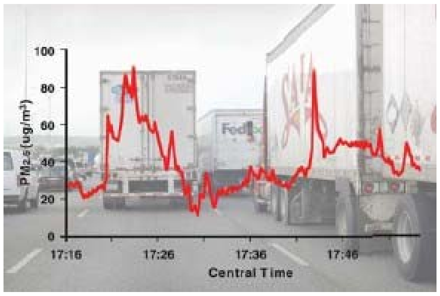


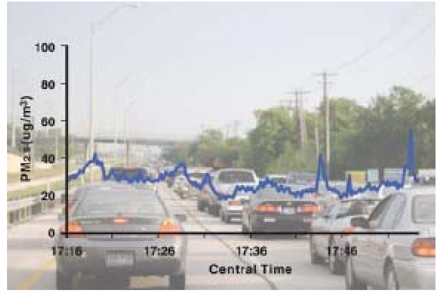
Car commute exposures for the four primary diesel pollutants were similarly high across the three cities where we conducted car tests. Bars represent for all runs the average and peak pollutionlevels inside the car compared to outdoor levels. (Pollutant exposure data was normalized by subtracting daily ambient background concentrations.)

Case Study: Austin, Texas

In Austin, Texas, CATF investigated simultaneous commuter exposures during commutes on Interstate 35 and on the MOPAC expressway between Austin and Roundrock, Texas, the home of Dell Computer. I-35 is a truck route while MOPAC prohibits heavy trucks, thereby providing a no-truck "control" for our study. All diesel pollutants were significantly higher on I-35 than on MOPAC, even when the two routes were comparably congested, and were many times higher than levels measured in downtown Austin.



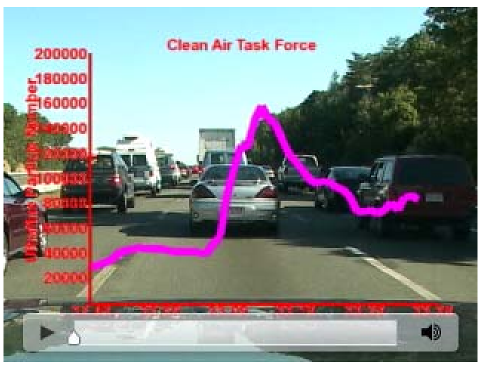




In-cabin particle exposures are much higher for commuters along routes with diesel trucks. The MOPAC highway (right) a no-truck alternative to I-35 (left) in Austin, Texas, had lower diesel pollution levels.

Case Study: Boston, Massachusetts

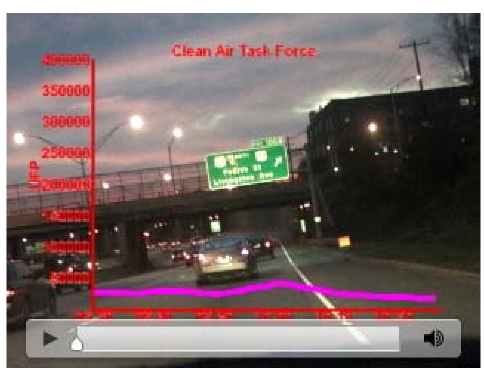
CATF investigated car commutes from the southern suburbs to downtown Boston and back along one of the busiest commuter routes in the northeast: the Southeast Expressway (I-93). Inbound morning commutes typically included heavy truck traffic, leading to elevated levels of all the measured pollutants. Some outbound evening commutes involved little or no truck traffic, providing a reasonable no-truck "control" for comparison purposes. CATF found pollutant levels during the car commutes in the presence of trucks were four times greater than during the commutes without trucks.



Above left: inbound traffic with trucks results in high diesel ultrafine particle exposures. Above right: traffic without trucks means commuting without particle pollution. To view videos, move pointer over above images to display video controls.

Case Study: Columbus, Ohio

CATF investigated car commutes in Columbus, Ohio, and recorded levels typically three times higher than at a monitoring site located in a downtown area. The level of pollution measured in the commuter car corresponded directly to the presence or absence of trucks in the roadway around the monitoring vehicle. CATF found that particle exposures were minimally higher than levels in the outdoor air when there were no trucks on the road. Truck-filled roads were found to result in much higher particle exposures.



In Columbus, Ohio, CATF found that particle exposures were lower when there were no trucks on the road (right). Truck-filled roads resulted in higher exposures (left). To view videos, move pointer over above images to display video controls.

Diesel Particle Filter: The 90 Percent Solution

Starting this year, because of new EPA regulations, new diesel trucks will be sold with a diesel particulate filter (DPF) that achieves a 90 percent-plus reduction in diesel particles. Cleaner, ultra-low sulfur diesel fuel is now available nationwide to help these cleaner engines stay that way. However, the EPA rules do not regulate the emissions from the 13 million diesel engines in use today. Nevertheless, most of these vehicles can take a diesel particle filter and achieve a comparable 90 percent level of reduction. These filters work. Our researchers detected minimal diesel pollutants following a truck retrofitted with a DPF. DPFs can be installed on most trucks built since 1994.

Solutions that work: CATF's installation of a diesel particle filter on a box truck dramatically reduced fine particles (PM2.5) near the tailpipe from 5,000 µg/m3 to 25 µg/m3. As a result, fine particles from the truck barely registered in the car following behind. To view videos, move pointer over above images to display video controls.

> ***The combination of Diesel Particulate Filters (DPFs) and Ultra-Low Sulfur Diesel (ULSD) can achieve a 90% reduction in diesel particles.***

Above: Honeycomb particle trap from DPF on box truck.

Left: Installation of a DPF simply requires replacement of muffler and tailpipe.

Because CATF's investigation demonstrated that the level of pollution exposure in the cabin of a commuter car is a function of the presence of diesel truck traffic, we wanted to test the difference in cabin exposure for commuters following a conventional truck vs. the same truck retrofitted with a diesel particle filter.

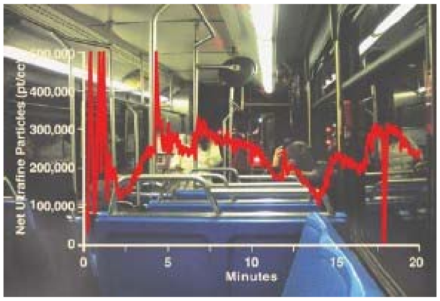
Our monitoring car followed behind the conventional truck and measured the elevated levels of diesel particles in the car's cabin. We then had a diesel particle filter installed on the same truck. When following the newly retrofitted truck, the investigators found minimal increases in diesel fine particles in the cabin of the chase vehicle. The particle filter virtually eliminated the exposure to diesel particles from the truck for the commuter car following behind.

Transit Buses

CATF investigated particle levels inside transit buses in Boston and following buses in Boston and New York City. In CATF's earlier school bus studies, we found that diesel exhaust from the bus tailpipe infiltrated the bus cabins, thus elevating on-board pollution levels. See www.catf.us/publications/view/82. CATF's results in the present study suggest that this same effect occurs in transit buses. However, inside buses that had been retrofitted with DPFs, particle levels were substantially lower.

Case Study: Boston, Massachusetts

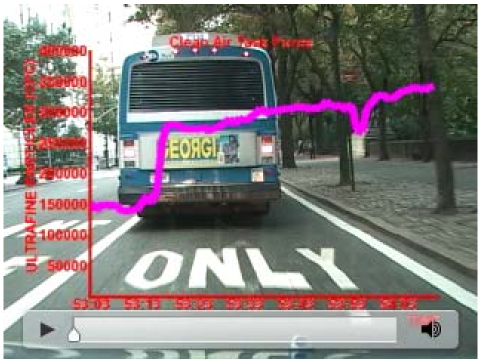
In Boston, CATF researchers boarded conventional buses as well as those retrofitted with particulate filters and measured in-cabin diesel particle levels. The Metropolitan Boston Transit Authority has replaced or retrofitted the vast majority of its bus fleet. Levels on the remaining conventional buses were on average four times higher than outdoors, whereas the particle levels on the new and retrofitted buses were substantially lower and sometimes even below outdoor levels, resulting in a cleaner, healthier ride.



Left: Pollution from a conventional bus infiltrates the cabin exposing passengers to elevated levels.
Right: Diesel ultrafine particle pollution from the bus is undetectable in the cabin of a bus with a DPF.

Case Study: New York City

In the past few years, New York City has retrofitted or replaced with lower-emitting diesel-electric hybrid buses the vast majority of its fleet. To test the benefits of these improvements relative to the conventional buses still on the street, CATF investigators followed buses in a commuter car outfitted with monitoring equipment. The investigators found high diesel exhaust levels behind conventional buses while levels behind buses with DPFs were barely detectable.



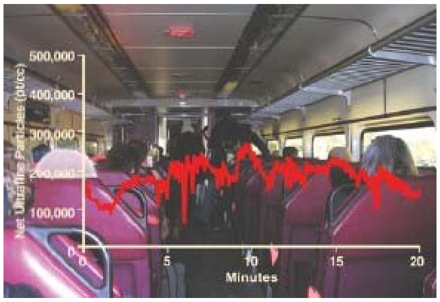
Left: Exhaust from a conventional New York City transit bus infiltrates a car following behind.
Right: Ultrafine particle levels behind a bus equipped with a diesel particulate filter are virtually eliminated.
To view videos, move pointer over above images to display video controls.

Commuter Trains

CATF investigators monitored pollutant levels inside passenger trains in Boston and New York City. Results suggest surprisingly high exposures to diesel exhaust in the passenger compartment, especially with the locomotive pulling the train. While trains with emissions control equipment were unavailable to test against conventional diesel trains, we nevertheless were able to conduct a "controlled" experiment. Many commuter trains are so-called "push-pull" trains. That is, the locomotive pulls the train in one direction to the end of its commuter run, e.g., inbound, and then pushes the train back to the other end of the line, e.g., outbound. CATF researchers observed that when a diesel locomotive pulls its passenger cars, the plume of diesel exhaust from the engine blows down onto the cars following the locomotive and invades the coaches. Pollution levels in the coach typically increased during the course of the commutes in a pulled train. However, on a train pushed by the diesel locomotive such that the exhaust plume was left behind, particle levels remained low. Even in trains being pushed by a locomotive, investigators found pollution levels spiked in the passenger cars when the doors opened at an underground station platform with inadequate ventilation in Boston.

Case Study: Boston, Massachusetts

In Boston, CATF investigators rode commuter trains inbound and outbound to study the relative pollution levels on board a "push" versus a "pull" train. Levels in the coaches of the trains being pulled by a diesel locomotive were many times higher than those when the train was being pushed.



In-coach levels of ultrafine diesel particles in this test were 10-100 times higher in coaches being pulled by a locomotive (left) than in coaches being pushed (right).

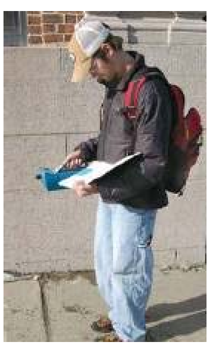
Case Study: New York City

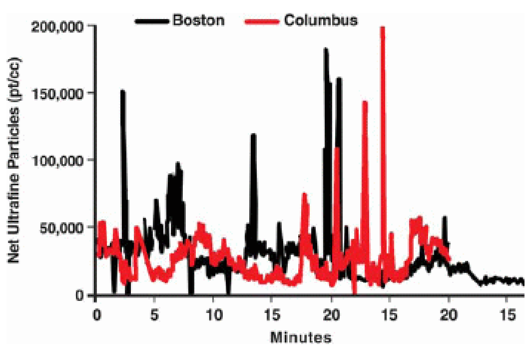
As in Boston, our researchers found elevated particle levels in New York City-area commuter trains being pulled by a locomotive while levels were low in trains that were pushed.

> ***In New York City, like Boston, monitoring revealed a stark difference in ultrafine particle levels on commuter trains between the "push" and "pull" segments.***

Pedestrians

People who walk to work near thoroughfares traveled by diesel vehicles also are exposed to high levels of pollutants. CATF investigators engaged in street-level monitoring in Boston, Massachusetts, and Columbus, Ohio. Peak pollutant levels on downtown streets next to traffic rivaled exposures experienced during commutes using other modes.



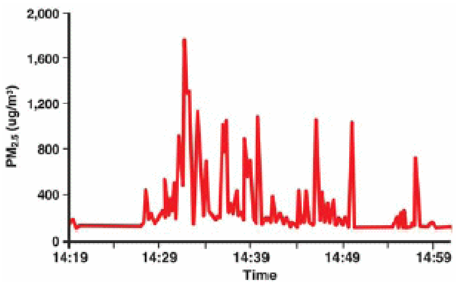


Above: Exposure during walking commutes in Boston and Columbus.

Top Left: Researcher with monitoring equipment in a backpack.

Commuting via Ferry

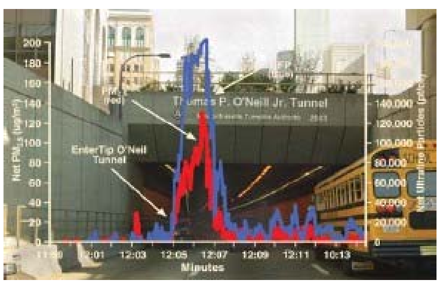
A relatively few commuters travel to work on a passenger ferry, but if they think they are getting fresh air, they may be wrong.



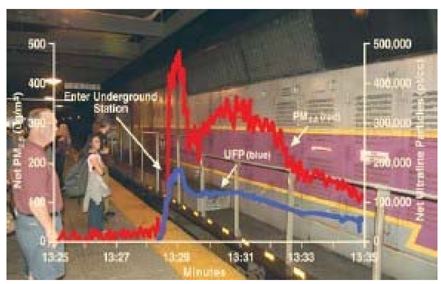
Extreme PM2.5 exposures on Boston harbor ferry. Exhaust smoke eddies behind the boat and enters through the rear door.

Motor Vehicle and Rail Tunnels

It may come as no surprise that air quality in vehicular and rail tunnels is exceptionally poor. A variety of tunnel studies have been undertaken in California. One study documented black carbon levels up to 50 times as high as in the already polluted outdoor air, especially in the presence of numerous trucks in the tunnel. Where one tunnel bore allows trucks and another does not, heavy-duty trucks were responsible for 93 percent of the black carbon emissions in the truck-influenced bore.[42] CATF's investigation confirms extreme exposures in tunnels.



Extreme change in particle levels entering and leaving Boston's Big Dig (O'Neill) Tunnel



Extreme particle levels in Boston's Back Bay train station

Summary of Results

Peak and average levels below indicate how many times greater CATF researchers found the pollution levels were in commuter vehicles compared to the levels in the outdoor air.

POLLUTANT		$PM_{2.5}$			Ultrafine Particles			PAH			Black Carbon		
		# runs	Peak	Average	# runs	Peak	Average	# runs	Peak	Average	# runs	Peak	Average
CAR													
Austin	I-35	15	8	1.4	15	35	4	4	22	3	15	33	7
Boston	I-93	15	14	1.7	15	38	4	6	60	9	14	35	6
Columbus	I-71	31	5	1.0	34	19	4	17	14	4	25	12	5
All-city Mean			*9*	*1.4*		*30*	*4*		*32*	*5*		*27*	*6*
BUS													
Boston	Conventional	5	11	2.4	5	11	4	1	22	12	n/a	n/a	n/a
	DPF	9	14	3.4	5	3	1	6	30	7	4	7	3
TRAIN													
Boston	Push	6	34	3.6	6	44	4	4	54	4	4	22	6
	Pull	6	45	3.2	6	60	17	5	69	15	4	45	17
New York	Push	2	28	1.0	2	19	5	2	11	2	n/a	n/a	n/a
	Pull	3	29	1.7	3	49	15	3	12	3	n/a	n/a	n/a
FERRY													
Boston		2	14	2.6	3	21	3	2	117	17	1	50	6
PEDESTRIAN													
Boston		6	12	1.5	5	19	2	1	43	8	1	15	2
Columbus		3	16	1.4	3	29	3	1	34	2	n/a	n/a	n/a

CATF's commuter study results suggest that breathing particles while commuting resulted in exposures

that are many times greater than breathing air pollution in the outdoor air no matter the mode of commute.

How the Studies Were Done

Representative cities were selected for investigating commuter exposure to diesel exhaust (Austin, TX; Boston, MA, Columbus, OH and New York City) using methodologies developed at major universities. Four key constituents of diesel exhaust were tracked with continuous monitors: fine particles (PM2.5), ultrafine particles (PM<0.1), black carbon, and particulate polycyclic aromatic hydrocarbons (PAHs). Because CATF's monitoring suggests ultrafine particles may be the best marker of fresh diesel exhaust across all modes of transit, those results are highlighted in this report. Graphics were selected to illustrate key findings. Pollutant exposure data was normalized by subtracting daily ambient background concentrations. For in-depth results and methodological details see companion white paper at www.catf.us/goto/noescape/.

- **Car Commutes:** In Boston, Austin and Columbus typical commute routes were run in a 2006 minivan equipped with four monitors for a total of 107 runs over 79 hours. CATF investigated the effects of window position, air conditioning, and recirculation of cabin air. The results from "windows open" runs are reported here.

A dashboard-mounted digital video camera inside the chase car allowed researchers to film the driver's-eye-view behind the diesel vehicles while monitoring instruments recorded pollution levels inside the car.

- **Transit Buses:** Researchers boarded buses in Boston and Columbus using monitors housed in backpacks and roll-around bags.

Above: CATF researcher setting up particle monitoring equipment to monitor both cabin and outdoor air simultaneously with two sets of equipment.

Left: Monitoring equipment in a roll-around suitcase was used for recording pollution levels in buses, trains and ferries.

- **Commuter Rail:** Researchers boarded trains in Boston and New York City with monitors housed in backpacks and roll-around bags for inbound (locomotive push) and outbound (locomotive pull) runs.
- **Ferries:** Researchers boarded Boston commuter ferries with monitors housed in a backpack.
- **Walking Commutes:** With monitors in backpacks, researchers walked from residential to commercial areas in Boston and Columbus.
- **Chase Studies:** CATF monitored comparative particle levels behind conventional and DPF retrofit buses in New York City and Boston and behind garbage trucks in New York City. As a controlled experiment, CATF retrofitted a Class-5 box truck with a DPF, testing air behind the truck before and after.

Previous Commuter Exposure Studies

Previously published, peer-reviewed studies firmly establish that we can be exposed to high levels of diesel pollution when we are commuting. Numerous exposure studies confirm that diesel pollutants are concentrated in areas of high traffic. Methods have been developed to quantify commuter pollutant exposures in a variety of cities around the world. CATF researchers employed similar instruments and protocols to those used in these previous studies:

- A 2003 California study points to commuting as the principal route of human diesel exposure accounting for up to one half of total exposure.[43] The ultrafine particle concentrations in California vehicles were seven times higher than the national average. Exposure levels on Los Angeles freeways were similar to the findings of the CATF study.[44]
- In a Los Angeles study, elevated exposures were recorded within 100 meters of a freeway (about the length of one large-city block) beyond which they fell rapidly.[45]
- A London study investigated ultrafine particle exposures while commuting on foot, by bicycle, in a car, in buses, and by taxi in London.[46] As in the CATF study, the researchers documented elevated exposures in every mode of transit. Exposures in taxicabs were the highest. Personal exposures on sidewalks were multiple times higher than

fixed urban background monitoring sites.[47]

- A 2004 study by researchers at the Northeast States for Coordinated Air Use Management of Boston diesel commuter rail exposures documented high levels of black carbon particles in passenger coaches and at train stations.[48]
- In Amsterdam, black carbon levels increased near highways by a factor of three times over more distant areas.[49]
- Elevated black carbon exposures on Harlem, New York, sidewalks are associated with increased truck and bus counts.[50] Exposures increased near a bus depot.[51] Researchers concluded that adolescents in Harlem are exposed to elevated levels of diesel exhaust.
- A personal exposure study in Mexico City found elevated fine particle exposures in a variety of microenvironments, including people riding in cars and using public transportation.[52]

London Taxi Study

You might think riding in a taxi would expose you to less air pollution than you would get walking down a city sidewalk, but that does not seem to be the case. Researchers at Imperial College, London, walked, biked, drove, and rode buses or taxis up and down streets in central London. Surprisingly, riding in a taxi resulted in the worst exposure—nearly twice as much as walking. The suggested explanation: taxis tend to get stuck in traffic surrounded by other pollution-belching vehicles. CATF used a similar methodology to the published, peer-reviewed techniques used in the London study to conduct its commuter study.

Health Effects of Diesel Exhaust

Diesel exhaust is unhealthy to breathe. The scientific community has been aware of the adverse health effects of breathing diesel pollution for decades. Diesel exhaust is a toxic combination of carbon, sulfur and nitrogen particulate matter compounds and related gases created from combustion of diesel fuel and burnt lubricating oil commonly containing minute metallic particles from the engine. Research, based on occupational studies conducted in the U.S. and Canada, has linked diesel exhaust exposure to cancer.[53] Recent investigations of health damages resulting from exposure to pollutants found in diesel exhaust include long-term, short-term and laboratory studies. But commuters are not the only people exposed to diesel exhaust—we all breathe it every day whenever we are near diesel vehicles whether we drive on a country road or a city street. We are surrounded by 13 million diesel engines—workhorses that power tractor-trailer trucks, transit and school buses, trains, ferries, and construction and agricultural equipment.

Particulate matter may be the most carcinogenic and harmful component in diesel exhaust. The International Agency for Research on Cancer (IARC) states that there is sufficient animal experimental evidence to establish the carcinogenicity of diesel engine exhaust particles, but inadequate evidence for the carcinogenicity of gas-phase diesel engine exhaust.[54] Nevertheless, coronary artery constriction has been documented in animal studies resulting from exposure to these gas-phase diesel compounds.[55]

Diesel particles are not only toxic, they also make up the tiniest fraction of combustion particles. In general, diesels emit two sizes of particles—fine particles, less than two and one-half microns (a millionth of a meter) in diameter, and ultrafine particles, less than a tenth of a micron. Under U.S. law, the Environmental Protection Agency has set daily and annual health standards for fine particles (35 µg/m3 and 15 µg/m3 respectively). Health standards have not yet been established for ultrafine particles, but recent health research suggests that their extremely small size may allow them to pass easily into the bloodstream where they can cause oxidative stress and inflammation leading to cardiovascular disease symptoms.[56] These particles are, at their core, commonly made up of black carbon. This core often is coated in toxic substances such as particulate polycyclic aromatic hydrocarbons (PAHs), a probable carcinogen, and metals from engine wear.

The U.S. Environmental Protection Agency's most recent National Air Toxics Assessment estimated that the average concentration of diesel particles in the air in the U.S. is about 1.2 µg/m3, much lower than CATF found in commuter vehicles.[57] Using the cancer potency factor developed by the California Air Resources Board (CARB), this translates to about 363 lung cancers per million, well above EPA's acceptable level of one cancer per million. Moreover, the cancer risk from diesel exhaust in the U.S. exceeds the combined total of all the other 132 air toxics tracked by EPA.[58]However, in many areas, diesel particles may be even more concentrated in 'hot spots' such as areas of congested traffic, heavy machinery use, or construction.

Proximity to Traffic is Associated with Adverse Health Risk

Traffic studies have consistently and overwhelmingly defined an adverse relationship between proximity to highly trafficked areas and a variety of illnesses. Epidemiological studies generally suggest that living within approximately 50-100 meters of a busy road may result in mild to acute respiratory symptoms. A New York City study underway links asthma to truck traffic.[59] An assessment of the health impacts of traffic-related air pollution estimated approximately 40,000 premature deaths annually in Austria, France and Switzerland, a whopping six percent of total mortality.[60]

Importantly, studies find that the volume of truck traffic is most strongly related to health risks rather than car v olume.[61], [62], [63]These studies comport with our findings that particle levels on freeways are directly associated with volume of truck traffic.

Medical studies have linked proximity to traffic to:

- Heart attacks (myocardial infarction).[64], [65], [66] A study of 700 heart attack survivors shows that they were most likely to have been in heavy traffic the hour before they suffered the heart attack than any other hour of the day.
- Increased risk of mortality.[67]
- Reduced lung function growth. In a cohort of 3677 children tracked for 8 years, those living within 500 meters of a California freeway had deficits in lung volume growth.[68]
- Heart rate variability changes. A study of North Carolina highway patrolmen found particle concentrations were linked to heart rate variability changes and irregular heartbeats.[69], [70]
- Chronic respiratory symptoms in children and adults such as cough, persistent wheeze and bronchitis.[71], [72], [73], [74], [75], [76]
- Asthma in children, with larger effects in girls, and children's hospital admissions for asthma.[77], [78], [79], [80]
- School absences.[81]
- Aging effect ("mortality rate advancement"), similar in magnitude to chronic respiratory and pulmonary diseases and diabetes.[82]

State Trooper Exposure Study

In a 2004 study, University of North Carolina researchers tracked particle exposures and cardiac response in young (ages 23-30), healthy and physically fit highway patrolmen on their daily shift. Using the same or similar monitoring devices as used by CATF researchers, particulate matter concentrations—well within the same ranges as CATF observed in the present study—were linked to significant changes in heart rate variability, irregular heartbeats, and increases in blood inflammatory markers within hours of exposure.

Recommendations: Today's Technology Can Mean Cleaner Commutes Now

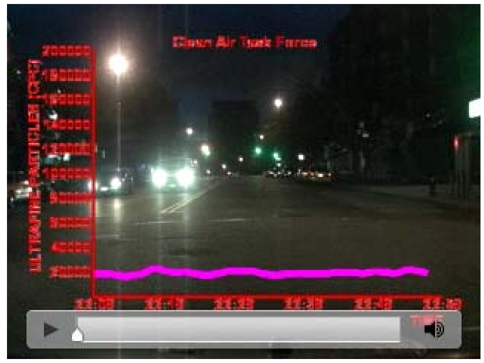
Tackling this serious public health problem now—for the health of this generation of Americans—depends on aggressive efforts to retrofit existing engines rather than waiting decades for cleaner new engines to replace the older dirty ones. While EPA's new engine rules will mean huge air quality improvements over time, a child born today will be 23 years old by the time those rules are fully effective. The emissions control technology required for new engines starting this year is available, affordable, and proven to reduce pollution significantly from most of the vehicles on the road today. In order to improve our health, and that of our children, millions of older engines still in use must be retrofitted using the same technology as required for today's new engines.

Retrofitting buses and trucks to reduce diesel particles by up to 90 percent can be as simple as replacing the muffler with a diesel particulate filter (DPF). In fact, the vast majority of highway diesel engines built since 1994 can be retrofit with a DPF.

With the availability now nationwide of ultra-low sulfur diesel (ULSD) fuel, there is no obstacle remaining to cleaning up today's diesel fleet.

- **State and local governments should clean up public fleets and fleets doing public work.**
  The State of New York recently required that every state-owned diesel vehicle and every vehicle used by firms that contract with the State use best available control technology on these vehicles. Cities such as Seattle, Washington, D.C., New York, and Boston have taken a lead, retrofitting much of their transit bus fleets with diesel particulate filters. Several cities, including Chattanooga, Tennessee, have been replacing their older buses with new diesel-electric hybrid or compressed natural gas buses. New York City has also retrofitted most of its fleet of sanitation trucks. Other cities are experimenting with other emissions controls strategies, such as the use of biodiesel fuel in Columbus, Ohio.

New York, Boston and Seattle operate large fleets of new or retrofitted diesel particulate filter-equipped transit buses.



The New York City garbage truck on the left leaves a diesel exhaust plume behind, in comparison to the truck on the right that has been retrofitted with a diesel particulate filter which leaves no measurable plume in its wake. The investment New York has made in DPFs means healthier air quality in and alongside the roadway and in adjacent neighborhoods. To view videos, move pointer over above images to display video controls.

- **States should create diesel cleanup funds.**
  The current cost of retrofitting a highway diesel engine with a diesel particulate filter averages between $5000-7000 per vehicle. It is likely that EPA's new engine rules will result in better economies of scale for the manufacture of diesel particulate filters and thus reduce their cost. States must step up to the plate to provide diesel retrofit funding. States can follow the lead of California (Carl Moyer $140 million per year) and Texas (Texas Emission Reduction Plan or TERP $120 million per year) in creating publicly funded programs to provide the money necessary to retrofit existing dirty diesel fleets.
- **Congress should fully fund federal diesel cleanup programs and states should use the money for diesel retrofits.**
  In 2005, as part of the Energy Bill, Congress passed the Diesel Emission Reduction Act (DERA) authorizing up to $200 million a year for five years to pay for the cost of diesel retrofits. To date, however, Congress has failed to appropriate the money. To clear the air and create a healthier ride for hundreds of millions of commuters stuck in traffic with dirty diesels, Congress should fully fund DERA and state and local governments should prioritize awarding federal money to diesel retrofit projects.

  In addition, the 2005 Transportation Bill (SAFETEA-LU) included $8.6 billion for congestion mitigation and air quality (CMAQ) projects. Congress gave priority to funding diesel retrofits because of their cost-effectiveness. The Federal Highway Administration should recognize this priority in its CMAQ guidance and urge states to target CMAQ funds to diesel retrofits. Ultimately though, it is up to local metropolitan planning organizations and state departments of transportation to award CMAQ monies for diesel retrofits. To date, only a few such projects have been funded.
- **U.S. EPA should adopt an engine rebuild rule requiring long-haul trucks to upgrade their emission controls whenever their engines are rebuilt.**
  Particularly key to healthier commutes will be regulations to clean up interstate long-haul trucks that travel city-to-city and state-to-state. A vast majority of retrofit funding to date has been focused on public fleets such as garbage collection, transit buses and even school buses in part because the source of the funding has been public. Long-haul trucks, however, consume the vast majority of the on-road diesel fuel sold every year and as a result represent most of the diesel pollution annually. They are typically corporately or privately owned. U.S. EPA has the authority under the Clean Air Act to require that trucks upgrade their pollution controls whenever they rebuild their engines. EPA should exercise this authority and equire that existing engines meet today's emission standards.

Installing a catalyzed diesel particulate filter (DPF) is nearly as simple as replacing the muffler. DPFs are extremely effective and remove over 90 percent of diesel exhaust particles. These filters can typically be installed on 1994 and newer vehicles that have electronic engine systems.

- **U.S. EPA should finalize its new engine rules for ferries and locomotives.**
  Retrofitting non-road vehicles is also an important part of the solution. Technologies to clean up locomotives and ferries are still largely under development with the most recent progress being the successful proof-of-concept for implementing oxidation catalyst technology on two-stroke diesel engines. For locomotive and ferry engines, the best practice first includes rebuilding with new internal components or repowering with the newer Tier 2 engines, followed by retrofitting with diesel emission control technology such as an oxidation catalyst. EPA should issue the new Tier 3 and Tier 4 standards in late 2007 and these new technology-forcing standards are expected to drive the implementation of diesel particulate filter (DPF) technology for these applications. This is substantially similar to the technology pathway on-road and off-road diesel engines have followed, but the timelines for rail and marine have lagged behind these other sectors. These emission control technologies also need ultra-low sulfur diesel (ULSD) fuel to perform at their best. For ferries and locomotives this fuel will not be required until 2012. Until then, the results of the CATF study suggest the need to improve coach ventilation systems on trains, have locomotives push passenger trains to the maximum extent feasible, and ban the use of diesel in underground stations and tunnels.

Overall, the best solution to the problem of commuter exposure to diesel exhaust is to clean up the existing diesel fleet with diesel particle filters so that we can all breathe easier. Until then, commuters can help protect themselves by taking clean transit, such as electrified subways and light rail. If you must drive to work, choose commuter routes that are less heavily traveled by trucks. To reduce your exposure when in traffic, our study suggests that you should close your windows and set your ventilation system to recirculate the cabin air. Installing a catalyzed diesel particulate filter (DPF) is nearly as simple as replacing the muffler. DPFs are extremely effective and remove over 90 percent of diesel exhaust particles. These filters can typically be installed on 1994 and newer vehicles that have electronic engine systems.
