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Summary: Diesel Particulate Matter Health Impacts

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Type Information

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Diesel engines emit a complex mixture of pollutants, including very small carbon particles, or "soot" coated with numerous organic compounds, known as diesel particulate matter (PM). Diesel exhaust also contains more than 40 cancer-causing substances, most of which are readily adsorbed onto the soot particles. In 1998, California identified diesel PM as a toxic air contaminant (TAC) based on its potential to cause cancer. Other agencies, such as the National Toxicology Program, the U.S. Environmental Protection Agency and the National Institute of Occupational Safety and Health, concluded that exposure to diesel exhaust likely causes cancer. The most recent assessment (2012) came from the World Health Organization's International Agency for Research on Cancer (IARC). IARC's extensive literature review led to the conclusion that diesel engine exhaust is "carcinogenic to humans," thereby substantiating and further strengthening California's earlier TAC determination.

Diesel engine emissions are believed to be responsible for about 70% of California's estimated known cancer risk attributable to toxic air contaminants. ^[1] Also, diesel PM comprises about 8% of outdoor fine particulate matter (PM_{2.5}), which is a known health hazard. As a significant fraction of PM_{2.5}, diesel PM contributes to numerous health impacts that



have been attributed to particulate matter exposure, including increased hospital admissions, particularly for heart disease, but also for respiratory illnesses, and even premature death.^[2] ARB estimates that diesel PM contributes to approximately 1,400 (95% confidence interval: 1,100-1,800) premature deaths from cardiovascular disease annually in California.^[3] Additionally, exposure to diesel exhaust may contribute to the onset of new allergies; a clinical study of human subjects has shown that diesel exhaust particles, in combination with potential allergens, may actually be able to produce new allergies that did not exist previously.

Several factors exacerbate the health risks of diesel PM exposure:

- Diesel PM is often emitted close to people so high exposures occur
- Diesel PM is in a size range that readily deposits in the lung
- Diesel PM contains compounds known to damage DNA and cause cancer

Additionally, diesel PM pollution can affect the environment:

- Diesel PM causes visibility reduction
- Diesel black carbon (soot) is a potent contributor to global warming

Assessments of Diesel Exhaust Health Impacts

Agency	Date	Summary of Findings
The National Institute for Occupational Health and Safety (NIOSH)	1988	<ul style="list-style-type: none"> • Animal evidence “confirmatory” for carcinogenesis • Human evidence “limited” • Diesel exhaust classified as “potential occupational carcinogen”



Agency	Date	Summary of Findings
International Agency for Research on Cancer (IARC)	1989	<ul style="list-style-type: none">• Rat data “sufficient” for carcinogenicity• Human epidemiology data “limited”• Diesel exhaust considered a “probable” human carcinogen
World Health Organization (WHO)	1996	<ul style="list-style-type: none">• Rat data support carcinogenicity• Human epidemiology data suggest “probably carcinogenic”• Epidemiology studies considered “inadequate for a quantitative estimate of human risk”
California Environmental Protection Agency	1998	<ul style="list-style-type: none">• Rat data “have demonstrated” carcinogenicity of diesel exhaust particles• Causal association of diesel exhaust and lung cancer in epidemiology studies is a “reasonable and likely explanation”• Designated diesel particulate matter a “toxic air contaminant”
National Toxicology Program (NTP)	2000	<ul style="list-style-type: none">• Diesel exhaust particulates listed as “reasonably anticipated to be a human carcinogen” based on findings of elevated lung cancer in occupational groups exposed to diesel exhaust and supporting animal and mechanistic studies



Agency	Date	Summary of Findings
U.S. Environmental Protection Agency (EPA)	2002	<ul style="list-style-type: none"> • Diesel emissions considered “likely to be carcinogenic to humans” • Strong but less than sufficient epidemiologic evidence • Evidence of carcinogenicity of diesel exhaust particles in rats and mice by non-inhalation routes of exposure • Extensive supportive data including the demonstrated mutagenic and/or chromosomal effects of diesel exhaust and its organic constituents
U.S. Environmental Protection Agency (EPA)	2009	<ul style="list-style-type: none"> • Although not diesel-specific, the relationship between particulate matter (such as diesel PM) and premature mortality was determined to be causal
National Toxicology Program (NTP)	2011	<ul style="list-style-type: none"> • Diesel exhaust particulates listed as “reasonably anticipated to be a human carcinogen, based on limited evidence of carcinogenicity from studies in humans and supporting evidence from studies in experimental animals and mechanistic studies”
International Agency for Research on Cancer (IARC; part of the World Health Organization (WHO))	2012	<ul style="list-style-type: none"> • Diesel engine exhaust classified as “carcinogenic to humans” • “Sufficient evidence” in humans for diesel exhaust as a cause of lung cancer • “Limited evidence” for increased risk of bladder cancer



1. Based on estimated ambient statewide diesel PM levels in 2012, the current cancer risk is estimated to be 520 new cases of cancer projected to occur per million residents exposed. This estimate was calculated using a unit risk factor of $8.94 \times 10^{-4} \mu\text{g}/\text{m}^3$ derived using methodology developed by the California Office of Environmental Health Hazard Assessment and assumes an ambient diesel PM concentration of $0.58 \mu\text{g}/\text{m}^3$. Derivation of both of these values are summarized in Proper et al. 2015. *Environmental Science & Technology* **49**(19):11329–11339.
2. A more extensive list of health impacts associated with particulate matter exposure was released in 2009 by the U.S. Environmental Protection Agency
3. Based on 2009 to 2011 exposure

RELATED RESOURCES

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**SNAPS Lost Hills Newsletter -
October 2020**

**Regulation for Limiting Ozone
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