Vehicle Emissions

Sources of Vehicle Emissions

The power to move a motor vehicle comes from burning fuel in an engine. Pollution from vehicles comes from the by-products of this combustion process. In addition, volatile organic compounds (VOC) escape through fuel evaporation. As vehicle exhaust systems have improved, evaporative emissions have become a larger component of total vehicle VOC emissions.

Exhaust Emissions

The combustion process results in emissions of volatile organic compounds (VOC), oxides of nitrogen (NO_X), particulate matter (PM), and carbon monoxide (CO), which are released from the tailpipe while a vehicle is operating. Exhaust emissions occur during two modes:

Cold Start - Starting and driving a vehicle the first few minutes results in higher emissions because the emissions control equipment has not yet reached its optimal operating temperature.

Running Exhaust Emissions - Pollutants are emitted from the vehicle's tailpipe during driving and idling after the vehicle is warmed up.

Evaporative Emissions

Volatile organic compounds (VOC) also escape into the air through fuel evaporation. With today's efficient exhaust emission controls and gasoline formulations, evaporative losses can account, on hot days, for a majority of the total VOC pollution from current model cars. Evaporative emissions occur in several ways:

Running Losses - The hot engine and exhaust system can vaporize gasoline while the vehicle is running.

Hot soak (Cooling Down) - The engine remains hot for a period of time after the vehicle is turned off, and gasoline evaporation continues when the car is parked while cooling down.

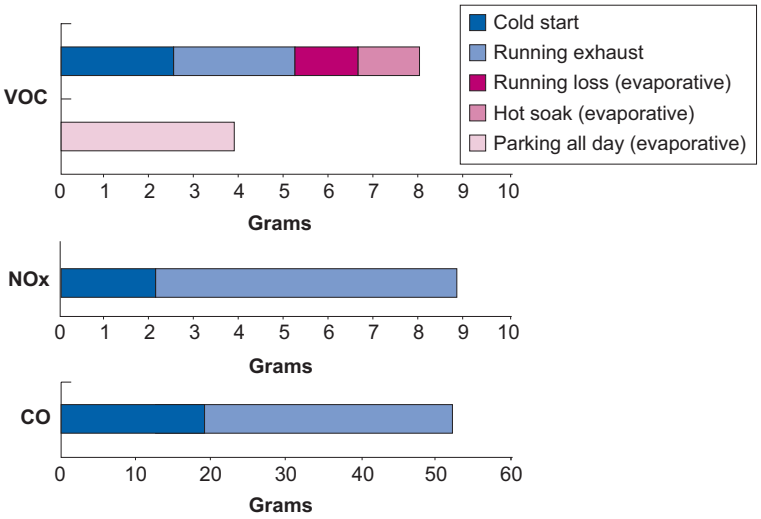
Diurnal Emissions (Emissions while Parked and Engine is Cool) - Even when the vehicle is parked for long periods of time, gasoline evaporation occurs as the temperature rises during the day.

Refueling - Gasoline vapors escape from the vehicle's fuel tank while the tank is being filled.

Source: U.S. EPA. "Automobile Emissions: An Overview." Fact Sheet OMS-5. August 1994.

Trip Emissions

Emissions of a typical car on the road in 1997, for a 5-mile trip



Starting a car cold increases trip emissions compared to starting the car warm. For a 5-mile trip by a typical car in 1997, the vehicle emits about 6.7 grams of NO_X and 32.5 grams of CO if the engine is already warm. If, however, the engine is cold, an additional 2.1 grams of NO_X and 19.7 grams of CO are generated. As a result, for a 5-mile trip, starting the car cold generates about 30% more NO_X and 60% more CO than starting the car when it is warm.

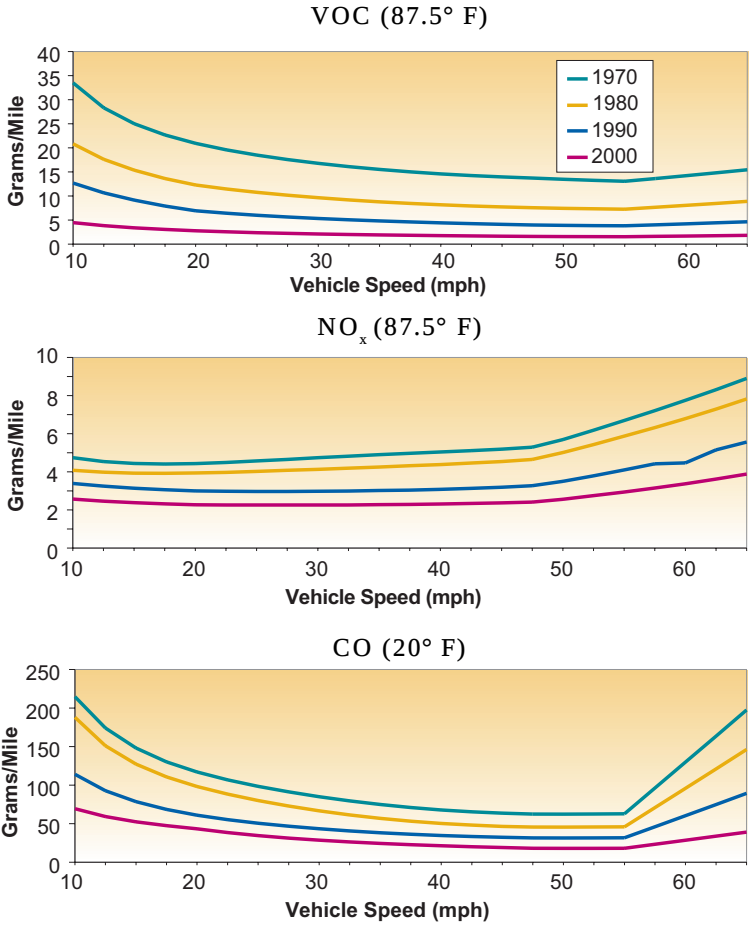
Volatile organic compounds (VOC) are emitted both from the tailpipe and through fuel evaporation. About 2.7 grams of VOC are emitted from the tailpipe if the engine is warm, and evaporative emissions (during travel and while cooling down) result in 2.8 grams of VOC. Starting the car cold generates another 2.5 grams of VOC.

Linking multiple trips—called trip chaining—helps reduce emissions by eliminating the cold start. However, on hot summer days, even when a car is parked all day, VOC evaporates from the vehicle's fuel tank. Approximately 3.8 grams of VOC per day are emitted simply from having the car parked all day.

Source: Estimates developed using MOBILE5a, assuming basic I&M (annual inspections), Summer temperature 62-72 degrees, 32 miles per hour average speed.

Emission Rates at Different Operating Speeds

Emission rates vary based on the speed a vehicle is traveling. The EPA's model for highway vehicle emissions—MOBILE5a—shows how speed affects emission rates. VOC emission rates typically drop as speed increases, whereas NO_x and CO emission rates increase at high speeds. Emission rates at all speeds have been falling over time as newer, more controlled vehicles enter the fleet.

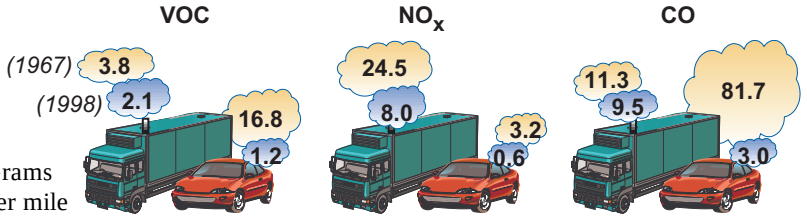


These curves do not represent the full range of effects associated with travel at different speeds. Emission rates are higher during stop-and-go, congested traffic conditions than at free flow conditions operating at the same average speed. Modeling improvements are underway to capture these effects.

Source: Estimates developed using MOBILE5a, fleet average, low altitude.

Car and Truck Emissions

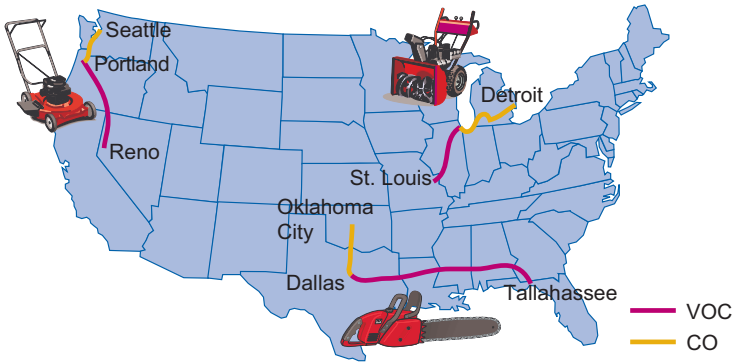
These comparisons show in-use emission rates for cars and heavy-duty diesel trucks with 1998 control technology versus 1967 vehicles (before significant control). Car emission rates have declined by 80 – 95% depending on the pollutant, while diesel truck emission rates have declined by 10 – 60%.



Source: U.S. EPA. *AP-42: Compilation of Air Pollutant Emission Factors.* Tables 1.1.IIA, B, C and Tables 1.7.IIA, B, C.

Car and Yard Tool Emissions

The map below shows the number of miles a typical 1998 car would have to drive to generate the same amount of emissions as one hour of tool use (pre-control lawnmower, snowblower, and chainsaw.)

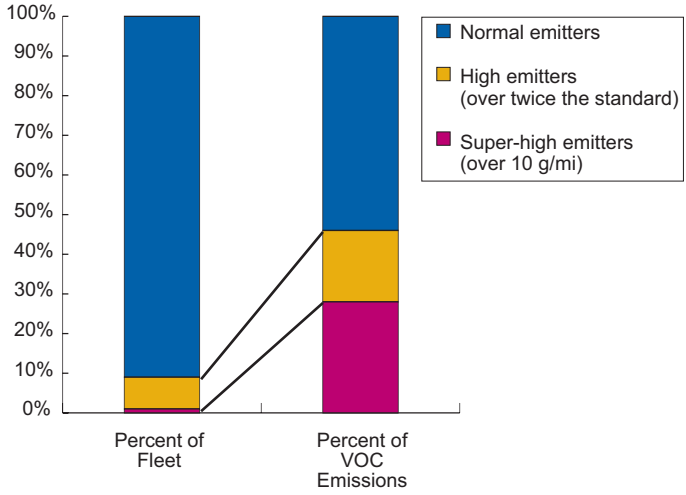


For example, using a chainsaw for 1 hour emits the same amount of VOC as driving 660 miles. To emit the same amount of CO as using a snowblower for 1 hour, one would have to drive 305 miles. Because non-road engines are a significant source of pollution, EPA has promulgated new regulations aimed at these types of engines.

Sources: U.S. EPA. *Nonroad Engine and Vehicle Emission Study-Report.* November 1991. Table 2-07 (yard tools). U.S. EPA. "Emission Facts." Fact Sheet OMS. 1998 (car).

Vehicle Emissions

Gross Emitters



A small percentage of vehicles emit a large percentage of the pollution from on-road vehicles. These "gross emitters" include not only older model vehicles but also some newer cars with poorly maintained or malfunctioning emissions control equipment. As shown in the diagram, EPA estimates that less than 10 percent of the vehicle fleet emits over 40 percent of hydrocarbon pollution. The "dirtiest" one percent of vehicles contribute over 25 percent of the hydrocarbon pollution.

Source: U.S. EPA, "Automobiles and Ozone." Fact Sheet OMS-4. January 1993.