Frequently Asked Questions

Near Roadway Air Pollution and Health: Frequently Asked Questions

With more than 45 million people in the United States living, working, or attending school within 300 feet of a major road, airport or railroad there is growing concern about the health impacts of roadway traffic. Below are frequently asked questions EPA receives concerning near roadway air pollution and what EPA is doing to address this important health issue.

What are the concerns associated with living, working, or attending school near major roads?

Air pollutants from cars, trucks and other motor vehicles are found in higher concentrations near major roads. People who live, work or attend school near major roads appear to have an increased incidence and severity of health problems associated with air pollution exposures related to roadway traffic including higher rates of asthma onset and aggravation, cardiovascular disease, impaired lung development in children, pre-term and low-birthweight infants, childhood leukemia, and premature death.

Pollutants directly emitted from cars, trucks and other motor vehicles are found in higher concentrations near major roads. Examples of directly emitted pollutants include particulate matter (PM), carbon monoxide (CO), oxides of nitrogen (NOx), and benzene, though hundreds of chemicals are emitted by motor vehicles. Motor vehicles also emit compounds that lead to the formation of other pollutants in the atmosphere, such as nitrogen dioxide (NO2), which is found in elevated concentrations near major roads, and ozone (O3), which forms further downwind. Beyond vehicles' tailpipe and evaporative emissions, roadway traffic also emits brake and tire debris and can throw road dust into the air. Individually and in combination, many of the pollutants found near roadways have been associated with adverse health effects.

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People who live, work or attend school near major roads appear to have an increased incidence and severity of health problems that may be related to air pollution from roadway traffic. Health effects that have been associated with proximity to roads include asthma onset and aggravation, cardiovascular disease, reduced lung function, impaired lung development in children, pre-term and low-birthweight infants, childhood leukemia, and premature death. Other than air pollution, road noise may also play a role in the health problems associated with roadway exposure.

What is a "major road" and how close to a such a road do you have to live, work or attend school to be considered "near" it?

Research findings indicate that roadways generally influence air quality within a few hundred meters – about 500-600 feet downwind from the vicinity of heavily traveled roadways or along corridors with significant trucking traffic or rail activities. This distance will vary by location and time of day or year, prevailing meteorology, topography, nearby land use, traffic patterns, as well as the individual pollutant.

What influences air quality near major roadways?

The type of vehicles and fuel used, traffic activity, and the wind speed and direction can all have big effects on pollutant levels near major roadways. Generally, the more traffic, the higher the emissions; however, certain activities like congestion, stop-and-go movement or high-speed operations can increase emissions of certain pollutants. The combination of rush hour and calm winds in the morning often leads to the highest concentrations during this time of the day. Emissions can be elevated near major roadways and arise from multiple vehicle-related processes, including tailpipe exhaust, evaporation of fuel, brake and tire wear, and dust kicked up from traffic. Certain wind and terrain conditions, certain times of the day, including rush hours can result in elevated concentrations of air pollution near the road and air pollutants traveling farther from the road. The presence of sound walls, buildings and vegetation also has an impact on pollutant dispersion. Typically, pollutant concentrations decrease with distance away from traffic although the degree of this decrease varies.

- The highest concentrations of roadway pollutants occur on or just downwind of a roadway. With greater distance from a roadway, concentrations generally decrease to background levels within 500-600 feet. Pollutant concentrations tend to be higher when winds blow from the road and wind speeds are low.

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Both heavy-duty trucks and light-duty gasoline vehicles emit a range of pollutants. However, their contributions to different types of compounds are not the same. Per vehicle, heavy-duty diesel trucks can emit more of certain pollutants (e.g., NOx and PM) and contribute disproportionately to the emissions from all motor vehicles. Gasoline-powered passenger cars generally emit more of other pollutants (e.g., CO, and benzene, a volatile organic compound (VOC)).

How many people live or spend time near major roads and other transportation facilities?

EPA estimated that in 2009, more than 45 million people in the United States lived within 300 feet of a highway with 4 or more lanes, a railroad, or an airport, and population trends suggest this number is increasing. Many schools and child care centers are located within a few hundred feet of highways, particularly in urban areas. Furthermore, every day, the average American spends more than an hour in travel, most of which takes place on major roadways

Are some people at greater risk from being close to major roadways or high traffic areas?

Children, older adults, people with preexisting cardiopulmonary disease, and people of low socioeconomic status are among those at higher risk for health impacts from air pollution near roadways.

Some people are known to be at greater risk of experiencing adverse health effects from air pollution, including those with asthma and other respiratory diseases and risk factors for heart attacks and strokes. Children, older adults, people with preexisting cardiopulmonary disease, and people of low socioeconomic status also are among those at higher risk for health impacts from some air pollutants associated with traffic emissions.

There are many factors being studied to better determine personal risk from air pollution generated from traffic. These include a person's current health status and age and the frequency and amount of exposure to air pollutants. EPA scientists and scientists funded through EPA grants continue to study the association between roadway air pollutants and potential health impacts. Studies are examining the role of traffic-related air pollutants on the initiation of asthma and other diseases in children and cardiovascular disease in adults.

What is EPA doing to address near-roadway air pollution?

Over the past three decades the U.S. EPA has worked to reduce harmful roadway-related emissions in a number of important ways. EPA has reduced pollution from new cars and trucks by establishing more stringent emission standards and cleaner fuel requirements. EPA also has a number of programs designed to reduce emissions from in-use vehicles not subject to the newest emission standards. In addition, EPA sets the health-based National Ambient Air Quality Standards (NAAQS) for pollutants that are emitted from on-road mobile sources and has recently required that air quality monitors be placed near high-traffic roadways for determining compliance with the NAAQS for NO2, CO, and PM2.5. Finally, EPA is conducting research to

better understand the phenomenon of near roadway pollution, exposure and adverse health effects, and how to reduce air pollution near these high-traffic areas

EPA has addressed pollution from motor vehicles by establishing more stringent emission and fuel standards to reduce emissions of a variety of pollutants including PM, NOx, CO, and volatile organic compounds (VOC) such as benzene. EPA's standards apply to heavy-duty truck engines, light-duty passenger cars, buses, motorcycles, and other motor vehicles. EPA establishes and maintains standards for fuel quality to enable lower emissions from vehicles.

A new vehicle on the road today has more than 90% lower emissions than a vehicle on the road 30 years ago. Over the next two decades, as new standards phase in, motor vehicle and nonroad engine emissions will continue to decrease substantially. EPA's Office of Transportation and Air Quality (OTAQ) maintains information on national standards (www.epa.gov/otaq).

EPA also has a number of programs designed to reduce emissions from the existing fleet of vehicles that are not subject to the newest emission standards. For example, through the National Clean Diesel Campaign, EPA works with stakeholder coalitions to plan and finance diesel emission reduction programs across the country.

In addition, EPA sets health-based National Ambient Air Quality Standards (NAAQS) for several pollutants that are emitted from on-road mobile sources, including CO, NOx (with NO2 used as the indicator), and PM. Recently, EPA has required that air quality monitors be placed near high-traffic roadways for determining NAAQS compliance for NO2, CO, and PM2.5 in addition to those existing monitors located in neighborhoods and other locations farther away from pollution sources. EPA also works with state and local governments to ensure that Federally-sponsored and approved transportation activities are consistent with state efforts to attain the NAAQS. The Agency also supports state and local efforts to reduce the number of vehicle miles travelled by promoting public transit use, carpooling, active commuting (biking and walking) and other alternatives to commuting (e.g., teleworking).

EPA has a near-roadway research program to investigate emissions, exposures, health impacts and ways to reduce air pollution near major roadways and high traffic areas. EPA and EPA-supported researchers have published numerous articles characterizing near-road air quality, exposures, and health effects, as well as methods of mitigating these impacts. As this research continues, the results will assist federal and state regulators, community and transportation planners, and the public with making sound decisions to protect public health.

Are there other actions that may reduce air pollution concentrations and exposures near major roadways?

There are a number of approaches that appear promising for reducing the air pollution near roadways. In addition to reducing vehicle emissions, other approaches involve the design of transportation projects and designs of buildings and facilities near major roadways. For example, research suggests that sound walls, cut sections, and roadside vegetation can reduce traffic-related air pollutants immediately downwind of a roadway, although the extent of this reduction can

vary by the dimension and type of feature. Research is still underway to quantify the specific impacts these features have in reducing air pollutants near-roadway areas. In addition, design and siting of new buildings, and the use of indoor air filtration, may also be a way to minimize exposures to pollutants while indoors.

Reducing the emissions of each vehicle on the road and the number of vehicle miles driven reduces air pollution. As noted above, EPA has established stringent fuel and emission standards for vehicles and non-road engines, and created other programs to further reduce diesel emissions from existing vehicle fleets.

Changing the design of transportation projects can also affect how and where air quality impacts occur. Research suggests that sound walls can reduce concentrations of traffic-related air pollutants immediately downwind of a roadway, although the extent of this reduction can vary by the wall height, length and distance from the road. Such barriers may also increase concentrations in the air on and immediately over the road as well as locations upwind and near the edges of the structure. For the same level of emissions, pollutant concentrations also are generally lower near cut section roads (roads below grade with steep walls) than near at-grade roads. Roadside vegetation, like trees and large bushes, can also impact air pollution concentrations. Studies suggest that the height, thickness, width, type of species, and continuity of the vegetation are all likely important factors in whether vegetation reduces pollutant concentrations in adjoining areas and communities. All of this research is promising, although further research is needed to be able to quantify the specific impacts of these features on reducing concentrations of traffic-related pollutants.

Building construction and location can also affect pollution exposures for residents. For mechanically-ventilated buildings near large roadways, air filtration devices installed in the ventilation systems can remove pollutants and improve indoor air quality. In addition, new buildings and facilities can be designed and located to minimize the time that at-risk people spend in near-roadway settings. For example, a school site could place maintenance and storage facilities closer to the road, while placing playgrounds, athletic fields, and classrooms as far from the road as possible.

What air pollution exposures occur in vehicles?

In-vehicle air quality is influenced by surrounding vehicles and sometimes emissions from the vehicle itself. Studies generally report higher concentrations of air pollutants in vehicles when following heavy-duty trucks and cars with visible tailpipe emissions. Tailgating and stopping very close to the vehicle in front during a traffic jam or at an intersection can increase air pollution in the following vehicle. A key factor in determining driver and passenger exposure is the vehicle's ventilation. Older diesel-powered buses also can have elevated concentrations of exhaust components inside the cabin.

Air quality in vehicles can be affected by traffic emissions on the roadway, with elevated concentrations inside vehicles of many of the same pollutants found outside the vehicle. Smoking in a vehicle creates concentrations of PM and other pollutants that generally

dominate any other factors. However, in-vehicle air quality is influenced by the surrounding vehicles, particularly in vehicles with no tobacco smoke. Studies generally report higher concentrations of air pollutants in vehicles when following heavy-duty trucks or cars with visible tailpipe emissions. Tailgating and stopping very close to the vehicle in front during a traffic jam can increase air pollution in the following vehicle.

A key factor in determining driver and passenger exposure is the vehicle's ventilation. When windows are open, outdoor air enters the passenger compartment rapidly. When windows are closed, the settings on a vehicle's ventilation system have a larger effect on exposure. When the ventilation is set to bring in air from outside the vehicle, outdoor air enters rapidly. The recirculation setting reduces the turnover of outdoor air into the vehicle. In vehicles equipped with properly functioning cabin air filters, recirculation reduces PM concentrations from the outdoors, although this may not reduce concentrations in vehicles where people are smoking tobacco.

Older diesel-powered buses (including school and public transit buses) also can have elevated concentrations of exhaust components inside the cabin. Emissions from the tailpipe and from blow tubes that ventilate the crankcase can result in higher concentrations of PM and other air pollutants inside the cabin than found outside. As part of the National Clean Diesel Campaign, EPA's Clean School Bus USA provides funding to school districts to retrofit buses with verified emission reduction technologies. For more information see www.epa.gov/cleanschoolbus

What is EPA doing about railyard and port emissions?

EPA has established emission standards that will reduce emissions from each engine, including those for locomotives and marine vessels. Reducing idling also prevents emissions and improves nearby air quality. Features such as walls and vegetation may also reduce concentrations of air pollutants near these facilities, but little direct research exists for these locations.

A number of studies have reported air pollution in elevated concentrations near rail yards and marine ports. In general, diesel engines power the trains, trucks, and large marine vessels that are found in these facilities. Although the body of scientific literature about air quality and health near these locations is not as large as the number of studies done near major roadways, it is clear that pollutant concentrations are influenced by similar factors. For example, concentrations of directly-emitted pollutants are generally found in higher concentrations closer to these facilities than farther away. Higher volumes of trains, boats, and other engines are likely to be associated with higher pollutant concentrations.

EPA has established emission standards for a range of mobile sources found at marine ports or rail yard facilities. For locomotives and marine engines under 30 liters per cylinder, EPA standards are reducing per-engine CO, NOx, VOC, and PM, and sulfur levels in non-road diesel fuel to enable new emission control technologies. The most stringent standards for these engines take effect between 2012 and 2017.

For large ocean-going vessels (marine engines greater than 30 liters per cylinder displacement), EPA has worked closely with the International Maritime Organization (IMO) to establish an Emission Control Area (ECA) extending up to 200 nautical miles from the coasts of U.S., Canadian, and French territories in North America. The ECA requires that ships within it operate on lower sulfur fuel which lowers emissions of NOx, SO2, and PM from ships. EPA has also established new stringent standards to reduce NOx from the largest marine diesel engines, which apply beginning in 2016.

In addition to emission standards, measures to reduce idling also can reduce concentrations near ports and rail yards. For example, shore connection systems (SCS) allow maritime vessels and locomotives to plug into an electric power source rather than using onboard engines while docked at port or stopped in a rail yard. Features such as walls and vegetation may also reduce concentrations of air pollutants near these facilities, but little direct research exists for these locations.

The U.S. EPA is involved in a number of nonregulatory efforts that seek to address railyard and port emissions. For example, the Ports Initiative seeks to partner with ports to reduce climate risks and improve air quality, the SmartWay Program encourages trucks and locomotives to not idle, and provides technical information on the benefits of not idling, and the DERA Program provides funding for clean diesel projects at ports and railyards.

Research Links

What EPA research is being conducted on near-roadway air pollution?

EPA's near-roadway research program is an integrated, multidisciplinary effort to better understand how motor vehicle emissions influence air quality invehicle, near major roads and the health of nearby populations, including those with asthma and cardiovascular disease. The studies have been designed to answer questions about potential health risks and what can be done to reduce exposures both in-vehicle and near roadways to maximize improvements in public health.

EPA's near-roadway research program is an integrated, multidisciplinary effort to better understand how motor vehicle emissions influence air quality near major roads and the health of nearby populations, including those with asthma and cardiovascular disease. The studies are designed to answer questions about potential health risks including:

What kinds of air pollutants near roadways have the most significant impacts on human health?

- What is the full range of potential health effects associated with air pollutants near roadways including consideration of possible impacts on populations living, working, or going to school near roads? How far do air pollutants travel from roadways?

- Who is most at risk for experiencing health effects associated with air pollution near roadways?

- What can be done to reduce exposures near roadways to maximize improvements in public health?
- How can research support the improvement of existing tools and development of new tools for use in transportation and community planning?
- How can research help inform regulatory decisions to improve near-road air quality and reduce occurrences of adverse health effects?

Research includes:

- Health effect studies of human populations in neighborhoods near major roads
- Toxicological and human clinical studies in controlled exposure environments
- Air monitoring studies on and near roadways
- Laboratory studies to measure motor vehicle emissions and simulate roadway conditions
- Computer modeling to understand air quality and the dispersion of pollutants away from the roadway
- Field and laboratory studies on the ways to reduce near-road air pollutants and adverse health effects and
- Impacts of ports, railyards, and airports on nearby air quality and people's exposures.

For more information, see:
www.epa.gov/air-research/research-near-roadway-and-other-near-source-air-pollution

What has been the impact of near-roadway research?

Near-roadway research has led to a number of programs aimed at reducing pollutant concentrations and protecting public health. The research contributed to a body of evidence on the connections between roadway-associated exposures and adverse health effects, which led EPA to develop the requirement for a national near-road air quality monitoring network and supported EPA programs for modeling the near-road air quality impacts of diesel vehicles on transportation projects. In particular, the health studies helped to identify health impacts near roads, the field measurements identified where and how best to monitor these impacts, and the field and laboratory studies suggested ways to potentially model and mitigate these impacts.

Communities have used products of this research to inform decisions on school and other facility placement. For example, research studies were cited in the recent EPA School Siting

Guidelines, which help school districts evaluate potential environmental hazards when identifying new school locations, and identify roadway-related factors and mitigation options that may reduce exposures. For recommendations on addressing near-road air quality in school siting, see section 8 in EPA's School Siting Guidlines:
www.epa.gov/schools/guidelinestools/siting/download.html

This research has also led community planners and developers to consider how people may be exposed to traffic emissions, and what steps may be taken to reduce nearby populations' exposures and health impacts.

Where can I find published research?

- To find specific publications related to near roadway research, enter "roadway" or "road" in the search box on the main page of the Science Inventory at: http://cfpub.epa.gov/si/.

- EPA's near roadway research:
www.epa.gov/air-research/research-near-roadway-and-other-near-source-air-pollution

- EPA also supports near roadway research conducted at other research institutions including the EPA Clean Air Research Centers and the Health Effects Institute (HEI). Information on near roadway research at these institutions can be found at the following sites:

    - Clean Air Research Centers:
    www.epa.gov/air-research/air-climate-and-energy-ace-centers-supporting-air-quality-and-climate-solutions-0
    - Health Effects Institute: www.healtheffects.org/