

Science *(and Engineering!)* in Action:
Industry's and HEI's Effective Partnership

John Wall

Cummins Vice President – Chief Technical Officer *(Retired)*

Health Effects Institute Annual Conference

April 30, 2023

Excerpt from IARC Press Release June 2012 following the diesel carcinogenicity study:

Increasing environmental concerns over the past two decades have resulted in regulatory action in North America, Europe and elsewhere with successively tighter emission standards for both diesel and gasoline engines. ***There is a strong interplay between standards and technology – standards drive technology and new technology enables more stringent standards.*** For diesel engines, this required changes in the fuel such as marked decreases in sulfur content, changes in engine design to burn diesel fuel more efficiently and reductions in emissions through exhaust control technology. However, while the amount of particulates and chemicals are reduced with these changes, it is not yet clear how the quantitative and qualitative changes may translate into altered health effects; research into this question is needed.

Inception of HEI, ca 1980

- Henry Schacht, CEO Cummins – “Facts are friendly!”
- Sought objective and trusted sources of diesel health effects data to inform policy decisions
- Proposed an independent agency, half funded by government and industry, to define, vet and support health effects research to inform all interested and affected parties

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A Case-Control Study of Lung Cancer and Diesel Exhaust Exposure in Railroad Workers

Eric Garshick , Marc B. Schenker , Alvaro Muñoz , Mark Segal , Thomas J. Smith , Susan R. Woskie , S. Katharine Hammond , and Frank E. Speizer

<https://doi.org/10.1164/arrd.1987.135.6.1242> PubMed: [3592400](#)

[Abstract](#)

[Cited by](#)

[PDF](#)

A case-control study of deaths among U.S. railroad workers was conducted to test the hypothesis that lung cancer is associated with exposure to diesel exhaust. Employed and retired male workers with ≥ 10 yr of service who were born on or after January 1, 1900 and who died between March 1, 1981 and February 28, 1982 were eligible. We collected 87% of the death certificates from 15,059 deaths reported to the U.S. Railroad Retirement Board (RRB). Cases of lung cancer (1,256) were matched to controls by age (± 2.5 yr) and date of death (± 31 days). Potential exposure to diesel exhaust was assigned based on an industrial hygiene evaluation of jobs and work areas. Each subject's work history was determined from a yearly job report filed by his employer with the RRB from 1959 until death or retirement. Asbestos exposure prior to 1959 was categorized by the job held in 1959, the end of the steam locomotive era, or by the last job held if retirement occurred before 1959. Smoking histories were obtained by questionnaire from next of kin. Using multiple conditional logistic regression analysis to adjust for smoking and asbestos exposure, workers 64 yr of age or younger at the time of death with work in a diesel exhaust exposed job for 20 yr had a significantly increased relative odds (odds ratio = 1.41, 95% CI = 1.06, 1.88) of lung cancer. No effect of diesel exhaust exposure was seen in workers 65 yr of age or older because many of these men retired shortly after the transition to diesel-powered locomotives. This study supports the hypothesis that occupational exposure to diesel exhaust increases lung cancer risk.

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It's important ... and relatively subtle

Predictive Models for Disposition of Inhaled Diesel Exhaust Particles in Humans and Laboratory Species

CP Yu, GB Xu

How is it distributed in the lungs?

Research Report 10,
1987

Dr. Yu's project addressed several important issues regarding improved quantification of dose from known concentrations of atmospheric particulate matter. By focusing first on a specific category of automotive-derived particles, diesel exhaust particulate, Dr. Yu was able to characterize those aerosol properties (such as the mass median aerodynamic diameter and size distribution) that influence regional deposition. After formulating a mathematical deposition model, Dr. Yu calculated and compared the deposition of inhaled diesel exhaust particulate in laboratory animals and in humans of different ages.



Research Report 10, including the Report of the HEI Review Committee

1.08
MB

Topics: *Diesel Exhaust, Biological Methods*

An Investigation into the Effect of a Ceramic Particle Trap on the Chemical Mutagens in Diesel Exhaust

Research Report 5

Susan T Bagley, et al.

1987

Topics: Diesel Exhaust

Dr. Bagley and colleagues at Michigan Technical University examined the chemical mutagenic effects of a ceramic particle trap on a medium-duty diesel engine. Diesel exhaust particles and vapor phase samples were collected from diluted (15:1) exhaust of a 10.4L displacement Caterpillar 3208 engine. The investigators compared uncontrolled (baseline) emissions with exhaust that had been modified by the use of an uncatalyzed monolithic ceramic trap.

[Read more >](#)

"IMPACTS OF DIESEL EMISSIONS CONTROL"

Presented to the Fourth
Health Effects Institute

Annual Conference

February 10, 1987

by

Dr. John C. Wall

Director-Emissions Research

Cummins Engine Company

HEI was building a body of evidence of health effects associated with mutagenicity and possibly carcinogenicity of diesel exhaust exposure in the late 1980s.

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1990 EPA and CARB rulemaking for 1994 HDD engines:

→ First significant reduction in diesel PM from 0.6 to 0.10 g/bhp-hr ... and first step in reducing fuel sulfur 5000 ppm → 500 ppm

→ NO_x to 5.0 g/bhp-hr in 1994 and then 4.0 g/bhp-hr in 1998.

1993 Review -- Criticism of HEI

“... lack of relevance and timeliness in its research products and poor relationships with its sponsors”

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→ *Dan Greenbaum ... 1994*

→ ***Dan Greenbaum***

- *HEI*

→ ***Dan Greenbaum***

- *HEI*
- *NAS*
- *ICCT*

→ *Dan Greenbaum*

- *HEI*
- *NAS*
- *ICCT*
- *MIT '73*

→ *Dan Greenbaum*

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Diesel Exhaust:

A Critical Analysis of Emissions, Exposure, and Health Effects

**A Special Report of the Institute's
Diesel Working Group**

Health Effects Institute

April 1995

The logo for the Health Effects Institute (HEI), consisting of the letters 'HEI' in a bold, serif font.

2000 EPA Heavy Duty Diesel Emissions Rule

- 2007 PM → 0.01 g/bhp-hr
- 2007 Fuel sulfur → 15 ppm
- 2010 NO_x → 0.20 g/bhp-hr

Reductions from unregulated diesel emissions:

- PM -99%
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2007



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M
IARC MONOGRAPHS



**DIESEL AND GASOLINE ENGINE
EXHAUSTS AND SOME NITROARENES**

VOLUME 105

IARC MONOGRAPHS
ON THE EVALUATION
OF CARCINOGENIC RISKS
TO HUMANS

International Agency for Research on Cancer



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→ ACES


Greenbaum Testifies on “Producing Credible Science for Decisions”

In February, HEI President Dan Greenbaum testified in Washington, D.C., before the Subcommittee on Energy and the Environment of the U.S. House Committee on Science, Space, and Technology. The purpose of the hearing was to air perspectives on the quality of scientific research that the U.S. Environmental Protection Agency (EPA) uses to inform regulatory policy and to invite suggestions for improvement in the agency’s research efforts. Greenbaum, who was invited by both parties, highlighted several of the guiding principles of HEI — which receives balanced funding from the EPA and industry — such as engaging independent, objective scientists, subjecting all research results to intense peer review, and conducting and reporting science with full transparency. “From its inception HEI has sought to produce its work with the widest degree of disclosure of results and underlying data,” Greenbaum said, addressing an issue emphasized by other witnesses. “This is critical to ensuring that all results — both positive and negative — are reported, and that the broader science community can fully access, and further analyze, the results and data.” 



Greenbaum at the congressional subcommittee hearing on February 3.

PHOTO BY JAY MALLIN

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All new trucks and buses must comply with the latest (2010) EPA emissions standards for heavy-duty diesel engines. Pictured is a 2010 Freightliner Cascadia.

PHOTO COURTESY OF DAIMLER TRUCKS NORTH AMERICA LLC

New HEI Health Effects Study of Modern Diesel Engine Emissions

HEI will release in mid-April the first results of health effects testing from exposure of animals to emissions from a modern diesel engine, as part of its Advanced Collaborative Emissions Study (ACES). Investigators at the Lovelace Respiratory Research Institute in Albuquerque, New Mexico, are exposing mice and rats 16 hours each day, 5 days a week, to diluted emissions from a 2007-model heavy-duty engine equipped with a diesel particle filter. HEI-sponsored work has previously shown that emissions from such engines contain very low levels of diesel particles and other pollutants. Emissions from older diesel engines have been evaluated by HEI and others in similar studies in the past, but this is the first, and so far only, study to focus on emissions from new engines now on the market, which comply with stringent emission regulations now in force.

Continued on page 5



HEALTH
EFFECTS
INSTITUTE

Number 184
January 2015

RESEARCH REPORT

Advanced Collaborative Emissions Study (ACES): Lifetime Cancer and Non-Cancer Assessment in Rats Exposed to New-Technology Diesel Exhaust

Part 1. Assessment of Carcinogenicity and Biologic Responses in Rats After Lifetime Inhalation of New-Technology Diesel Exhaust in the ACES Bioassay
Jacob D. McDonald et al.

Part 2. Assessment of Micronucleus Formation in Rats After Chronic Exposure to New-Technology Diesel Exhaust in the ACES Bioassay
Jeffrey C. Bemis et al.

Part 3. Assessment of Genotoxicity and Oxidative Damage in Rats After Chronic Exposure to New-Technology Diesel Exhaust in the ACES Bioassay
Lance M. Hallberg et al.

Part 4. Assessment of Plasma Markers and Cardiovascular Responses in Rats After Chronic Exposure to New-Technology Diesel Exhaust in the ACES Bioassay
Daniel J. Conklin and Maiying Kong



Includes a Commentary by the Institute's ACES Review Panel

Overall, these results indicate that rats exposed to one of three levels of NTDE from a 2007-compliant engine for up to 30 months, for 16 hours per day, 5 days a week, with use of a strenuous operating cycle that more accurately reflected the real-world operation of a modern engine than cycles used in previous studies, showed few exposure-related biologic effects. In contrast to the findings in rats chronically exposed to TDE, there was no induction of tumors or pre-cancerous changes in the lung and no increase in tumors that were considered to be related to NTDE in any other tissue. The effects that were observed with NTDE were limited to the respiratory tract and were mild and generally seen only at the highest exposure level. The histologic changes in the lungs were consistent with previous findings in rats after long-term exposure to NO₂ — a major component of the exposure atmosphere, which is being substantially further reduced in 2010-compliant engines.

So ... are we done?

So ... are we done?

NO!

- EJ + EJ

- Environmental Justice

+

- Economic Justice

- EJ + EJ

- Environmental Justice

+

- Economic Justice

*(for the small/individual
vehicle operators who can't
afford more)*

- EJ + EJ

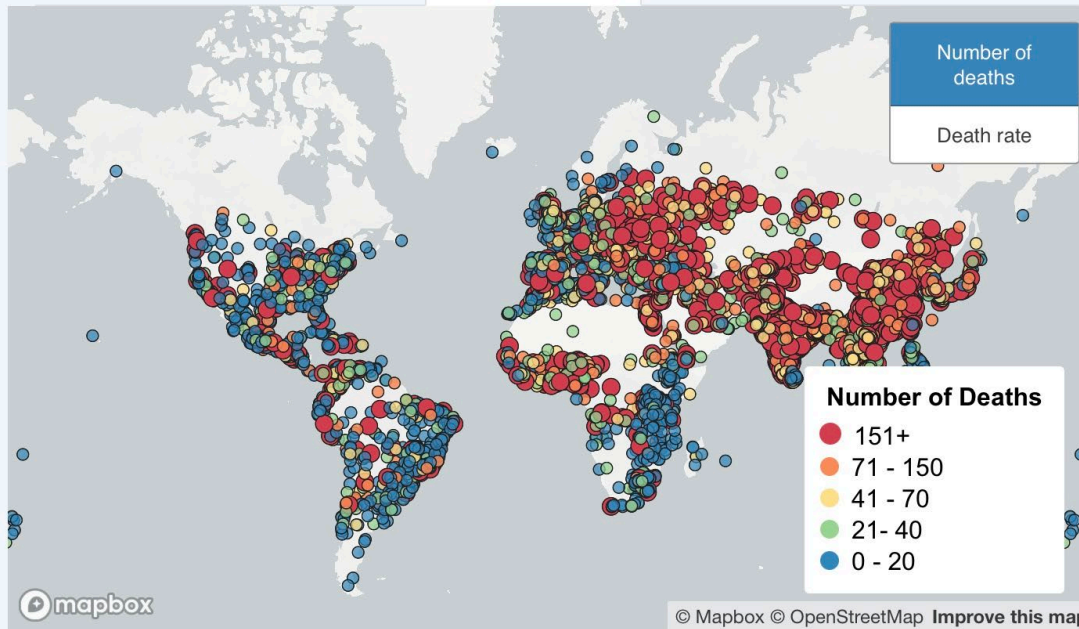
- International

Air Pollution and Health in Cities

Horizontal Tabs

Air Pollution Exposure

Health Impact



Population-weighted annual average pollutant concentrations and associated health burden in cities, in 2019.

HEI – *Play on!!*

HEI – *Play on!!*

Dan – Welcome to retirement!
Play on!!