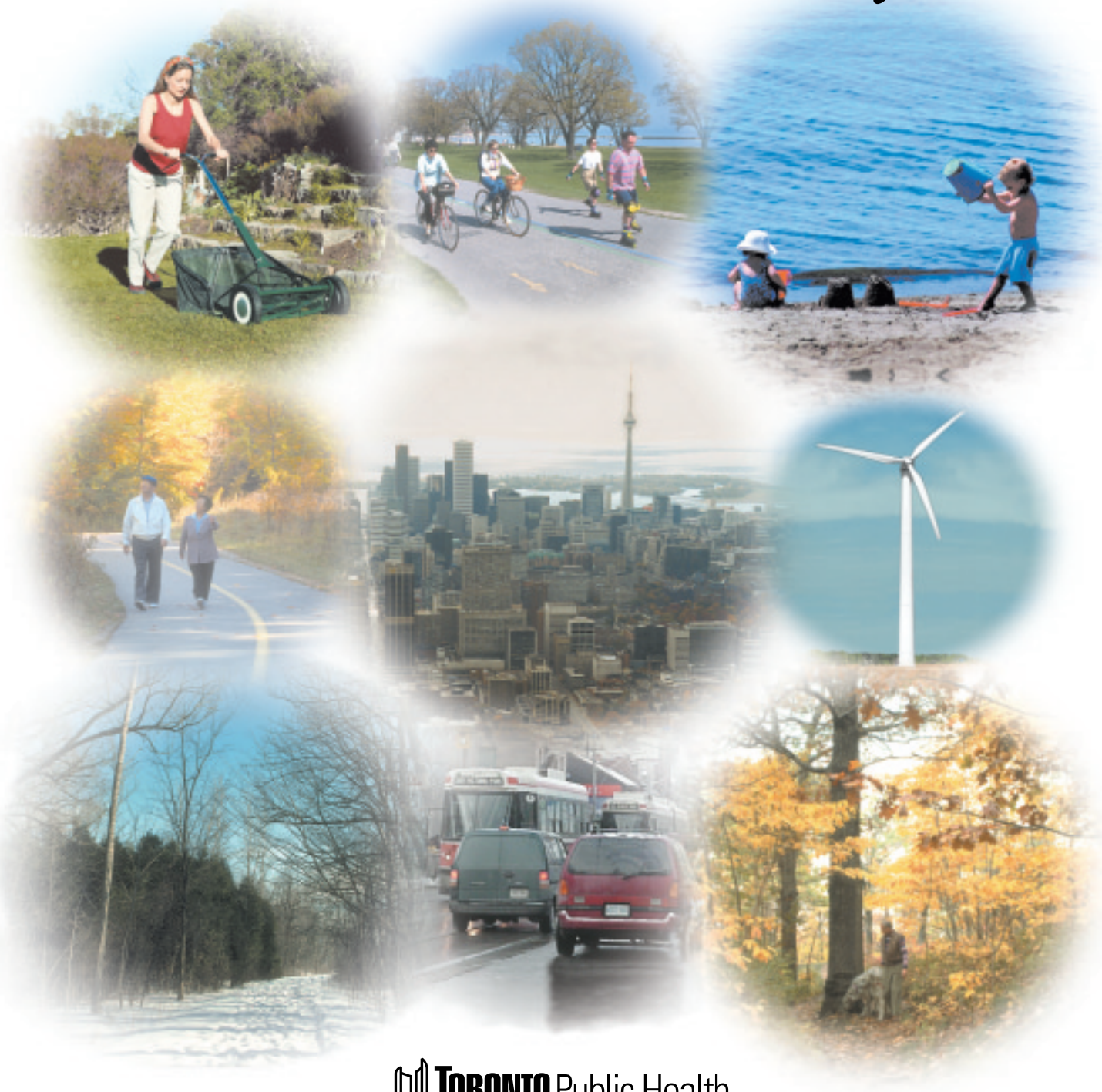
Toronto's Air:

Let's Make It Healthy



TORONTO Public Health

Toronto's Air: Let's Make it Healthy

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TORONTO Public Health

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About this report

This report provides information on the serious impact of air pollution on the health of people living in Toronto. It is our hope that this report will serve as a catalyst for further action to improve the air quality not only in the city, but also in the whole region.

The report summarizes results from the May 2000 Toronto Public Health study: *Air Pollution Burden of Illness in Toronto*. It includes an overview of air quality trends and pollution sources in the Toronto. It indicates some of the initiatives the City has already taken to help improve Toronto's air quality and points to additional actions that will be needed to reduce the adverse impact of air pollution in Toronto.

The City of Toronto is embarking on a project: *20/20 - A Clear View to Clean Air*. This initiative will encourage a network of partners to join forces on a journey towards cleaner and healthier air.

About the Health Promotion & Environmental Protection Office

The Health Promotion & Environmental Protection Office promotes improved environmental quality in Toronto. It aims to reduce and prevent the adverse health effects experienced by the residents of Toronto that are the result of pollution. We promote health and protect the environment through research, advocacy and education. We encourage governments, the private sector and the public to take actions that will lead to a cleaner environment.

About the project team:

This report was written by Ronald Macfarlane with help from Monica Campbell, Lorraine Fung, Angela Li-Muller, Carol Mee, David Pengelly, Kim Perrotta, Franca Ursitti and Jane Ying.

Copies of this report or of the technical report *Air Pollution Burden of Illness in Toronto* are available from:

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To find out more about us or about what to do about air pollution in Toronto:

Visit our website http://www.city.toronto.on.ca/health/
Or
Contact us at 416-392-6788

1 Our City, Our Air, Our Health

Air pollution in Toronto is causing illness and earlier death

The quality of Toronto's air is affected by many factors. Industry is a source of pollution, but our daily activities such as travelling in a car or bus and heating or cooling our homes also create pollutants. Air does not stay in one place. Winds will carry pollutants with them. Since Toronto is situated in the densely populated Great Lakes Basin, our air is also affected by human activity beyond the city as far away as the Ohio Valley in the USA.[1]

The potential impact of air pollution on health was highlighted in the great London Fog of 1952 when 4,000 people died.[2] Since then many studies have been done to better understand the effects of the major air pollutants on our health. The levels of pollution in Toronto are now much lower than those experienced during the London Fog or other similar air pollution episodes. Yet, there is strong evidence that human health is affected by the low levels of air pollution that are commonly found in Toronto.[3] The Ontario Medical Association has recently estimated that the health cost of air pollution in Ontario is more than 1 billion dollars each year.[4]

Toronto Public Health has recently completed a study that used the most up-to-date data to estimate the number of deaths and hospital admissions in the City of Toronto.[5] This confirmed that air pollution contributes to poor health. Each year in Toronto, air pollution adds about 1,000 early-deaths and 5,500 admissions to hospitals, even when the air quality index (AQI) indicates the quality of the air is "good" or "very good" 95 per cent of the time.

Air pollution affects all people, not only the sick and the elderly

Air pollution at levels often experienced in the City of Toronto can increase difficulty in breathing, cause coughing or wheezing, and worsen both heart and lung disease. These effects can result in an increase in the number of visits to the doctor or hospital, use of medication, hospital admissions, and even early-death. For sensitive individuals, such as asthmatics and other people with respiratory problems, any increase in pollution

The Main Pollutants in the Great Lakes Region

Ground-level ozone
Particles
Acid aerosols
Nitrogen oxides
Sulphur oxides
Polyaromatic hydrocarbons (PAHs)
Volatile organic compounds (VOCs)

makes their illness more severe. Healthy people are also affected if they do strenuous activities, such as construction work or cycling. These effects not only last during the times of high pollution, but can also cause long-term damage.

The respiratory system is most vulnerable to air pollutants, although airborne lead, pesticides and volatile organic compounds can be absorbed and cause damage to other organs in the body.[6] When trying to find out the effects of pollutants, air pollution studies have sometimes focussed on specific pollutants. At other times it has not been possible to separate out the combined effects of various substances found in the air. The main airborne contaminants in the Great Lakes region include ground-level ozone, particles, acid aerosols, nitrogen oxides, sulphur oxides, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs).[7] The first five are referred to as criteria pollutants, and the last two are described as toxic contaminants.

In Toronto, motor vehicles are the largest source of harmful air pollutants

Although poor air quality is often associated with summer smog, data show that air pollution affects us all year. In Toronto, nitrogen dioxide is the air pollutant linked with

the most early-deaths and hospitalizations. This pollutant is present at higher levels in the winter than in the summer.[8]

One major source of criteria pollutants is the burning of fossil fuels such as oil, gasoline, diesel, and coal in our furnaces, cars, trucks and in industry. In Toronto, transportation is the most important source of these pollutants. The air in Toronto is also affected by emissions from coal-fired electricity generation in Ontario and the USA.

Change is needed before the air quality in Toronto can improve. These include reduced reliance on the private automobile for transportation, which would be made easier with improved public transit in the short-term and a more compact urban form in the long-term. Stricter emission standards for cars and reduction of the allowable levels of sulphur in fuels will also help. Using natural gas instead of coal in electricity generating stations, as well as limiting the total amount of pollution released every year (emission caps), are other ways to address pollution from major sources outside of Toronto. Greater energy efficiency and use of alternative energy sources will help clean the air and reduce the emission of carbon dioxide, an important greenhouse gas. These gases add to global warming and climate change.

Greenhouse Gases

The term greenhouse gas is used to describe pollutants in the air that help trap the heat in the air. Carbon dioxide is the major greenhouse gas. Human activity has increased the amount of carbon dioxide in the air by so much that scientists predict that this will change the climate. Other greenhouse gasses include chlorofluorocarbons (CFCs), methane, nitrogen oxides and sulphur dioxide. (See section 3.8 for more information on the health impact of climate change).

Criteria Pollutants

Carbon monoxide (CO)
Nitrogen dioxide (NO_2)
Ozone (O_3)
Sulphur dioxide (SO_2)
Suspended particles (SP or PM_{10})

2 Air Pollution and Illness in Toronto

There is strong evidence that air pollution caused by ozone, airborne particles and acid aerosols are linked to various illnesses and breathing problems in Toronto. Days with high levels of pollution result in higher hospital admissions and early death. Health effects of air pollution also include difficulty in breathing, coughing, wheezing, and worsening of heart and lung diseases. Long-term effects such as making breathing more difficult (reduced lung function) are hard to assess, but also of great concern.

Pollutants considered

To better understand how many people are affected by air pollution in Toronto, Toronto Public Health looked at six pollutants for which there was enough information to calculate the number of people affected by a certain level of pollution. These are carbon monoxide (CO), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), fine particles (PM_{10}) and sulphates (SO_4).

Calculating the Effects of Air Pollution

From studies that measured levels of pollution and compared these to various health effects, Toronto Public Health estimated how many early-deaths or hospitalizations each unit of pollution could possibly cause. By multiplying the level of pollution for each day with the effect of each unit this gave the number of deaths or hospitalizations that occurred on any given day. These were then added up to give a total for a given year.

Toronto Public Health used results from studies across the world and applied these to calculate the number of people who died or were admitted to hospital in Toronto due to each of the pollutants. These were then added up to give a total for 1995, the most recent year for which reliable data is available.

Since we are exposed to more than one pollutant at a time, this method can over-estimate the impact of air pollution. Toronto Public Health therefore also calculated effects using a multi-pollutant method. However, since this second method considered fewer types of health problems, it probably underestimated the total impact. The numbers reported by Toronto Public Health for the total impact of air pollution on the people of Toronto are halfway between the low and high values given by each of these methods.

The number of early-deaths and hospitalizations in Toronto

The results of these calculations were made public in May 2000 in the report: *Air Pollution Burden of Illness in Toronto*. Using data from 1995, Toronto Public Health estimates that, as the result of air pollution, about 1,000 people died earlier than expected and 5,500 hospital visits were linked to heart or lung diseases. Given that the air quality in Toronto has not improved since that time, Toronto Public Health believes that these estimates apply to the situation today.[9]

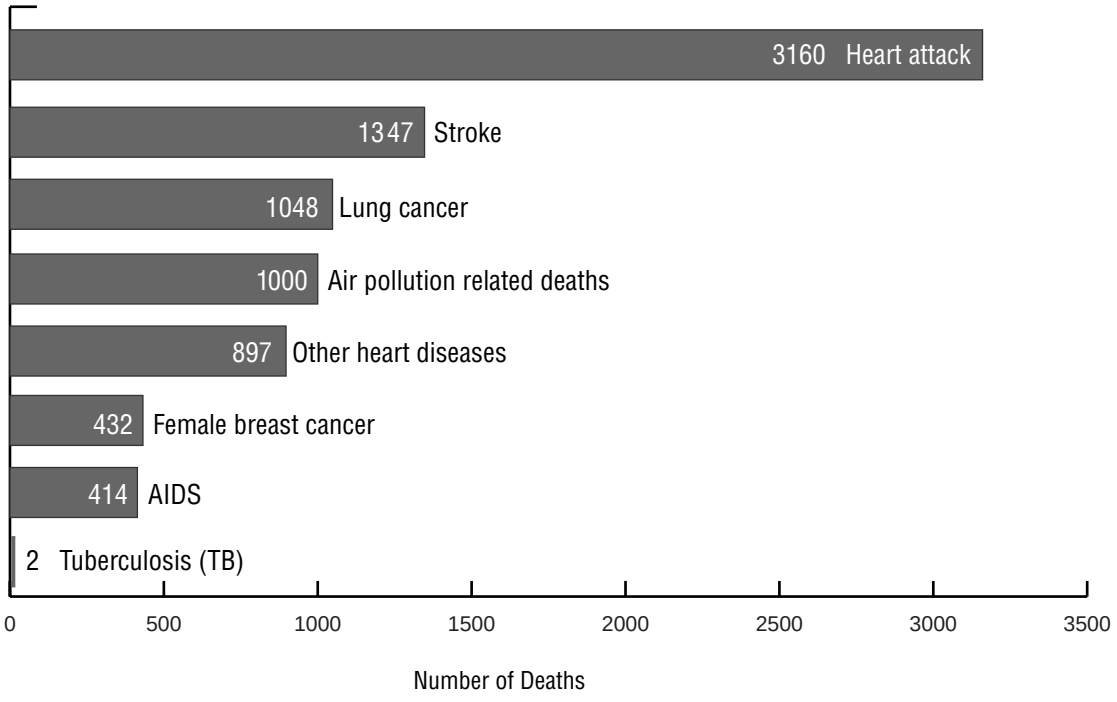
Air pollution in Toronto is linked to 1000 early-deaths and 5,500 hospital admissions every year

Air pollution compared to other causes of illness or death

The importance of air pollution on health can be seen if we compare the number of deaths from air pollution to those from other causes. In 1995, air pollution in Toronto was linked to about the same number of deaths as lung cancer. It leads to more deaths than such important diseases as breast cancer or AIDS. Similarly, hospital admissions related to air pollution were more than twice the number of reports of food borne illness.

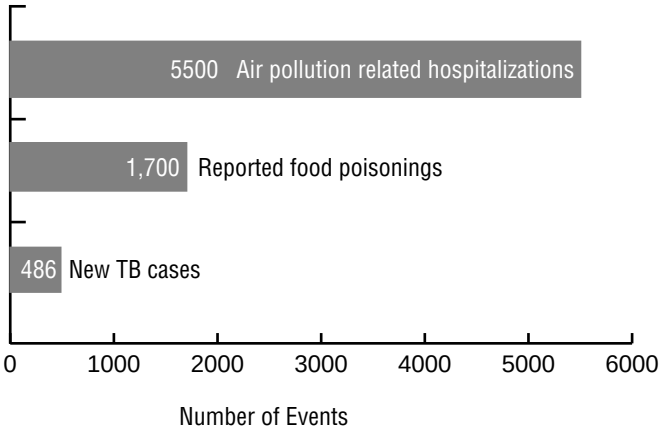
Pollution is an important cause of death and disease

Figure 1
Number of deaths due to various causes in Toronto in 1995



Source: Toronto Public Health.

Figure 2
Comparison of selected illness events in Toronto in 1995



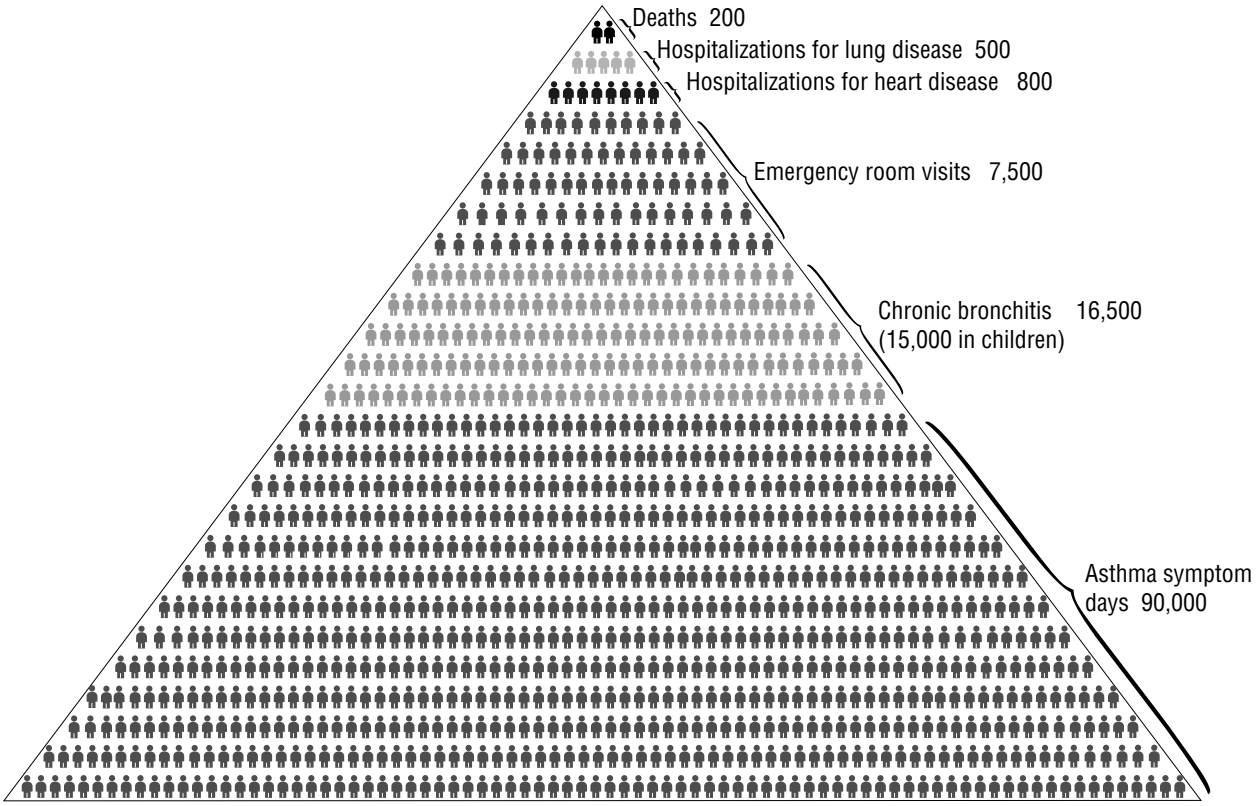
Source: Toronto Public Health.

The pyramid of effects

Data available show only part of the total impact of air pollution on health

The data available shows only part of the total impact of air pollution on health. Most studies have looked at the increase in number of deaths or hospital admissions. This is because records of these more severe effects are more readily available and reliable. They represent the more severe impacts of air pollution, but do not give the whole picture. They form the top of the pyramid of effects, with fewer people experiencing the most severe effects, and many more experiencing less severe ones (see figure 3). They do not count the following people: those who visit doctors or emergency rooms, those who need to reduce their activity level, increase their medication, have more symptoms and reduced lung function or other subtle effects of which people are not aware.[1]

Figure 3
Pyramid of Health – Approximate numbers of people affected by PM_{10} in Toronto in 1995



Air pollution affects us all year

Poor air quality is often associated with smog that occurs in the summer. However, the calculations done by Toronto Public Health show that air pollution causes adverse effects all year. All six pollutants studied contribute to illness and early-death. While three of them (ozone, particles and sulphates) have higher levels in the summer, the other three (nitrogen dioxide, carbon monoxide, and sulphur dioxide) have higher levels in the winter. Of these six pollutants, nitrogen dioxide is the pollutant linked with the most number of early-deaths and hospitalizations.[8]

Air pollution affects us all year

Meeting air quality criteria has little impact on deaths and hospitalizations

The calculations by Toronto Public Health show that air pollution is linked to adverse effects at levels below the air quality criterion for all six pollutants in this study. In fact,

the data show that even if all ambient air quality criteria had been met in 1995, the number of deaths and hospital admissions would have been reduced by less than 1 percent. This means that even when air quality – as measured by the Air Quality Index – is good, pollution in Toronto is having an impact on health. Current air standards need to be made stricter so that they better protect our health.

Evidence of health effects of air pollution

Many studies around the world have looked at air pollution and its possible effect on health.[3] Several studies have looked at levels of air pollution and health effects in Toronto and other parts of Canada. Most of these have shown a link between days with high pollution and the number of people admitted into hospital. They have also shown that more people die on or just after high-pollution days. Approximately 1,800 people in Ontario are thought to die earlier because of particles in the air.[10] Researchers at Health Canada estimate that other pollutants such as nitrogen dioxide, sulphur dioxide and ozone lead to more deaths than inhaled particles do on their own.[11] In addition, carbon monoxide and sulphates are linked to higher hospital admissions for heart disease.[12]

There is no threshold for health effects by air pollution

Data also suggests that there is no threshold below which ozone or particles will cause no effects on the lung. That is, at all levels of these pollutants, even the lowest, some effect can occur in some people.[13]

Long-term effects

Not many studies have looked at long-term effects of air pollution. A study in Switzerland found that air pollution from the burning of fossil fuels was linked to a decrease in lung function.[14] The *Harvard Six City Study* showed that cities with higher concentrations of respirable particles ($PM_{2.5}$) had higher death rates.[15] This implies that air pollution causes not only short-term effects, but also contributes to long-term ill health and reduces life expectancy by a matter of months to a few years.[16]

Sensitive individuals

Some people are more sensitive to the effects of air pollution than others. For example, the elderly, people with heart disease or lung problems such as asthma, emphysema, and chronic bronchitis will experience adverse effects at lower levels of pollution. Air pollution events can be life threatening for such people. Children are also more sensitive than adults because they breathe faster and spend more time active outdoors in the summer. For sensitive individuals, even a small increase in pollution levels can make their symptoms more severe. People who work or exercise outdoors are also more affected since they experience more exposure to pollutants.

For children, the elderly, people with heart or lung disease, even a small increase in pollution levels can make their symptoms more severe

Asthma and children

Environmental pollutants are major contributors to asthma. In the United States, asthma is the most common admission diagnosis for children in U.S. hospitals and they have doubled between 1980 and 1993.[17] A study of 16 Canadian cities showed that the symptoms of asthmatics became worse with higher levels of ozone, and particles such as sulphates and acid aerosols.[18] In Toronto, for children under 10, the second most important reason for being in hospital is disease of the lung, throat and nose.[19] Pollution episodes not only aggravate

Lung and other breathing problems are the second most common reason why children are in hospital

Infants Admitted into Hospitals

Based on available information of all the children admitted into Toronto hospitals for lung problems in 1995, about 250 would have been linked to air pollution.

Pollutants, at levels below air standards, are causing health problems.

symptoms in asthmatics, but also cause symptoms in non-asthmatics. In Southern Ontario, researchers have found a connection between days with high levels of air pollution and the number of hospital admissions for breathing complaints. For children under one year old, 15 per cent of respiratory admissions were associated with air pollution events.[20]

A need to revise the air pollution index

The Ontario Ministry of the Environment has created the air quality index (AQI) to help people understand when pollution levels are high and therefore could produce some health problems.[21] Unfortunately, we now know that even when the AQI indicates the air quality is good, some people are affected. It is now believed that for many of the air pollutants in this report there is no threshold. That is, even at very low levels of pollution, some adverse effect will occur in some people. If the AQI is to continue to be meaningful, it needs to be revised to take into account newer data that show adverse effects occur at levels much lower than we thought before.

What is the Air Quality Index?

The Air Quality Index or AQI translates the levels of certain pollutants into numbers. These numbers are meant to help people know when the air quality is good or poor. It was last revised by the Ontario Ministry of the Environment in 1995.[21]

- If the AQI value is below 32, the Ministry describes the air quality as **good or very good.** At this level, the Ministry expects that most people will not experience any health problems.
- If the AQI value is in the range of 32 to 49, the Ministry describes the air quality as **moderate.** More sensitive people could experience some health problems.
- When the AQI value is 50 to 99, the Ministry describes the air quality as **poor.** In this range it may have adverse effects on the sensitive people and animals, or may cause damage to vegetation and property.
- When the AQI is 100 or more, the Ministry describes the air quality as **very poor.** It may effect the health of a large number of people and animals as well as plant life and property.
- The air quality is described as poor whenever the level of a substance is higher than the following concentration:

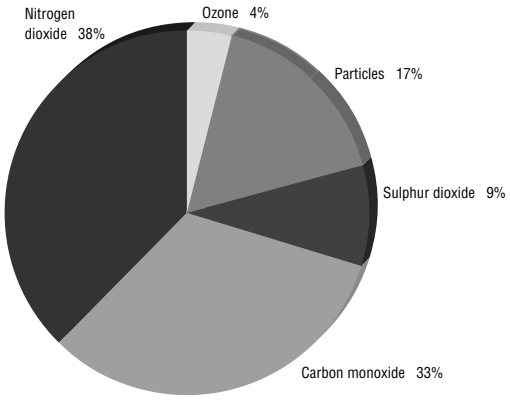
Carbon monoxide	30 ppm	Nitrogen dioxide	254 ppb
Ozone	80 ppb	Sulphur dioxide	340 ppb
Suspended particulates	Coefficient of haze of 3.94		

Toronto Public Health notes however, that research shows health effects occur below these levels.

3 Health Effects of Specific Pollutants

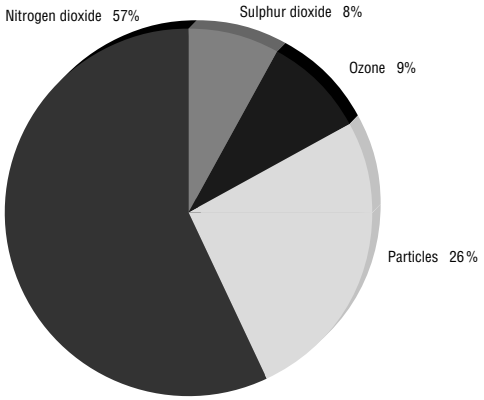
Ozone is perhaps the most familiar pollutant because it is associated with summer haze and smog alerts. However, calculations by Toronto Public Health showed that, although ozone was linked to a high number of hospital admissions, nitrogen dioxide was responsible for more early-deaths and more hospital admissions than any other of the six pollutants we looked at. Below we consider the effects of individual pollutants in more detail. All of the six pollutants contribute to the health problems at the levels of pollution found in Toronto's air. Not only is there a need to revise air quality standards based on more up-to-date information, we must also keep in mind that we are exposed to a mix of pollutants. Actions taken to deal with air pollution must look at reducing levels of the entire mix of pollutants, not just one substance.

Air Pollution Related Early-Deaths by Pollutant (Toronto 1995)

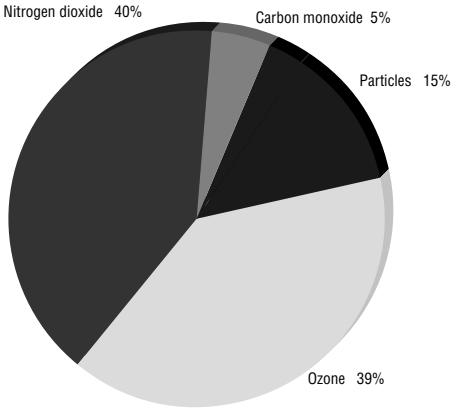


(adds to more than 100 due to rounding)

Air Pollution Related Lung Problem Hospital Admissions by Pollutant (Toronto 1995)



Air Pollution Related Heart Problem Hospital Admissions by Pollutant (Toronto 1995)



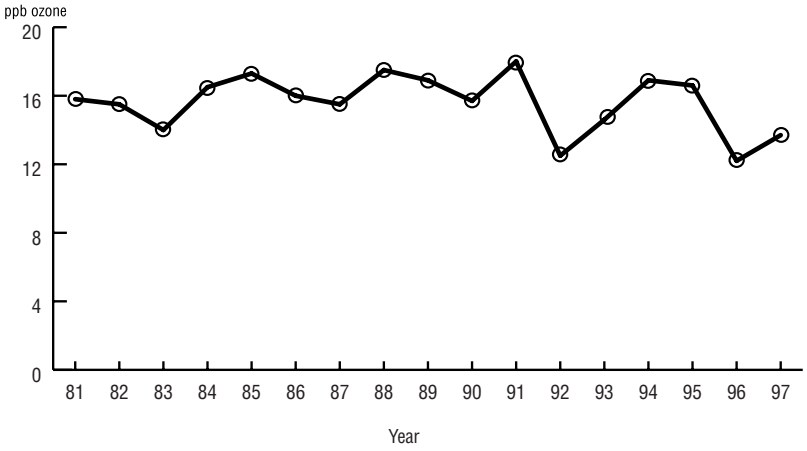
Source: Toronto Public Health.

3.1 Ground-level ozone

Effects of ozone occur at levels of 20 ppb, four times lower than current standards

Ground-level ozone is formed when nitrogen oxides and volatile organic compounds (VOCs) react together in the presence of sunlight. The weather directly affects the levels of ozone in the air, and thus the maximum levels measured in any given year will vary greatly. Levels of ozone are often lower in cities than in rural areas because nitric oxides emitted from vehicles help remove some of the ozone.

Figure 4
Yearly average levels of ozone in Toronto 1981-1997 (ppb)



Source: Ontario Ministry of the Environment.

Ground-level ozone levels are increasing

In Toronto, ozone often exceeds the air quality criteria. In 1996, levels of ozone measured in York exceeded the Ontario ambient air quality criterion 48 times.[22] Summertime ozone levels in Toronto averaged between 31 and 37 ppb at the various monitoring stations in 1995.[23] It is difficult to tell the long-term trends for ozone since levels are influenced by the weather. However, when adjusted for temperature, Environment Canada data shows yearly average levels of ozone in Toronto are on the increase.[24] Environment Canada believes this increase could be linked to warmer summers.

Health effects of ground-level ozone

Toronto Public Health calculated that ozone could explain 39 per cent of admissions to hospital for air pollution-related heart problems, 9 per cent of admissions to hospitals for air pollution-related lung problems and 4 per cent of air pollution-related early-deaths.

The effects of ground-level ozone on health include the inflammation of the lung, decreased lung function (the ability of the lung to release carbon dioxide and take in oxygen), airway hyperactivity and respiratory symptoms. A study of berry pickers in the Fraser River Valley of British Columbia showed that ozone levels between 13 to 84 ppb decreased lung function and this decrease lasted a day or more.[25] This shows that people can be affected by air pollution without showing any symptoms and that this happens below current air quality standards.[26]

Studies carried out in North America give strong evidence that higher ozone levels result in a larger number of hospital visits and admissions for problems related to asthma or lung problems. This is not surprising since ozone at low concentration causes inflammation of the lungs and increases the effect of allergens.[27] A study of hospital admissions in Ontario found that 5 per cent of admissions related to lung problems were linked to the levels of ozone: the higher the level of ozone the higher the number of admissions.[28] In children, ground-level ozone is linked to reduced lung capacity in healthy children, an increased rate of respiratory infections such as pneumonia and bronchitis, as well as an increase in hospitalization for asthma and chronic lung disease.[29]

Some Effects of Ground-Level Ozone

In outdoor workers there is a decreased ability of the lung to take in oxygen.

In children:
- Reduced lung capacity
- More pneumonia, bronchitis and other lung infections
- More asthma symptoms
- More long-term lung disease

No threshold for effects from ground-level ozone

Effects of ozone can start to be seen at levels as low as 10 ppb. Clear effects start to be seen at ozone concentrations of 20 ppb for one hour. There does not appear to be a threshold for adverse health effects from ozone.[30] This means that any level of ozone can result in symptoms.

People are affected by ozone even when they show no symptoms

3.2 Particles

Particles can explain 1/4 of admissions to hospital for pollution-related lung problems

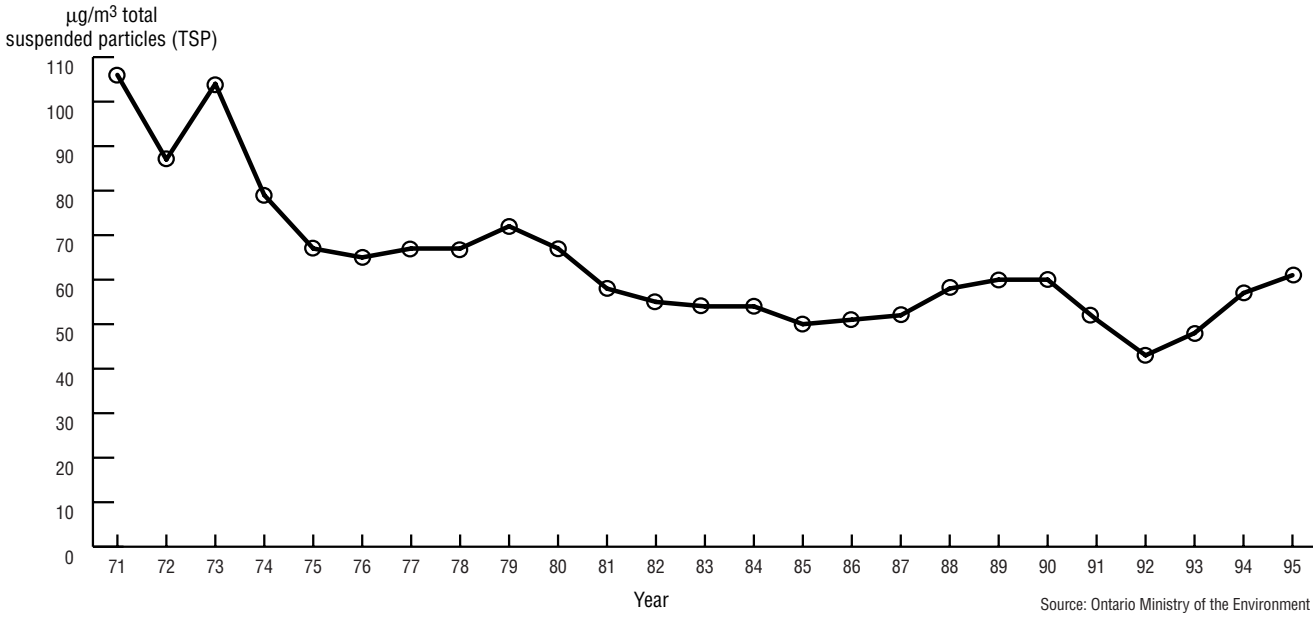
Particles in the air are described according to their size. Total suspended particulate matter (TSP) refers to all particles. PM_{10}, inhalable particulate matter, are particles that are 10 microns or less in size. Then we have respirable particulate matter, $PM_{2.5}$, which are particles 2.5 microns or less in size. Toronto Public Health calculated that particles (PM_{10}) could explain 26 per cent of admissions to hospitals for pollution-related lung problems, 17 per cent of pollution-related early-deaths and 15 per cent of admissions to hospital for pollution-related heart problems.

Levels of particles

These deaths and illnesses occurred although the average daily levels of PM_{10} were below the Ontario interim guideline of 50 µg/m^3. In 1995, average daily levels ranged from 19.7 to 23.9 µg/m^3 at the various monitoring sites in Toronto. Data from the Ontario Ministry of the Environment shows a decreasing trend in TSP from 1971 to 1992. Since 1992, total TSP has started to increase again. Motor vehicles and road dust are the main sources of particles in urban air. In 1996, the maximum level of TSP measured in Toronto was 282 µg/m^3. The 24-hour Ambient Air Quality Criterion (AAQC) of 120 µg/m^3 was

Figure 5

Yearly average levels of suspended particles in Toronto 1971-1995 (µg/m^3)



Source: Ontario Ministry of the Environment

exceeded nine times at this North York location. $PM_{2.5}$ was measured in Etobicoke. The yearly average levels were 14 µg/m^3. The highest levels measured were 135 µg/m^3 for 1-hour period and 62 µg/m^3 measured over a day.[22]

Effect of particle size

Particles in the air are mostly responsible for haze – the loss in visibility. They also have an effect on health, which depends on their size and the chemicals they are made up of. Studies have shown that smaller particles are more dangerous to health than larger ones. It is now common to measure particles of 10 microns or less (PM_{10}) or even those 2.5 microns or less ($PM_{2.5}$) rather than focus only on total particle levels (TSP). The smallest are of most concern because they can find their way deep into the lungs.

The elderly, children and those with heart and lung conditions are the most affected by increases in particle levels

Content of particles

Particles in the air are made of different materials. Some particles can contain acid aerosols, metals, or polyaromatic hydrocarbons (PAH). Some are directly emitted into the air (primary) and others are the result of interactions in the air (secondary). Sulphur dioxide, nitrogen oxides, volatile organic compounds (VOCs), and ammonia are involved in the formation of secondary particles such as sulphates and nitrates. These are mostly very fine particles.

Particles

Particles come in different sizes and make-up.

- TSP is for total suspended particulates, the sum of all particles in the air.
- PM_{10} is that part of TSP made of inhalable particulate matter, particles 10 microns or less in size; these particles are not easily filtered by the nose and can end up in the lung.
- $PM_{2.5}$ is that part of TSP made of respirable particulate matter, particles 2.5 microns or less in size; these particles can get deep into the lungs.
- Acid aerosols are very fine particles that contain acidic materials, for example sulphates.
- Particles can contain toxic substances such as metals or polyaromatic hydrocarbons (PAHs); this can make a difference in the toxicity of particles.

Health effects of particles

Many studies have looked at the relationship between health and particles in the air. These have looked at death rate, hospital admissions, emergency department visits, respiratory health, and lung function. A few studies have also looked at cancer. The review of health effects of particles undertaken by the CEPA/FPAC Working Group on Air Quality Objectives and Guidelines found that based on data from 20 cities around the world, there was an association between the level of particles in the air and death. The data shows that effects can occur at any level of particles in the air, that is, there is no threshold.[31]

Hospitalizations due to particles

There is no threshold for the effects of particles in the air

Studies that have looked at the number of people admitted into hospital have also shown a link with the levels of particles in the air. There is also an association with admissions for heart disease. Studies that looked at $PM_{2.5}$ found a larger impact than for PM_{10}. Acid aerosols, sulphates in particular, showed the strongest association with hospitalization. The elderly, children, and those with heart and lung conditions are the most affected by increases in particle levels. In people with asthma or other lung disease, an increase in particle level can make symptoms such as bronchitis and cough worse. Breathing difficulties because of pollution by particles can be severe enough to result in days off work or school. Particles can also cause small decreases in lung function in children without breathing problems or asthma. These effects are occurring at levels of particles in the air that now exist in Canada.

Long-term effects due to particles

There have been very few studies that looked at the long-term effects of particles. The *Harvard Six City Study* looked at exposures of up to 20 years. This study found that over 14 years, the life span of people in the most polluted city was two years less than in the least polluted city.[32] This implies that higher death rates observed during days of higher pollution levels are not only due to earlier deaths of people who are already sick. Data from North America shows that particles can result in the increase in bronchitis and decreases

Diesel and Cancer

Air pollution in and around Los Angeles, California, is calculated to cause about 1400 extra cancer cases per million people. Around 70 percent of these, or 1000, are linked to particles from diesel exhaust.[46]

in lung function, capacity, growth and development in children.[33] When these children grow up they are more susceptible to various lung diseases. Finally, some studies have suggested that particles may cause cancer.[34]

Recommended levels

The Canadian Working Group on Air Quality Objectives and Guidelines concluded that there was a strong link between exposure to particles and effects on the heart and lung.[35] Based on the available data from human studies, the Working Group recommended that reference levels for particles be set at 25 µg/m^3 for PM_{10} and 15 µg/m^3 for $PM_{2.5}$. These levels represent the levels where the Working Group had confidence that effects observed are due to particles. Although effects could occur below these levels, they were thought to be very small. The recently adopted Canada-wide standard for $PM_{2.5}$ is a daily average of 30 µg/m^3 to be met by the year 2010.[26] This is higher than the levels found to cause effects.

People who live in cities with cleaner air live longer than people who live in more polluted cities

Effects of Particles

- Higher number of deaths.
- More hospitalization.
- Effects on the working of the lung in children and in asthmatic adults.
- Breathing problems that can lead to days lost from work or school.
- Shorter life expectancy.
- Increases in bronchitis and asthma in some adults.
- Increase in heart disease.
- Effects of particles are seen at levels as low as 10 µg/m^3.
- An increase of 10 µg/m^3 in PM_{10} leads to an extra 0.4 to 1.7 per cent in death rate.
- An increase of 10 µg/m^3 in $PM_{2.5}$ leads to an extra a 1.5 per cent in death rate.
- An increase of 10 µg/m^3 of PM_{10} leads to between 0.45 and 4.7 per cent increase in admission into hospitals for lung problems.
- An increase of 10 µg/m^3 of $PM_{2.5}$ found a 2.5 to 9.6 per cent increase in hospitalization for lung problems.[35]

3.3 Sulphates

Sulphates are an important component of particles in the air linked to health effects

Sulphates (SO_4) are important components of particles. They are the result of the transformation of sulphur dioxide in the air. A study of hospitals in Ontario found that sulphates could be the reason for one per cent of hospital admissions due to respiratory problems.[20] Admissions due to heart failure also increase with higher levels of sulphate.[36] In Toronto, in 1995, the SO_4 portion of the air particles could account for about half of the deaths due to particles, about 30 per cent of admissions for lung problems related to particles, and about 20 per cent of admissions for heart problems related to particles. These effects were seen when the 1995 daily average levels of sulphates in Toronto were between 3.0 and 3.5 $\mu g/m^3$. Ontario does not have air quality criteria for sulphates at present.

3.4 Sulphur dioxide

About 1/3 of the pollution related deaths are linked to sulphur dioxide

About 75 per cent of the sulphur dioxide (SO_2) emitted in Ontario comes from smelters and the generation of electricity by coal-fired plants. In Toronto however, transportation contributes 60 per cent of sulphur dioxide, mostly from diesel vehicles such as trucks and off-road vehicles. Another important source in the city is heating. According to the Ontario Ministry of the Environment, SO_2 emissions in Ontario have decreased by 81 per cent between 1971 and 1996. Most of this decrease occurred in the 1970s. Sulphur dioxide levels in Toronto are not as high as in other cities in Ontario such as Hamilton, Sarnia, Sudbury, or Windsor. Levels of SO_2 measured in Toronto in 1996 were all below the ambient air quality criteria. The maximum values (1-hour average) were measured in Etobicoke (131 ppb) and York (111 ppb).[22]

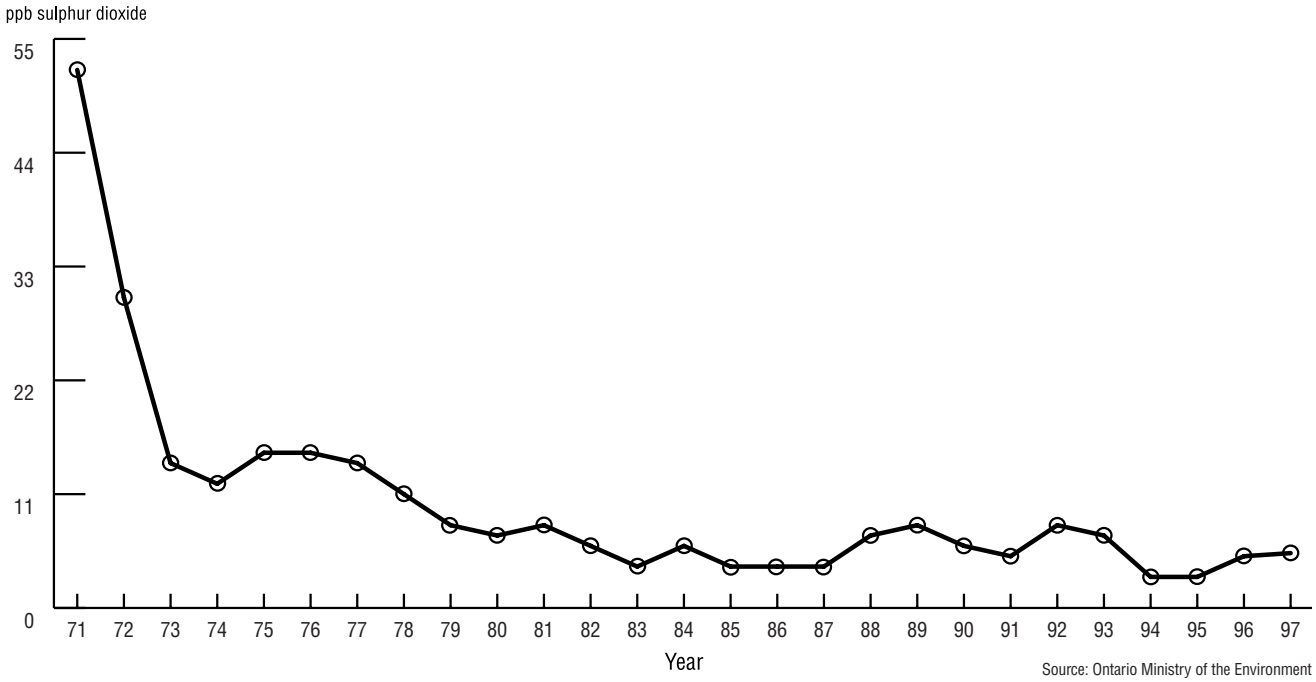
Effects of SO_2 seen below the air standard

The Ontario ambient air quality criteria for sulphur dioxide are 250 ppb for one-hour, 100 ppb for 1-day and 20 ppb for 1-year averages. In 1995, average levels in Toronto were well below these. The yearly average ranged between 2.4 to 4.1 ppb at the six monitoring sites, with the highest 1-hour level of 210 ppb. Yet, Toronto Public Health calculated that SO_2 was linked to about 9 per cent the pollution-related early-deaths and about 8 per cent admissions to hospitals from pollution-related lung problems. Asthmatics are especially sensitive to the levels of sulphur dioxide in the air.[37] Sulphur dioxide is also a concern because it can react in the atmosphere to create sulphates. As discussed previously, sulphates are an important component of particles that cause health effects.

Effects of Sulphur Dioxide

- The narrowing of air passages in the lungs of asthmatics while exercising occur at levels as low as 250 ppb.[37]
- Data from 12 European cities showed that about a 20 ppb (50 µg/m^3) increase of sulphur dioxide was associated with an increase of 3 percent mortality (both lung and heart disease).[5]
- A study of 11 cities in Canada found that sulphur dioxide was responsible for an average of 1.4 percent increase in risk of death.[11]

Figure 6
Yearly average levels of sulphur dioxide in Toronto 1971-1997 (ppb)



Source: Ontario Ministry of the Environment

3.5 Nitrogen dioxide

A large part of the air pollution related health problems are linked to exposure to nitrogen dioxide

Nitrogen dioxide (NO_2) levels are generally higher in large urban centres than elsewhere in Ontario. Combustion is the main source of this pollutant with 60 per cent coming from transportation in Ontario. In Toronto, an even higher portion comes from motor vehicles – 83 per cent in 1995. Electricity generation, at about 20 percent, is the next major source. Long-term concentrations of NO_2 in Ontario have remained relatively constant around 20 ppb over the last twenty years. The highest levels are found in Toronto. In 1996, the yearly average level of NO_2 measured downtown was 34 ppb. The maximum daily average was 100 and the maximum 1-hour average was 171 ppb at the monitoring site in York. The Ontario ambient air quality criteria for NO_2 are 200 ppb for 1-hour, and 100 ppb for 24-hour average.[22] These criteria do not take into account newer studies that show that nitrogen dioxides may be causing adverse health effects at much lower concentrations.

The pollutant causing the most disease

Even though levels of NO_2 are generally well below the standards, Toronto Public Health found that for 1995, nitrogen dioxide was the pollutant with the strongest link to air pollution related health problems. It could account for nearly 40 per cent of pollution related early-deaths as well as nearly 60 per cent of admissions to hospitals for pollution related lung problems and about 40 per cent of admissions for pollution related heart problems. These effects were seen although average levels of nitrogen dioxide at six monitoring stations that year were between 17 and 30 ppb, well below the current Ontario standards.[5]

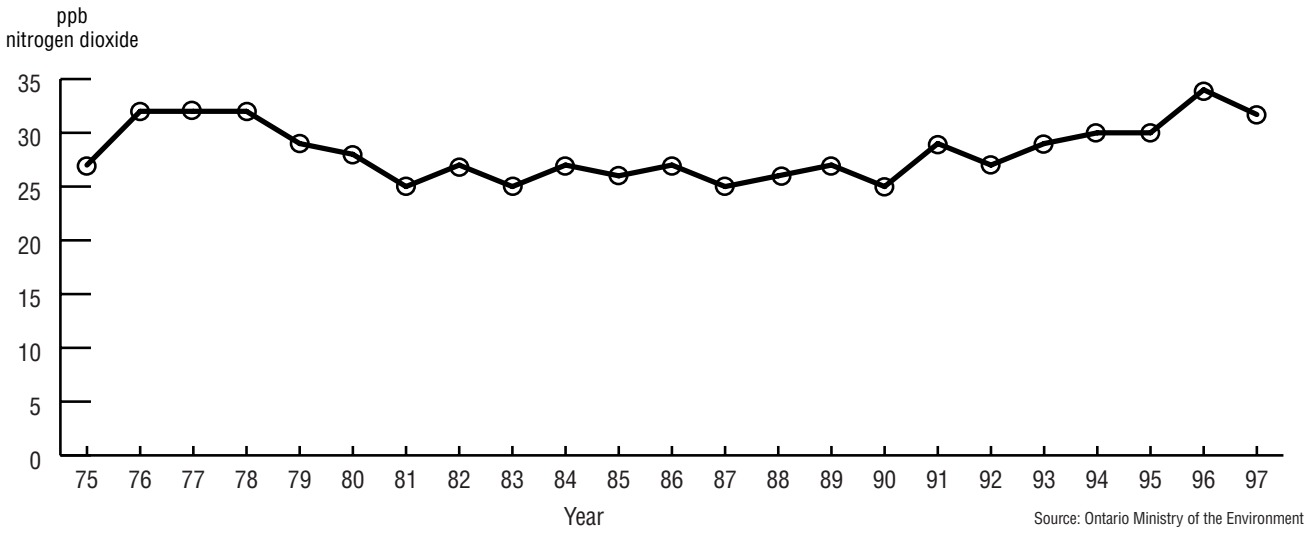
Nitrogen oxides have effects at levels below current air standards

Nitrogen oxides are important because of both their health effects and their effects on smog

Nitrogen oxides are a group of seven compounds of which nitrogen dioxide is the compound of greatest health concern in outdoor air. Although nitrogen oxides are important because of their role in the chemistry of ground-level ozone, they also have a direct impact on health. The body readily absorbs nitrogen

dioxide through the lung, throat, and nose. People with asthma and lung disease, children, and the elderly are more at risk. Studies have shown that low levels of nitrogen dioxide (as low as 200 ppb) can increase breathing difficulties by the narrowing of the airways.[37] But recent Health Canada research suggests that nitrogen dioxide could be causing effects at much lower levels. A 4.1 per cent increase in the risk of deaths was found in a study of 11 Canadian cities where average daily nitrogen dioxide levels were between 14 and 28 ppb.[11] These levels are much lower than current standards.

Figure 7
Yearly average levels of nitrogen dioxide in Toronto 1975-1997 (ppb)



Source: Ontario Ministry of the Environment

3.6 Carbon Monoxide

In Toronto during 1995, about 90 per cent of carbon monoxide (CO) came from transportation sources such as cars, buses, trains, and aeroplanes. Levels are related to traffic patterns and vary greatly during the day. CO levels made a big drop in the early 1970s after the adoption of catalytic converters in cars. Since then the decrease has continued, but much more slowly. If we compare 8-hour averages for Ontario, levels have dropped slightly from around 5 ppm to 4 ppm between 1987 and 1996. Annual average for CO in Ontario was about 0.8 ppm in 1986 and 0.5 ppm in 1995. Maximum 1-hour concentrations are more variable. In 1996, average concentrations at the various monitoring stations in Toronto ranged from 0.7 to 1.3 ppm,

Carbon monoxide is linked to about 1/3 of early-deaths related to air pollution

with a maximum 1-hour concentration of 11 ppm downtown. These are well within the ambient air quality criteria of 30 ppm (1-hour) and 13 ppm (8-hour).[22] Calculations done by Toronto Public Health using 1995 data showed that at daily average concentrations of 0.5 to 1 ppm, carbon monoxide could be responsible for about 33 per cent of early-deaths due to air pollution. It was also linked to 5 per cent of pollution-related hospital admissions for heart problems.[5]

Carbon monoxide is linked to heart problems

Carbon monoxide is an air pollutant closely associated with adverse effects on the heart. Carbon monoxide binds with haemoglobin in the blood reducing the ability of the blood to carry oxygen. The most used measure of exposure to carbon monoxide is the carboxyhaemoglobin (COHb) level in the blood. People with heart disease are most susceptible to the effects of carbon monoxide. Other groups who may be at higher risk include pregnant women, the unborn, infants, children, the elderly, and people with anemia and respiratory or lung disease.[38]

Recommended levels

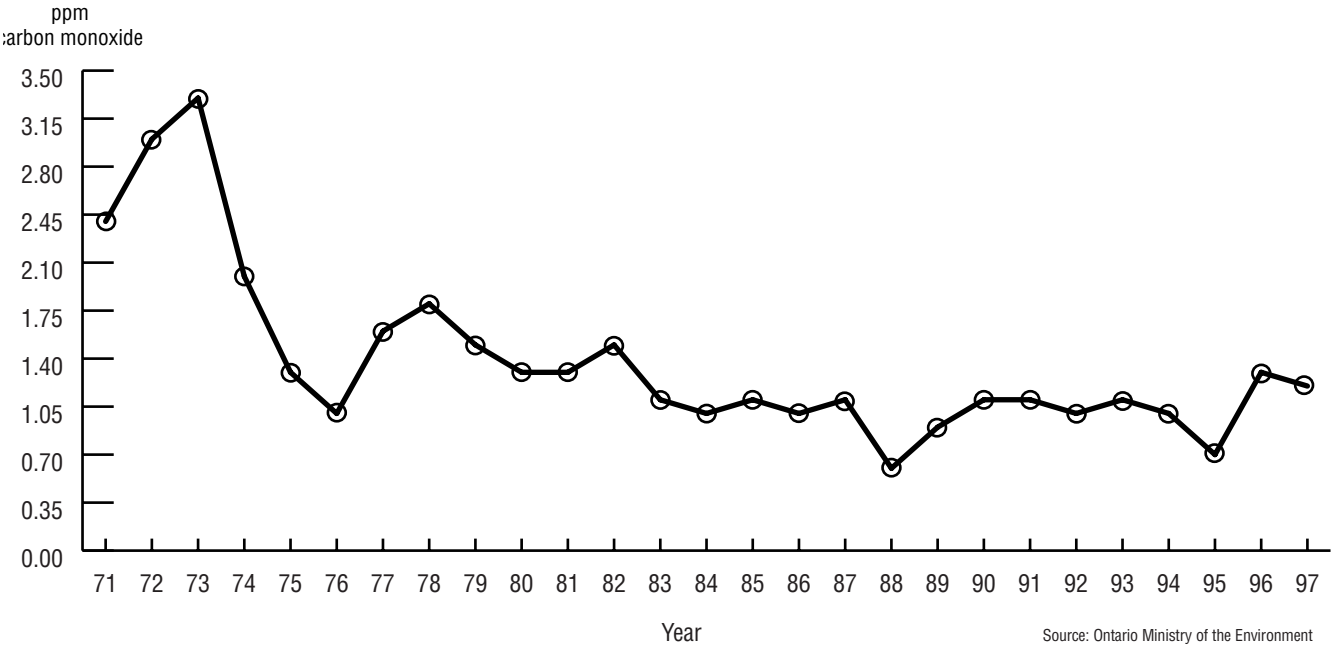
Canadian recommendations for maximum acceptable levels of carbon monoxide and the equivalent Ontario Ambient Air Quality Objectives (30 ppm for 1-hour; 13 ppm for 8-hour average) are based on keeping blood COHb levels below 2 per cent. This level was chosen based on the lowest effect level of COHb found to cause adverse effects. Two per cent COHb resulted in adverse electrocardiogram values and induced angina in people doing exercise. At concentrations averaging 13 ppm over 8-hour, it is estimated that less than 1 per cent of people in Toronto would experience COHb levels of more than 2 percent. Maximum desirable levels (13 ppm for 1-hour, 5 ppm for 8-hour average) are based on keeping COHb levels less than one percent. This is the normal level for a non-smoker.[38]

Levels of carbon monoxide vary greatly

Studies that have used personal monitoring equipment show that people are exposed at higher levels of carbon monoxide than the levels measured at fixed monitoring stations. This is because levels vary greatly according to the micro-environment in which people move during the day. The greatest carbon monoxide exposures occur inside vehicles and in homes close to combustion sources such as fireplaces, gas stoves, and furnaces. This partly explains why effects are being seen although monitoring shows that the levels of carbon monoxide are well below guidelines.

Figure 8

Yearly average levels of carbon monoxide in Toronto 1971-1997 (ppm)



Source: Ontario Ministry of the Environment

Priority Toxic Pollutants identified in Toronto

- Benzene
- 1,3-Butadiene
- Cadmium
- Chloromethane
- Chromium (VI)
- 1,2-Dichloroethane
- Dichloromethane
- Manganese
- Nickel
- Styrene
- Tetrachloroethane
- 1,1,2-Trichloroethane
- Trichloroethene
- Trichloromethane[19]

3.7 Toxic Pollutants

Air contaminants, sometimes called air toxics, refer to a wide range of chemicals than can be found in the air in low concentrations. These include metals such as lead and hydrocarbons such as volatile organic compounds (VOCs). Some of these toxic chemicals, for example lead and polyaromatic hydrocarbons (PAHs), are found in particles. Many toxic air contaminants are found at levels much below levels that are considered a concern. Based on the levels at which they were found in the City, in 1992 Toronto Public Health identified 14 contaminants of priority concern.[19] A short description of the effects of major toxic air pollutants is found in Appendix A.

3.8 Global Warming

The burning of fossil fuels has increased dramatically since the beginning of the Industrial Revolution. In addition to the pollutants mentioned above, this releases large amounts of carbon dioxide into the air. One of the effects of carbon dioxide and other greenhouse gases is to keep more heat trapped in the atmosphere. This results in an increase in temperatures with warmer summers and milder winters. The 1990s were the hottest decade on record. The accumulation of greenhouse gases in the atmosphere has contributed to this phenomenon. At double the concentration of carbon dioxide, the number of days with temperatures above 30°C could multiply five-fold.[48] In Canada, transportation and electricity generation are major contributors of greenhouse gases to the atmosphere. In 1995, cars and light trucks contributed more than half of the transportation related greenhouse gas emissions in Canada.[49]

Health effects of climate change

The International Panel on Climate Change has stated that "Climate change is likely to have a wide-ranging and mostly adverse impact on human health".[50]

The most direct impact of climate change is on the number and duration of heat waves. Heat waves aggravate existing

medical conditions, especially among the young, the elderly, and the sick. A heat wave in Chicago lead to several hundred deaths in 1995. Between 1951 and 1980, the number of days above 30°C averaged 10 per year in Toronto. If the amount of carbon dioxide in the air doubles, this is likely to increase to 53 days a year. Heat related deaths in Toronto are expected to increase from about 20 per year now to 290 in 2020.[48] Although air conditioning can decrease some of the effects of heat stress this is counter productive. Use of air conditioners, refrigerators, and freezers in hot weather increases demand for electricity. This in turn leads to increases in use of fossil fuels to generate electricity which then results in increased emissions of not only carbon dioxide, but also of other pollutants such as nitrogen oxides, sulphur dioxide, and particles.

As we have discussed above, hot summer weather helps in the creation of smog. Higher summer temperatures will result in a larger number of smog days. Higher summer temperatures will result in an increase in deaths and of the frequency of allergic, lung and cardiovascular disorders linked to air pollution. Increased energy efficiency in buildings, industry, and transportation will provide multiple benefits. Not only will it result in a decrease in emissions of carbon dioxide; it will also reduce levels of other pollutants associated with fossil fuel combustion. Health will benefit on both counts.

If current trends continue, by 2020, the number of people dying from heat in Toronto would increase more than 10 times to 290 per year

As winters get milder and summers longer the range and numbers of mosquitoes and other pests will extend northward to Canada. This could result in an increase in the incidence of diseases such as malaria, dengue, and encephalitis in Canada. It is also possible that an increase in the prevalence of pests will encourage greater use of pesticides. Pesticides can have adverse effects on health and the environment. Reduction of emissions from the burning of fossil fuels will therefore help address both climate change and health.[48]

How Does Toronto Fare in the World?

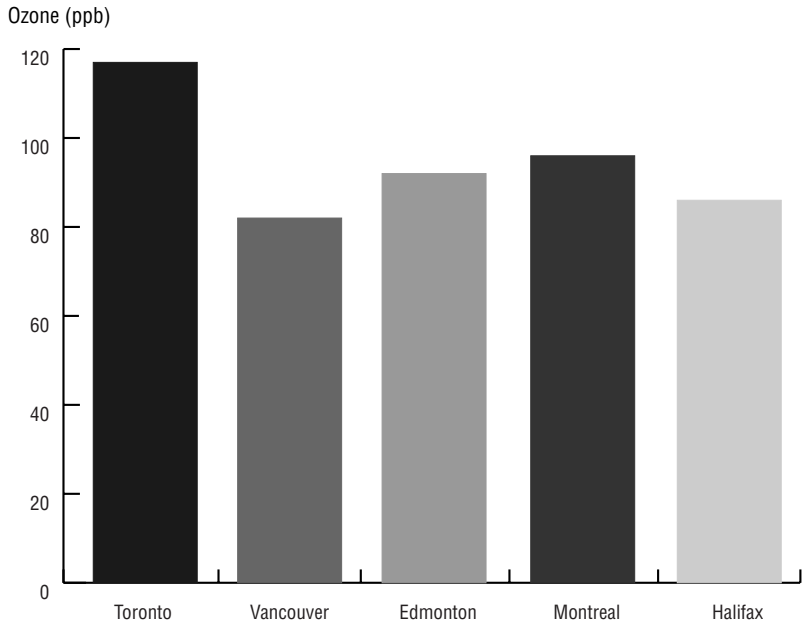
Out of about 40 cities around the world, in 1995, Toronto ranked as follows:

PM_{10}:	8th best
Ozone:	8th best
Carbon monoxide:	10th best
Sulphur dioxide:	10th best
Nitrogen dioxide:	18th best[51]

4 Air Quality in Toronto

There is no easy way to compare Toronto with other cities. The levels that are measured depend in part on the distance between the monitors and specific sources of pollution. As well, levels of specific pollutants may be lower and others higher than those found in other cities. Figure 9 compares data from various cities across Canada.[51] For ozone, the one pollutant that is above the Ambient Air Quality Criterion (AAQC), Toronto has the highest value. In an international comparison, Toronto is in the "middle of the pack".[51]

Figure 9
Maximum 1-hr levels of ozone in 5 Canadian cities in 1995 (ppb)



Source: Ontario Ministry of the Environment

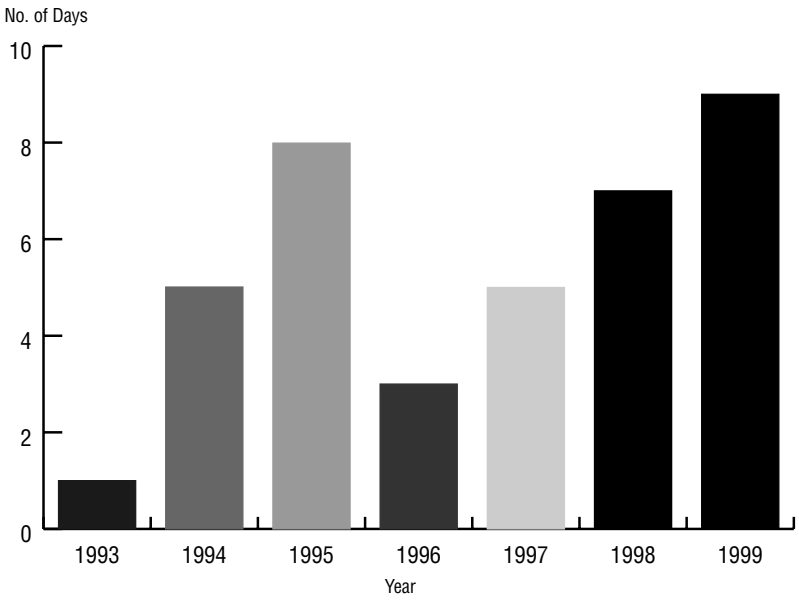
Long-term trends

It is difficult to make definitive statements on the improvement of air quality over time. For some pollutants such as lead, the pattern of improvement is clear, but for others less. If we compare current data with data from the early 1970s, for some pollutants we do see a decrease in measured levels. However, in many cases, most of the improvement came in the

early period and since then levels have remained fairly constant. Some of the decrease seen in the early 1990s is due to lower economic activity during that period. The booming economy with increased transport of goods and movement of people will result in higher pollution levels unless stricter emission controls are put in place and there is a reduction in the use of fossil fuels. Data from the Ontario Ministry of the Environment show an increasing number of hours in Southwestern Ontario with moderate or poor air quality from 1992 to 1996. This is mostly due to high levels of ozone. Warmer summers contribute to this.[22]

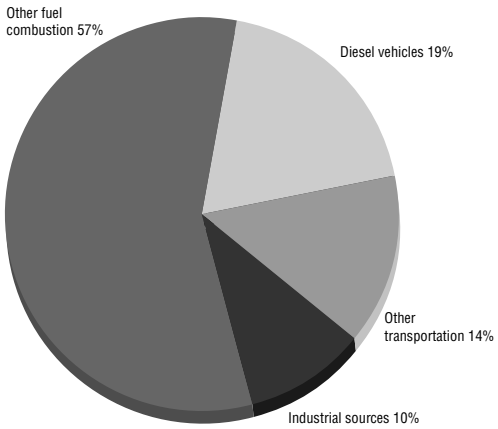
The Ontario Ministry of the Environment issues an air quality advisory or smog alert when it thinks the AQI will reach 50 or above. Most of the time ozone causes the high AQI reading. Five advisories were issued in 1995 for a total of 8 days with high ozone levels. In 1996, there were 2 advisories with a total of 3 days. The number of smog-days increased to 5, 7, and 9 in 1997, 1998, and 1999 respectively.[52] The highest level of ozone measured in Ontario in recent years was during the unusually hot summer of 1988.[22]

Figure 10
Number of smog-alert days in Toronto

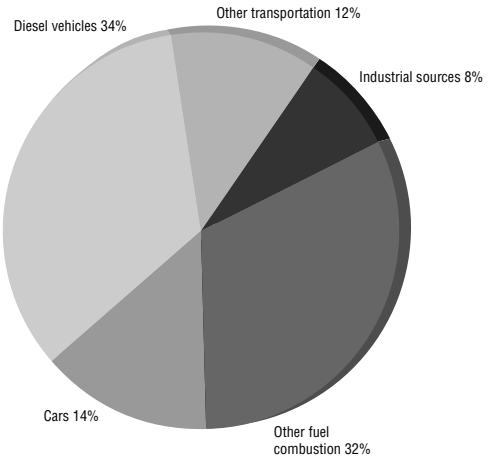


Source: Ontario Ministry of the Environment.

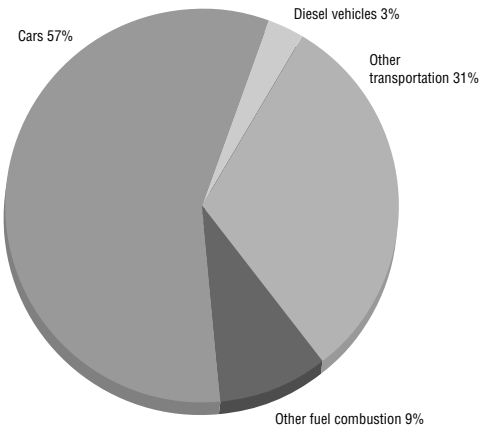
Sources of particles in Toronto (1995 data)



Sources of sulphur dioxide in Toronto (1995 data)



Sources of carbon monoxide in Toronto (1995 data)



Source: Ontario Ministry of the Environment.

4.1 Where is the Pollution coming from?

Smog is the result of the interaction between pollutants and sunlight. The most important substances in smog include the criteria pollutants and volatile organic compounds or VOCs. Weather conditions are important in the creation of smog. As we mentioned above, warmer summer seasons are more favourable to the creation of smog. Overall, the number of smog alert days in Toronto from 1993 to 1999 increased. Smog is the most visible part of air pollution.

Emissions from Toronto

Human activity in the City of Toronto creates pollution. A major source of pollution is the result of the burning of fossil fuels for heating and in motor vehicles. Based on Ontario Ministry of the Environment data for 1995, vehicles are responsible for more than 80 per cent of nitrogen oxides and 90 per cent of carbon monoxide emissions in the City. As well, motor vehicles contribute about 60 per cent of sulphur dioxide emissions. Heating is another important source of pollution. It is estimated to contribute about 30 per cent of sulphur dioxide and nearly 60 per cent of particles in the city.

Commercial and industrial activities accounted for 44 per cent of VOCs emitted due to human activity. Transportation was the next largest source at 30 percent.[53] Although natural sources are an important contributor to VOCs, in urban areas like Toronto, human activities account for more than half of the VOCs in the air.[22]

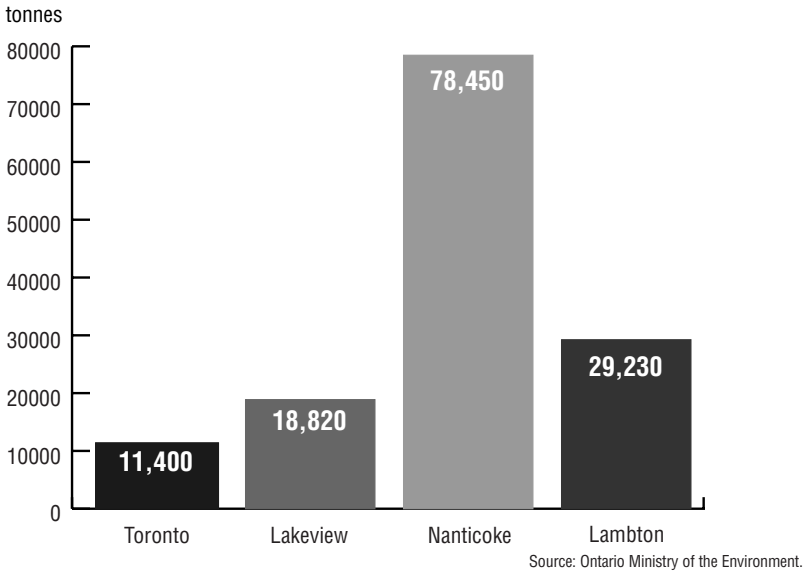
Emissions from outside Toronto

Pollution created elsewhere also affects Toronto. About 50 per cent of ozone in southwestern Ontario is blown in from the United States. Up to 95 per cent of sulphates are the result of sulphur dioxide and nitrogen oxide emissions in the mid-western United States.

Three Ontario coal-fired power plants also affect the quality of the air in Toronto – Lakeview, Lambton, and Nanticoke generating stations. Lakeview, which is located in Mississauga just west of Toronto, has a direct impact on the city. In 1995, it emitted as much sulphur dioxide as all the sources in Toronto. In 1998, when Lakeview was used to generate more electricity, it emitted one and a half times as much sulphur dioxide as all the sources in Toronto. In 1998 the Nanticoke generating station on Lake Erie emitted 7 times more sulphur dioxide than all sources in Toronto, and the Lambton generating station in Sarnia, 2.5 times.[54]

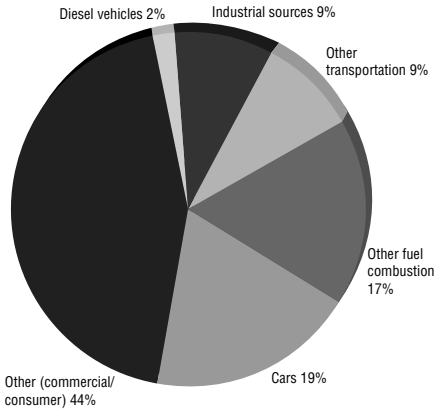
Figure 11

Sulphur dioxide emissions from all sources in Toronto (1995) compared to emissions for 3 coal-fired electricity generating stations (1998)

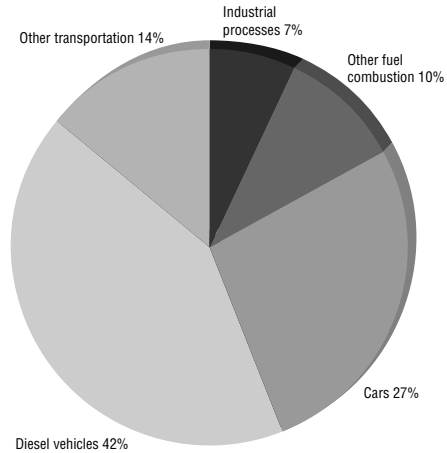


Source: Ontario Ministry of the Environment.

Sources of volatile organic compounds (VOCs) in Toronto (1995 data)



Sources of nitrogen oxides (NOx) in Toronto (1995 data)



Source: Ontario Ministry of the Environment.

5 Improving Toronto's Air Quality

There are economic and environmental benefits to a good public transport system

Improving Toronto's air will not be an easy task. It will need the co-ordinated action of all levels of government, the United States, industry, and individuals to make it happen. The largest contributor to air pollution in Toronto and the surrounding region is the burning of fossil fuels such as gasoline, diesel, and coal. These fuels are used for transportation, heating, cooling, and industrial production. Increased energy efficiency and reduced reliance on automobiles for transportation are two important areas that can contribute in a large measure to improved air quality and reduction in emissions of greenhouse gases.

Public transport

The Greater Toronto Services Board has shown that greater efficiency in transportation can help reduce costs and thus increase economic competitiveness in the region.[55] Thus there are economic as well as environmental benefits to be gained by greater use of public transportation.

Getting Out of Cars

Getting people out of cars and into public transit, cycling or walking is one way to help the air quality. In a modeling study done for Toronto Public Health, it was calculated that a 50 per cent reduction in the number of trips by car could reduce transportation emissions in Toronto as follows:

- Carbon monoxide by 34 per cent
- Nitrogen oxides by 14 per cent
- Sulphur dioxide and sulphates by 6 per cent
- Particles (PM_{10}) by 5 per cent

Emissions could be reduced even more by converting diesel buses to natural gas. With such a conversion buses would then emit:

- Nearly 4 times less carbon monoxide
- About 3.5 times less nitrogen oxides
- About 4 times less sulphur dioxide and sulphates
- Nearly 10 times fewer particles (PM_{10})[57]

An efficient public transport depends on various things. In addition to being affordable, it needs to be convenient. The way we plan and build our city makes a difference. A more compact city means there are enough people on a bus route to make it more profitable. A mixed-use neighbourhood means that the distance from home to shops and offices can be shorter. This makes walking or cycling more possible.[56]

If 5 percent of travel in North America shifted from cars to bicycles the savings could reach US $100 billion[59]

Sulphur in fuel

A large contributor to sulphur dioxide in the air is the sulphur content in fuel, especially diesel. There is a need to establish stricter standards for sulphur not only in gasoline, but also in diesel, especially "off-road" diesel (diesel sold for use other than trucks, buses and cars). Environment Canada has said that it will be matching the stricter requirements of the US Environmental Protection Agency. It would also be possible to follow the example of Montreal by preventing the use of off-road diesel within City boundaries.

Converting coal-fired plants

Natural gas is a much cleaner fuel than coal. Therefore, the province of Ontario should encourage coal-burning electricity generating plants to convert from the use of coal to natural gas. There also needs to be much more effort placed in developing alternative sources of energy, such as solar and wind energy, and to encourage greater energy efficiency in vehicles, products and industry.

Fuel Efficiency Measures that Can Help Reduce Air Pollution

- Improved and mandatory fuel economy for new vehicles sold in Canada
- Phased increases in diesel and gasoline tax matched by reduction in other taxes
- Increased urban transit availability
- Creating a level playing field for electricity generation which would mean a gradual reduction in coal-fired generation
- Increasing energy efficiency in industry
- Retrofitting buildings and mandating R-2000 building codes for new homes

Stricter emission standards

A limit (emission cap) should be established on the total amount of pollution produced by power plants. In addition, the Ontario allowable emission rate for specific pollutants such as nitrogen dioxide should be strengthened so that they match those in the United States.

Stricter health standards

Ambient air quality criteria should be revised to take into account newer information that shows that effects are occurring at much lower levels than previously thought.

5.1 What is the City of Toronto Doing to Improve Smog?

Better energy efficiency and reduced reliance on the automobile are key to achieving cleaner air

The City of Toronto is committed to taking action to improve our air quality. In 1998, City Council adopted a plan to prevent and reduce smog. The City's Environmental Task Force built on the recommendations of the City's smog plan. *Clean, Green and Healthy: A Plan for an Environmentally Sustainable Toronto, the Environmental Plan,* was endorsed by City Council in April 2000. The plan's recommendations include ways to improve Toronto's air.[56] Some ways in which the City of Toronto will contribute to cleaner air are:

- An Employee Trip Reduction program to reduce the amount of travelling done by City employees, including making it easier for people work from home.
- A Municipal Smog-Alert Program which ensures that City departments limit activities that contribute to smog during smog-alerts.
- The purchase of fuel with lower levels of sulphur for its motor vehicles and replacing existing vehicles with low-emission vehicles as part of its Green Fleets initiative.
- Encouraging action by the provincial, federal and U.S. governments that will lead to lower emissions from such sources as power plants.
- Advocating for stricter air quality standards to ensure that the public's health is protected.

Compact Urban Form

The density of Toronto is about 3,800 people per square kilometer, with even higher densities in the former City of Toronto, York and East York. In the surrounding "905" area, the density is less than half that, about 1600.[56]

Compact urban planning can leave 50 percent of the land area for open space, reduce cost of infrastructure by 40 percent and create homes that are in greater demand.[59]

- Increasing energy efficiency in the City's operations, and retrofitting 40 per cent of buildings in Toronto as part of the Better Buildings Partnership.
- Making a commitment to buy 25 per cent of the City's energy needs through "Green Power".
- Developing an air quality strategy for the City.
- Promoting compact growth in areas of the city where the infrastructure such as transit already exists.
- Developing a Sustainable Transportation Plan for Toronto.
- Increasing the number of cycle paths/lanes.
- Encouraging green roofs and roof top gardens.
- Educating the community about ways they can help improve air quality.

The City of Toronto is also undertaking the production of an Official Plan. The new Official Plan, *Toronto Plan,* will set forth a vision and a plan of action for the next 30 years. Its Directions Report *Toronto at the Crossroads: Shaping Our Future* describes how the plan will integrate environmental concerns into both everyday land use and transportation decisions, and long-term strategic policies for compact urban form and a transportation system that is less reliant upon the private automobile.[58]

Green Power

Green Power is energy that is generated from renewable sources such as water, solar and wind. Green power does not create harmful smog emissions. Every watt of electricity used by the City of Toronto that comes from green power means less smog. Green Power also helps combat global climate change.

5.2 What can Individuals do about Smog?

Everyone can help reduce smog and make the air we breathe cleaner. Individual action does make a difference. If we all change our behaviours, even for a few days of the week we could decrease the emissions and improve air quality. By taking these actions, everyone can play a part in making Toronto's air cleaner.

There is Money to be Saved

Studies show that 11 to 30 billion dollars could be saved in Canada with reductions in motor vehicle emissions of particles, NOx, VOCs and other toxic contaminants. These include savings on health costs, impact on forest, fisheries, and agriculture, and savings from spending less on fuel.[48]

Reduce energy use

- Plant trees to create shade over roofs and paved areas.
- White roofs and white pavement absorb less heat than black ones.
- Don't pave your parking area.

- Set a warmer temperature on your home air conditioner or turn it off. A temperature difference of 5°C between outdoors and indoors is sufficient to feel cool.
- In summer, at work, dress casually and ask that the office temperature be kept a little higher.
- Do an energy audit of your home and find out ways to reduce energy use.
- Turn off lights and equipment when not in use, especially at night.
- Buy electricity from a green-energy supplier.

Reduce car emissions

- Walk or cycle to local stores and use a shopping cart.
- If you are moving, consider having your new home close to public transit.
- Leave your car at home, especially on smog alert days.
- Reduce your number of trips.
- Consider joining or organizing a car-sharing group.
- Ask about the possibility of telecommuting or working out of an office closer to your home.
- Keep your car tuned and your tires properly inflated.
- Don't idle your engine.
- Refuel the car in the evening after the sun has set and the air has cooled. Vapours that escape while gasoline is being pumped contribute to smog.
- Start or join a walking school bus for children going to school.
- Ask your municipal, provincial and federal representative what actions are being taken to keep the air clean and make the city more friendly for walking, cycling and transit use.
- Encourage more compact mixed-use communities to make it easier to walk, cycle or provide transit services.
- Encourage the development of more cycling paths and cycling lanes.

Cost of Owning a Car

The annual cost of owning and operating a car is between $7,000 and $8,000 a year. (The yearly cost of transit is about $1,000, and for cycling only $300). Especially if you live downtown and most of your activities, including work, are within the city, consider not owning a car. The money saved will pay for taxis or car rentals on the occasions that you actually need a car – and you'll have lots of money left over to spend or invest however you choose.

Clean the air

- Use alternatives to pesticides.
- Buy locally grown food or grow your own (pesticide-free).
- Avoid using solvents and oil-based paints, glues or cleaners.
- Don't barbecue on smog alert days.
- Avoid the use of gasoline-powered garden tools such as lawn mowers or leaf blowers, especially on Smog Alert days. You can use a push mower, or better yet, replace your lawn with other hardy plants.
- Join an environmental group.
- Work with your neighbourhood or school to convert a parking lot into a park.

Walking School Bus

A walking school bus involves one or two parents collecting a group of children from their neighbourhood and escorting them to and from school.

5.3 What Business or Industry Can Do[59]

Business and industry can also be leaders in the effort for cleaner air, for example:

- Through greater energy efficiency in their operations and buildings.
- Adopting pollution prevention in their operations.
- The development of green technology.
- Choosing to locate in areas that are accessible to transit to reduce the dependence on the private automobile for their employees or customers.
- Encouraging employees to work from home or from satellite offices closer to where people live.
- Providing transit passes for employee transportation allowances.
- Facilitating car pooling.
- Providing shower facilities and bicycle storage for employees who cycle to work.

Making Toronto Cycling Friendly

Some ways that can help Toronto become friendlier for cyclists include:

- Establishing a comprehensive network of bike lanes and routes including trails and paths suitable for cycling in parks, green space or hydro and rail corridors.
- Provide convenient connections between trails and on-street systems.
- Provide secure/monitored bicycle parking/storage at the workplace, close to shops, and in transit stations.
- Provide shower/change facilities and cyclist friendly dress code at the workplace.
- Provide safety education to both cyclists and motorists.
- Bicycle registration to reduce theft.

5.4 Collective Action

Cleaner air for Toronto needs the effort of all people in society – governments (federal, provincial, and municipal), business, industry, community groups, and individuals. Each one of us has a part in creating clean air in Toronto. Every step counts, whether from individual behaviour and lifestyle changes, emissions reduction by industries, infrastructure changes that improve transit and cycling routes, to policy and standards development by all levels of government. It is by working together that we will all make a difference to the air we breathe in the city. Toronto Public Health is launching a campaign *20/20 – A Clear View to Clean Air* to encourage the various partners to join forces on the journey towards cleaner and healthier air. Collective action to improve Toronto's air is needed and needed now.

Greater energy efficiency can profitably address 90 percent of health concerns from smog, particles, and toxic chemicals [59]

6 Appendix – Toxic Air Pollutants

Benzene

Benzene is a naturally occurring substance and is found in gasoline and other petroleum products. It is a known carcinogen. Benzene affects the blood forming tissues and can cause anemia, internal bleeding and leukemia.[29] The US Environmental Protection Agency has estimated that levels of 1 µg/m^3 over a life-time could result in 2.2 to 7.8 cases of cancer.[39] Canada is in the process of developing a Canada-wide Standard for benzene. Phase 1 aims at reducing emissions by 30 percent. Phase 2 is to be developed by 2001.[40]

1,3-Butadiene

1,3-Butadiene is a product of incomplete combustion from both human activity and natural sources. It is also used in the manufacture of some plastics and rubber products. Levels of this substance are higher in urban than in rural air. Motor vehicles are an important source of 1,3-butadiene in Toronto.

1,3-Butadiene is a volatile organic compound (VOC) and contributes to the creation of smog. It is considered a cancer-causing agent. 1,3-Butadiene has caused cancer in experimental animals and exposed workers have shown a higher risk of developing leukemia. It can cause damage to genes and has caused adverse effects to reproductive organs in animals at low concentrations. In May 1999, the Canadian government recommended that 1,3-butadiene be added to the list of toxic substances under the Canadian Environmental Protection Act (CEPA).[41]

Lead

Levels of lead in the air have been reduced dramatically since the introduction of unleaded gasoline. The highest levels of lead in Toronto's air in 1996 were at the monitoring site near Mosley and Leslie streets: 2.90 µg/m^3. This is above the 24-hour ambient air quality criterion of 2 µg/m^3. The daily average at this site was 0.19 µg/m^3.[22]

Lead is a neurotoxin – it affects the nervous system. Low levels of exposure can result in lower IQ, speech, and hearing impairment, decreased childhood size, and subtle behavioural problems. The fetus, infants, and children up to six years of age are more susceptible to the adverse effects of lead. The level of lead found in the blood determines lead poisoning. Although 10 µg/dL is used to indicate potential lead poisoning, adverse developmental and behavioural effects have been observed at blood lead levels, which are typical of the general population, and as low as 0.5 µg/dL. It has been suggested that there is no threshold for the effects of lead. That is, any level of lead can be harmful.[42]

Manganese

The 1996 daily average level of manganese in Toronto was 0.039 µg/m^3, which is higher than the provincial average of about 0.017 µg/m^3.[51] The 24-hour air quality criterion is 2.5 µg/m^3. Manganese is a naturally occurring substance and higher levels measured in the urban air may be due to higher levels of dust. In areas with high traffic density, the gasoline additive MMT (methylcyclopentadienyl manganese tricarbonyl) is an important contributor to overall levels of manganese. Health Canada found levels of manganese to be low in most areas in Canada except around specific industries such as steel mills.[43]

Manganese is an essential element for humans. It is therefore beneficial at low levels. However, at high levels it is neurotoxic. It can result in manganism, a condition with symptoms similar to Parkinson's Disease. Infants and the elderly are more at risk to the effects of manganese. Breathing in manganese is more toxic than taking it through food or water.

Mercury

Almost all mercury contamination in the Great Lakes is the result of air pollution. Although mining contributed in the past to most of the pollution by mercury, the largest source of mercury emissions to this region is now coal-fired electricity generation. As the electricity sector is privatized there will be pressure to generate electricity at the lowest cost. This could result in greater use of coal-fired plants and their associated emissions, including mercury.[44] The Canada-wide standards for mercury aim at reducing emissions from smelters and incinerators. Standards for coal-fired plants are still being developed.[45]

Methyl mercury is the form that is highly toxic. Mercury bioaccumulates in fish and other animals. It affects the nervous system including the brain. At very high levels of exposure, mercury will lead to Minamata disease. Children exposed in the womb at low levels have shown language difficulties. People, such as native people, who eat a lot of fish are most at risk.[1]

Polyaromatic Hydrocarbons (PAHs)

Polyaromatic hydrocarbons (PAHs) are another class of toxic compounds present in city air. They are mostly found in particles. PAHs are formed during the burning of wood and fossil fuels. Exhaust from diesel motors and smoke from wood stoves are the major sources of PAHs in outdoor air. PAH concentrations in the air are usually much lower than ambient air quality criteria for these compounds. PAHs are cleared from the air by precipitation (rain or snow) as well as dry deposition.

Several PAH compounds such as benzo(a)pyrene have been classified as cancer causing agents. Diesel exhaust, which contains PAHs, has also been shown to cause cancer. The California South Coast Air Quality Management District has calculated that particles from diesel exhaust to be responsible for about 70 per cent of cancer cases caused by air pollution.[46]

Volatile Organic Compounds (VOCs)

Levels of total hydrocarbons in the air in Ontario have remained fairly stable around 2 ppm between 1971 and 1992. Stricter emission standards for cars have contributed to lower emissions of volatile organic compounds or VOCs in Ontario since 1990. Although levels of selected VOCs are much lower than the ambient air quality criteria, they are of concern because they contribute to the formation of ground-level ozone. Vegetation is a natural source of some VOCs compounds, but most VOCs found in Toronto's air are emitted from industrial and commercial processes as well as from motor vehicles. The Ontario Ministry of the Environment does not routinely measure VOCs in Toronto's air.[47]

7 Endnotes

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