Occupational Exposure Summary

Mining Sector

This report serves as a summary of CAREX Canada's results on priority exposures to known or suspected carcinogens in the mining sector in Canada. Assembling various CAREX Canada data, tools, and resources, it provides an overview of the most prevalent exposures for those working in the sector, including diesel engine exhaust, crystalline silica, solar radiation, gasoline engine exhaust, and radon. Our aim is to provide a useful guide for those looking to better understand – and help reduce or eliminate – common carcinogenic exposures associated with the mining sector.

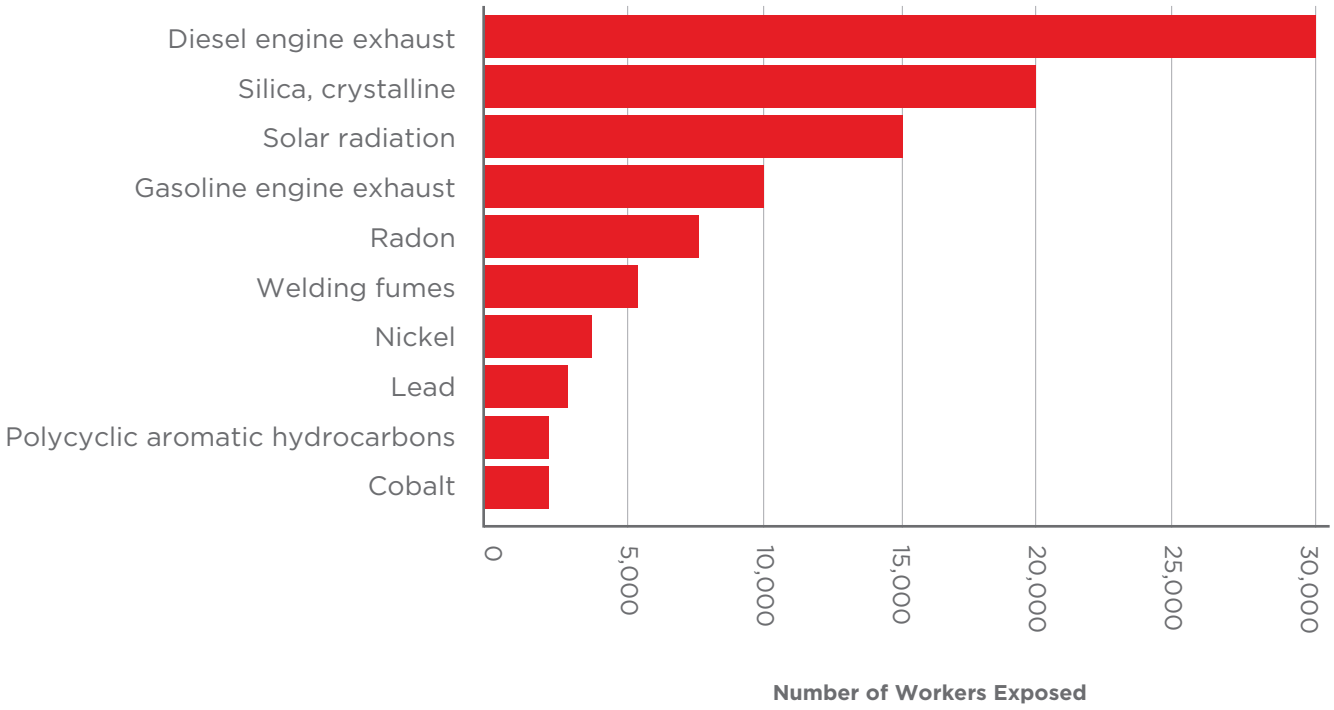
Mining sector in Canada

In 2016, the mining sector employed 74,000 workers, many of those located in Ontario (29%) and Quebec (20%). The sector is comprised of establishments that primarily engage in mining, beneficiating or otherwise preparing metallic and non-metallic minerals (including coal), and unspecified mining. Excluded from this sector are establishments that provide support services required for mining and quarrying minerals.

Estimates of prevalent exposures

CAREX Canada estimates of the number of workers exposed to carcinogens in the mining sector are summarized in Figure 1. They include diesel engine exhaust, crystalline silica, solar radiation, gasoline engine exhaust, and radon. Exposure level estimates, where available, are summarized in the Carcinogen Profiles below.

Figure 1. Top 10 prevalent carcinogen exposures for the mining sector, CAREX Canada, 2016



Notes: (1) High prevalence does not necessarily indicate a high cancer risk. For more information or assistance interpreting the data in this table, please contact us at info@carexcanada.ca. (2) Shiftwork is also an important exposure for workers in the mining sector in Canada. However, due to limited detail in the survey used to generate the estimates, shiftwork in the mining sector cannot be characterized and therefore is not included here.

We classify carcinogens based on evaluations made by the International Agency for Research on Cancer (IARC). Most of the agents listed in Figure 1 are classified as known carcinogens (IARC 1), where there is sufficient evidence linking the agent with cancer in humans.

More information, including detailed carcinogen information, exposure estimates, methods, and references, is available under the Carcinogen Profiles tab of our website

Carcinogen profiles

The CAREX Canada website contains detailed information on use, production and trade, exposure routes, and health effects for the top ten carcinogen exposures for the mining sector listed above. A sample of these are summarized below.

Diesel Engine Exhaust

KNOWN CARCINOGEN (IARC 1)

What is diesel engine exhaust?

The combustion of diesel fuel in engines produces diesel engine exhaust, a **complex mixture of gases and particulates** that 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.

What are its health effects?

Cancer: There is sufficient evidence linking diesel engine exhaust to **lung cancer**, and limited evidence for bladder cancer in humans

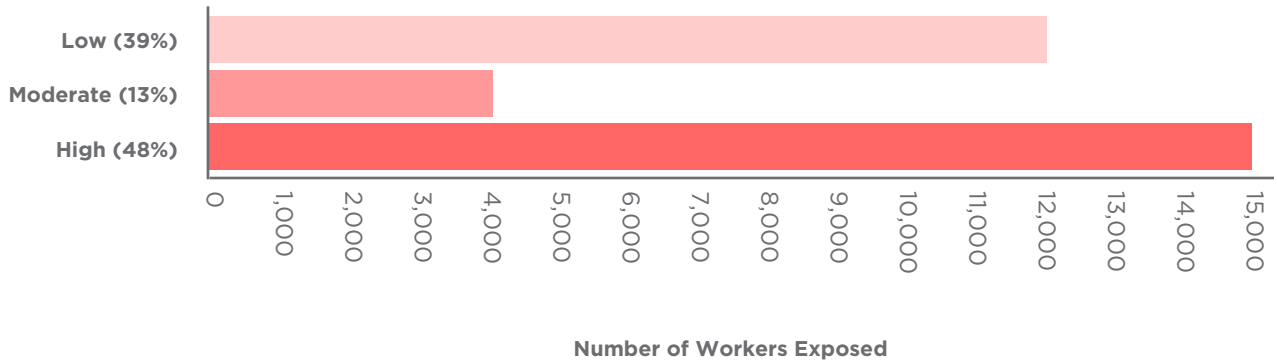
Non-cancer: Short-term exposure to diesel engine exhaust can cause irritation of the eyes, throat, and bronchi, as well as lightheadedness, nausea, and respiratory symptoms such as cough and phlegm. Diesel exhaust may initiate allergic reactions or increase immunological response to other allergens.

Occupational exposure to diesel engine exhaust

Inhalation is the most common route of exposure. Assessing exposures to diesel engine exhaust is complex because it is difficult to separate diesel exhaust from other air contaminants with similar characteristics.

Approximately 30,000 workers are exposed to diesel engine exhaust in the mining sector. Occupations with the largest number of exposed workers in this sector include **underground production and development miners, heavy equipment operators,** and **transport truck drivers.**

Workers exposed to diesel engine exhaust in the mining sector by exposure level



Crystalline Silica

KNOWN CARCINOGEN (IARC 1)

What is silica?

Silica is **one of the most common minerals on earth** and is a basic component of soil, sand, and rocks including granite and quartzite. Quartz is the most common form of crystalline silica and the most commonly used industrially. Quebec, Ontario, and Alberta are the primary silica producers in Canada, followed by Saskatchewan, British Columbia, and Nova Scotia.

What are the main uses of silica?

Crystalline silica is used in foundry castings, abrasives and sandblasting materials, hydraulic fracturing, silicon and ferrosilicon metal production, and as a filter for large volumes of water (i.e. in municipal water and sewage treatment plants). Very fine grades of crystalline silica called flours are used in the ceramic and pottery sector, in manufacturing chrysotile cement, as filler in rubber and paints, and as an abrasive in soaps and cleaners.

What are its health effects?

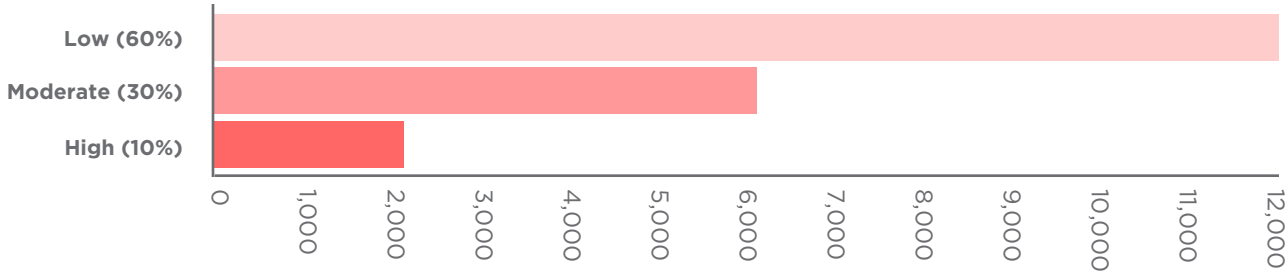
Cancer: Occupational exposure to crystalline silica is associated with an increased risk of lung cancer, with the strongest link in quarry and granite work and ceramic, pottery, refractory brick, and diatomaceous earth industries.

Non-cancer: Silicosis, a non-reversible fibrotic lung disease, is caused by inhaling crystalline silica particles. Occupational silica exposure is also linked to pulmonary tuberculosis, chronic obstructive pulmonary disease (COPD), and autoimmune disease (rheumatoid arthritis).

Occupational exposure to silica

Exposure concerns arise when silica-containing products are disturbed by grinding, cutting, drilling, or chipping, which creates respirable particles. Inhalation is therefore the most important route of occupational exposure. Approximately 20,000 workers are exposed to crystalline silica in the mining sector. Occupations with the largest number of exposed workers in this sector include **underground production and development miners; heavy equipment operators; and supervisors in mining and quarrying.**

Workers exposed to crystalline silica in the mining sector by exposure level



Solar Radiation

KNOWN CARCINOGEN
(IARC 1)

What is solar radiation?

The sun, or solar radiation, is the **main natural source of exposure to ultraviolet radiation**, and is a type of non-ionizing radiation. The southern prairies are the sunniest place in Canada, receiving approximately 2,400 hours of bright sunshine per year.

What are its health effects?

Cancer: Solar radiation is the most important cause of **skin cancer** and the most common cancer worldwide. Additional studies identify associations between solar radiation and melanoma of the eye and non-Hodgkin lymphoma.

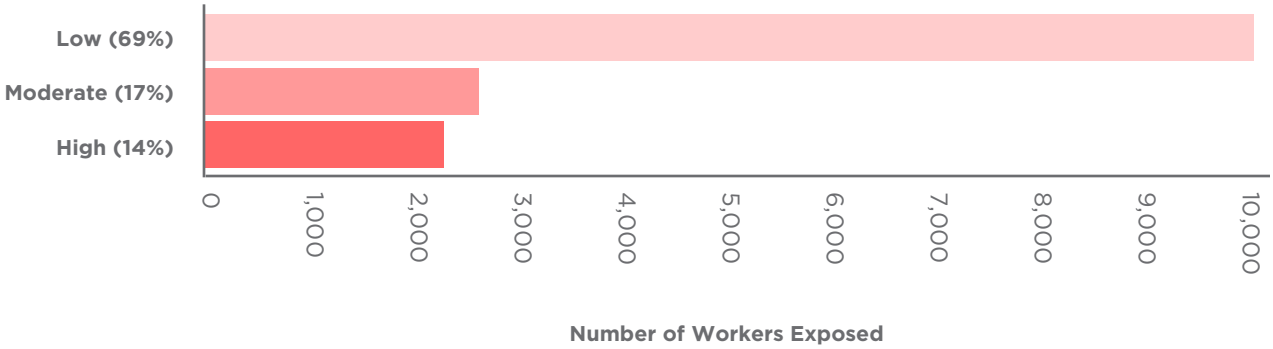
Non-cancer: Exposure to solar radiation can cause eye damage (e.g. cataracts) and skin damage (e.g. premature aging and actinic keratoses). It can also suppress the immune system, weakening the skin's ability to protect against foreign invaders.

Occupational exposure to solar radiation

Exposure to solar radiation can occur via skin or eyes. Levels of exposure vary depending on conditions related to geography, seasonality, time of day and meteorology, as well as time spent out of doors and the amount of exposed skin surface. All outdoor occupations have a potential for exposure to solar radiation.

Approximately 15,000 workers are exposed to solar radiation in the mining sector. The occupations with the largest number of exposed workers in this sector include **heavy equipment operators, supervisors in mining and quarrying,** and **heavy-duty equipment mechanics.**

Workers exposed to solar radiation in the mining sector by exposure level



eWORK

Exploring the CAREX Canada estimates

Our eWORK Tool allows users to explore CAREX exposure data by carcinogen, sector, occupation, province, sex, and exposure level. We offer two versions of the eWORK Tool: eWORK Online and eWORK Excel. eWORK Online is for users who prefer quick, accessible, yet high-quality statistics on occupational exposures to various carcinogens. eWORK Excel uses a Microsoft Excel PowerPivot interface that allows users to search for – and visualize – exposures of interest.

eWORK Online and eWORK Excel are available under the Resources tab of our website.

Reducing exposures

CAREX Canada's resources and estimates can be used to inform programs, policies, and practices related to carcinogen exposures. Identifying the priority exposure scenarios and substances for exposure reduction can help guide agenda- and priority-setting for cancer prevention.

As outlined by the **Canadian Centre for Occupational Health and Safety** (CCOHS), a variety of strategies can help protect workers from exposures to harmful substances such as carcinogens. These strategies are listed in order of effectiveness in controlling a risk.

Elimination is the most effective way to control a risk; it involves removing the hazard from the workplace. This process may also involve substitution. *An example of substitution is using lead-free paints and glazes instead of those that contain lead.*

Engineering controls minimize risk of exposure through strategic designs or modifications, which include process controls, enclosure/isolation of the source, and ventilation. *An example of a process control is using wet methods instead of dry when grinding or drilling to reduce dust.*

Administrative controls alter the way the work is done through rules or policies. *An example of an administrative control is shorter work times in areas where exposure may occur.*

Personal protective equipment (PPE) provides a barrier between the worker and the hazard. *Examples of PPE include respirators, eye protection, face shields, gloves, and footwear.*

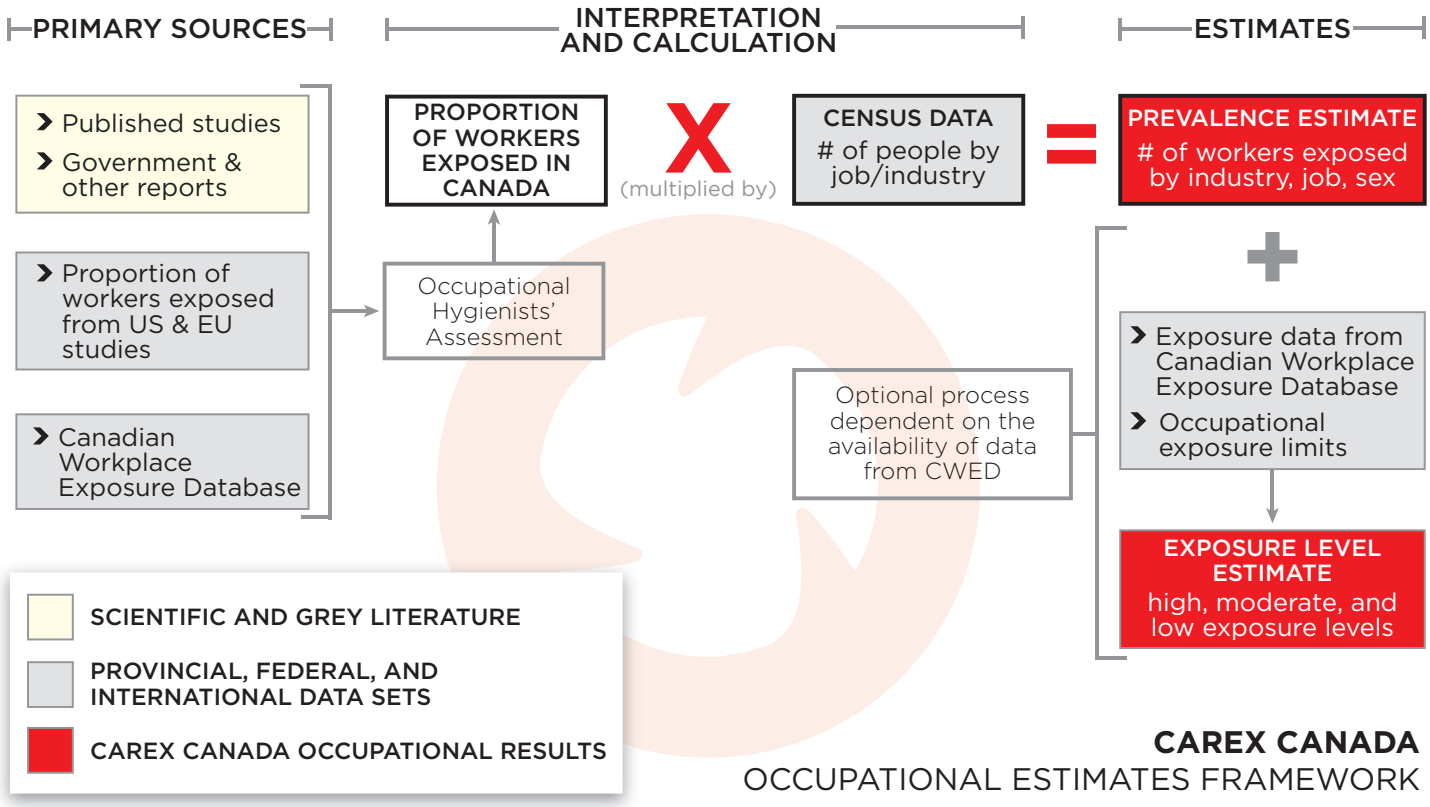
A compilation of additional exposure reduction resources, including the Canadian Partnership Against Cancer's Prevention Policies Directory and the Canadian Cancer Society's Cancer Information portal, is available on our website.

Methods

The goal of the CAREX Canada project is to estimate Canadians' potential exposures to known and suspected carcinogens in the workplace, prioritizing agents that are most relevant to Canadians. Estimates of the numbers of workers exposed to these agents are calculated by sector, occupation, province, sex, and level of exposure (where data are available). They are developed using information gathered in a scientific literature review, data included in the Canadian Workplace Exposure Database (CWED), information from previous CAREX projects in Europe, Canadian-specific information on exposure from government and other sources, and CAREX occupational hygienists' expert assessment. Most of our estimates use the 2016 Census of Population, with some exceptions noted in our documentation. CAREX Canada's general approach to producing occupational prevalence and exposure level estimates is summarized in Figure 2.

More information on our methods and data is available under the Carcinogen Profiles tab on our website

Figure 2. CAREX Canada's occupational estimates framework



Relevant publications and reports

IARC Monographs Volume 105: Diesel and Gasoline Engine Exhausts and Some Nitroarenes | International Agency for Research on Cancer, 2013.

IARC Monographs Volume 100C: A Review of Human Carcinogens: Arsenic, Metals, Fibres, and Dusts | International Agency for Research on Cancer, 2012.

IARC Monograph Volume 100D: A Review of Human Carcinogens: Radiation | International Agency for Research on Cancer, 2012.

CAREX Canada: An enhanced model for assessing occupational carcinogen exposure | Peters CE, Ge CB, Hall AL, Davies HW, Demers PA. Occup Environ Med. 2015;72(1):64-71.

Prevalence of exposure to solar ultraviolet radiation (UVR) on the job in Canada | Peters CE, Nicol AM, Demers PA. Can J Public Health 2012;103(3):223-26.

Exposure-response estimates for diesel engine exhaust and lung cancer mortality based on data from three occupational cohorts | Vermeulen R, Silverman DT, Garshick E, Vlaanderen J, Portengen L, Steenland K. Environ Health Perspect. 2014;122(2):172-177.

CAREX Canada is hosted at Simon Fraser University and is funded by the Canadian Partnership Against Cancer

CANADIAN PARTNERSHIP AGAINST CANCER | PARTENARIAT CANADIEN CONTRE LE CANCER

Where can you learn more?

Visit our website at www.carexcanada.ca

Follow us on Twitter @CAREXCanada

Email us at info@carexcanada.ca

Acknowledgments for photos: Roy Luck, Helen Wilkinson, and Tony Alter

CAREX CANADA

DECEMBER 2021