WHAT IS THE IMPACT OF COAL-FIRED POWER GENERATION ON ASTHMA?

1. What is Asthma?
2. The Causes of Asthma
3. Asthma Triggers and Inducers
4. Indoor Air Pollution and Chemical Triggers
5. Outdoor Air Pollution and Asthma
6. Impact of Ontario's Coal-Fired Power Generation on Ontario Air Quality

1. What is Asthma?

Asthma is characterized by a cough, shortness of breath, chest tightness and wheezing, often associated with exposure to asthma triggers. (Lung Association)

“Asthmatic people have airways that are very sensitive to certain irritants and allergens, going into spasm when exposed to even normal amounts. During an asthma episode the muscles surrounding the bronchial tubes constrict and the lining inside the tubes swells and produces an excessive amount of mucous.” (TeenGrowth.com)

Asthma is a common disease that has been increasing in frequency for many years. "Increases have been reported in the number of individuals with asthma and in the severity of the disease, including hospitalizations and deaths, despite more awareness of asthma and improvements in asthma treatment. The number of individuals with asthma increased by 42% in the U.S. during the last decade and has roughly doubled since 1980." (ProtectingourHealth.org) This trend is paralleled in Canada.

2. Causes

The general consensus is that the causes of asthma are not fully known or understood. According to Environment Canada, "it appears to be the result of a complex interaction of three factors:

1. Predisposing factors, such as atopy - a tendency to have an allergic reaction to foreign substances.
2. Causal factors, which may sensitize the airways, such as cat and other animal dander, dust mites, cockroaches, or workplace contaminants.
3. Contributing factors, which may include maternal cigarette smoking during pregnancy or exposure to cigarette smoke as a child, respiratory infections, and indoor and outdoor air quality**."**

“Asthma often runs in families and children can inherit the tendency to get inflamed bronchial tubes. Children can also inherit the tendency to have allergies (this is called atopy), which increases the risk of developing asthma.” (BUKA – see sources) "Childhood asthma is a disorder with genetic predispositions and a strong allergic component. Approximately 75 to 80 percent of children with asthma have significant allergies." (American Lung Association)

3. Asthma Triggers and Inducers

The Canadian Lung Association indicates that triggers and inducers are the two factors that provoke asthma.
Some triggers (also called 'inciters') only cause tightening of the airways (bronchoconstriction) that lasts for just a short time. Other triggers (also called 'inducers') also increase the underlying inflammation of the airways and may have longer-term effects.

(i) Triggers (inciters) irritate airways and result in bronchoconstriction.

These include:
•Infections such as colds and flu (A respiratory viral infection is probably one of the most common causes of asthma. - Lung Association);
•Cold air;
•Irritants such as dust, cigarette smoke (including second hand smoke), strong fumes and chemicals;
•Exercise, especially in cold, dry air;
•Certain food additives like sulfites, artificial food colouring – food allergies;
•Strong emotions (excitement, fear, anger); emotional upsets and stress.

(ii) Inducers cause airway inflammation and hyperresponsiveness.

The most common inducers include:
•Allergens such as pollen (grass, trees, ragweed);
•Animal secretions (cats and horses are the worst);
•Molds;
•House dust mites;
•Certain air pollutants.

(iii) Occupational irritants
Occupational asthma is characterized by something in the work environment that triggers asthma. A clue to determining this is if asthma symptoms are worse during the work week and improve on days off.

The Asthma Society of Canada and the Centre for Occupational Health and Safety provide an extensive list of occupations at risk for development of asthma. They are related to the categories of:
• Mill workers and carpenters (saw mills, wood dust, especially red cedar dust);
• Grains, flours, plants and gums (Bakers and farmers);
• Textile workers (cotton dust);
• Animals, insects and fungi;
• Chemicals/Materials; and Isocyanates and Metals **(i. e.** Boat builders, foam manufacturers, office workers, plastics factory workers, refrigerator manufacturers, boiler cleaners, gas turbine cleaners, cement workers, rubber workers, welders, etc. – metal fumes);
• Drugs and enzymes (pharmaceuticals and detergent manufacturers)**;** and

The US Food and Drug Administration summarizes the contributors to asthma as follows:

"Common asthma triggers include dust, pollen, cockroaches, cold air, smoke, and other strong odors, such as paint, cleaning fluids, perfume, hair spray, and powder. For some people, the problem is animal dander, flakes of skin and dried saliva from furry or feathered animals. For others, asthma can be triggered by medication, such as aspirin, or sulfites, preservatives used in food.

Stress is thought to be a trigger of asthma. Stress can create strong physiologic reactions that lead to airway constriction. Stress can also alter the immune system, which can, in turn, increase the likelihood of an asthma attack in people with asthma. According to the Centers for Disease Control and Prevention (CDC), after the Sept. 11, 2001, attacks on the World Trade Center, some adults in Manhattan reported an increase in their asthma symptoms due to stress, as well as from smoke and debris."

4. Indoor Air Pollution and Chemical Triggers

According to The American Lung Association, levels of air pollution inside the home can be two to five times higher (and occasionally 100 times higher) than outdoor levels. Considering that we spend, on average, more than 90% of our days indoors, and that many of the asthma contributors originate indoors, more attention should be focused on these.

• Numerous volatile organic compounds (VOCs) are found in modern buildings, particularly those in urban areas (Kinney *et al.* 2002). These chemicals include many respiratory irritants such as formaldehyde, toluene, and chloroform. VOCs may enter from outside but remain trapped in the indoor environment, or they may be released from building materials, carpets, and furniture. These compounds are also found in some household products including glues, paints, and detergents. (protectingourhealth.org)

• A study recently published in American Journal of Respiratory and Critical Care Medicine, reported that the regular use of home air freshener sprays increased the risk of asthma by 30 to 50 percent.

• Asthma, emphysema, bronchitis, and allergies can all be adversely affected by the chemicals found in scented products. According to the Lung Association, one study found that 72 per cent of people with asthma had adverse reactions to perfumes. (Canadian Safety Council)

4. Outdoor Air Pollution and Asthma

The impact of outdoor air pollution on asthma has not been conclusively determined. There is conflicting information.

• "While air pollution as a cause of asthma has not been verified, there is good evidence that pollution causes the symptoms of many people with asthma to get worse on days when the air-quality index is high." (asthma.ca - the Asthma Society of Canada)

• The jury is still out on whether air quality causes asthma or just aggravates existing asthma. ... (Environment Canada)

• Smog and some air pollutants can make asthma symptoms worse. Smog is a combination of vapors, gases and particles that react to sunlight to produce ozone near the ground. The particles in the air along with ozone, cause lung damage and breathing problems in people with asthma. Where possible, avoid going outdoors on days that have poor air-quality indexes. (asthma.ca)

• Sometimes there is conflicting information within an article. "Asthma is made substantially worse by current concentrations of particles and ground-level ozone. …Asthma is a complex disease that is multifactorial: in many cases, a genetic predisposition followed by an environmental exposure is a common process sequence. There is good reason to be suspicious of the contemporary role of air pollutants, but proof about them causing increasing asthma prevalence is not available at the present time. …
Ozone, together with acid aerosols, may well be playing a combined role in the exacerbation (worsening) of asthma. Ozone in smog causes airway inflammation, and higher levels increase the frequency of symptomatic asthmatic attacks. It is not known whether any of these agents are affecting prevalence rates of the disease." (Ontario Medical Association)

There appears to be evidence that air contaminants adversely impact asthma. Over half of asthma sufferers noted their conditions worsened on smoggy days. Increased asthma episodes for children were related to higher emissions reported from transport vehicles idling at the Ontario/Michigan border crossing in Windsor in the days following the 9/11 attacks. "Asthma is more common in the urbanized areas of industrialized countries, and is particularly common in children living along busy roads and trucking routes (protectingourhealth.org - Brunekreef *et al.* 1997).

On the flip side, there are those who question whether outdoor air pollution contributes in any appreciable way to asthma concerns. It is important to note that air pollution in North America is decreasing - air quality has improved over the past few decades - while asthma is increasing significantly.

• A very insightful article, "Facts Not Fear on Air Pollution", notes that "According to the Centers for Disease Control, the incidence of asthma in the United States rose 75 percent from 1980 to 1996, and nearly doubled for children. ... But air pollution cannot be the cause, since it declined at the same time asthma prevalence increased. While the incidence of asthma has more than doubled in California since 1982, air pollutants of all kinds have steadily declined. ...
The pattern of hospital visits for asthma suggests air pollution cannot be significantly exacerbating the condition. ... emergency room visits and hospitalizations for asthma are lowest during July and August, when ozone levels are highest....
Asthma rates are highest in wealthy Western countries that have relatively low air pollution levels, while developing countries with awful air pollution have low asthma rates. Before 1991, for example, the former East Germany had high air pollution levels and low asthma prevalence. But after reunification East Germans adopted Western lifestyles, incomes increased and air pollution declined — but the incidence of asthma rose to levels comparable to West Germany."

• US scientists in Colorado studied the link between asthma and pollution and concluded that "When they looked at the levels of six air pollutants, including particulate pollution, ozone and carbon monoxide, they found no obvious relation to asthma severity. Higher carbon monoxide levels were marginally associated with increased use of asthma medication and daily asthma symptoms were marginally associated with ozone levels, but this was not significant." Yet, upper respiratory infections doubled the chances a child would suffer an asthma exacerbation and more

than quadrupled the odds a child would suffer asthma symptoms. Co-author Dr. Nathan Rabinovitch said, 'This is good news for parents. Instead of worrying about air pollution they can focus their efforts on preventing and treating the real wintertime threat to their children's health – colds and other respiratory infections.'" This article did mention that air pollution may still trigger summer time asthma. (Story from BBC NEWS:http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/3995097.stm)

• A recent study revealed a high incidence of asthma amongst people who spend a lot of time in arenas. Air quality tests were done, and it was found that there was a high level of fine particulate in the air resulting from ice cleaning machines.

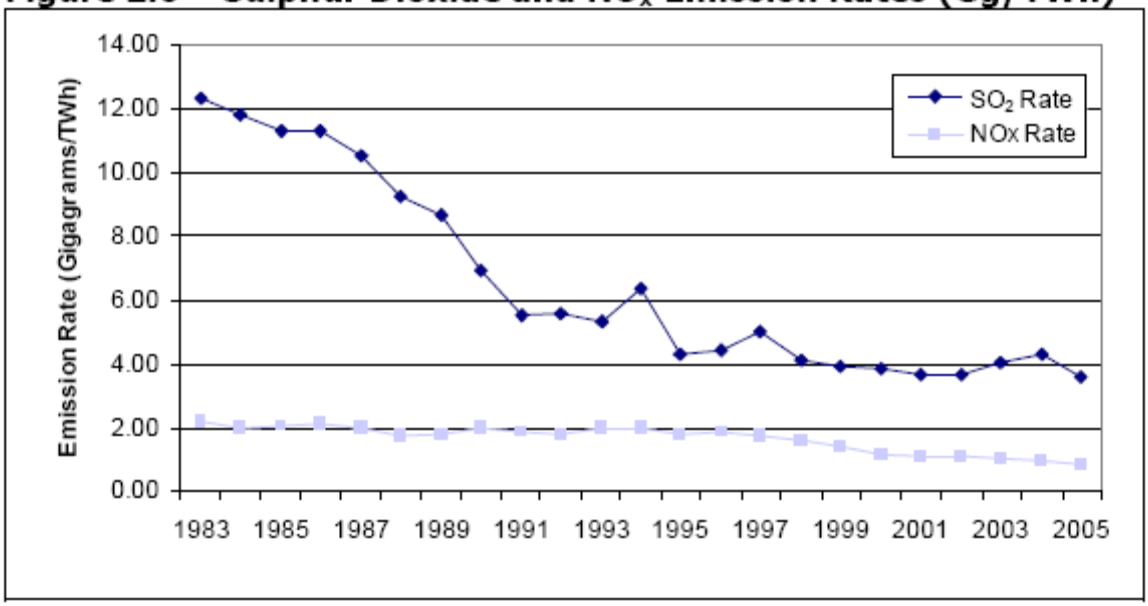
5. Impact of Ontario's Coal-Fired Power Generation on Ontario Air Quality

If we acknowledge - on the side of caution - that outdoor air pollution does contribute to asthma in Ontario, how significantly does coal-fired generation in the province impact air pollution and consequently asthma?

According to the Ontario Ministry of Energy, emissions from coal-fired power plants are associated with major health impacts including increased hospital emissions for patients with asthma. This statement and similar comments from the Ministry of Energy imply that coal-fired power generation is a significant contributor, and that ceasing to use coal-fired power in the province will lead to an alleviation of asthma episodes. This is a highly exaggerated claim. Consider:

1) Coal-Fired emissions have lessened, but asthma is rising

Figure 2.6 – Sulphur Dioxide and NO_x Emission Rates (Gg/TWh)



Source: OPG

From Ontario Power Authority (OPA) Discussion Paper Supply Mix - Integrated Power System Plan

2) Coal-Fired generation contributes about 6% to Ontario's overall air quality concerns

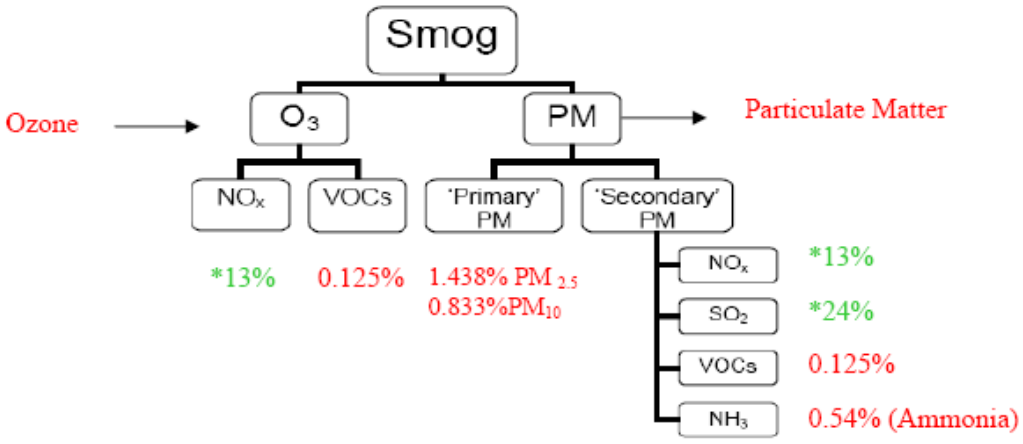
• The Ontario Medical Association indicates that health issues associated with pollution are attributable to **chronic** and **acute** exposure to **5** common pollutants, namely:

Ozone (O3) which is comprised of NOx (nitrogen oxides) + VOCs (volatile organic compounds); PM $_{2.5}$ (particulate matter); CO (carbon monoxide); and SO_2 (sulphur dioxide). (Ministry of the Environment)

• As noted on the following chart, coal's contribution to the provincial emissions of the smog precursors, VOCs, and CO are less than 1%. (Transportation is by far the greatest contributor.)

• Coal fired generation in Ontario is responsible for 1.438% of provincial $PM_{2.5}$ and 0.833% of PM_{10} emissions. (Residential fuel wood combustion - wood stoves, fireplaces - produces more than double the particulate emissions of all Ontario coal-fired generating plants combined.)

CONTRIBUTION OF COAL FIRED POWER GENERATION TO ONTARIO'S PORTION OF SMOG PRECURSORS



Environment Canada Air Contaminant Emissions tracking also includes CO (carbon monoxide). Coal-fired generation in Ontario contributes 0.49% to Ontario's portion of CO emissions

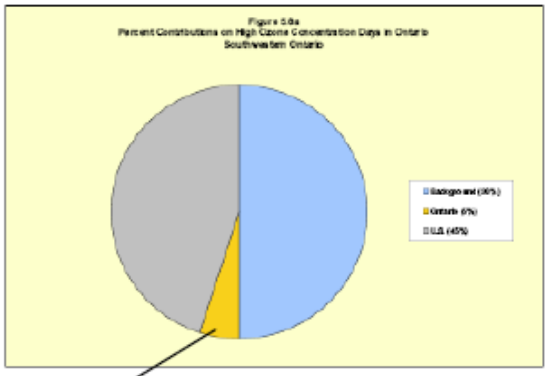
(These figures include Lakeview GS, now closed.)

(* These emissions can, and are being, significantly decreased using currently available emissions reduction technology.)

• Coal does contribute more to SO_2 and NO_x emissions. However, when transborder air pollution, and background emissions are taken into consideration, the coal fired portion is minimal.

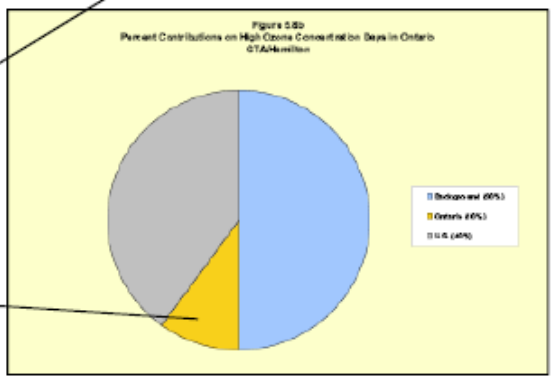
• 55% of Ontario's air contaminant emissions originate in the U.S. "Background" emissions, described as "natural and human sources from outside of North America, together with natural sources within North America", also contribute significantly to Ontario air quality. (Ministry of the Environment)

% CONTRIBUTION ON HIGH OZONE DAYS IN ONTARIO



Southwestern Ontario

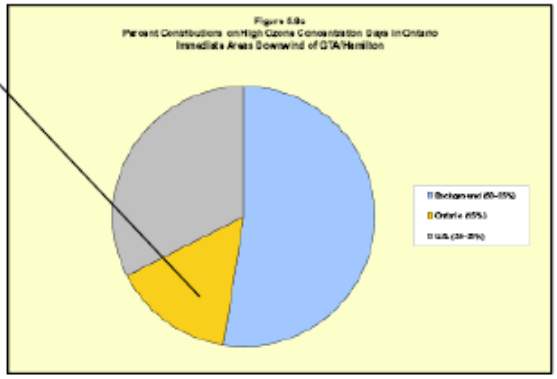
* Background - 50%
US Sources - 45%
All Ontario Sources – 5%



GTA/Hamilton

* Background - 50%
US Sources - 40%
All Ontario Sources – 10%

Coal emissions represent a small portion of this amount



Downwind of the GTA/Hamilton

* Background - 50%-55%
US Sources - 30-35%
All Ontario Sources – 15%

*Background ozone concentrations refer to the contributions at a given location in Ontario that are primarily the result of manmade and natural emissions from outside North America and natural sources within North America.
(Air Quality in Ontario, 2005 - Ontario Ministry of the Environment)

On days of low ozone, background ozone concentrations are expected to dominate, and **manmade sources would not contribute as much**. Background contributions were estimated to be about 75-80% for the GTA/Hamilton and 80-85% downwind of GTA/Hamilton. (Ministry of the Environment)

TRANSBOUNDARY EMISSIONS vs ONTARIO CONTRIBUTIONS

• ONTARIO SOURCES • US CONTRIBUTION

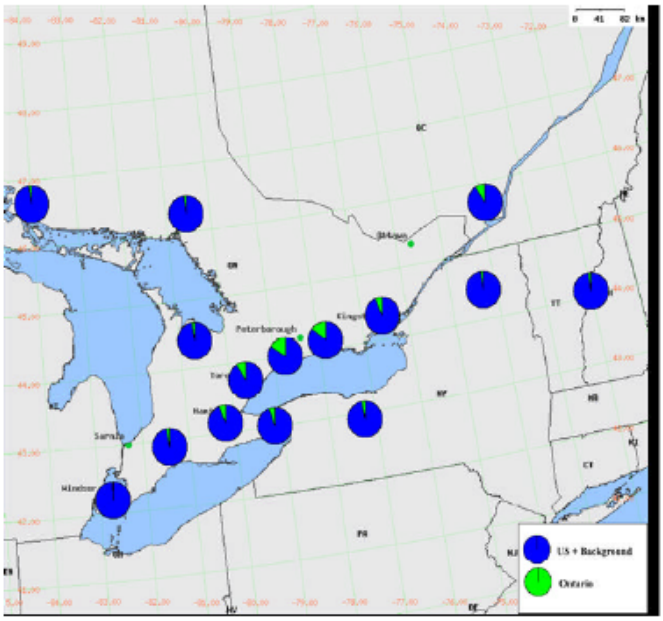


Figure 3.4: Graphic of Transboundary vs. Ontario Contribution for Ozone on High Concentration Days during 1998 Spring/Summer Season.

OZONE

Coal-fired generation contributes to the Ontario Sources represented by the "green" portion - in the proportion as shown in the chart on page 6. Therefore, coal fired emissions represent about 6% to overall air contaminant emissions in Ontario.

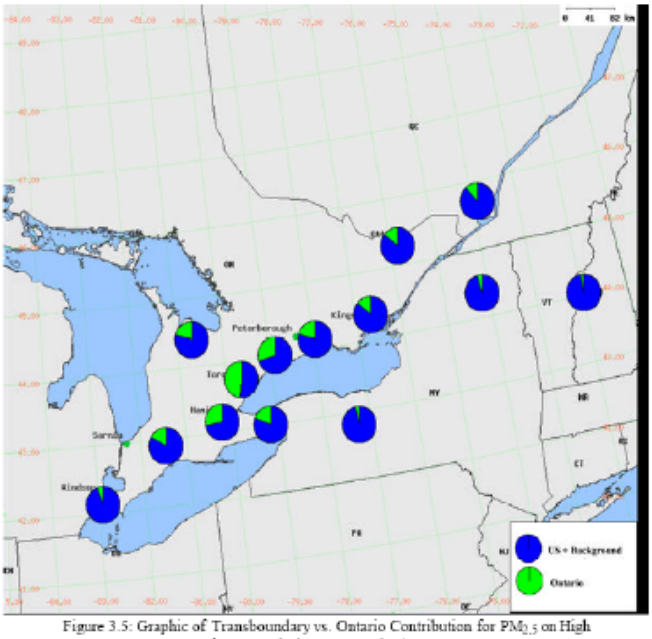


Figure 3.5: Graphic of Transboundary vs. Ontario Contribution for $PM_{2.5}$ on High Concentration Days during 1998 Spring/Summer Season.
(source: Ontario Ministry of the Environment)

PM $_{2.5}$

(Air Quality in Ontario, 2005 - Ontario Ministry of the Environment)

PM 2.5 originates from particles emitted directly from sources and from particles formed in the atmosphere. The precursor gases SO2, NOx, ammonia and certain VOCs react in the atmosphere to form ammonium sulphates, ammonium nitrate and organic particles. Air quality models include all of these components.

Net Impact of Coal-Fired Power Plants on Ontario's Air Quality:

• Small (about 6% overall); negligible from Thunder Bay and Atikokan sites

• Provincial government information shows that "… the Toronto ozone level from the Ontario coal plants (during smog season) is only 0.03 ppb." That is less than 1%. (Ontario's Cost-Benefit Analysis – Replacing Ontario's Coal-Fired Electricity Generation)

• An assessment of contribution of harmful emissions to air quality from Ontario's coal fired power plants was completed as part of the government's Cost-Benefit Analysis. This report demonstrates that coal fired power in Ontario contributes **less than 1% to ozone in southern Ontario; less than 5% to PM_{10}** ("Primary PM_{10}, particulate nitrate, and particulate sulphate concentrations were summed to arrive at total PM_{10} concentrations.") (Ontario's Cost-Benefit Analysis - Replacing Ontario's Coal-Fired Electricity Generation, prepared for the Ontario Ministry of Energy, April, 2005)

• The role of Ontario's power plants in forming ground-level ozone in Ontario was studied in a report by RWDI consultants, 2004. The results indicated that had the power plants been removed, there would have been almost no difference. "The reduction in ozone formation across the region would have been imperceptibly small." (Pain Without Gain, Fraser Institute, January, 2005)

• "Overall, closing down the CFG (coal fired generating) facilities is forecast to improve air quality in most parts of southern Ontario. … However, these improvements are small compared to the overall ambient concentrations of these pollutants. The ambient concentrations of these pollutants are influenced by various sources including transboundary air pollution and vehicle emissions." (Ontario's Cost-Benefit Analysis - Replacing Ontario's Coal-Fired Electricity Generation, prepared for the Ministry of Energy, April, 2005)

• The Ministry of the Environment operates an extensive network of air quality monitoring sites - 38 locations - across the province. An AQI (Air Quality Index) is based on recordings from these sites, of pollutants that have adverse effects on human health and the environment.

The data collected is summarized and included in the Ministry's Air Quality report. The most recent is the data from 2005. Most sites showed good or very good air quality 85% of the time; moderate 13%-15%; poor on average, less than 1.5% of the time.

The following chart shows the impact of emissions on health and the environment. This chart is from the Ontario Ministry of the Environment 2005 Air Quality report. The contributions from Ontario's coal-fired power plants has been inserted at the bottom.

Table 5.1: Air Quality Index Pollutants and Their Impacts*

Index	Category	Ozone (O_3)	Fine Particulate Matter ($PM_{2.5}$)	Nitrogen Dioxide (NO_2)	Carbon Monoxide (CO)	Sulphur Dioxide (SO_2)	Total Reduced Sulphur (TRS) Compounds
0-15	Very good	No health effects are expected in healthy people	Sensitive populations may want to exercise caution	No health effects are expected in healthy people	No health effects are expected in healthy people	No health effects are expected in healthy people	No health effects are expected in healthy people
16-31	Good	No health effects are expected in healthy people	Sensitive populations may want to exercise caution	Slight odour	No health effects are expected in healthy people	Damages some vegetation in combination with ozone	Slight odour
32-49	Moderate	Respiratory irritation in sensitive people during vigorous exercise; people with heart/lung disorders at some risk; damages very sensitive plants	People with respiratory disease at some risk	Odour	Blood chemistry changes, but no noticeable impairment	Damages some vegetation	Odour
50-99	Poor	Sensitive people may experience irritation when breathing and possible lung damage when physically active; people with heart/lung disorders at greater risk; damages some plants	People with respiratory disease should limit prolonged exertion; general population at some risk	Air smells and looks brown; some increase in bronchial reactivity in asthmatics	Increased symptoms in smokers with heart disease	Odour; increasing vegetation damage	Strong odour

Coal contribution ^ ^ ^ ^ ^

VOCs 0.125% 1.438% 13% 0.49% 24%

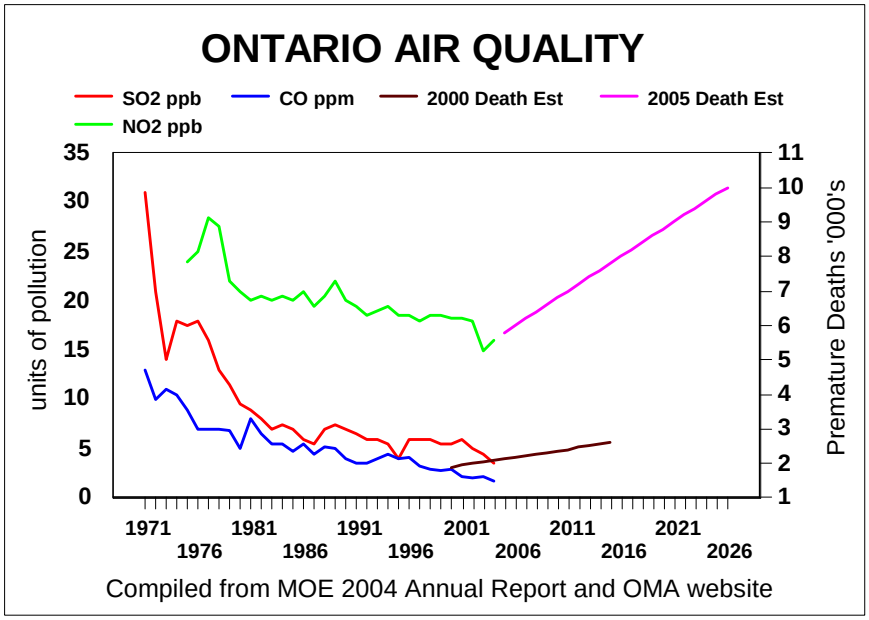
\+ NOx 13%

• There were no impacts for healthy people 85% of the time. For 15% of the time, the adverse conditions noted are odour and **potential** "respiratory irritation" in **sensitive people during vigorous exercise;** those with heart/lung disorders potentially at some risk. (Noted elsewhere, "moderate" air quality days, according to the Ministry of the Environment, "may have some adverse effects for very sensitive people".)

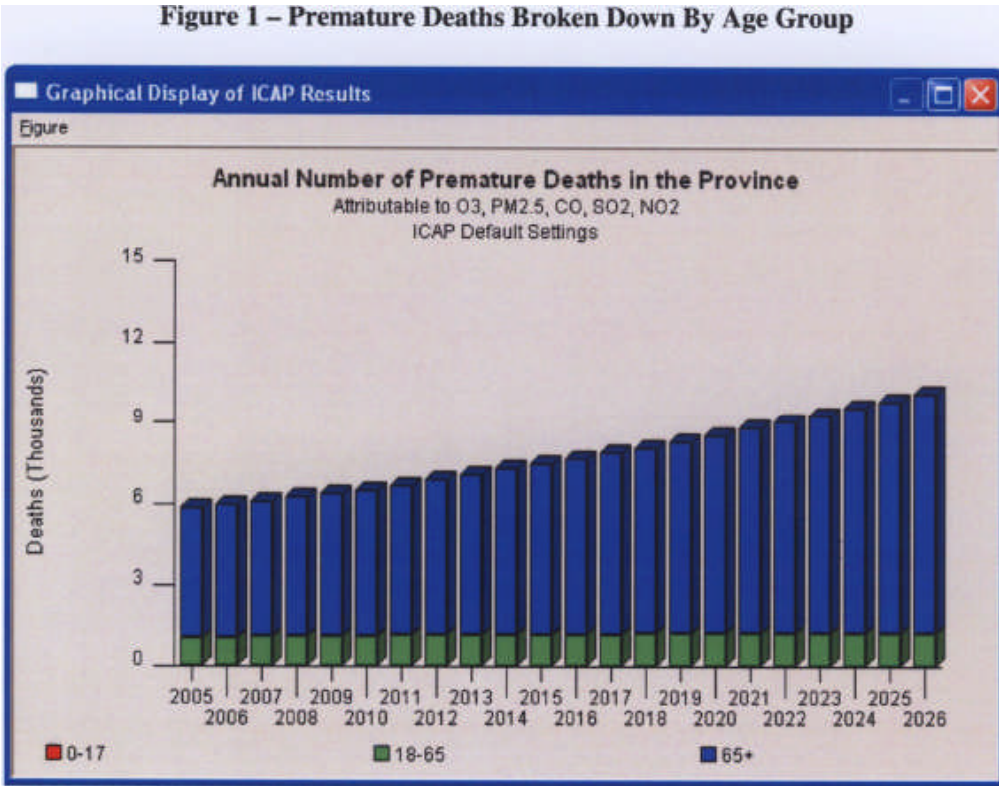
• Asthma is most commonly triggered by pollens, dust, pet dander, mould, stress, as well as outdoor air pollution; respiratory viral infection is one of the most common causes. (Canadian Lung Association) From this information, it can be concluded that coal fired generation contributes an insignificant amount to hospital admissions related to asthma.

3) Air quality in Ontario has improved, but asthma is rising

The following chart shows information from the Ministry of the Environment (green, red, blue) relating to reduced air emissions that contribute to poor air quality. This demonstrates a reduction in air pollution. Compare this information with the statistics from the Ontario Medical Association (black, purple) that demonstrates a predicted, significant rise in premature deaths attributed to air pollution.



The following chart from the OMA's "Ground Level Ozone Position Paper" reflects this premise.



In spite of the downward trend, claims are made that pollution related deaths are "going through the roof". How can this be?

• These deaths, and associated "costs", are not actual deaths but statistical numbers developed from mathematical models that have considerable margins of error.

• Many researchers cast serious doubt about these numbers.

• One study on Toronto pollution that did take into account margins of error, found that after looking at 567 trillion combinations of factors, a correlation between mortality and pollution could not be established. (Measuring the Health Cost of Air Pollution - To What Extent Can We Really Say that People are Dying From Bad Air? Koop and Tole - University of Glasgow, 2002)

• The present government's own report states "it is impossible to identify which specific deaths that occur over a given time are actually attributable to pollution. Air pollution is a CONTRIBUTORY factor….and is never the overriding or irrefutable cause of death." (Ontario's Cost-Benefit Analysis - Replacing Ontario's Coal-Fired Electricity Generation, April, 2005) Yet pollution is being "charged the full amount" for these deaths.

• "A number of commentators have suggested air pollution levels may be causing increases in the rates of asthma. Recently, the UK government's *Committee on the Medical Effects of Air Pollution* studied the question and concluded that this claim is unfounded ... Perhaps surprisingly, long term exposure to air pollution is unlikely to be a cause of the increased number of people now suffering from asthma in the UK. [United Kingdom Department of Health, 2004]" (Pain Without Gain)

• In another study, "ARIES provides insight into the relative toxicity of those various pollutants that other studies cannot. ... Findings to date, which cover four years of health and air quality data, show statistically significant associations with a number of air pollution parameters, including carbon-containing particulate matter, metals, and criteria gases. There are no consistent associations with sulfates, which are commonly associated with coal combustion. Thus, ARIES shows that utility emissions have not been found, with reasonable scientific certainty, to cause adverse health effects. Ironically, most federal and state regulatory programs target sulfate as the primary means to reduce ambient PM2.5 concentrations." (Facts Not Fear on Air Pollution)

4. Then why is coal-fired generation targeted as a main contributor to asthma?

Some environmental activists have misrepresented pollution information, and have exaggerated the health and environmental impacts. This information is circulated in the media, is accepted by the public, and through lobbying efforts forms the basis for government policy. It is difficult to counter misinformation once it has been circulated, particularly by organizations deemed credible in the public eye. Only a humble government can acknowledge error of judgment and reverse policy. Otherwise it is defended with further misinformation. Such has been the case with coal-fired power generation.

The Ontario Medical Association promotes warnings of increasing premature deaths from air pollution in the province. The OMA's "Ground Level Ozone Position Paper" notes that a principal concern is the use of coal to generate low-cost electricity, "with resulting increases in the emission of pollutants such as sulphur dioxide, nitrogen oxides, particulate matter, mercury

and carbon dioxide. In Ontario, coal-fired electric stations are major emitters of these pollutants. ... During the OMA's review of various air pollution-control strategies and scenarios, it quickly became clear that the coal-fired power plant produces most of the pollutants at issue. Key strategies must therefore concentrate on power plants and motor vehicles situated in both the U.S. Midwest and in Ontario. …"

It must be noted however that the OMA attributes their information on coal fired generation from the Institute for Environmental Studies - University of Toronto in partnership with Pollution Probe. Emissions from coal-fired electric utilities: Environmental Health Effects and Reduction Options. January 19, 1998. The current spokesperson for Pollution Probe regarding coal-fired generation in Ontario is Jack Gibbons, a lobbyist on behalf of natural gas distributors and gas-fired generators who benefit financially with the coal closure mandate.

It is also noted that "these findings suggest that the harm from current levels of ambient air pollution in Ontario are much smaller than has been asserted by the OMA and Toronto Public Health studies and the studies on which they are based." Further, "There are other, serious, flaws in the models used by the OMA ... study that detract from their plausibility. For instance the Toronto Public Health model predicts such high death rates from pollution that, using the observed pollution levels from the 1960s it would attribute at least half and, in one case, more than 100%, of monthly deaths in Toronto to air pollution." (Pain Without Gain, Fraser Institute, January, 2005)

CONCLUSION

Although coal-fired power generation may contribute a smaller amount to air pollution which may in turn exacerbate asthma, the emissions of concern can be effectively, and significantly reduced for marginal cost. The Ontario Medical Association recommendation for emissions reductions includes the note that "Current estimates indicate that controls could be implemented for perhaps one to two per cent of the capital costs associated with Hydro's nuclear recovery plans. Effective emission controls would establish a strong and credible foundation for the Canadian case in support of U.S. emission reductions." (Ground Level Ozone - OMA)

The success of emissions reduction technology is evidenced in reports generated by and for the Ministry of Energy, including the Cost Benefit Analysis Report and the OPA's Discussion Paper "Emission Control Alternatives for Ontario Coal Generators", April 2007. These reports show that the emissions from Lambton Generating Station Units 3 and 4 are approximately 75%-85% less for NO_x , SO_2, and for mercury emissions, as a result of installed technology installed on these units. Electrostatic precipitators (dry ESP) installed at coal fired power plants, including Lambton Generating Station, reduce 99% of particulate matter, of concern regarding asthma.

The Ontario government has instead chosen to implement natural gas-fired generation which could be worse from an asthmatic perspective, and will come at great cost to the Ontario ratepayer. "Possibly more troubling are the emissions of fine particulates from gas-fired power plants. Though particulate emissions are about one-tenth what they are for coal power, the U.S. Environmental Protection Agency estimates that 77% of particulates from natural gas plant are dangerously small. These fine particulates have the greatest impact on human health because they by-pass our bodies' natural respiratory filters and end up deep in the lungs. In fact, many studies have found no safe limit for exposure to these substances." (David Suzuki Foundation)

Information from:

• The Asthma Society of Canada - www.asthma.ca
• The Ontario Lung Association
• The American Lung Association
• www.newtoasthma.com – asthma information
• Canadian Centre for Occupational Health and Safety (http://www.ccohs.ca/oshanswers/diseases/asthma.html)
• The Canadian Lung Association - www.lung.ca
• Environment Canada - http://www.ec.gc.ca/cleanair-airpur/Asthma-WSF0AA3018-1_En.htm
• BUPA - The UK's leading provider of private health care insurance, hospitals and health care services.
• The US Food and Drug Administration
• H. Sterling Burnett, Ph.D., "Breathe Easy on Air Quality," National Center for Policy Analysis, Brief Analysis No. 577, January 29, 2007. For text http://www.ncpa.org/pub/ba/ba577/
• OMA Ground Level Ozone Position Paper (Ontario Medical Association)
• New EPA Particulate Matter Standards Promise Little Benefits, Significant Cost for Utilities, Quinlan Shea, Executive Director, Environment, Edison Electric Institute - EnergyPulse
• David Suzuki Foundation - C:\Documents and Settings\Compaq_Owner\My Documents\Suzuki - Climate Change - Energy Fossil Fuels - Natural Gas.htm
• Facts Not Fear on Air Pollution: How Regulators, Environmentalists and Scientists Exaggerate the Level and Health Risks of Air Pollution and Impose Counterproductive Regulations by Joel Schwartz - Web site: www.ncpa.org/pub/st/st294
• http://www.protectingourhealth.org/newscience/asthma/2003-04peerreviewasthma.htm - The Collaborative on Health and the Environment
• Pain Without Gain: Shutting Down Coal-Fired Power Plants Would Hurt Ontario, Fraser Institute, January, 2005
•Ontario's Cost-Benefit Analysis - Replacing Ontario's Coal-Fired Electricity Generation, prepared for the Ministry of Energy, April, 2005