



# Asbestos

## Burden of Occupational Cancer Fact Sheet



### WHAT IS ASBESTOS?

Asbestos is **a group of naturally occurring, fibrous silicate minerals**. It has historically been useful for many construction applications because of its heat resistance, tensile strength, and insulating characteristics. It is found primarily in roofing, thermal and electrical insulation, cement pipe and sheets, flooring, gaskets, coatings, and other products.

The Government of Canada banned most uses of asbestos and asbestos-containing products in 2018. However, the vast majority of exposures that occur today are due to contact with older asbestos-containing products. Asbestos may be encountered during the maintenance, renovation, and modification of existing public, residential, and commercial buildings.

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

### WHAT ARE ITS HEALTH EFFECTS?

- Mesothelioma (a cancer of the protective lining of many internal organs)
- Lung, laryngeal, and ovarian cancer
- Asbestosis (scar tissue in the lungs)

### THE BURDEN OF CANCER FROM WORKPLACE EXPOSURE TO ASBESTOS 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.

**1,900**  
Lung cancers due to workplace asbestos exposure

Approximately **1,900 lung cancers** and **430 mesotheliomas** are due to occupational asbestos exposure each year, based on past exposures (1961-2001). This amounts to **8% of all lung cancers** and **81% of all mesotheliomas** diagnosed annually (almost all of the remaining mesotheliomas are likely due to environmental asbestos exposure).

### WHAT IS THE ECONOMIC IMPACT?

Work-related asbestos exposure resulted in approximately **\$2.35 billion in costs for newly diagnosed lung cancer and mesothelioma cases** in 2011.

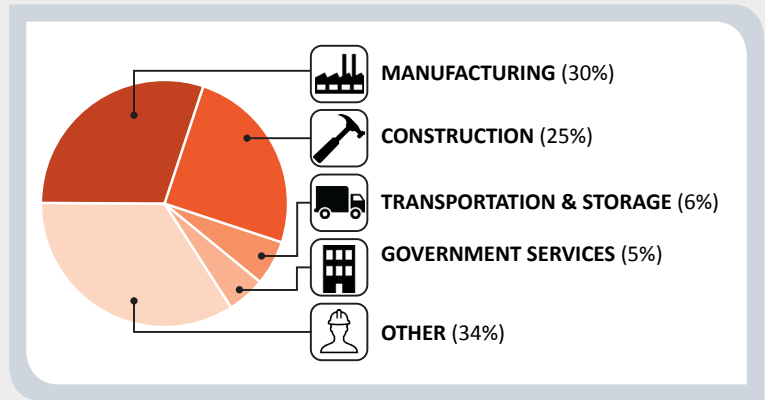
This includes approximately:

- 65% in health-related quality of life losses
- 8% in direct costs including health care, out of pocket expenses, family care giving, and workers' compensation administration
- 27% in indirect costs including output and productivity losses

**\$2.35 billion**  
Estimated yearly cost of lung cancer and mesothelioma due to workplace asbestos exposure

## WHAT WORKERS ARE MOST AFFECTED?

Most asbestos-related cancers occur among workers in the **manufacturing** and **construction sectors** (see pie chart on right). These cancers also occur among workers in the transportation and storage sector and government services. Some of the other sectors affected include communication and other utilities, educational services, and wholesale trade.



## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO ASBESTOS\*

Inhalation is the most important route of occupational exposure to asbestos. Approximately 152,000 Canadians are exposed to asbestos at work.

Industries with the largest number of exposed workers in Canada include:

- **Specialty trade contractors** (82,000 people exposed)
- **Building construction** (52,000 exposed)
- **Automotive repair and maintenance** (4,300 exposed)

Occupations with the largest number of exposed workers include:

- **Carpenters** (34,000 exposed)
- **Construction trades helpers and labourers** (28,000 exposed)
- **Electricians** (16,000 exposed)

*\*Note: CAREX Canada estimates of exposure were not used to develop the burden of occupational cancer estimates for asbestos.*

## HOW CAN EXPOSURE BE REDUCED?

The Canadian government banned asbestos in 2018. However, asbestos still exists in many public buildings, workplaces, and homes. Exposure can be reduced or eliminated by safely removing all existing asbestos-containing materials from buildings and workplaces before it deteriorates. A public registry of all public buildings and workplaces that contain asbestos can inform the public and workers about where there may be risk of exposure. For more details, visit the [OCRC exposure controls webpage](#).

## ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study quantified the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It was a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health (who led the economic analyses), University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.



For more information, please visit OCRC at [www.occupationalcancer.ca](http://www.occupationalcancer.ca) or CAREX Canada at [www.carexcanada.ca](http://www.carexcanada.ca).

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# 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
- Bladder cancer (suspected)
- Irritation to eyes, throat, and bronchi
- Light-headedness, nausea, cough, and phlegm
- Allergic reactions

### THE BURDEN OF 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 due to workplace diesel exhaust exposure

Approximately **560 lung cancers** and possibly **200 suspected bladder cancers** are due to occupational exposure to diesel engine exhaust each year in Canada, based on past exposures (1961-2001). This amounts to **2.4% of lung cancer cases** and **2.7% of suspected bladder cancer cases** diagnosed annually.

### WHAT IS THE ECONOMIC IMPACT?

Work-related diesel engine exhaust exposure resulted in approximately **\$684 million in costs for newly diagnosed lung and suspected bladder cancer cases** in 2011.

This includes approximately:

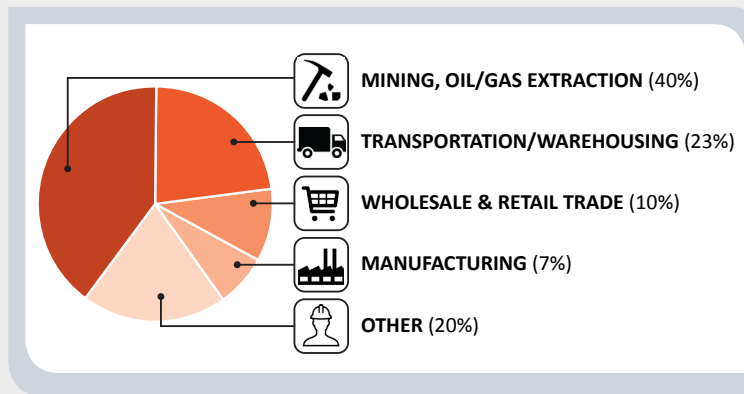
- 65% in health-related quality of life losses
- 7% in direct costs including health care, out of pocket expenses, family care giving, and workers' compensation administration
- 28% in indirect costs including output and productivity losses

**\$684 million**

Estimated yearly cost of lung and suspected bladder cancers due to workplace diesel exhaust exposure

## WHAT WORKERS ARE MOST AFFECTED?

Most occupational lung cancers associated with diesel engine exhaust occur among workers in the **mining and oil and gas extraction sector** (see pie chart on right). These cancers also occur among workers in the transportation and warehousing, wholesale and retail trade, and manufacturing sectors. Some of the other sectors affected include construction, forestry and logging, and public administration.



## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO DIESEL ENGINE EXHAUST

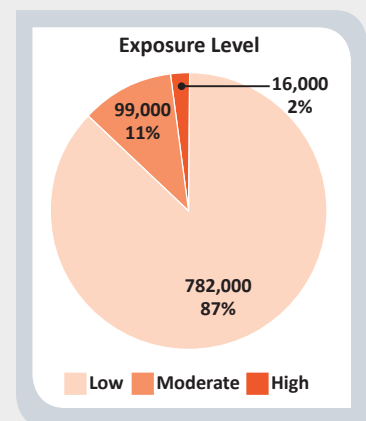
Inhalation is the most common route of exposure to diesel engine exhaust. Approximately 897,000 Canadians are exposed to diesel engine exhaust at work.

Industries with the largest number of exposed workers in Canada include:

- **Truck transportation** (206,000 people exposed)
- **Transit and ground passenger transportation** (110,000 exposed)
- **Public administration** (42,000 exposed)

Occupations with the largest number of exposed workers include:

- **Truck drivers** (305,000 exposed)
- **Heavy equipment operators** (83,000 exposed)
- **Transit operators** (79,000 exposed)



Results show the majority of workers exposed to diesel engine exhaust are in the low exposure level category, with a significant number at risk for moderate to high exposure (see pie chart above). To learn more about how these exposure levels are defined, visit the [CAREX Canada website](#).

## HOW CAN EXPOSURE BE REDUCED?

Outside of the mining industry, there are currently no occupational exposure limits for diesel engine exhaust in any Canadian jurisdiction. Strategies for reducing exposure include replacing old diesel engines, using diesel fuel alternatives, performing regular engine maintenance, implementing exhaust treatment systems, and using exhaust extraction systems in indoor work environments. For more details, visit the [OCRC exposure controls webpage](#).

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# Polycyclic Aromatic Hydrocarbons

## Burden of Occupational Cancer Fact Sheet



**WHAT ARE POLYCYCLIC AROMATIC HYDROCARBONS?**

Polycyclic aromatic hydrocarbons (PAHs) are a **group of over 100 chemicals formed during the incomplete burning of coal, oil, gas, wood, garbage, and other organic substances** such as tobacco and charbroiled meat. PAHs occur naturally and generally exist as complex mixtures (i.e. combustion products). They can also be manufactured for a variety of industrial purposes.

Most PAHs are by-products found in many substances including coal tar, coal tar pitch, creosote, bitumen, and asphalt. Coal tar products may be used as fuel, to pave roads and roofs, to manufacture carbon electrodes, and to preserve wood.

The International Agency for Research on Cancer has classified different PAHs as **known, probable, and possible carcinogens** (IARC 1, 2A, 2B), while others lack enough evidence to be classified (IARC 3).

**WHAT ARE ITS HEALTH EFFECTS?**

- Lung cancer
- Skin cancer
- Bladder cancer (suspected)
- Skin inflammation and lesions
- Reduced lung and immune function

**THE BURDEN OF CANCER FROM WORKPLACE EXPOSURE TO PAHS 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.

**130**  
Lung cancers due to workplace PAH exposure

Approximately **130 lung cancers, 50 skin cancers**, and possibly **80 suspected bladder cancers** are due to occupational exposure to PAHs each year in Canada, based on past exposures (1961-2001). This amounts to **0.6% of all lung cancers, 0.1% of all skin cancers, and 1% of all bladder cancers** diagnosed annually.

**WHAT IS THE ECONOMIC IMPACT?**

Work-related PAH exposure resulted in approximately **\$183 million in costs for newly diagnosed lung, non-melanoma skin, and suspected bladder cancer cases** in 2011.

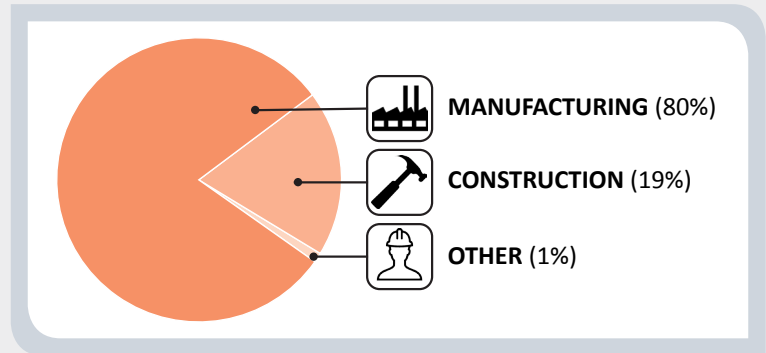
This includes approximately:

- 65% in health-related quality of life losses
- 7% in direct costs including health care, out of pocket expenses, family care giving, and workers’ compensation administration
- 28% in indirect costs including output and productivity losses

**\$183 million**  
Estimated yearly cost of lung cancer, non-melanoma skin cancer, and suspected bladder cancer due to workplace PAH exposure

## WHAT WORKERS ARE MOST AFFECTED?

Most PAH-related cancers occur among workers in **manufacturing** and **construction** (see pie chart on right). This includes attributable lung, skin, and suspected bladder cancers.



## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO PAHS

Inhalation and dermal contact are the most important routes of occupational exposure to PAHs. Approximately 350,000 Canadians are exposed to PAHs at work.

Industries with the largest number of exposed workers in Canada include:

- **Food services and drinking places** (102,000 people exposed)
- **Repair and maintenance services** (44,000 exposed)
- **Gasoline stations** (42,000 exposed)

Occupations with the largest number of exposed workers include:

- **Chefs and cooks** (123,000 exposed)
- **Mechanics** (116,000 exposed)
- **Occupations in protective services** (27,000 exposed)

PAHs occur as part of complex mixtures, making it challenging to assess occupational exposure levels.

## HOW CAN EXPOSURE BE REDUCED?

Strategies for reducing exposure to PAHs include implementing local exhaust ventilation systems, ensuring that workers are enclosed and separated from contaminated air, and employing wet cleaning methods to reduce contamination on surfaces or equipment. For more details, visit the [OCRC exposure controls webpage](#).

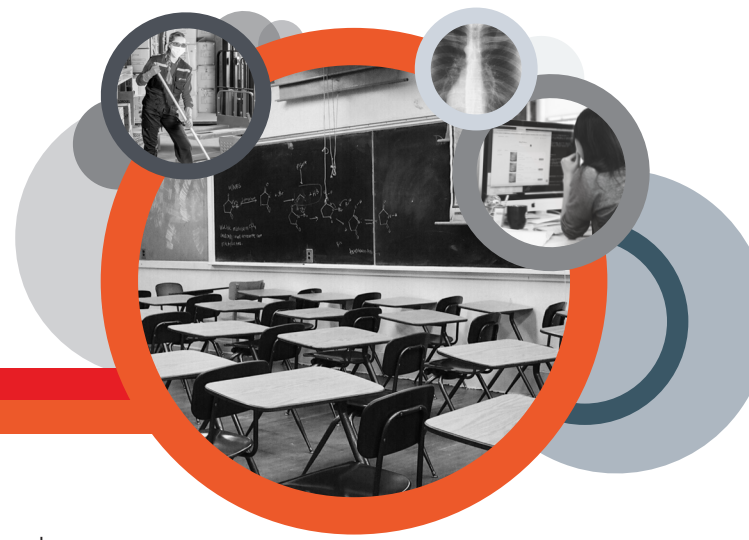
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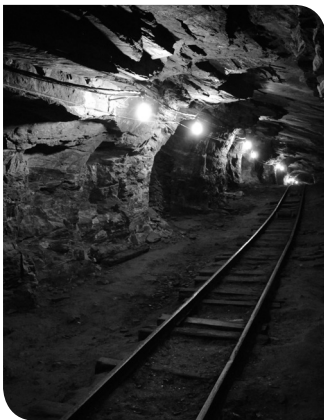
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# Radon

## Burden of Occupational Cancer Fact Sheet



### WHAT IS RADON?

Radon is a **naturally occurring radioactive gas** produced from the natural breakdown of uranium in soils and rocks and is colorless, tasteless, and odourless. Radon in groundwater, soil, or building materials may enter the home or work environment and then decay, emitting ionizing radiation. Levels of radon in confined spaces or underground are often significantly higher than outdoor air levels. The International Agency for Research on Cancer classifies radon as a **known carcinogen** (IARC 1).

### WHAT ARE ITS HEALTH EFFECTS?

- Lung cancer

### THE BURDEN OF LUNG CANCER FROM WORKPLACE EXPOSURE TO RADON 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.

**190**  
Lung cancers due to  
workplace radon exposure

Results show that approximately **190 lung cancers** are due to occupational exposure to radon each year in Canada, based on past exposures (1961-2001). This amounts to **0.8% of all lung cancers** diagnosed annually.

### WHAT IS THE ECONOMIC IMPACT?

Results show that work-related radon exposure resulted in approximately **\$185 million in costs for newly diagnosed lung cancer cases** in 2011.

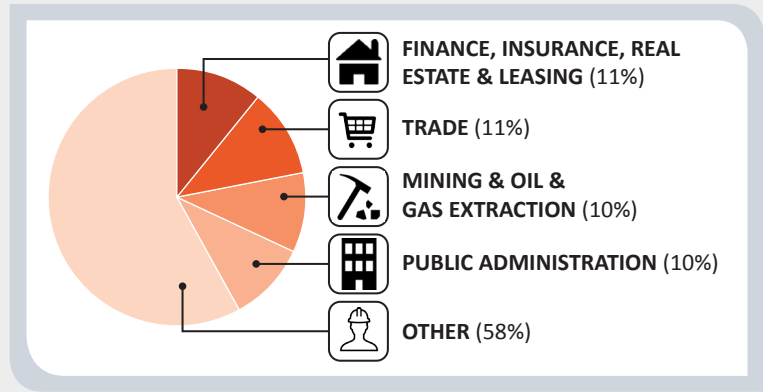
This includes approximately:

- 66% in health-related quality of life losses
- 7% in direct costs including health care, out of pocket expenses, family care giving, and workers’ compensation administration
- 27% in indirect costs including output and productivity losses

**\$185 million**  
Estimated yearly cost of lung  
cancer due to workplace  
radon exposure

## WHAT WORKERS ARE MOST AFFECTED?

Radon exposure occurs very broadly across workers in many industries. The groups with the largest burden of radon-related cancers are **finance, insurance, real estate and leasing; trade; mining and oil and gas extraction; and public administration** (see pie chart on right). Some of the other sectors affected include manufacturing, educational services, and professional, scientific and technical services.



## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO RADON

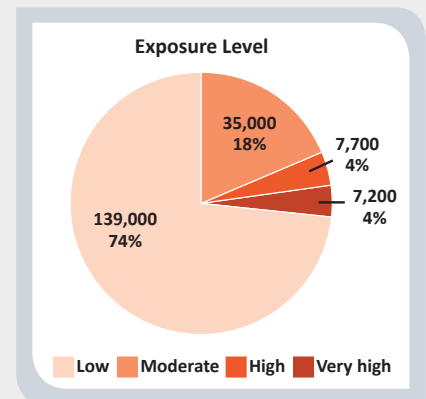
Inhalation is the most common route of occupational exposure to radon. Approximately 188,000 Canadians are exposed to radon at work.

Industries with the largest number of exposed workers in Canada include:

- **Elementary and secondary schools (16,000 people exposed)**
- **Provincial and territorial public administration (5,900 exposed)**
- **Depository credit intermediation (5,600 exposed)**

Occupations with the largest number of exposed workers include:

- **General office clerks (6,200 exposed)**
- **Elementary school and kindergarten teachers (6,000 exposed)**
- **Janitors, caretakers and building superintendents (5,000 exposed)**



Results show the majority of workers exposed to radon are in the low exposure level category (see pie chart above). The workers at risk of highest exposure to radon are those who work in underground mines. To learn more about how these exposure levels are defined, visit the [CAREX Canada website](#).


*\*Note: Modified CAREX Canada estimates of exposure were used to develop the burden of occupational cancer estimates for radon.*

## HOW CAN EXPOSURE BE REDUCED?

Reducing radon in the workplace begins with a testing program. The Canadian NORM Guidelines recommend keeping occupational radon levels below 200 Bq/m<sup>3</sup>. If radon levels exceed this guideline, control measures include installing radon gas mitigation systems, changing ventilation patterns, and developing an exposure reduction program. For more details, visit the [OCRC exposure controls webpage](#).

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# Night Shift Work

## Burden of Occupational Cancer Fact Sheet



**WHAT IS NIGHT SHIFT WORK?**

Night shift work refers to **work schedules that are consistently outside of standard daytime work hours**. Workers are considered exposed to night shift work if they work regular night shifts or rotate through day and/or evening and night shifts, as these schedules have the strongest evidence for increased cancer risk.

Shiftwork at night (generally between the hours of 12am and 5am) **disrupts circadian rhythms**, or the internal biological 'clock' that generates the sleep-wake cycle in humans. Circadian disruption suppresses melatonin production, disrupts sleep patterns and food digestion, and de-regulates genes involved in cancer pathways.

The International Agency for Research on Cancer classifies night shift work as a **probable carcinogen** (IARC 2A).

**WHAT ARE ITS HEALTH EFFECTS?**

- Breast cancer (suspected)
- Colorectal cancer (suspected)
- Prostate cancer (suspected)
- Fatigue, stress, anxiety, depression
- Heartburn, nausea, loss of appetite
- Cardiovascular disease (suspected)

**THE BURDEN OF BREAST CANCER FROM WORKPLACE EXPOSURE TO NIGHT SHIFT WORK 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.

**470-1,200**  
suspected female breast cancers due to shiftwork

Approximately **470 to 1,200 suspected breast cancers in women** are possibly due to night shift work each year, based on past exposures (1961-2001). This amounts to **2 to 5% of all female breast cancers** diagnosed annually. These results are shown as a range because research studies are not in agreement on the impact of night shift work on breast cancer risk.

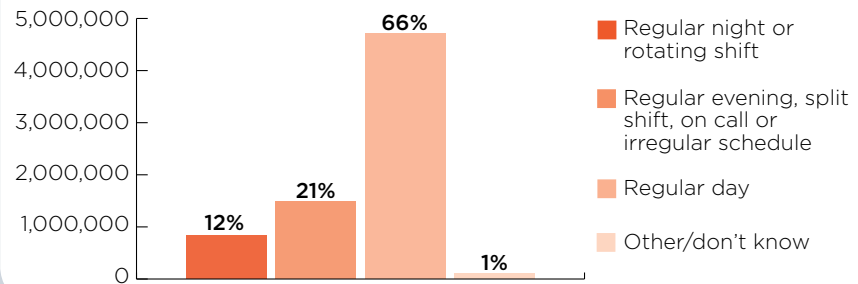
**WHAT WORKERS ARE MOST AFFECTED?**

Most occupational breast cancers in women associated with night shift work occur among workers in the **health care industry** (see pie chart on right). These cancers also occur among workers in the accommodation and food services, trade, and manufacturing sectors. Some of the other sectors affected include public administration, and finance, insurance, real estate and leasing.

Sector	Percentage
HEALTH CARE & SOCIAL ASSISTANCE	43%
ACCOMMODATION & FOOD SERVICES	18%
TRADE	11%
MANUFACTURING	11%
OTHER	17%

## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO NIGHT SHIFT WORK

Approximately 844,000 Canadian women perform regular night or rotating shiftwork, based on 2006 labour data. This amounts to approximately 12% of working female Canadians (see bar chart on right).



Industries with the largest number of female night shift workers in Canada include:

- **Health care and social assistance** (236,000 people exposed)
- **Trade** (224,000 exposed)
- **Accommodation and food services** (137,000 exposed)

### HOW CAN EXPOSURE BE REDUCED?

Completing work during standard, daylight hours is the best way to limit circadian disruption. However, night work is necessary to maintain essential services, as well as continuous processes and services in various industries, and eliminating it is often not practical. Interventions that may help reduce the negative impacts of circadian disruption include optimizing the design of the shift schedule or using flexible work schedules that allow workers to have some input on their schedules. For more details, visit the [OCRC exposure controls webpage](#).

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# Second-Hand Smoke

## Burden of Occupational Cancer Fact Sheet



### WHAT IS SECOND-HAND SMOKE?

Second-hand smoke (SHS) is **a mixture of tobacco smoke and ambient air produced by cigarettes or other smoking devices**. It is a combination of solid particles and gases from the burning end of tobacco products and exhaled smoke, which enters the surrounding environment and may be inhaled by others.

SHS contains more than 4,000 chemicals, of which at least 250 are known to be carcinogenic or toxic. These include arsenic, benzene, cadmium, chromium, and vinyl chloride, among others. In Canada, smoking is prohibited in nearly all enclosed public places and places of employment.

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

### WHAT ARE ITS HEALTH EFFECTS?

- Lung cancer
- Laryngeal cancer (suspected)
- Pharyngeal cancer (suspected)
- Eye, nose, and throat irritation
- Dizziness and nausea
- Heart disease
- Aggravation of allergies and asthma symptoms

### THE BURDEN OF CANCER FROM WORKPLACE EXPOSURE TO SHS 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.

**130**  
 Lung cancers due to  
 workplace SHS exposure

Approximately **130 lung cancers** and possibly **20 suspected laryngeal cancers** and **35 suspected pharyngeal cancers** are due to occupational exposure to SHS each year in Canada, based on past exposures (1961-2001). This amounts to **0.6% of all lung cancers**, **1.6% of all laryngeal cancers**, and **2.4% of all pharyngeal cancers** diagnosed annually. These estimates are

focused on non-smokers due to difficulties in separating the impact of personal smoking and SHS exposure on cancer risk.

### WHAT IS THE ECONOMIC IMPACT?

Work-related SHS exposure resulted in approximately **\$129 million in costs for newly diagnosed lung cancer cases** in 2011.

This includes approximately:

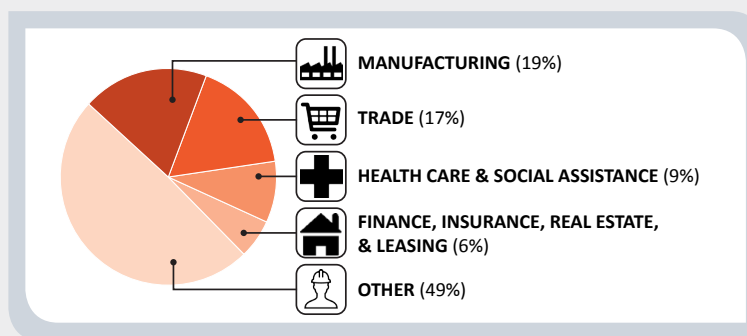
- 66% in health-related quality of life losses
- 7% in direct costs including health care, out of pocket expenses, family care giving, and workers' compensation administration
- 27% in indirect costs including output and productivity losses

**\$129 million**

Estimated yearly cost  
 of lung cancer due to  
 workplace SHS exposure

## WHAT WORKERS ARE MOST AFFECTED?

Most SHS-related lung cancers occur among workers in the **manufacturing** and **trade** industries (see pie chart on right). These cancers also occur among workers in health care and social assistance, and finance, insurance, real estate and leasing. Some of the other sectors affected include construction and public administration.



## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO SHS\*

Inhalation is the most common route of occupational exposure to SHS. Approximately 520,000 Canadians are exposed to SHS at work.

Occupations with the largest number of exposed workers in Canada include:

- **Trades, transport and equipment operators** (256,000 people exposed)
- **Sales and service** (68,000 exposed)
- **Primary industry** (56,000 exposed)

Patterns of occupational exposure to SHS have changed in Canada with the introduction of smoking ban legislation in most jurisdictions. Current occupational exposure to SHS is substantially lower than in the past. Of the 520,000 exposed workers, an estimated **253,000 are exposed to high levels** (i.e. in workplaces with no smoking restrictions), and approximately 287,000 are exposed to moderate levels (i.e. in workplaces that permit designated smoking areas).

*\*Note: CAREX Canada estimates of exposure were not used to develop the burden of occupational cancer estimates for SHS.*

## HOW CAN EXPOSURE BE REDUCED?

Smoking bans are the most effective way to reduce SHS exposure. Implementing and enforcing smoke-free legislation in all workplaces, including outdoor workplaces (e.g. construction sites), and promoting smoking cessation programs within workplaces, can help reduce exposure. For more details, visit the [OCRC exposure controls webpage](#).

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# Crystalline Silica

## Burden of Occupational Cancer Fact Sheet



### WHAT IS SILICA?

Crystalline silica is a **naturally occurring mineral found in soil, sand, and rocks**. Work processes such as breaking, grinding, or sawing these materials releases crystalline silica dust into the air. Workplace exposure to crystalline silica is common in several trades due to its presence in many handled materials such as concrete, mortar and brick.

The International Agency for Research on Cancer classifies crystalline silica as a **known carcinogen (IARC 1)**.

### WHAT ARE ITS HEALTH EFFECTS?

- Lung cancer
- Silicosis (thickening and scarring of the lungs)
- Chronic obstructive pulmonary disease (COPD)
- Rheumatoid arthritis
- Tuberculosis

### THE BURDEN OF LUNG CANCER FROM WORKPLACE EXPOSURE TO SILICA 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.

**570**  
Lung cancers due to  
workplace silica exposure

Approximately **570 lung cancers** are due to occupational exposure to crystalline silica each year in Canada, based on past exposures (1961-2001). This amounts to **2.4% of lung cancer cases** diagnosed annually.

### WHAT IS THE ECONOMIC IMPACT?

Work-related silica exposure resulted in approximately **\$562 million in costs for newly diagnosed lung cancer cases** in 2011.

This includes approximately:

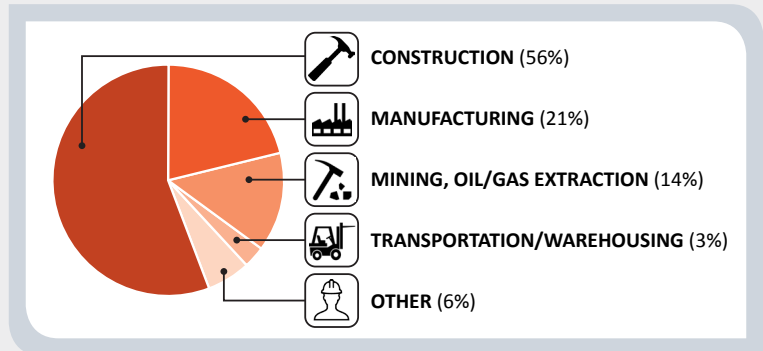
- 66% in health-related quality of life losses
- 7% in direct costs including health care, out of pocket expenses, family care giving, and workers' compensation administration
- 27% in indirect costs including output and productivity losses

**\$562 million**

Estimated yearly cost  
of lung cancer due to  
workplace silica exposure

## WHAT WORKERS ARE MOST AFFECTED?

Most occupational lung cancers associated with crystalline silica occur among workers in the **construction sector** (see pie chart on right). These cancers also occur among workers in the manufacturing, mining and oil and gas extraction, and transportation and warehousing sectors. Some of the other sectors affected include wholesale trade, public administration, and utilities.



## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO SILICA

Inhalation is the most important route of occupational exposure to silica. Approximately 380,000 Canadians are exposed to silica at work.

Industries with the largest number of exposed workers in Canada include:

- **Specialty trade contractors** (141,000 people exposed)
- **Building construction** (65,000 exposed)
- **Heavy and civil engineering construction** (31,000 exposed)

Occupations with the largest number of exposed workers include:

- **Construction trades helpers and labourers** (105,000 exposed)
- **Heavy equipment operators** (41,000 exposed)
- **Plasterers and drywallers** (34,000 exposed)




Results show the majority of workers exposed to crystalline silica are in the low exposure level category, with a significant number at risk for moderate to high exposure (see pie chart above). To learn more about how these exposure levels are defined, visit the [CAREX Canada website](#).

## HOW CAN EXPOSURE BE REDUCED?

For some applications, silica can be replaced with safer materials. For example, garnet or high pressure water can be used instead of sandblasting with silica. Other control strategies include eliminating processes that generate silica, implementing local exhaust ventilation, and using wet sweeping, cutting, and drilling methods. For more details, visit the [OCRC exposure controls webpage](#).

## ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study quantified the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It was a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health (who led the economic analyses), University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.

 For more information, please visit OCRC at [www.occupationalcancer.ca](http://www.occupationalcancer.ca) or CAREX Canada at [www.carexcanada.ca](http://www.carexcanada.ca).

This fact sheet was produced by CAREX Canada in partnership with OCRC. The Burden of Occupational Cancer Study is led by OCRC and is supported by the Canadian Cancer Society. CAREX Canada is hosted at Simon Fraser University and supported by the Canadian Partnership Against Cancer. Acknowledgments for header photos: Chris RubberDragon, Wyliepoon.



# Solar Radiation

## Burden of Occupational Cancer Fact Sheet



### WHAT IS SOLAR RADIATION?

Solar radiation is the **main natural source of exposure to ultraviolet radiation**. Levels of exposure vary depending on geography, seasonality, time of day and meteorology, as well as time spent out of doors and the amount of skin exposed. All outdoor occupations have a potential for exposure to solar radiation.

The International Agency for Research on Cancer classifies solar radiation as a **known carcinogen** (IARC 1).

### WHAT ARE ITS HEALTH EFFECTS?

- Skin cancer
- Sunburns
- Heat stress/stroke
- Thick, scaly skin patches
- Cataracts
- Eye lesions and cancer

### THE BURDEN OF SKIN CANCER FROM WORKPLACE EXPOSURE TO SOLAR RADIATION 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.

**4,600**  
Skin cancers due to workplace sun exposure

Approximately **4,600 non-melanoma skin cancers** are due to occupational solar radiation each year, based on past exposures (1961-2001). This amounts to **6.3% of non-melanoma skin cancer cases** diagnosed annually.

### WHAT IS THE ECONOMIC IMPACT?

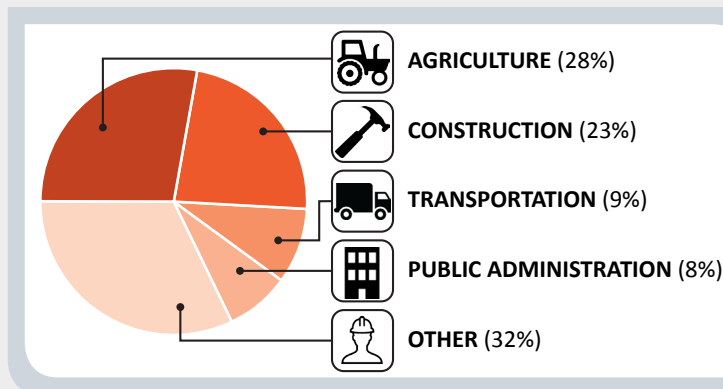
Work-related solar radiation exposure resulted in approximately **\$34.2 million in costs for newly diagnosed non-melanoma skin cancer cases** in 2011.

- This includes approximately:
- 17% in health-related quality of life losses
  - 58% in direct costs including health care, out of pocket expenses, family care giving, and workers' compensation administration
  - 25% in indirect costs including output and productivity losses

**\$34.2 million**  
Estimated yearly cost of non-melanoma skin cancer due to workplace sun exposure

## WHAT WORKERS ARE MOST AFFECTED?

Most occupational non-melanoma skin cancers associated with solar radiation occur among workers in the **agricultural** and **construction sectors** (see pie chart on right). These cancers also occur among workers in the transportation and public administration sectors. Some of the other sectors affected include forestry and logging, manufacturing, and mining and oil and gas extraction.



## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO SOLAR RADIATION

Exposure to solar radiation can occur via skin or eyes.

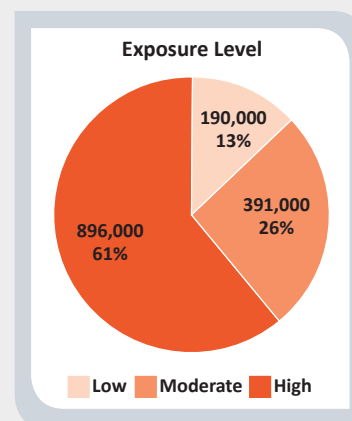
Approximately 1.5 million Canadians are exposed to solar radiation at work.

Industries with the largest number of exposed workers in Canada include:

- **Construction (all types)** (343,000 people exposed)
- **Farms** (264,000 exposed)
- **Services to buildings and dwellings** (83,000 exposed)

Occupations with the largest number of exposed workers include:

- **Farmers and farm managers** (150,000 exposed)
- **Construction trades helpers and labourers** (125,000 exposed)
- **Landscaping and ground maintenance labourers** (115,000 exposed)



Results show the majority of workers exposed to solar radiation are in the high exposure level category, with a significant number at risk for low to moderate exposure (see pie chart above). To learn more about how these exposure levels are defined, visit the [CAREX Canada website](#).

## HOW CAN EXPOSURE BE REDUCED?

Providing shade is the best way to protect workers from solar radiation. Other controls include modifying reflective surfaces, tinting windows on vehicles, and minimizing time spent in the sun during peak UV hours (11 am – 3pm). [Sun Safety at Work Canada](#) provides resources on how workplaces can develop and implement sun safety programs. For more details, visit the [OCRC exposure controls webpage](#).

## ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study quantified the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It was a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health (who led the economic analyses), University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.



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# Welding and Welding Fumes

## Burden of Occupational Cancer Fact Sheet



### WHAT ARE WELDING AND WELDING FUMES?

**Welding is the process of joining materials**, usually metals or thermoplastics. Workers who operate production welding, brazing, and soldering equipment are also included in this classification. **Welding fumes are a mixture of very fine particles** of metallic oxides, silicates, and fluorides that come from both the electrode (welding rod) and the material being welded. This mixture can also contain known and suspected carcinogens such as nickel, chromium VI, cadmium, polycyclic aromatic hydrocarbons (PAHs), benzene, and particulate matter. Significant levels of ultraviolet (UV) radiation are also produced during electric arc welding operations.

The International Agency for Research on Cancer classifies welding fumes and UV radiation from welding as **known carcinogens** (IARC 1).

### WHAT ARE ITS HEALTH EFFECTS?

- Lung cancer (welding fumes)
- Chronic bronchitis
- Metal fume fever
- Ocular melanoma (UV radiation from welding)
- Irritation to eyes, nose, throat, and bronchi
- Allergies and other respiratory problems

### THE BURDEN OF CANCER FROM WORKPLACE EXPOSURE TO WELDING AND WELDING FUMES

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.

**310**

Lung cancers due to workplace exposure to welding fumes

Approximately **310 lung cancers** and **15 ocular melanomas** are due to occupational exposure to welding fumes and welding each year in Canada respectively, based on past exposures (1961-2001). This amounts to **1.3% of lung cancer cases** and **5.4% of ocular melanomas** diagnosed annually.

### WHAT IS THE ECONOMIC IMPACT?

Work-related exposure to welding fumes resulted in approximately **\$308 million in costs for newly diagnosed lung cancer cases** in 2011.

This includes approximately:

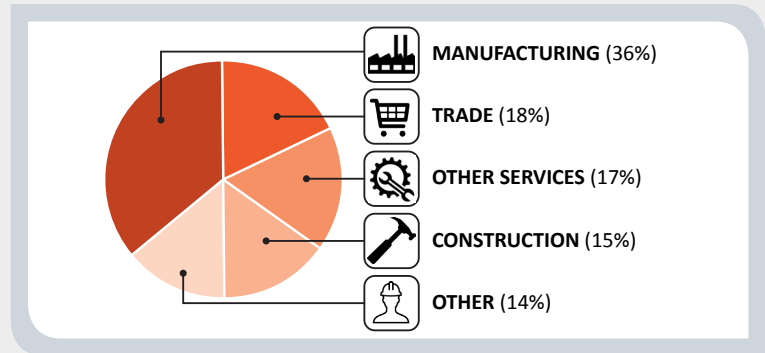
- 66% in health-related quality of life losses
- 7% in direct costs including health care, out of pocket expenses, family care giving, and workers' compensation administration
- 27% in indirect costs including output and productivity losses

**\$308 million**

Estimated yearly cost of lung cancer due to workplace exposure to welding fumes

## WHAT WORKERS ARE MOST AFFECTED?

Most occupational lung cancers associated with welding fumes occur among workers in the **manufacturing sector** (see pie chart on right). These cancers also occur among workers in the trade, other services, and construction sectors. Some of the other sectors affected include mining and oil and gas extraction, and transportation and warehousing.



## CAREX CANADA ASSESSMENT OF OCCUPATIONAL EXPOSURE TO WELDING FUMES\*

Inhalation is the most important route of occupational exposure to welding fumes. Approximately 333,000 Canadians are exposed to welding fumes at work.

Industries with the largest number of exposed workers in Canada include:

- **Machinery and equipment repair and maintenance** (26,000 people exposed)
- **Building equipment contractors** (25,000 exposed)
- **Automotive repair and maintenance** (22,000 exposed)

Occupations with the largest number of exposed workers include:

- **Welders and related machine operators** (102,000 exposed)
- **Construction trades helpers and labourers** (25,000 exposed)
- **Automotive service technicians, truck & bus mechanics, and mechanical repairers** (23,000 exposed)

*\*Note: CAREX Canada estimates of exposure were not used to develop the burden of occupational cancer estimates for welding fumes.*

## HOW CAN EXPOSURE BE REDUCED?

Local exhaust ventilation is a common engineering control for welding fumes. Other strategies include choosing materials or welding processes that generate lower amounts of gases and fumes, and isolation to reduce exposure to nearby workers. New occupational exposure limits are needed in Canada to reflect the International Agency for Research on Cancer's classification of all welding fumes as carcinogenic. For more details, visit the [OCRC exposure controls webpage](#).

## ABOUT THE BURDEN OF OCCUPATIONAL CANCER STUDY

The Burden of Occupational Cancer Study quantified the number of cancers that are caused by exposure to carcinogens in the workplace in order to identify priority areas for prevention. It was a collaboration between researchers at OCRC, CAREX Canada, the Institute for Work & Health (who led the economic analyses), University of British Columbia, Université de Montréal, Institut de recherche Robert-Sauvé en santé et en sécurité du travail, and Imperial College London.



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