



Occupational  
Cancer  
Research  
Centre

# Assessing environmental & occupational exposures: CAREX Canada and the OCRC

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# What we know about occupational and environmental carcinogens?



Based on IARC there are:

- ~ **60** definite or probable carcinogens
  - Radon, diesel exhaust, asbestos, benzene, arsenic...
- Over **100** additional exposures are possible carcinogens
  - Night shiftwork, chlorination by-products, pesticides...
- Many other exposures with a suspicion of human carcinogenicity

# Canadian Funding for Cancer Research: 2005-2007\*



- Funding from 37 federal, provincial, and voluntary programs for cancer research
  - Funding for all cancer research: \$1,143 million
  - Risk and prevention research: \$122.3 million (10.7%)
  - Occupational cancer \$1.3 million (0.11%)
  - Air, water, soil contaminants \$7.9 million (0.69%)
- 2008: CAREX Canada funded by CPAC: \$4.2 million
  - (renewed in 2012: \$3 million)
- 2009: Occupational Cancer Research Centre funded by WSIB, Canadian Cancer Society, Cancer Care Ontario: \$4.6 million

\* Investment in Cancer Risk and Prevention Research, 2005-2007.  
Canadian Cancer Research Alliance. May, 2010

# CAREX Canada

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## **Surveillance of occupational and environmental exposures for cancer prevention**

The CAREX Canada Team is based at:

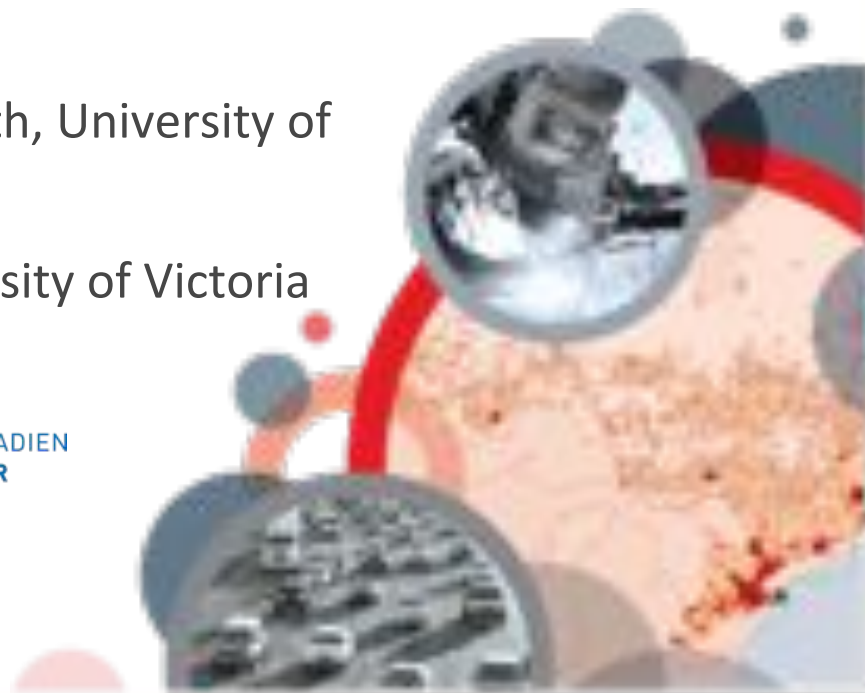
School of Population and Public Health, University of British Columbia

Spatial Sciences Research Lab, University of Victoria

CANADIAN **PARTNERSHIP**  
AGAINST **CANCER**



**PARTENARIAT CANADIEN**  
CONTRE LE **CANCER**



# CAREX Canada - OVERVIEW

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- The objectives of CAREX Canada are to:
  - develop estimates of the **number** of Canadians exposed to IARC carcinogens in their workplace & community environments,
  - identify **how** & **where** people are exposed, and
  - when possible, determine their **level** of exposure.
- Estimates are generated using existing Canadian exposure data, census population data & the best exposure estimation procedures available.



Surveillance of environmental & occupational exposures for cancer prevention

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Print Profile

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Quick Summary

## Arsenic

METALS - Known Carcinogen (IARC 1)

PEOPLE

ENVIRONMENTAL ESTIMATES

OCCUPATIONAL ESTIMATES

CAS No. 7440-38-2



[General Information](#)

[Exposures and Guidelines](#)

[Main Text](#)

[Canadian Production and Trade](#)

[Occupational Exposures](#)

[Environmental Exposures](#)

[Sources](#)

Photo Source: Wikimedia Commons<sup>[1]</sup>

IARC Monograph Vol. 23, Suppl. 7, 1987  
(Group 1)

IARC Monograph Vol. 84, 2004  
(Arsenic in Drinking Water, Group 1)

IARC Monograph Vol 100C, 2012 (Group 1)  
(Group 1)

### General Information

Arsenic is a semi-metallic element. Although it is rare to find pure arsenic in nature, toxic arsenic compounds are found in complex minerals containing copper, lead, iron, nickel, cobalt, and other metals.<sup>[1]</sup> Most arsenic compounds are white powders with no odor.<sup>[1]</sup> Of all commercially used arsenic compounds, arsenic trioxide is the most important.<sup>[1]</sup> There are numerous other symptoms and potential causes for arsenic; see IICCR

## Benzene

INDUSTRIAL DYES/CAES - River Estrogen (AR2 1)

## Provincial Estimates

## Maps

## Predicting Concentrations

[View a video](#) about these tables and maps, with [French subtitles](#)

The average concentration of benzene measured in outdoor air in 2006 was  $0.05 \mu\text{g}/\text{m}^3$ , but concentrations of benzene can be higher or lower than average in many locations. We used a [model](#) to predict annual average concentrations of benzene in outdoor air in residential locations for the year 2006 in order to calculate the the number of people in each exposure level by province or territory.

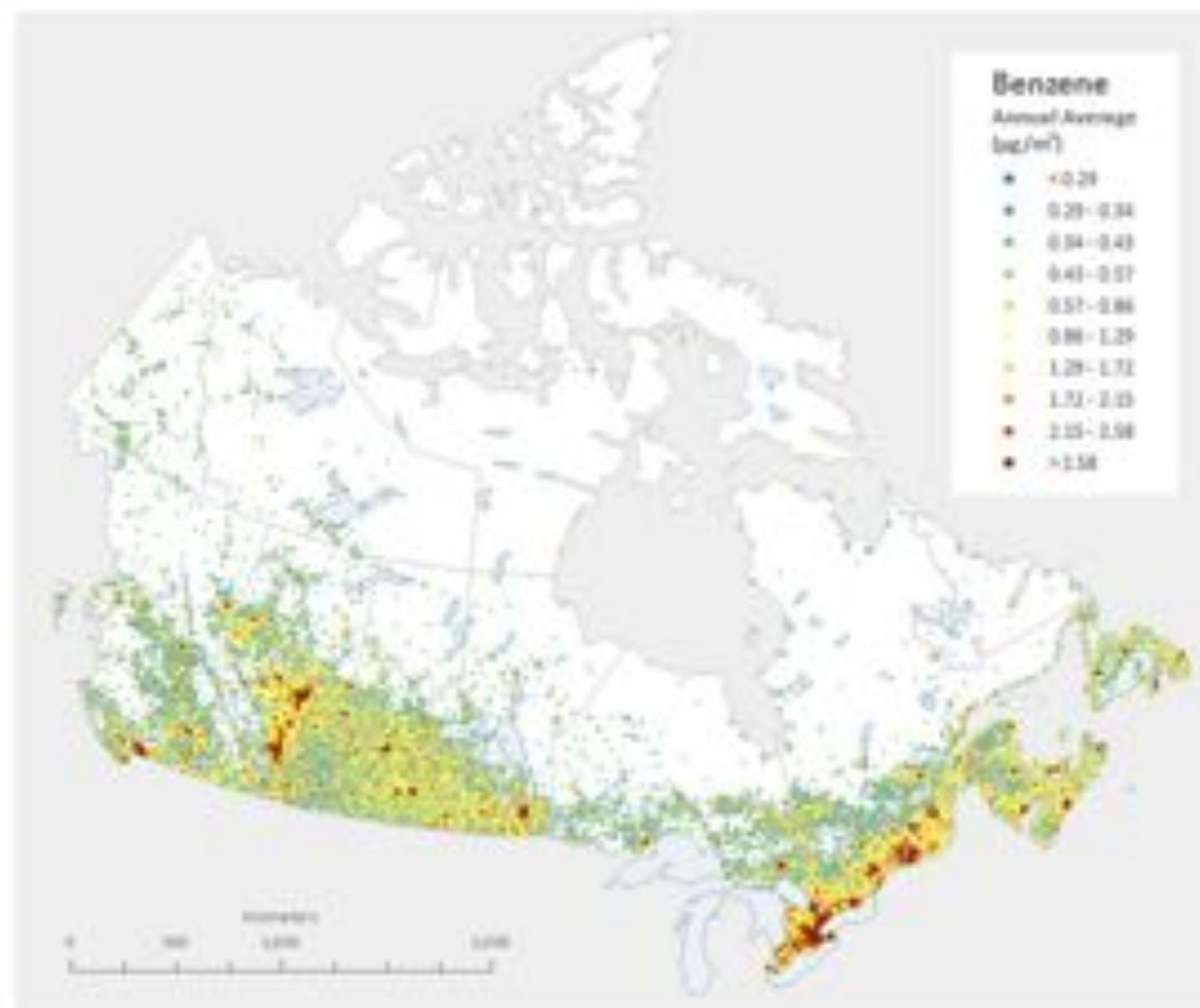
The tables below show provincial populations by concentration levels (either annual average or number of times above/below the national average) and the associated potential [lifetime excess risk](#) given different cancer potency factors. A method for calculating the expected number of excess cancers for a given population and range of excess risk levels is provided below the tables.

Population by Estimated Concentration of Benzene in Outdoor Air

Estimated annual average concentration ( $\mu\text{g}/\text{m}^3$ )	less than 0.05	0.05 to 0.04	0.04 to 0.03	0.03 to 0.02	0.02 to 0.01	0.01 to 0.005	0.005 to 0.002	0.002 to 0.001	0.001 to 0.0005	More than 0.0005
Compared to national average ( $0.05 \mu\text{g}/\text{m}^3$ )	+3x lower	1.5 to 3x lower	1 to 1.5x lower	1.5 to 3x lower	1 to 1.5x lower	1 to 1.5x higher	1.5 to 3x higher	2 to 3x higher	3 to 5x higher	+30x higher
BC	--	--	761,158 (19.0%)	469,424 (11.4%)	140,110 (3.4%)	1,115,977 (27.2%)	1,409,229 (34.3%)	118,717 (2.8%)	20,794 (0.5%)	12,033 (0.3%)
AB	--	--	174,904 (17.5%)	107,340 (9.8%)	10,313 (1.7%)	890,369 (33.1%)	1,104,919 (33.4%)	114,405 (3.3%)	17,493 (0.5%)	15,842 (0.5%)
SK	--	--	106,116 (12.7%)	187,624 (20.4%)	3,405 (0.4%)	403,358 (42.7%)	12,061 (1.3%)	1,061 (0.1%)	1,305 (0.1%)	201 (+0.1%)
MB	--	--	113,353 (17.3%)	105,085 (11.4%)	80,150 (8.3%)	156,476 (13.4%)	440,905 (34.1%)	16,589 (1.4%)	4,447 (0.4%)	2,254 (0.2%)



2006 Predicted Annual Average Benzene Concentrations in Outdoor Air at Residential Locations



Range of Predicted Concentrations ( $\mu\text{g}/\text{m}^3$ ): minimum 0.05 to maximum 12.43



# Compare Substances

Trends

Methods

Data

Data Quality

Outdoor Air

Indoor Air

Dust

Drinking Water


Food & Beverages

## 2006 CANADIAN POTENTIAL LIFETIME EXCESS CANCER RISK ESTIMATE - OUTDOOR AIR

(assuming no change in measured levels)

**Average Risk:**  
based on average intake  
x cancer potency or  
unit risk factor from:

Health Canada   
CA OEHHA   
USEPA 

**Maximum Risk:**   
based on maximum  
intake x highest cancer  
potency factor or  
unit risk factor

When potential lifetime  
excess cancer risk is  
**more than 1 per million**  
**in any single pathway,**  
a more detailed risk  
assessment may be

### IARC 1 - KNOWN CARCINOGENS

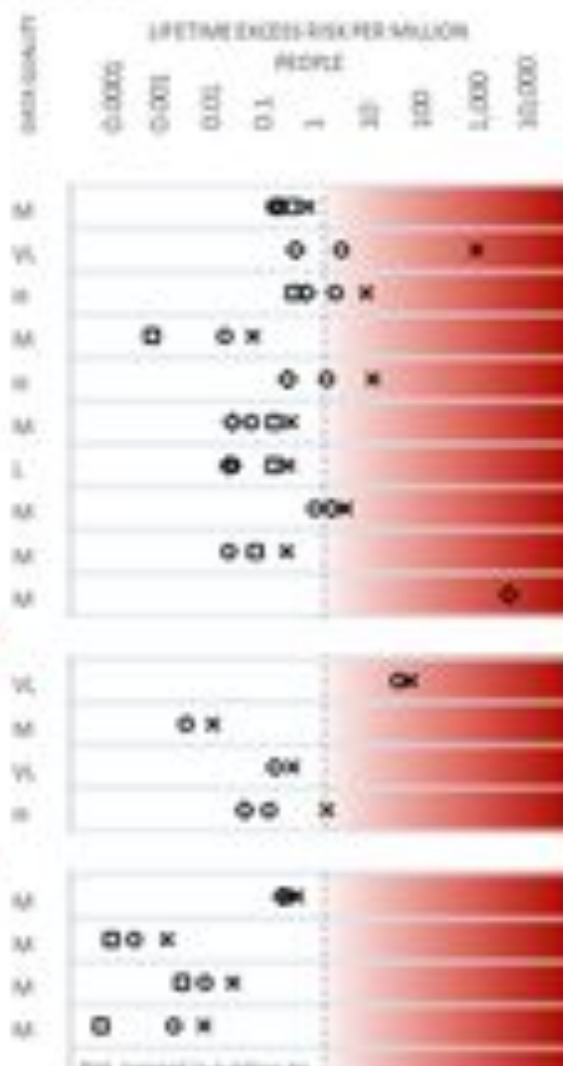
Arsenic and arsenic compounds	M
Asbestos	VL
Benzene	M
Benzo(a)pyrene	M
1,3-Butadiene	M
Cadmium and cadmium compounds	M
Chromium (hexavalent)*	L
Formaldehyde	M
Nickel and nickel compounds	M
Radon	M

### IARC 2A - PROBABLE CARCINOGENS

Diesel engine exhaust**	VL
Lead and lead compounds	M
Polycyclic aromatic hydrocarbons	VL
Tetrachloroethylene	M

### IARC 2B - POSSIBLE CARCINOGENS

Acetaldehyde	M
Ben(a)anthracene	M
Benzo(b)fluoranthene	M
Benzo(k)fluoranthene	M



# CAREX Emissions Mapping Project

Mapping Sources and Concentrations of Known and Suspected Carcinogens

Home

Ranks By Toxicity

Pesticides

More Google Earth Files

Resources and Tutorials

Am I Exposed?

About Us

Welcome to the CAREX Emissions Mapping Project. Our goal is to help people working in the fields of health and environmental regulation learn more about sources and concentrations of known and suspected carcinogens in the Canadian environment. By reducing or eliminating Canadians' exposure to these substances now and in the future, we hope to see fewer cancer cases over time.

View these files with Google Earth to explore differences in environmental quality across Canada; identify data gaps; and prioritize substances, sources, and geographic areas for targeted exposure reduction programs.

Look in the Resources and Tutorials section to learn more about how to use Google Earth, how to understand the files, and how to create and display your own local data along with ours.

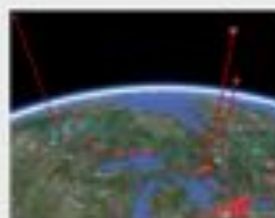
## RANKING FILES



Communities and regions ranked by toxicity of emissions of known and suspected carcinogens to air in 2006.

[Major cities](#)  
[Provinces](#)  
[Health regions](#)  
[Watersheds](#)

## MORE FILES



More Google Earth files about emitters and measured levels of known and suspected carcinogens.

By Substance:  
[Large emitters](#)  
[Mine tailings and waste rock](#)  
[Levels in air, soil, and sediment](#)

More:  
[Contaminated sites](#)  
[Files from other sources](#)

## PESTICIDE FILES



Estimated amounts of pesticides used in agriculture and on golf courses in 2006.

[Chlorothalonil](#)  
[Atrazine\\*](#)  
[2,4-D\\*](#)  
[MCPA\\*](#)  
[MCP\\*](#)

\* In Progress









## Benzene

INDUSTRIAL CHEMICALS - Known Carcinogen (IARC 1)

[PROFILE](#)[ENVIRONMENTAL ESTIMATE](#)[OCCUPATIONAL ESTIMATE](#)

Results show that nearly 275,000 Canadians (approximately 2% of the working population) are exposed to benzene in their workplaces; 52% of these workers are male. Alberta, Nova Scotia, Manitoba and Saskatchewan have a higher proportion of workers exposed to benzene than the national average (>2.2%), and Prince Edward Island, the Yukon and Nunavut have less workers exposed to benzene than the national average (<1.2% of workers exposed to benzene in these provinces). Industries with the greatest numbers of exposed workers are auto repair, taxi and limousine service, and the printing industry (Table 2). Exposure to benzene in public administration is mostly attributed to the fact that firefighters are included in the industry.

When benzene exposure is examined by occupation, automotive service technicians and mechanics are the group with the greatest number of workers exposed to benzene (50,500). Other jobs with high numbers of workers exposed include delivery and courier drivers (31,000), taxi and limousine drivers (33,000), and firefighters (27,000). Other groups with significant numbers of workers exposed include motor vehicle body repairers, material handlers, truck drivers, and welders.

**Table 1: Number of People Exposed to Benzene by Region**

BC	42,000
AB	48,000
SK	12,000

**Table 1: Number of People Exposed to Benzene by Region**

BC	41,000
AB	46,000
SK	12,000
MB	14,000
ON	147,000
QC	81,000
NS	7,000
NB	11,000
PE	1,100
NL	4,400
PT	300
MT	300
NJ	200
Canada	275,000

**Table 2: Number of People Exposed and % Exposed to Benzene by Industry**

Automotive repair and maintenance	30,000	20%
Tax & insurance services	30,000	10%
Printing and related support activities	20,000	31%
Local, municipal and regional public administration	21,000	9%
Automotive dealers	18,000	11%
General freight trucking	10,000	3%
Rubber product manufacturing	10,000	26%
Oil & gas extraction	8,700	10%
Couriers	8,400	17%
Household and institutional furniture and kitchen cabinet manufacturing	6,300	3%
Plastic product manufacturing	4,100	8%
Motor vehicle parts manufacturing	4,800	3%
Motor vehicle manufacturing	3,200	3%
All others	174,000	

Prevalence Estimate

Level of Exposure

Data Sources & Methods

## Benzene

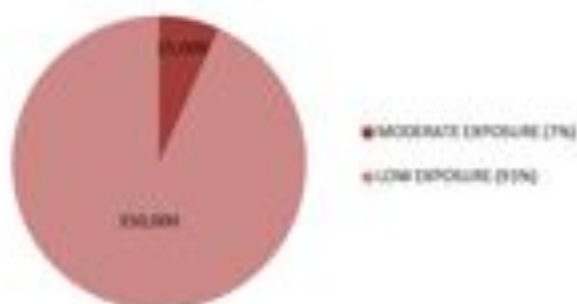
INDUSTRIAL CHEMICALS – known Carcinogen (ARC 1)

POPULATION

ENVIRONMENTAL ESTIMATE

OCCUPATIONAL ESTIMATE

In total, approximately 375,000 Canadians are exposed to benzene in their workplaces. The majority of workers exposed to benzene are in the low exposure category. A substantial number of benzene-exposed workers are at risk for moderate exposure, but very few are at risk of high exposure.



	Low Exposure (%)	Moderate Exposure (%)	Total Workers Exposed (%)
811 Repair and maintenance	40,000	0	40,000
400 Transit and ground passenger transportation	40,000	0	40,000
320 Printing and related support activities	16,000	11,000	27,000
910 Local, municipal and regional public administration	27,000	0	27,000
441 Motor vehicle and parts dealers	16,000	0	16,000
330 Plastics and rubber products mfg	16,000	0	16,000
400 Truck transportation	16,000	0	16,000
330 Transportation equipment manufacturing	14,000	200	14,200
490 Couriers and messengers	12,000	0	12,000
331 Primary metal manufacturing	4,000	7,000	11,000
211 Oil and gas extraction	8,700	0	8,700
331 Furniture and related product manufacturing	9,200	0	9,200

\*Numbers may not add up due to rounding



# Occupational Cancer Research Centre

- Identification of causes of cancer in the workplace
  - Example: Studies of pesticides and the risk of cancer
- Surveillance of occupational cancers & workplace exposures
  - Example: Linkage of the 1991 Census with national tumour registry data
- Intervention & related research to develop & evaluate prevention & exposure reduction strategies
  - Example: Program to support Ontario's Toxic Use Reduction legislation



# Prevention Framework

- Conducting policy-relevant research to identify the causes of occupational disease and on interventions to promote evidence-based decision making for prevention
- Raising awareness among employers, unions, workers, and regulators to promote reduction of exposure or changes in process
- Raising awareness among health care providers and victims to promote early recognition of occupational disease to promote better treatment, appropriate compensation, and provide an incentive for prevention

# Occupational Cancer Research Centre

## Example Prevention Activities



- Assessing the current & future burden of occupational cancer in Ontario
- Review of the Ministry of Labor's occupational exposure limits compared to other jurisdictions in Canada & elsewhere
- A pilot intervention study on improving the recognition and reporting of asbestos-related lung cancer and mesothelioma
- Assessing exposure to anti-neoplastic agents among health care workers
- Publications and public events on occupational cancer to raise awareness, encourage prevention efforts, and promote early recognition



**Towards** advancing occupational cancer research

## News & Events

**Student Research Prize for Occupational  
Cancer Research**  
September 23, 2010

OCRC is accepting applications for its annual Student Research Prize, a competition that recognizes the work of one student who has made a significant...

**Students recruited to OCRC**  
September 23, 2010

OCRC continues to recruit students to work on several occupational cancer research projects. Manisha Pahira is an occupational/environmental health graduate...

[More News](#)

## About OCRC

The Occupational Cancer Research Centre (OCRC), established in 2009, is the first of its kind in Canada. The Centre was established to fill the gaps in our knowledge of occupation-related cancers and to translate these findings into preventive programs to control workplace carcinogenic exposures and improve the health of workers.

The Centre is establishing and leading a program of integrated research that will involve collaborations between researchers, worker organizations and employers.

[Read More](#)

## Featured Profile



**Shelby Harris**  
Scientist

[Biography](#)

[List of Projects](#)

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