Cancer Risk from Diesel Particulate:

National and Metropolitan Area Estimates for the United States

Prepared by the

State and Territorial Air Pollution Program Administrators

and the

Association of Local Air Pollution Control Officials

March 15, 2000

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Executive Summary

Diesel engines are significant contributors to air pollution. Moreover, the adverse health impacts of diesel pollution are dire, posing a serious threat to public health nationwide, and especially in urban areas. The hazardous mixture that comprises diesel exhaust contains hundreds of different chemical compounds that wreck havoc on our air quality in a variety of ways, playing a role in ozone formation, particulate matter, regional haze, acid rain and global warming. But perhaps the greatest threat posed by diesels comes from their toxic emissions. Diesel exhaust contains over 40 chemicals that are listed by EPA and California as toxic air contaminants, known human carcinogens, probable human carcinogens, reproductive toxicants or endocrine disrupters. In 1998, California declared particulate emissions from diesel-fueled engines a toxic air contaminant, based on data that supported links between diesel exposure and cancer. Dozens of other studies, including EPA's own draft health assessment document for diesel emissions, have also demonstrated a link between diesel exhaust and cancer.

Last fall, the South Coast Air Quality Management District (SCAQMD) in Los Angeles, California released a draft final report, the *Multiple Air Toxics Exposure Study in the South Coast Air Basin* (MATES-II), which included an analysis of the cancer risk in the region from exposure to diesel particulate. Based on this analysis – which estimated diesel particulate levels by using elemental carbon as a surrogate and applied a cancer potency factor determined by the state of California – SCAQMD concluded not only that mobile sources were responsible for approximately 90 percent of the cancer risk in the area, but that 70 percent of the total cancer risk was attributable to diesel particulate.

Alarmed by these findings, the State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) sought to extend the evaluation of cancer risk from diesel particulate to other cities across the country and to estimate how many cancers nationwide are the result of exposure to diesel particulate. STAPPA and ALAPCO's findings are no less frightening: the filthy soot spewed by diesel engines is responsible for a shocking 125,000 cancers in the United States. This is not only cause for tremendous concern, but reason for swift and certain federal action.

The U.S. Environmental Protection Agency (EPA) is currently preparing a proposal, for release this spring, for more stringent emission standards for onroad heavy-duty diesel vehicles and substantial cuts in levels of sulfur in diesel fuel used in onroad

applications. In addition, the agency is contemplating its course of action for emission and fuel quality standards for nonroad heavy-duty diesel engines, such as construction and agricultural equipment. The magnitude of the cancer threat from diesel particulate seals the overwhelmingly compelling case for aggressive and timely action by EPA for onroad and nonroad diesel engines and their fuels. To this end, STAPPA and ALAPCO strongly urge that EPA:

- Set more stringent nitrogen oxide (NO_x) and particulate matter (PM) emission standards for onroad heavy-duty engines – NO_x standards no less stringent than 0.2 grams per brake-horsepower hour (g/bhp-hr) and PM standards no less stringent than 0.01 g/bhp-hr, based on the most advanced technologies possible. Both of these standards should apply to 100 percent of the fleet in the 2007 model year;

- Set more stringent emission standards for nonroad heavy-duty diesel engines, equivalent to those for onroad heavy-duty diesels and in the same timeframe;

- Sharply reduce sulfur in diesel fuel used in onroad and nonroad diesel engines to ultra-low levels, to take effect in mid-2006, with an interim nationwide sulfur cap of no higher than 30 ppm, to take effect by 2004; and

- Ensure that all heavy-duty diesel engines – onroad and nonroad – operate as cleanly in-use as they are supposed to.

The fact is that tens of thousands of cancers, not to mention a host of other public health and environmental hazards, can be avoided if EPA implements these recommendations. Because states and localities have limited authority under the Clean Air Act to tackle this perilous source of air pollution, it is entirely up to EPA to exercise federal leadership to address this critical national issue.

About STAPPA and ALAPCO

STAPPA and ALAPCO are the national associations of state and local air quality control officers in the states and territories and over 165 metropolitan areas across the country. The members of STAPPA and ALAPCO have primary responsibility for implementing our nation's air pollution control laws and regulations. Both associations serve to encourage the interchange of information and experience among air pollution control officials; enhance communication and cooperation among federal, state and local regulatory agencies; and promote air pollution control activities. STAPPA and ALAPCO have joint headquarters in Washington, DC.

For further information, contact STAPPA and ALAPCO at 444 North Capitol Street, NW, Suite 307, Washington, DC 20001; telephone: (202) 624-7864; e-mail: 4clnair@sso.org; or website: www.4cleanair.org.

Cancer Risk from Diesel Particulate

National Totals

	Estimated Cancers
Metropolitan Areas	119,570
Non-metropolitan Areas	5,540
United States Total	**125,110**

Cancer Risk from Diesel Particulate: Estimates for 50 Largest Metropolitan Areas

Metropolitan Area	Cancers
Atlanta	1,930
Austin	570
Boston	2,900
Buffalo	595
Charlotte	710
Chicago	4,535
Cincinnati	1,005
Cleveland	1,500
Columbus	755
Dallas/Fort Worth	2,470
Denver	1,220
Detroit	2,810
Grand Rapids	535
Greensboro/Winston-Salem	600
Hartford	590
Houston	2,270
Indianapolis	780
Jacksonville, FL	540
Kansas City	895
Las Vegas	680
Los Angeles	16,250
Louisville	515
Memphis	565
Miami/Fort Lauderdale	1,880
Milwaukee	845
Minneapolis	1,460
Nashville	595
New Orleans	675
New York	10,360
Norfolk	795
Oklahoma City	535
Orlando	775
Philadelphia	3,085
Phoenix	1,510
Pittsburgh	1,210
Portland, OR	1,105
Providence	580
Raleigh	555
Richmond	495
Rochester	555
Sacramento	870
Salt Lake City	655
San Antonio	790
San Diego	1,430
San Francisco	3,510
Seattle	1,765
St. Louis	1,320
Tampa	1,160
Washington/Baltimore	3,750
West Palm Beach	530

Methodology for Estimating Cancer Risk from Diesel Particulate[1]

Estimating Diesel Particulate Concentrations

There is no method for measuring diesel particulate directly. However, diesel particulate concentrations can be estimated using concentrations of elemental carbon, as per research conducted by H.A. Gray[2] and used by the California Air Resources Board.[3] Therefore, elemental carbon can serve as a surrogate for diesel particulate. According to the research mentioned above, approximately 67 percent of the final elemental carbon mass in the atmosphere in Los Angeles came from diesel engine emissions. Of all diesel exhaust particles emitted, elemental carbon averaged approximately 64 percent of the total. Therefore, elemental carbon concentrations are multiplied by 1.04 (1.04 is derived from dividing 67 percent by 64 percent) to arrive at the diesel particulate concentrations.

Estimating Cancer Risk

The California Environmental Protection Agency (CalEPA) recommends using a cancer risk level for diesel particulate of 300 in a million per microgram per cubic meter (ug/m^3) of diesel particulate (3.0×10^{-4} per ug/m^3). This represents the risk of developing cancer over a 70-year lifetime. In deriving this figure, CalEPA considered evidence suggesting that diesel risks are from 150 in a million to 1,500 in a million per ug/m^3. The choice of 300 in a million per ug/m^3 represents a conservative estimate.

To arrive at cancer risk estimates using information about concentrations of elemental carbon, the following formula is used:

Elemental carbon concentration x 1.04 = diesel particulate concentration.

Diesel particulate concentration x 3.0×10^{-4} (or 3/10000) per ug/m^3 = cancer risk estimate.

Development of National and Metropolitan Area Estimates

To develop cancer estimates for the entire country, it is necessary to estimate levels of elemental carbon. The average level of elemental carbon in the Los Angeles, CA area is 3.3 ug/m^3. Based on monitoring data for levels of elemental carbon in several areas around the country, it was assumed that the levels of elemental carbon in metropolitan areas in the United States are one-half of the Los Angeles area average (1.65 ug/m^3) and levels in non-metropolitan areas are one-tenth of the Los Angeles average (.33 ug/m^3).

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[1] Based upon methodology used in the South Coast Air Quality Management District's Multiple Air Toxics Exposure Study (MATES-II) Draft Report, November 5, 1999.

[2] Gray, H.A. 1986. Control of Atmospheric Fine Primary Carbon Particle Concentrations. EQL Report No. 23, Environmental Quality Laboratory, California Institute of Technology, Pasadena, CA.

[3] ARB. 1998 Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant. Part A, Exposure Assessment. California Environmental Protection Agency, Air Resources Board.

The population of the United States[4] is divided into residents of metropolitan areas[5] (80 percent of the population) and residents of non-metropolitan areas (20 percent). The metropolitan population total (~216.5 million) was multiplied by the appropriate formula (1.65 ug/m^3 x 1.04 x $3x10^{-4}$ per ug/m^3) and then the result was adjusted upward to account for the higher levels of diesel particulate in the Los Angeles CMSA. These calculations resulted in the estimated cancer risks for metropolitan-area residents. The non-metropolitan population total (~53.8 million) was multiplied by the appropriate formula (.33 ug/m^3 x 1.04 x $3x10^{-4}$ per ug/m^3) to arrive at the estimated cancer risks for non-metropolitan-area residents.

To estimate the cancer risk for each of the individual metropolitan areas, the population of each location was multiplied by the formula for metropolitan areas (1.65 ug/m^3 x 1.04 x $3x10^{-4}$ per ug/m^3).

[4] Population figures throughout this study are based on U.S. Census Bureau estimates.
[5] "Metropolitan Areas" include Consolidated Metropolitan Statistical Areas and Metropolitan Statistical Areas.