



Friday, December 5, 1952, began as an average winter's day in London, clear and cold. It had been unusually cold for the previous week, so many households shoveled more coal into the furnace. Most of England's supply of hard, anthracite coal was sold for export to pay off the country's war debt, leaving people in London to burn the softer, high-sulphur, bituminous variety.

During the night, a mass of cold air had moved over the city, creating an inversion and trapping warm air plus all the smoke from homes, factories, and traffic at the surface. By mid-day East Londoners could not see their feet. For five days banks of dense yellow fog smothered London. Cars, trains, and buses stopped running. Businesses, restaurants, and theaters closed, trapping people in their homes, but the choking cloud even seeped under doorways.

Thousands of people were treated at hospitals for respiratory problems. Official estimates at the time put the number of fatalities at 4,000—more civilian casualties than any single incident during the war. Recent research, however, suggests that what became known as the "Great Smog" may have caused as many as 12,000 deaths.

London had a long history of these so-called "pea-soupers." The legendary London fog was not fog at all, but choking smog, mostly particulate pollution from coal fires. The Great Smog of 1952, however, was the worst ever, and it was a turning point. It led to a major cleanup of city air quality and the passage of a revolutionary clean-air law in 1956, seven years before the U.S. Clean Air Act.

The new law banned the burning of polluting fuels in "smoke control areas" across the United Kingdom. The results were dramatic: a hundred-fold decrease in atmospheric particulate levels. Public health was vastly improved; flora and fauna that had all but vanished from urban places by the 1950s began to flourish; and the grand architecture of Britain's cities was no longer obscured beneath a thick layer of soot and grime.

London now has an expanding public transportation network. The first section of Crossrail, a 118-kilometre (73-mile) railway line linking London and Berkshire, Buckinghamshire, and Essex counties, will open in 2018; there is a thriving bike share program; and drivers must pay a congestion charge of £11.50 (\$15) to drive into the city. Yet, while pea-soupers are a thing of the past, pollution persists.

Some of London's air-quality problems are an unintended consequence of efforts to fight climate change. In 1998, European car makers committed to reducing CO<sub>2</sub> emissions by 25 percent, and as a result, the European car fleet switched from largely gasoline to predominant diesel, because diesel emits less carbon dioxide. Diesel, however, produces significant amounts of both particulates and NO<sub>2</sub>—enough to swamp London's pollution-reduction efforts even as CO<sub>2</sub> emissions fall.

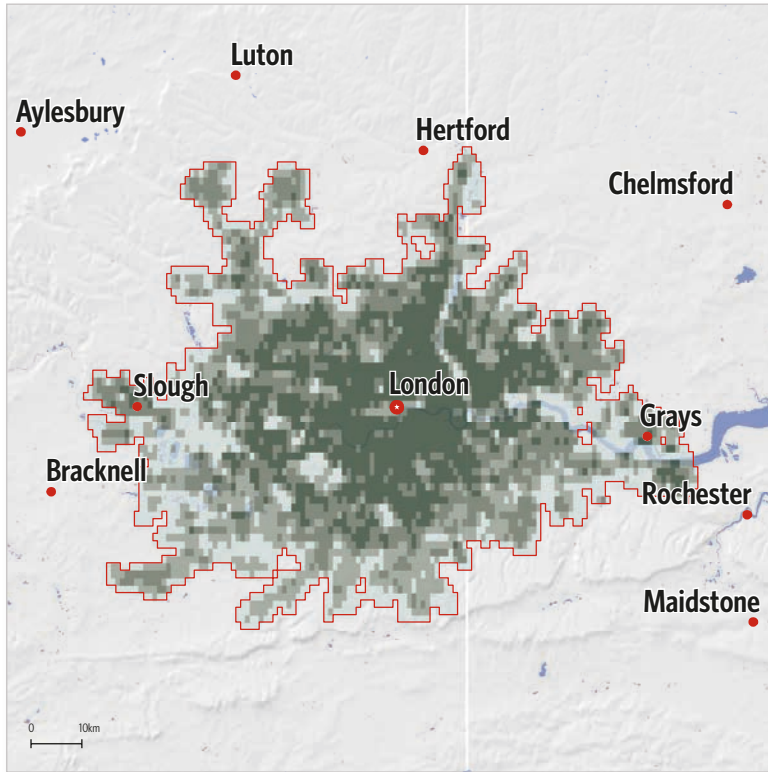
In 2014, the government agency, Public Health England, said that PM<sub>2.5</sub> probably killed more than 3,000 people in London in 2010. That was down from previous studies, but still worrisome.

Nitrogen dioxide is an even bigger problem, with levels in London that are among the highest anywhere in the world.

The 2014 statistics suggest that London and southeast England have by far the worst air in Britain, largely due to traffic levels. In London, in addition to death attributable to particulate pollution, more than 40,000 "life years" were lost in 2010. In southeast England, more than 4,000 people died and almost 42,000 years were lost.

London has moderate median ROI for tree planting, relative to other cities internationally. The neighborhoods with the highest ROI are in the center portion of the city, which is relatively higher density. For an additional annual investment of \$18 million in street tree planting, we estimate that 1.5 million people could have a  $> 1 \mu\text{g}/\text{m}^3$  reduction in PM.

## Results from the London study



Map 20. Neighborhood-level ROI for London (PM reduction).

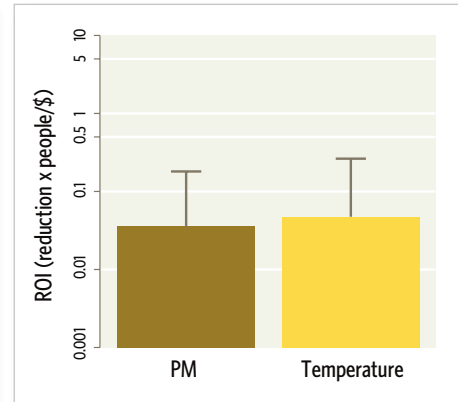


Figure 25. ROI for tree planting for London.

Investment	Annual Cost (\$)	$> 1 \mu\text{g}/\text{m}^2 \text{PM}_{2.5}$	1.5 deg C
10% of sites	1.77E+7	1,570,000	2,440,000
20% of sites	3.52E+7	2,870,000	3,910,000
Full Investment	1.52E+8	5,840,000	7,260,000

Table 13. Temperature and PM reduction benefits under three investment scenarios for London.

London is planning other aggressive steps to improve its air quality. In addition to the congestion charge, London has a Low Emissions Zone, which charges trucks and buses that do not meet EU emission standards for particulates a fee of up to £200 (\$280) per day. An even stricter Ultra Low Emissions Zone is planned for 2020 that would require all vehicles, including cars and motorcycles, to meet the emissions standards or pay the £200 fee. By 2018, new models of London’s iconic black cabs will have to be electric, the first time any city has proposed to develop a zero-emissions cab fleet. The first fully electric double-decker bus hit the streets in the fall of 2015.