




Occupational  
Cancer  
Research  
Centre

## Canadian Occupational Burden of Cancer Project: Results for diesel engine exhaust

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- OCRC was established in 2009
- Funded jointly by Cancer Care Ontario, Canadian Cancer Society, Ontario Ministry of Labour and competitive grants and contracts
- Steering Committee composed of representatives of the funders and stakeholders

## Diesel Engine Exhaust, IARC 2012

- IARC Group 1, human carcinogen
  - Sufficient evidence: Lung cancer
  - Limited evidence: Bladder cancer
  - Based on studies of miners, railroad workers & trucking industry workers
  - Key human studies used particulate matter as a measure of diesel engine exhaust
  - Animal studies positive for particulate, not gas phase exhaust




## Burden of Occupational Cancer in Canada & Collaboration



*This project is funded by Canadian Cancer Society Research Institute Multi-Sector Team Grant #701285*

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## A National Occupational & Environmental Exposure Surveillance Project

**Based at:**

1. Faculty of Health Sciences, Simon Fraser University, Vancouver
2. School of Population and Public Health, University of British Columbia, Vancouver
3. Alberta Health Sciences, Calgary, Alberta
4. Occupational Cancer Research Centre, Toronto



## What is Burden of Disease?

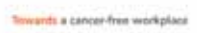


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***Estimate of the human impact and/or the economic costs associated with a specific cause of disease***

“a modelling technique that combines multiple data sources to count and compare ... health loss”

– Australian Institute of Health and Welfare



## Assessing the Burden of Occupational Cancer in Canada

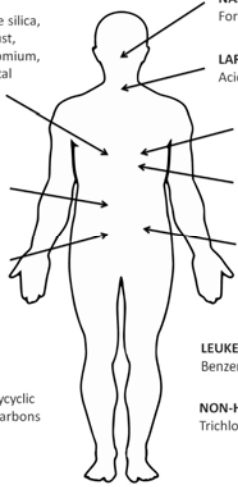


**LUNG**  
Asbestos, crystalline silica, diesel engine exhaust, radon, arsenic, chromium, nickel, environmental tobacco smoke

**LIVER AND BILIARY TRACT**  
Trichloroethylene, vinyl chloride

**BLADDER**  
Aromatic amines

**SKIN**  
Solar radiation, mineral oils, polycyclic aromatic hydrocarbons



**NASOPHARYNX**  
Formaldehyde

**LARYNX**  
Acid mists, asbestos

**MESOTHELIOMA**  
Asbestos


**BREAST**  
Shiftwork

**OVARY**  
Asbestos

**LEUKEMIA**  
Benzene, formaldehyde

**NON-HODGKIN LYMPHOMA**  
Trichloroethylene

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Canadian Cancer Society / Société canadienne du cancer

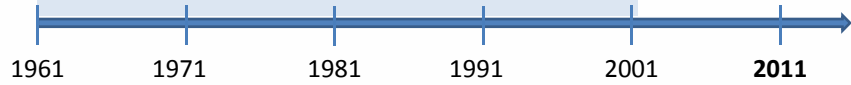
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## Challenge: Estimating History of Exposure among the General Population

Identify everybody exposed in all exposure circumstances by sex, age, industry, occupation, duration and level of exposure

**At Risk of Cancer**

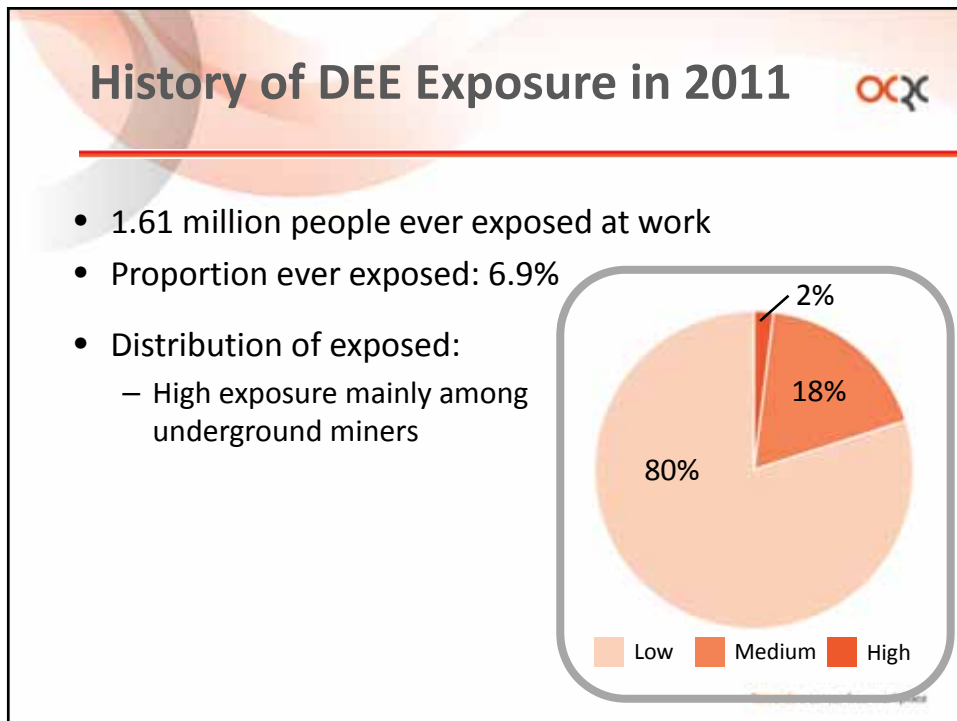
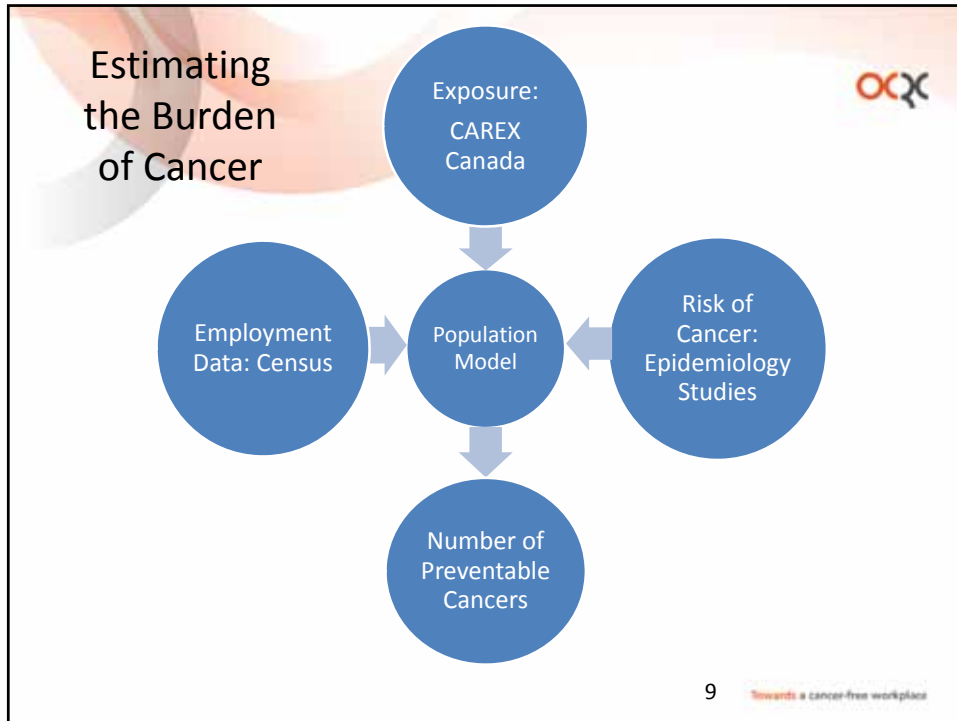


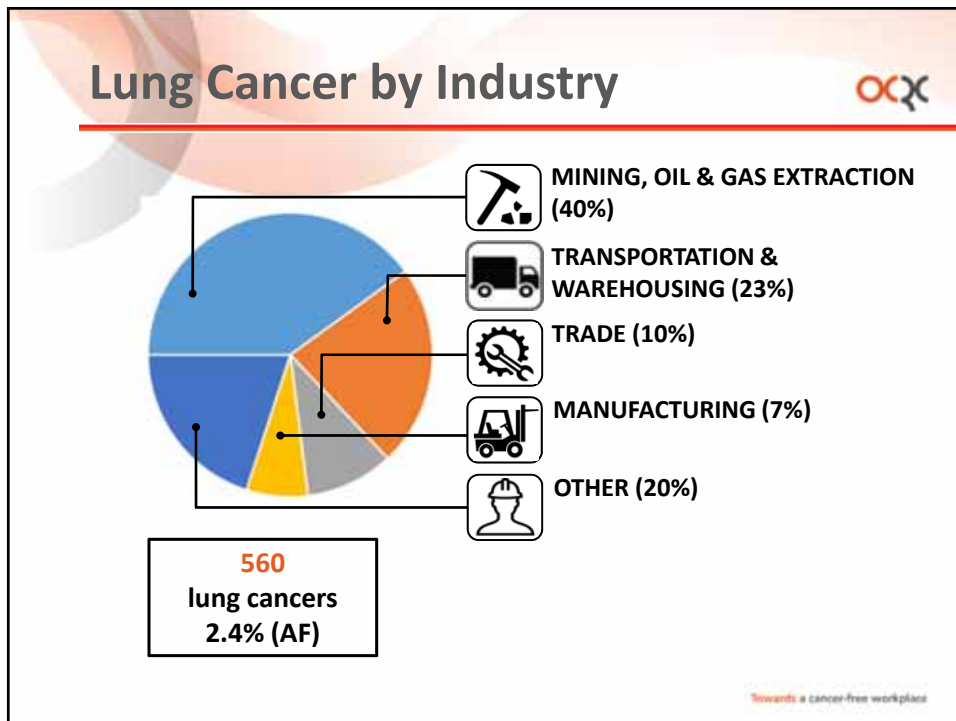
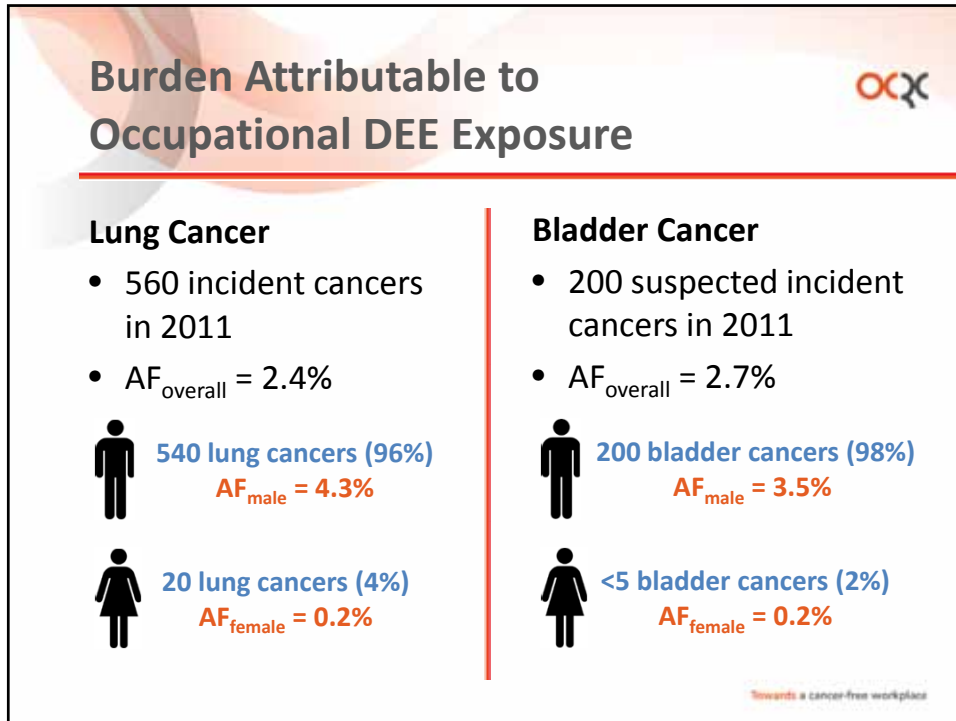


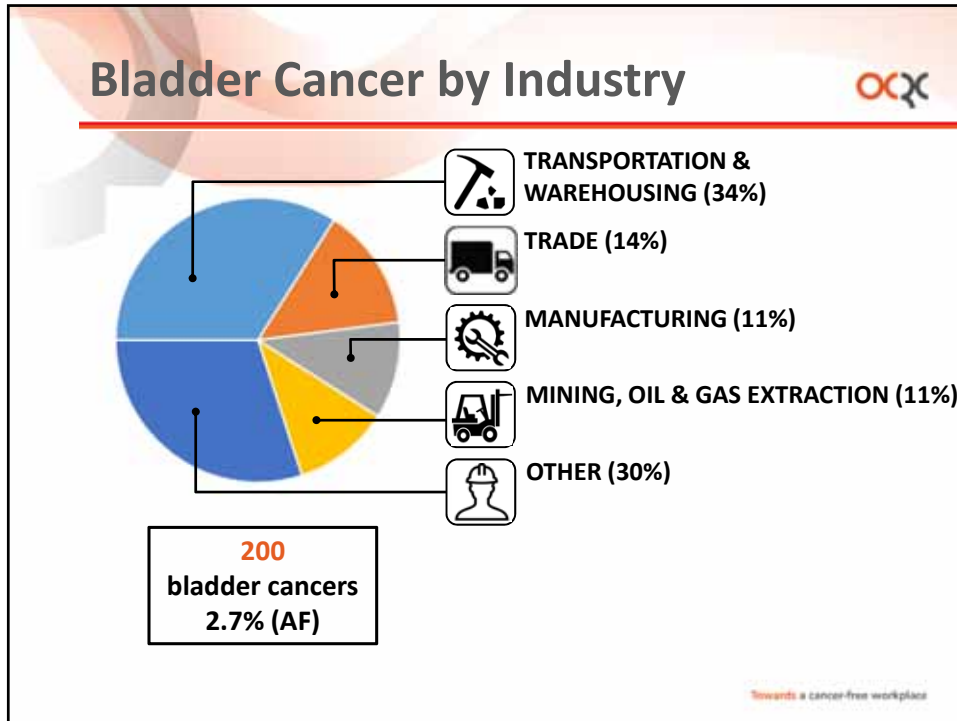
1961    1971    1981    1991    2001    2011

**Risk Exposure Period**

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**OCCC** | **CAREX CANADA**

## Diesel Engine Exhaust

Burden of Occupational Cancer Fact Sheet

**WHAT IS DIESEL ENGINE EXHAUST?**

The combustion of diesel fuel in engines produces diesel engine exhaust, a **complex mixture of gases and particulates**. This mixture can contain other known and suspected carcinogens, such as benzene, polycyclic aromatic hydrocarbons (PAHs), metals, and particulate matter.

The composition of the mixture depends on a number of factors including the type of engine (heavy or light duty), the type of fuel and oil, sulphur levels, speed and load of operation, and emission control systems.

The International Agency for Research on Cancer classifies diesel engine exhaust as a **known carcinogen (IARC 1)**.

**WHAT ARE ITS HEALTH EFFECTS?**

- Lung cancer
- Irritation to eyes, throat, and bronchi
- Light-headedness, nausea, cough, and phlegm
- Allergic reactions

**THE BURDEN OF LUNG CANCER FROM WORKPLACE EXPOSURE TO DIESEL EXHAUST IN CANADA**

The term "burden" refers to the human impact (deaths, illness, years of life lost) and the economic costs (health care, productivity) associated with a cause or group of causes of disease.

**560**  
Lung cancers caused by workplace diesel exposure

Results show that approximately **560 lung cancers** and **200 suspected bladder cancers** are attributed to occupational exposure to diesel engine exhaust each year in Canada, based on 2011 cancer statistics. This amounts to **2.4% of lung cancer cases** diagnosed annually.

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# Burden of Occupational Cancer in Ontario

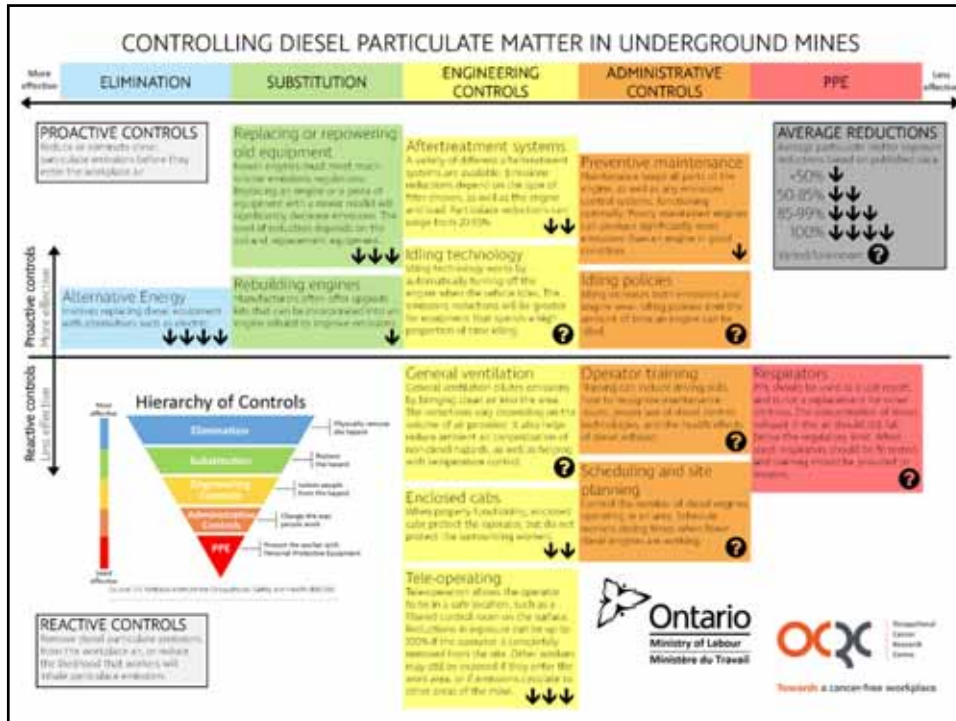
Major Workplace Carcinogens and Prevention of Exposure

**OCCC** | Occupational Cancer Research Centre

**Ontario**  
Cancer Care Ontario

[www.occupationalcancer.ca/2017/occupational-burden-ontario-report/](http://www.occupationalcancer.ca/2017/occupational-burden-ontario-report/)






## Canadian OELs

- Mining
  - Many provinces have adopted 1.5 mg/m<sup>3</sup> respirable combustible dust (RCD), generally restricted to underground mining
  - Ontario and Quebec have adopted 400 µg/m<sup>3</sup> Total Carbon (TC)
- General workplace OEL's
  - None, although Ontario has a proposal

**OCCC** Occupational Cancer Control Centre

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**§57.5060(b)(3) Final DPM PEL**

- Effective May 20, 2008, a miner's personal exposure to diesel particulate matter (DPM) in an underground mine must not exceed an average 8-hour equivalent full shift airborne concentration of *160 micrograms of total carbon (TC) per cubic meter of air (160 TC µg/m³)*

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**Advisory report for public review 'Diesel engine exhaust'**

The Dutch Expert Committee on Occupational Safety of the Health Council advises on the health-based state of the art in setting occupational exposure limits (OEL). In the present draft report the committee recommends a health-based OEL for diesel engine exhaust.

The president of the Health Council would like to give you the opportunity to comment on the draft report. The report is presented to the Working Conditions Committee of the Social Economic Council of the Netherlands, and to experts of employer's organizations and trade unions. Also other interested parties or persons may comment. Comments may be sent before May 1, 2018 to: Mrs J.M. Rijnkels, PhD, ([draftOSH@gr.nl](mailto:draftOSH@gr.nl)), The Health Council of The Netherlands, Dutch Expert Committee on Occupational Safety (DECOS) of the Health Council, PO Box 16052, 2500 BB, The Hague, The Netherlands. The comments will be taken into account in deciding on the final version of the document.

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<b>DIESEL PARTICULATE MATTER (as Elemental Carbon)</b>		<b>5040</b>
C	AW: 12.01	CAS: none RTECS: none
METHOD: 5040: Issue 3		EVALUATION: FULL
		Issue 1: 15 May 1996 Issue 3: 15 March 2003
OSHA: no PEL		PROPERTIES: nonvolatile solid
NIOSH: no REL		
ACGIH: 20 µg/m <sup>3</sup> as elemental carbon (proposed [1])		
SYNONYMS (related terms): diesel particulate matter, diesel exhaust, diesel soot, diesel emissions		
SAMPLING		MEASUREMENT
SAMPLER:	FILTER: quartz-fiber, 37-mm; size-selective sampler may be required [2].	TECHNIQUE: Thermal-optical analysis; flame ionization detector (FID)
FLOW RATE:	2 to 4 L/min (typical)	ANALYTE: Elemental carbon (EC). Total carbon is determined, but an EC exposure marker was proposed. See [2] for details.
VOL-MIN:	142 L @ 40 µg/m <sup>3</sup>	FILTER PUNCH SIZE: 1.5 cm <sup>2</sup> (or other [2])
-MAX:	19 m <sup>3</sup> (for filter load of ~90 µg/cm <sup>2</sup> )	CALIBRATION: Methane injection
SHIPMENT:	Routine	RANGE: 1 to 105 µg per filter portion (See also [2].)
SAMPLE STABILITY:	Stable	ESTIMATED LOD: 0.3 µg per filter portion
BLANKS:	2 to 10 field blanks per set	
ACCURACY		

## NIOSH Method 5040



- Issue 1: 1996, Issue 3: 2001
- References ACGIH 20 µg/m<sup>3</sup> as elemental carbon (20 µg/m<sup>3</sup> REC was proposed 2001, was later withdrawn 2003)
- Analyte: Elemental Carbon (EC). Total carbon is determined, but EC exposure was proposed.
  - EC proposed because of organic carbon interference (cigarette smoke, oil mists, coal dusts...)

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## In Closing



- The Burden of Occupational Cancer project is helping to describe the extent of occupational cancer in Canada
- Occupational diesel engine exhaust exposure is an important risk factor for lung cancer and possibly bladder cancer
- These results can be used to promote the prevention of occupational cancer and other diseases
- Next step is to look forward, assess impact of preventive actions on future cancer burden

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## Thank you



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Canadian  
Cancer  
Society

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