Workplace Safety North™

Hazards Associated with Diesel Exhaust Emissions:

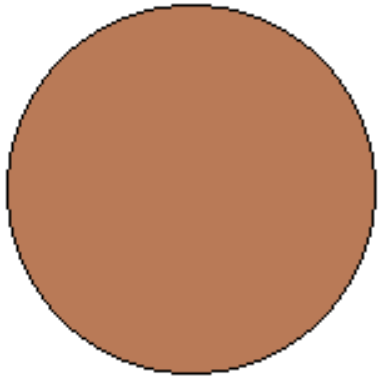
A resource for all industries

1.888.730.7821 (Toll free Ontario)
workplacesafetynorth.ca

Learning objectives

- Understand the composition of diesel and reasons it is dangerous
- Discuss the debilitating effects (short-term and long-term) of diesel exhaust inhalation
- Identify sources of diesel in various industries
- Read and recognize legislation applicable to diesel-powered equipment use
- Apply the RACE principle to curb the negative effects associated with diesel exhaust emissions

How Small is a Diesel Particle?



Tip of a hair strand
50 micron

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Diesel particulate
Less than 1 micron

Why is DPM Dangerous?

- Diesel is a Group 1 substance according to the World Health Organization: definite carcinogen (vs. Group 2 – potential carcinogen – which was its designation until 2012)

- Animal lab tests have shown lung tumours grow in those exposed to diesel particulate matter (DPM)

How DPM Looks to Us

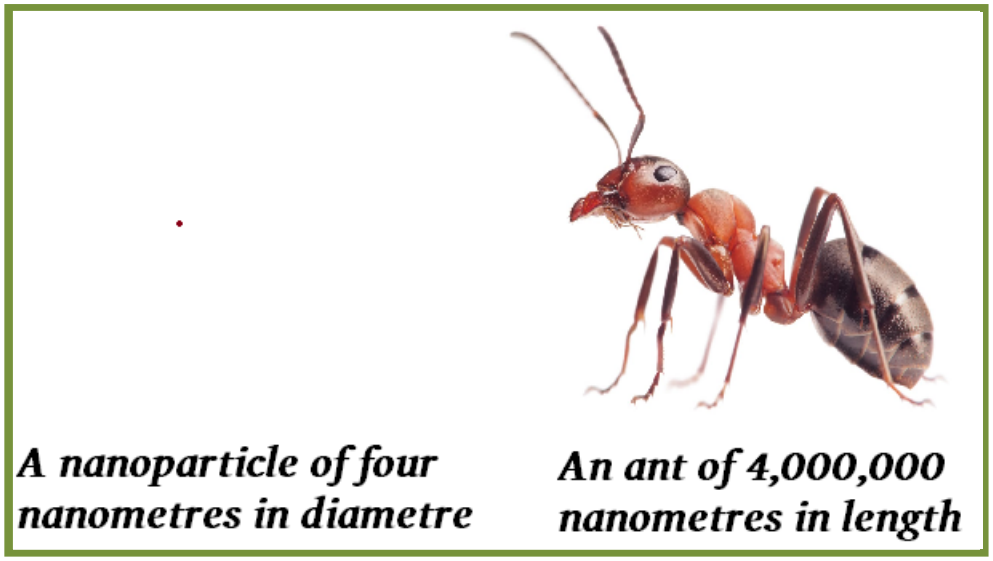
- *En masse*, emissions look the same as car exhaust (black/grey/blue smoke)
  - **You do not need to see smoke to be in danger!**
- Made of gases, vapours, mist, and particulates (soot):
  - Gas: CO2, CO, NO, Sox, PAHs
  - Soot: C, PAHs, metallic compounds
- A number of negative PAHs are in diesel particulate matter (DPM).

What DPM Does to Us

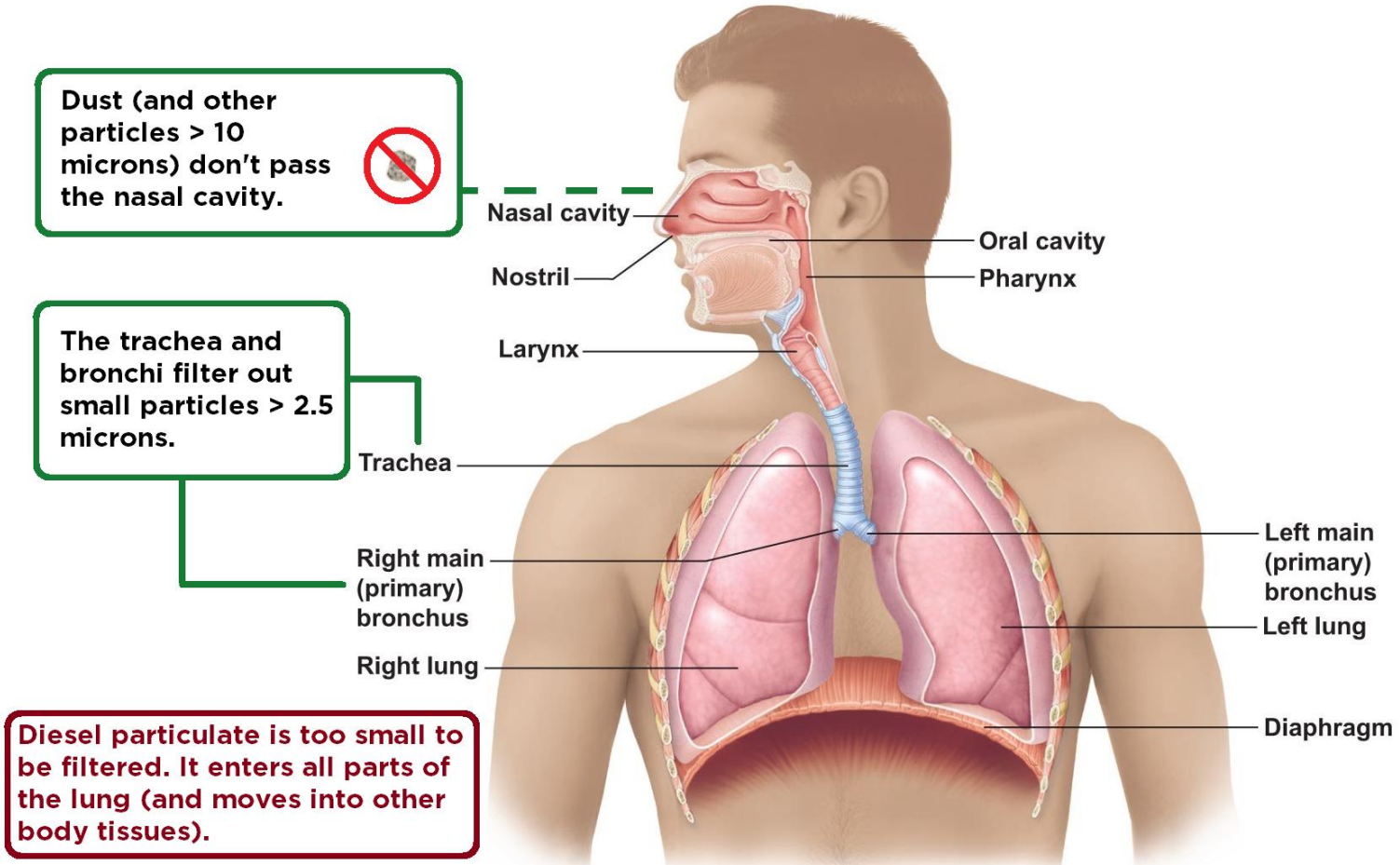
- PAHs affect *skin, liver, immune system*
  - Formed when coal, oil, gas, garbage, and tobacco are burned
  - Some PAHs may be carcinogenic

More on Diesel Composition

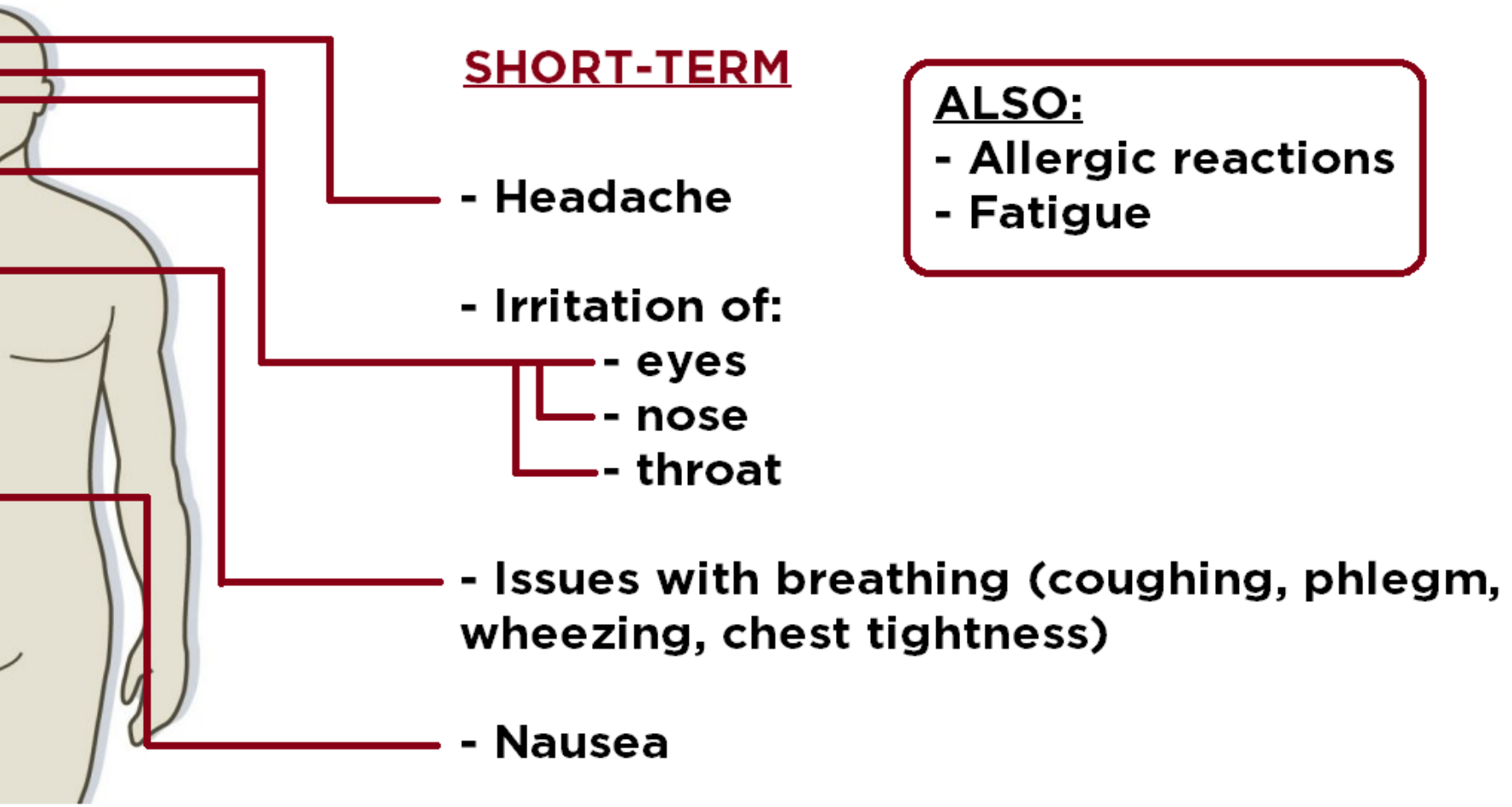
- DPM is made of both solid and liquid aerosol particles of varying sizes (as small as 50 nanometres in size)
  - That's 0.00005 millimetres!
- Several known carcinogens are in DPM



Dangers of Diesel Exhaust



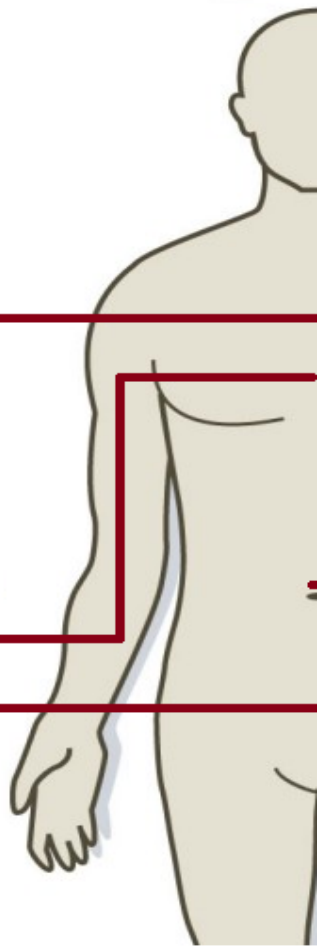
Diesel Exhaust's Short-Term Effects



Diesel Exhaust's Long-Term Effects

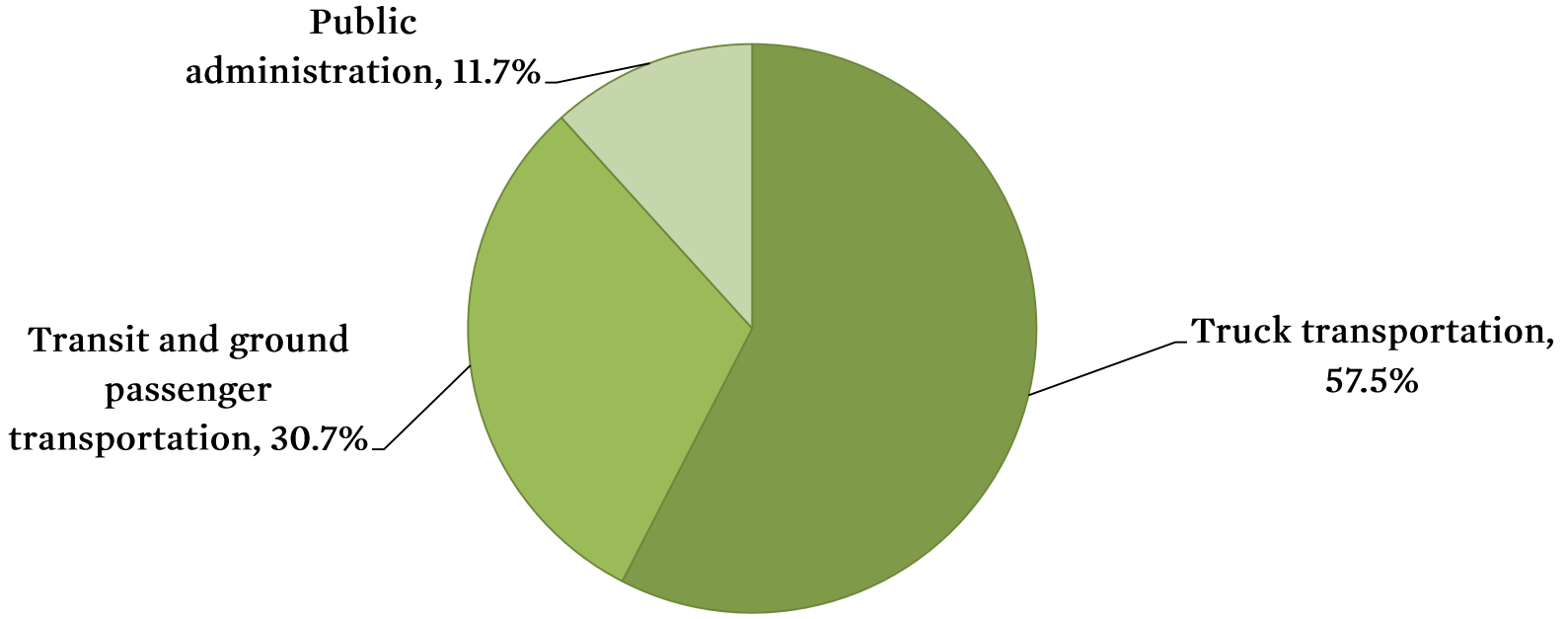
LONG-TERM

- Potential development of asthma
- Aggravated existing respiratory conditions and allergies
- Lung disease
- Lung cancer
- Cardiovascular disease
- Bladder cancer



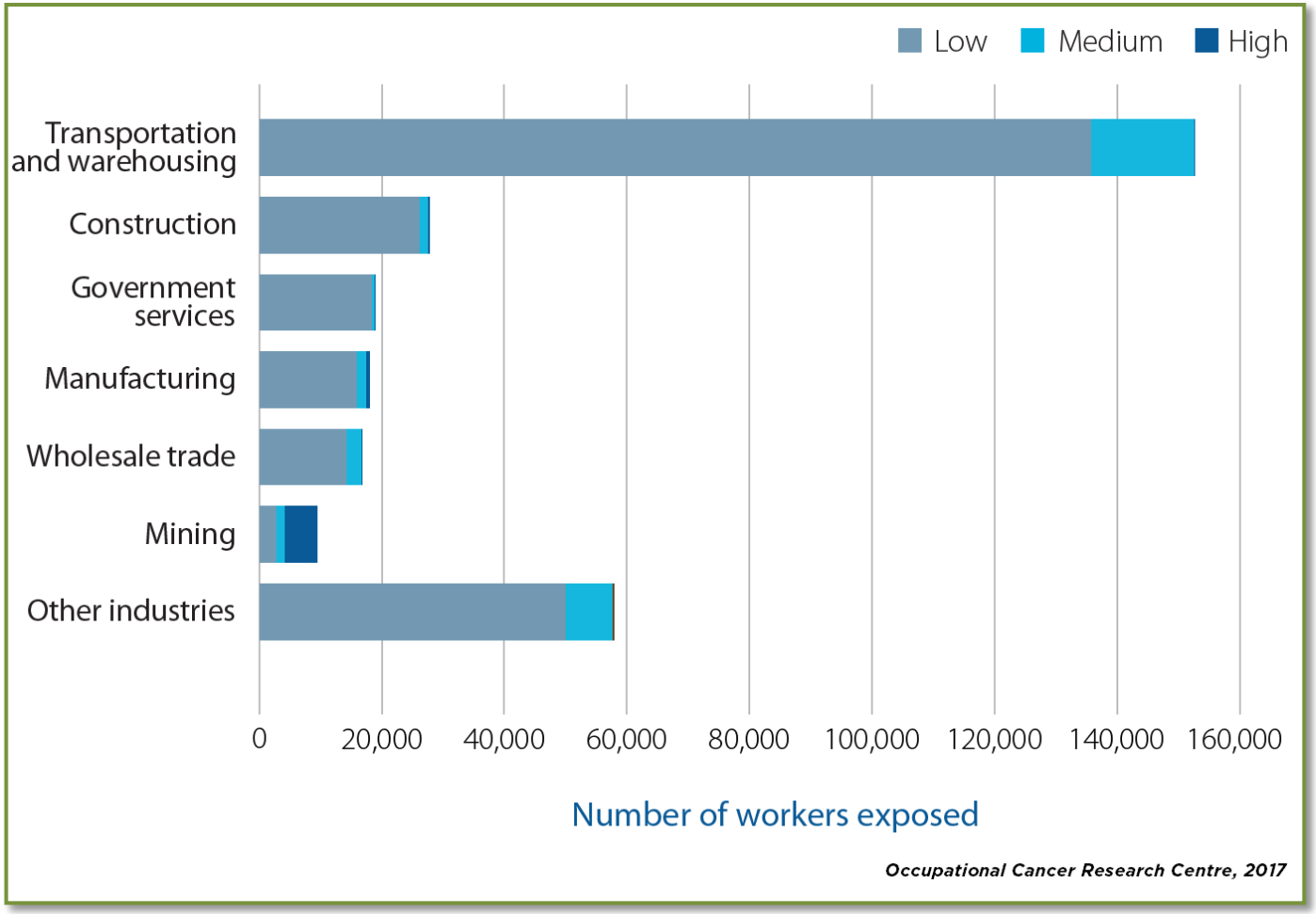
Some Canadian Facts

Approximately 897,000 Canadians are exposed to diesel engine exhaust per year. The top three affected industries contains 358,000 of those affected. They are:



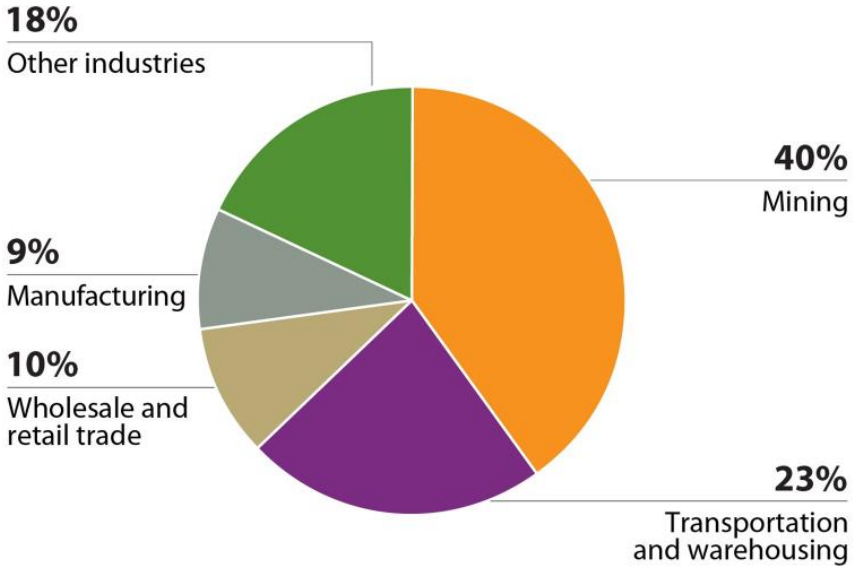
Approximately 301,000 of these workers are in Ontario and comprise about five percent of the province's working population.

Why is Diesel Exhaust Important to Me?

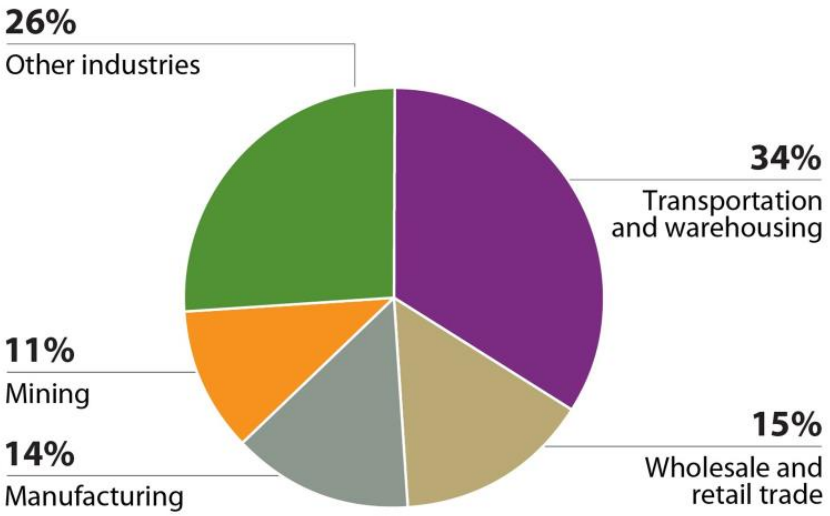


Looking at Cancers from Diesel Exhaust in Ontario

Industry breakdown of total lung cancers attributed to occupational exposure



Industry breakdown of total bladder cancers that may be attributed to occupational exposure



Visit http://www.occupationalcancer.ca/2017/news-occupational-burden-ontario-report/ for more information!

Time for some diesel emissions trivia!
(10 question-and-answer combinations to follow)

Question #1

<u>True or False:</u> The 301,000 workers who are exposed to diesel emissions in Ontario are the only ones affected by diesel exhaust.

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FALSE

That number only speaks to those exposed as a result of their work. This number only includes those in the industries we have spoken about.

Question #2

One group particularly threatened by diesel exhaust is _____.

<u>Hint:</u> Think of a generational category.

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Hint: Think of a generational category.

CHILDREN

"Children are also especially vulnerable to air polluted with diesel exhaust. They generally spend a lot of time outside actively playing and inhale proportionally more air than adults. Many are transported to school in diesel-fueled school buses adding to their exposure burden."

Workers Health and Safety Centre

Question #3

<u>True or False:</u> Researchers and public health authorities report <u>hundreds</u> of Canadians will suffer premature death annually because of exposure to diesel exhaust.

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FALSE

(or true, depending on how you look at it)

"Researchers and public health authorities report <u>thousands</u> of Canadians will suffer premature death annually because of exposure to diesel exhaust."

<u>Workers Health and Safety Centre</u>

Question #4

A Health Canada study found more than ___ people died prematurely in 2015 because of exposure to diesel exhaust from vehicles.

(Hint: It's in the hundreds.)

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A Health Canada study found more than ___ people died prematurely in 2015 because of exposure to diesel exhaust from vehicles.

(Hint: It's in the hundreds.)

700

"[In 2016], a Health Canada study found more than 700 people in Canada died prematurely in 2015 because of exposure to diesel exhaust just from vehicles, including about 400 attributed directly to black carbon. That doesn't include the number of premature deaths that could be caused by exposure to other sources of black carbon including diesel generators."

The Hamilton Spectator

Question #5

Diesel engine exhaust is a prevalent lung carcinogen, causing almost ___ cases of lung cancer annually in Ontario.

(Hint: It's in the hundreds.)

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(Hint: It's in the hundreds.)

200

Diesel engine exhaust is a prevalent lung carcinogen, causing almost 200 cases of lung cancer annually in Ontario. Reducing exposure to diesel exhaust will lead to fewer lung cancers. Further regulation is needed to effectively protect workers from this exposure.

Cancer Care Ontario

Question #6

In Canada, diesel-powered vehicles are the main source of black carbon, which is ____ times more potent as an environment warming agent than carbon dioxide.

(Hint: It's in the thousands.)

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(Hint: It's in the thousands.)

3,200

"In Canada, diesel-powered vehicles are the main source of black carbon, which is ____ times more potent as an environment warming agent than carbon dioxide."

The Hamilton Spectator

Question #7

In non-occupational settings, diesel exhaust causes an estimated ___% of lung cancers simply through its presence in general air pollution.

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4.8%

"An increased risk of lung cancer is present even at very low levels of exposure. For example, in non-occupational settings, diesel exhaust causes an estimated 4.8% of lung cancers simply through its presence in general air pollution."

Cancer Care Ontario

Question #8

<u>True or False:</u> City buses are the only municipal transit service relying on diesel-powered vehicles.

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FALSE

"If you're a regular GO Transit commuter and you're concerned about your health, you may want to start sitting at the back of the train. New research from the University of Toronto has found that in some circumstances passengers on commuter trains are at risk for exposure to 'markedly high levels' of carcinogenic diesel exhaust."

Toronto Star

Question #9

A 2005 study indicated air pollution in the province (including diesel, but counting other pollutants) results in ____ premature deaths and $____ billion in health and environmental costs annually.

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5,800; $9.6 billion

"Based on a multi-year and multi-party study commissioned by the Government of Ontario and released in 2005, the cost of air pollution in Ontario includes 5,800 premature deaths and $9.6 billion in health and environmental costs annually. Thousands more Canadians suffer from respiratory illnesses such as bronchitis and asthma due to the poor air quality."

Green Energy: Basic Concepts and Fundamentals

Question #10

<u>True or False:</u> Ontario currently has legal occupational exposure limits for whole diesel exhaust and diesel particulate matter.

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<u>True or False:</u> Ontario currently has legal occupational exposure limits for whole diesel exhaust and diesel particulate matter.

FALSE

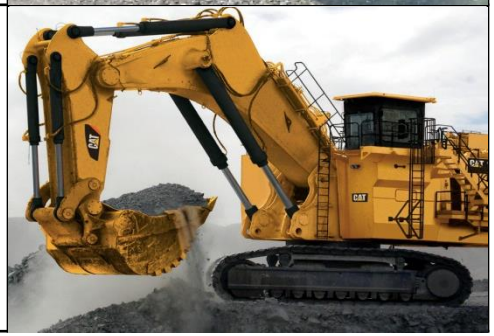
"Ontario and other jurisdictions in Canada have no legal occupational exposure limits for whole diesel exhaust or diesel particulate matter. Though, Ontario has established allowable exposure limits for many of the gaseous compounds in diesel exhaust… in the regulation respecting the Control of Exposure to Chemical and Biological Agents."

Workers Health and Safety Centre

Other Reasons for its Importance

- "Diesel is the main source of electricity for more than 200 remote communities in Canada, including *every Inuit community in both Nunavut and the Northwest Territories*."
- A study that looked at occupational diesel exhaust exposure from 1961 to 2001 – where 1.4 million people were exposed – found that *1 in 20 men* and *1 in 37 people overall* diagnosed with lung cancer from occupational exposure were specifically affected by diesel exhaust.
- A UBC study found that short-term exposure to diesel exhaust can affect the coating on DNA. ***See the study here!***
- *Regulation 854: Mines and Mining Plants* is the only Ontario legislation regulating exposure to diesel exhaust, particularly.
  - *It permits three times higher levels of exposure to other international occupational exposure limits in Australia and the United States.*

Examples of Diesel-Fueled Equipment in Various Industries

Lift Trucks		**Dump Trucks**	
Pickup Trucks		**Bulldozers**	
Backhoe Loaders		**Excavators**	

What does the Ontario Law have to say about Diesel Exhaust Emissions? (1)

- **Reviewing parts per million**
  - One penny in $10,000
  - One minute in two years
  - One dime in a stack of pennies, one mile high
- **Regulation 833:**
  - Information in occupational exposure tables either from table in Regulation, or from ACGIH

What does the Ontario Law have to say about Diesel Exhaust Emissions? (2)

Occupational Exposure Limits for Ontario Workplaces

Agent	TWA	STEL
Carbon dioxide	5,000 ppm	30,000 ppm
Carbon monoxide	25 ppm	
Nitrogen dioxide	3 ppm	5 ppm
Diesel fuel as total hydrocarbons	100 mg/m^3 (inhalable fraction and vapour)	

Regulation 854, Mines and Mining Plants:

183.1(5) *The flow of air must,*

(a) reduce the time-weighted average exposure of a worker to total carbon to not more than 0.4 milligrams per cubic metre of air; or

(b) reduce the time-weighted average exposure of a worker to elemental carbon, multiplied by 1.3, to not more than 0.4 milligrams per cubic metre of air.

* Mining industry expectations

Applying the RACE Principle to Diesel Exhaust Emissions Safety

Recognize → Assess → Control → Evaluate Controls

<u>Other Means to Assist with Safety:</u>

- ✓ Eliminate
- ✓ Substitute
- ✓ Engineering Controls
- ✓ Administrative Controls
- ✓ Use Personal Protective Equipment

Control #1: Eliminating Diesel Emissions Hazards

- Elimination:
  - **Most effective practice**
  - Key way to eliminate diesel exhaust issues is to replace diesel-powered equipment with electric or battery-powered equipment

Can you think of any equipment in your workplace that relies on electricity or battery power (instead of diesel)?

List possible pros and cons to altogether eliminating diesel-powered equipment in the workplace.

Control #2: Substituting for Diesel Emissions Hazards

- Not as effective as **elimination** strategies, but still effective
  - Replacing engines and other equipment pieces
  - Rebuilding engines with upgrade kits
  - Alternative fuels (e.g.: biodiesel)

Are you aware of whether diesel-powered equipment in your workplace has had work done to it, such as the replacement of its engines or exhaust manifolds?

Share whether you were aware of upgrading kits for engines on diesel-powered equipment, and state some experiences you may have had with witnessing or working with these upgrade kits.

Control #3: Engineering Controls for Diesel Emissions Hazards

- Also implemented through adjustments to diesel-powered equipment or to general infrastructure at the mine worksite

- Engineering controls include:
  - Aftertreatment system additions (including **diesel particulate filters** and **diesel oxidation catalysts**)
  - Idling technology

Does your workplace rely on any of these engineering controls for its diesel-powered equipment?

So How Does a DPF Work, Anyway?

- Particulate matter (PM) retained in a chamber while vehicle is operating
- *Regeneration* – when filter is full, heat is injected into the chamber to burn off the PM
- Can reduce PM emissions by over 90 percent!
- Available for all types of diesel-powered equipment (lift trucks, backhoes, transports, etc.)

Control #4: Administrative Controls (The Facts)

- Routine maintenance can decrease particulate matter emissions by up to 55% on certain machines
- Tune-ups on ‘gross smoke emitting’ vehicles reduce emissions by an average of 40%
- Clogged air filters cause a 40-50% increase of emissions
- Excess oil consumption (most often preventable through maintenance) causes a 100% increase in emissions
- Lubricant oil consumption causes up to 85% higher emissions

Using Administrative Controls for Diesel Emissions Hazards

- Routine maintenance of machinery is one effective administrative control

How could we make sure equipment operators recognize the need for maintenance on the machine with which they work?

Apart from reduced emissions, what other benefits could result from routine equipment maintenance?

How an Effective Health and Safety Culture Enhances Administrative Controls

- Administrative controls are less effective than elimination, substitution, and engineering controls, but they are more commonly implemented
- The role of *the worker* in ensuring success of administrative controls is paramount
- Characteristics of a strong health and safety culture:
  - Trust, ongoing communication, respect, openness, encouragement to report and discuss potential hazards, competence, commitment from all parties

Control #5: Personal Protective Equipment

- Remember: PPE is **not** a replacement for other controls.
  - Air quality still must meet regulatory standards
- Respirators are one example of PPE
  - Training must be provided to workers to use these things properly
- Impervious gloves should also be used if topical exposure to diesel fuel could happen; it is also a skin irritant according to Regulation 833

What issues could result in ineffective use of respirators?

What other things about respirator use need to be in place to make them most effective?

Evaluating Controls (The End of the RACE)

Kidding. The RACE never ends!