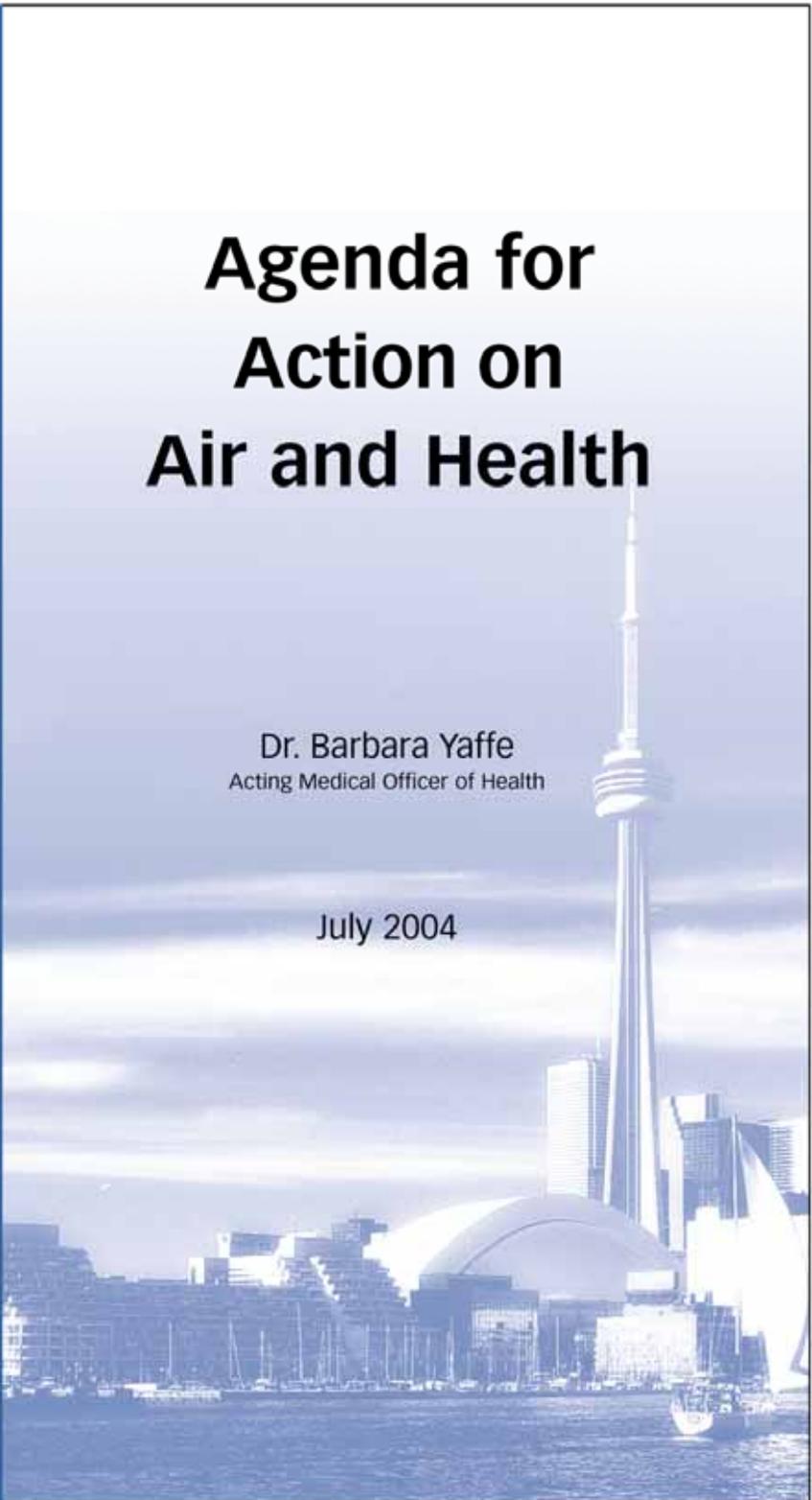


Agenda for Action on Air and Health

Dr. Barbara Yaffe
Acting Medical Officer of Health

July 2004



Reference: Toronto Public Health. *Agenda for Action on Air and Health*, Toronto, Ontario: July 2004.

Authors: Kim Perrotta, Monica Campbell, Angela Li-Muller, Ronald Macfarlane & Sarah Gingrich

Acknowledgements: The authors would like to thank the following people who offered advice, information and/or insights that were valuable to the preparation of the report:

Dr. Fran Scott, Toronto Public Health
Jill McDowell, Toronto Public Health
Karen Clark, Toronto Public Health
Franca Ursitti, Toronto Public Health
Carol Mee, Toronto Public Health

Anna Pace, Chief Administrative Officer's Office, Toronto
Joe D'Abramo, Urban Development Services, Toronto
Christopher Morgan, Works & Emergency Services, Toronto
Peter Moore, Urban Development Services, Toronto
Greg Stewart, Urban Development Services, Toronto
Steve McKenna, Works & Emergency Services, Toronto
Rob Graham, Finance Department, Toronto

Ken Ogilvie, Pollution Probe
Jack Gibbons, Ontario Clean Air Alliance
Mark Winfield, The Pembina Institute
Quentin Chiotti, Pollution Probe
Keith Stewart, Toronto Environmental Alliance
Brian Stocks, Ontario Lung Association
John Wellner, Ontario Medical Association

The views expressed in this report are however solely the responsibility of the authors and Toronto Public Health as are any errors or omissions.

Distribution: This report and the summary of it are available on the website at: www.toronto.ca/health/hphe/air_and_health.htm

For More Information: Health Promotion and Environmental Protection Office
Toronto Public Health
277 Victoria Street, 7th Floor,
Toronto, Ontario
Canada M5B 1W2.

Tel: 416-392-6788

Fax: 416-392-7418

Executive Summary

In Toronto, as in many large urban centres in industrialized nations, air quality continues to present a significant concern for public health. The updated burden of illness estimates indicate that the five key air pollutants contribute to about 1,700 premature deaths and 6,000 hospitalizations each year in Toronto. These air-pollution health impacts, which represent a much larger number of less severe health outcomes, are preventable.

Over the last few years, progress has been made on many fronts. The City of Toronto has, among other things, developed an Official Plan that encourages mixed land use, compact urban form, re-urbanization, and alternative modes of transportation; extended its energy efficiency program across the amalgamated City of Toronto; and developed, in consultation with other public health units in the Greater Toronto Area, a social marketing campaign that aims to reduce home energy and vehicle use by individuals across the community. The provincial government has successfully developed and implemented an inspection and maintenance program for existing vehicles (i.e. *Drive Clean*). And the Federal government has introduced fuel and vehicles standards that promise huge reductions in emissions from light-duty and heavy-duty vehicles in the coming years. But there is much more to be done.

Given the interest that the new provincial government has expressed in environmental issues, Toronto Public Health has prepared this report to assure that the provincial government takes actions that would directly or indirectly improve air quality for the City of Toronto. The transportation sector is the most significant source of air pollutants within the City. The industrial sector and fuel consumption for activities such as electricity generation and home heating are important contributors of air pollutants as well. Toronto's air quality is also affected by emissions from large point sources such as coal-fired power plants that are upwind in southwestern Ontario and the mid-western United States.

Based on an examination of emission sources, potential for exposure, and existing policies, this report takes a multi-pronged approach dividing issues and recommendations into several priority areas:

- 1) Reducing use of, and emissions from, the transportation sector;
- 2) Reducing emissions associated with fuel consumption for activities such home heating and electricity generation;
- 3) Reducing emissions from point sources that contribute to local and regional air quality concerns; and
- 4) Enhancing the support systems needed to encourage air quality improvements.

For the transportation sector, the two goals deemed most significant for air quality are: Increasing ridership on public transit within the Greater Toronto Area; and Curbing urban sprawl and integrating land-use and transportation planning to both decrease dependence upon cars and trucks and encourage the use of alternative modes of transportation. Two recommendations are also directed at reducing emissions from existing on-road diesel vehicles and off-road diesel equipment.

To address emissions associated with fuel combustion for activities such as home heating and electricity generation, it is recommended that the provincial government phase out coal-fired power plants, aggressively promote energy efficiency and the development and utilization of renewable energies; and facilitate the development of high efficiency natural gas generators and co-generation to meet short-falls in generating capacity that may be experienced over the next two decades. The phase-out of coal-fired power plants will also strengthen the province's hand when negotiating agreements respecting transboundary air pollution with the United States (U.S.) because U.S. coal-fired power plants are a significant source of the air pollution that affects southern Ontario.

To address emissions associated with point sources that contribute to local air quality concerns, it is recommended that the Province improve the Certificate of Approval process by improving the air standards, dispersion models, and risk management framework that support it. To address point sources that contribute to regional air quality concerns, it is recommended that the Province develop a regional air quality plan that mandates significant reductions over time in smog-forming precursors from Ontario's industrial sector.

A number of recommendations are directed at the support systems needed to encourage air quality improvements. These recommendations address the need for:

- Health protective air quality criteria that drive government policies, Certificates of Approval, and individual actions;
- Consultation processes that are fair, transparent and equitable;
- Solid information that can be used to assess, monitor and evaluate the impact of air quality policies on local and/or regional air quality;
- Enhanced resources to build air quality capacity within the public health sector;
- Collaboration on social marketing campaigns that encourage the behavioural shifts needed among individuals to reduce home energy and vehicle use; and
- Improvements in the Air Quality Index and smog messaging system.

Table of Contents

Executive Summary	i
Glossary of Terms and Abbreviations	v
1.0 Introduction.....	1
1.1 Purpose of this Report.....	1
1.2 City’s Commitment to Air Quality	1
1.3 Human Health and Air Pollution	4
1.4 Air Pollution Burden of Illness in Toronto	4
1.5 Emission Sources within Toronto.....	5
1.6 Emission Sources Outside the City.....	7
2.0 Reduce the Use of and Emissions from the Transportation Sector.....	8
2.1 Reduce Vehicle Use by Funding Public Transit	8
2.2 Reduce Vehicle Use by Curbing Urban Sprawl	11
2.3 Reduce Emissions from Existing Vehicles and Equipment.....	16
3.0 Reduce Emissions associated with Fuel Consumption	20
3.1 Phase-out Coal-Fired Power Plants	20
3.2 Aggressively Promote Energy Conservation	21
3.3 Aggressively Promote Renewable Energies	24
3.4 Managing the Transition.....	25
3.5 Reduce Emissions from Residential Wood-Burning	27
4.0 Reduce Emissions from Point Sources	28
4.1 Improve Regulatory System for Local Point Sources.....	28
4.2 Establish an Air Quality Plan to Address Regional Air Quality	33
5.0 Enhancing the Support Systems Needed for Air Quality Improvements	40
5.1 Need Health Protective Air Standards	40
5.2 Enhance Air Quality Planning Capacity	42
5.3 Improve Public Consultation Processes.....	44
5.4 Enhance Environmental Health Capacity in the Public Health Sector	45
5.5 Support Public Education to Shift Behaviour.....	46
5.6 Improve the AQI and Smog Messaging System.....	48
6.0 Conclusions.....	51
7.0 Summary of Recommendations.....	53
8.0 References.....	58

List of Tables and Figures

Table 1:	Heavy-Duty Diesel Opacity Standards	18
Table 2:	Forecast Electricity Consumption in Ontario, 2005-2020, Business-as-Usual vs. Energy Efficient Case (GWh/Year)	22
Table 3:	Potential Renewable Energy Supply, 2010-2020, Ontario (GWh/Year)	24
Table 4:	Electrical Generation Technologies for Transition, Cost Comparison	26
Table 5:	NO _x and SO _x Emission Trends in Ontario	39
Table 6:	Air Levels, Six Air Pollutants, Toronto Monitoring Stations, and Applicable Air Standards	42
Figure 1:	% of Total Air Pollutants Emitted Within Toronto	6

List of Appendices

Appendix A:	Table A – Estimated Top Ten Sources for Each Air Pollutant from Human Activities Conducted inside Toronto	67
Appendix B:	Table B – MOE Break Points, AQI Value, Rating and Advice for PM _{2.5}	68

Glossary of Terms and Abbreviations

AAQC	Ambient air quality criteria
AQI	Air Quality Index
CAPI	Clean Air Plan for Industry
CCME	Canadian Council of Ministers of the Environment
CEC	Commission for Environmental Cooperation
CofA	Certificate of Approval
CSA	Canadian Standards Association
CCNG	Combined cycle natural gas or “high efficiency natural gas”
CO	Carbon monoxide
CO ₂	Carbon dioxide
CWS	Canada-wide standards
EBR	Environmental Bill of Rights
EPA	Environmental Protection Agency
GHG	Greenhouse gases
GWh	Gigawatt-hours; a measure of electricity generated or consumed
GVRD	Greater Vancouver Region District
GTA	Greater Toronto Area
HPPA	Health Protection and Promotion Act
IGCC	Integrated gasification combined cycle or “clean coal”
kWh	Kilowatt-hours
kT	Kilotonnes or 1000 tonnes
MW	Megawatts; a measure of electricity generating capacity
NO	Nitrogen oxide
NO _x	Nitrogen oxides
PAHs	Polycyclic aromatic hydrocarbons
POI	Point of Impingement
ppm	Parts per million
ppb	Parts per billion
PM ₁₀	Fine particulate matter less than or equal to 10 microns in diameter
PM _{2.5}	Fine particulate matter less than or equal to 2.5 microns in diameter
RPS	Renewable Portfolio Standard
SO ₂	Sulphur dioxide
SO _x	Sulphur oxides
STAC	Selected Targets for Air Compliance
TSP	Total Suspended Particulates
ug/m ³	micrograms per cubic meter of air
VOCs	Volatile organic compounds

1.0 Introduction

1.1 Purpose of this Report

In the fall of 2003, there was a change of government in Ontario. The new government was elected on a platform that put considerable emphasis on environmental issues, which if addressed, have the potential to significantly and positively impact on human health. Key areas of concern identified during the election include the phase-out of coal-fired power plants, the preservation of greenspace, the containment of urban sprawl, and the protection of water quality.

Given this expression of interest in environmental issues, Toronto Public Health believes that it is an appropriate time to examine the actions that could be taken by the provincial government to improve air quality and human health within the City of Toronto. This report was prepared to advise on an agenda for action by key provincial agencies with the authority to improve air quality and thereby better protect the public's health.

This report builds on many reports and recommendations that have been submitted to the Toronto Board of Health and/or City Council by Toronto Public Health, Works & Emergency Services, Urban Development Services and the Chief Administrative Officer's (CAO's) Office over the last few years. It has been prepared as a companion piece to the new Toronto Public Health report, *Air Pollution Burden of Illness in Toronto: 2004 Summary*, which updates the estimates of human health impacts associated with air pollution in the City of Toronto (TPH, 2004).

1.2 City's Commitment to Air Quality

Although this report focuses attention on the Province's role in air quality, it is recognized that the municipal government also has responsibility for this issue. The City of Toronto has been working hard to improve air quality in Toronto. For over a decade, many of the City's Departments have been actively engaged in research, policy analysis, program development, health promotion and advocacy on a broad array of issues that directly or indirectly impact on Toronto's air quality. For example:

- Toronto's Official Plan identifies and incorporates "smart growth" principles that encourage compact urban form, alternative modes of transportation, mixed land use development, and the protection of greenspace, all of which lead to improved air quality by reducing dependence upon cars and trucks;
- Toronto's Energy Efficiency Office works to increase the energy efficiency of public buildings, institutions, and

privately-owned buildings within the City, an action that simultaneously reduces emissions of greenhouse gases and criteria air pollutants that contribute to poor air quality;

- Toronto Public Health, in consultation with other public health units in the Greater Toronto Area, has developed *20/20: The Way to Clean Air*, a social marketing campaign designed to reduce home energy and vehicle use by 20% among residents in the Greater Toronto Area;
- The City, in collaboration with a number of local and regional governments in the Greater Toronto Area and Hamilton, has secured \$2.5 million in funding from the Urban Transportation Showcase Program, to establish a GTA-wide Smart Commute Initiative that will be directed at reducing auto-dependency within the Greater Toronto Area and Hamilton;
- Toronto's Air Quality Improvements Branch has been collecting, analysing and modelling data pertaining to emissions sources, air quality, geography, and land uses to determine air quality in localized areas within the City and to evaluate the air quality impacts of various emission reductions strategies; and
- Toronto's Purchasing Department, in collaboration with other Divisions, has implemented a low sulphur fuel purchasing policy that has reduced emissions of sulphur dioxide from the City's fleet of vehicles and off-road equipment by about 80% or 23 tonnes per year (OPHA, 2003).

In addition, staff from across different Divisions within the City continue to work together to: integrate and coordinate their activities; identify gaps in information, policies and programs; and develop programs and policies to address air quality concerns within the City. This collaborative work has led to the development of a variety of programs and reports including:

- The Corporate Smog Alert Response program in 1998/1999;
- The inventory of corporate air quality activities provided in the report, *Smog Prevention and Reduction: Detailed Status Report and Work Plan*, released in May 1999 (HCO, Toronto, 1999);
- The report, *Moving Towards Clean Air*, released in June 2001, that describes the progress made in developing an air quality strategy for the City (Toronto, 2001);
- The analysis of emissions, current activities, and policy gaps in a report currently being prepared entitled, *Findings Report: Toronto's Air Quality Improvement Strategy*; and
- On-going participation in the GTA Clean Air Council and in the development of the Inter-governmental

Declarations signed each year at the annual Smog Summits.

The work of City staff on air quality has been influenced and supported by the City's Environmental Task Force and the Toronto Atmospheric Fund (TAF). The Environmental Task Force, struck after amalgamation to engage the community and experts on actions needed to improve Toronto's environment, prepared a report entitled, *Clean, Green and Healthy: A Plan for an Environmentally Sustainable Toronto* (ETF, Toronto, 2000). This Plan, which includes numerous recommendations with the potential to improve air quality in the City, has been used by staff and Councillors to guide policy development and budgetary allocations.

The Toronto Atmospheric Fund (TAF), established with an endowment by the former City of Toronto in 1992, has played an important and influential role on air quality improvements within the City by financing municipal and community-based research and projects that encourage: Improvements in air quality; Reductions in greenhouse gas emissions; and/or The mitigation of climate change impacts. For example, TAF's funds have been used to support the development of Toronto's first wind turbine, the replacement of the City's street lights with energy efficient lighting, the reforestation of the Rouge River Valley, the development of the 'Walking School Bus' program, the preparation of the Findings Report for the Comprehensive Air Quality Strategy, and the development of the City's Heat Health Alert System. While many of TAF's projects have been directed at retarding or mitigating the impacts of climate change, many have produced air quality benefits as well, by directly or indirectly reducing emissions of air pollutants that contribute to poor air quality.

In addition, in May 2004, Mayor David Miller announced a new \$35 million initiative to reduce emissions that contribute to climate change and smog. This initiative will be used for city-based projects that increase energy efficiency within the community and within the City's corporate operations, thereby reducing air emissions associated with the generation of electricity and/or the burning of fuel. The funds will be used for projects such as the replacement of old appliances with new energy efficient ones in City housing, the installation of advanced energy-reducing lamps in the City's traffic signal intersections, and the installation of energy efficient lighting, boilers, and motors in civic centres and corporate facilities. This initiative promises to reduce the City's budget costs by cutting electric bills, make social housing more comfortable for tenants, help the City achieve its Kyoto commitment, while enhancing air quality and public health (News Release, May 12, 2004).

The City will continue to work on existing programs, and to develop programs and policies in other areas where the City has the authority, the jurisdiction and/or the opportunity to do so. However, on the

In many ways, the City lacks the jurisdiction, the authority, and/or the resources needed to address poor air quality.

issue of air quality, there are many things that the City of Toronto cannot do. In many ways, the issues that impact on air quality are beyond the City's control because the City lacks the jurisdiction, the authority, and/or the resources needed for the task. The point of this report is to identify those actions that could be taken by the Province that would either improve air quality directly, or improve air quality indirectly by providing the policy or resource supports needed.

While this report has been prepared with a clear sense of Toronto's needs with respect to air quality, we believe that many of the recommendations would result in enhanced air quality and human health in communities across the province.

1.3 Human Health and Air Pollution

Over the last decade, a large body of scientific evidence has accumulated which confirms that acute exposure to low levels of air pollution, such as those experienced in Toronto, can produce a wide range of health outcomes including reduced lung function, acute bronchitis, asthma attacks, an increase in the number of emergency room visits and hospitalizations for respiratory and cardiovascular conditions, and elevated mortality rates (HEI, 2000; Samet, 2000; Gent, 2003; Burnett, 1997a/b; Burnett, 1998; Burnett, 1999; Steib, 2002; U.S. EPA, 2004; Vedal, 2003; Brook, 2002).

Air pollution in Toronto contributes to about 1,700 premature deaths and 6,000 hospitalizations per year.

Several long-term studies have indicated that chronic exposure to low levels of air pollution can increase the risk of developing cardiopulmonary and lung diseases such as lung cancer and ischemic heart disease, permanently affect lung function, elevate mortality rates, and reduce life expectancy as well (Pope, 2002; Gauderman, 2000; Hoek, 2002).

A large number of studies have indicated that children, the elderly, and those with pre-existing conditions such as asthma, diabetes, and congestive heart failure are more susceptible to the negative impacts of air pollution (Gent, 2003; Gauderman, 2000; Gong, 1997; McConnell, 2003; Steib, 2002). At least one study has also suggested that air pollution may increase the risk of congenital birth defects (Ritz, 2002).

1.4 Air Pollution Burden of Illness in Toronto

In May 2000, Toronto Public Health released the report *Air Pollution Burden of Illness in Toronto*. Using 1995 as its base year, the study estimated that exposure to five common air pollutants contributed to about 1,000 premature deaths and 5,500 hospitalizations of Toronto residents each year (Pengelly et al., 2000).

Toronto Public Health retained the lead scientist for the previous study to update the burden of illness estimates for Toronto using both, more recent scientific literature regarding the health effects of air pollutants, and more current data respecting air pollution, mortality and hospitalizations for Toronto (i.e. 1999 data). In this updated study, entitled, *Air Pollution-Related Burden of Illness in Toronto: 2004 Update*, it is estimated that the five common air pollutants are responsible for about 1700 premature deaths and 6,000 hospitalizations per year in Toronto (Pengelly, 2004). The five common air pollutants are fine particulate matter (PM₁₀ and PM_{2.5}), nitrogen dioxide (NO₂), sulphur dioxide (SO₂), ground level-ozone and carbon monoxide (CO).

This estimate of the burden of illness in Toronto represents only the most serious health effects associated with air pollution. Scientists have long recognized that air pollution contributes to a 'pyramid' of health effects with the least common but most serious health outcomes appearing at the peak of the pyramid and the less serious but more numerous health outcomes such as asthma symptom days and respiratory infections, appearing in progressive levels below that peak.

1.5 Emission Sources within Toronto

According to the emissions data available for Toronto, it appears that the transportation sector is the most significant source of emissions within the City with on-road vehicles, off-road equipment and paved roads collectively responsible for about 64% of nitrogen oxides (NO_x), 38% of sulphur oxides (SO_x), 74% of CO, 24% of PM₁₀, 26% of PM_{2.5} and 15% of volatile organic compounds (VOCs) emitted within the Toronto area (See Figure 1 and Appendix A).

The transportation sector is the most significant source of emissions within the City.

Within the transportation sector, cars, trucks and buses are a particular concern, because they release air pollutants at ground level where they can be readily inhaled by people, and on in neighbourhoods where people live, work and recreate. There is a growing body of literature which suggests that exposures along transportation corridors may be greater than indicated by ambient air quality readings for a community, and that adverse health effects are strongly correlated with proximity to transportation corridors (Cavanaugh, 2004; Hoek, 2002).

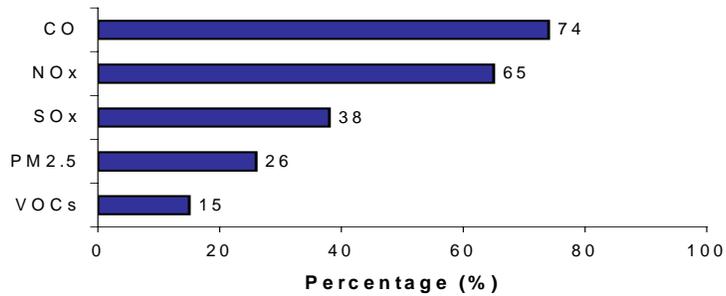
Fuel consumption for activities such as home heating and electrical generation are also significant sources of air emissions within the City responsible for up to 25% of VOCs, 22% of NO_x, 20% of SO_x, 15% of PM₁₀, and 24% of CO (see Figure 1 and Appendix A).

While the contribution of Toronto's industrial sector to air emissions is dwarfed by the contribution of the transportation and fuel combustion sectors, it is not an unimportant source of emissions.

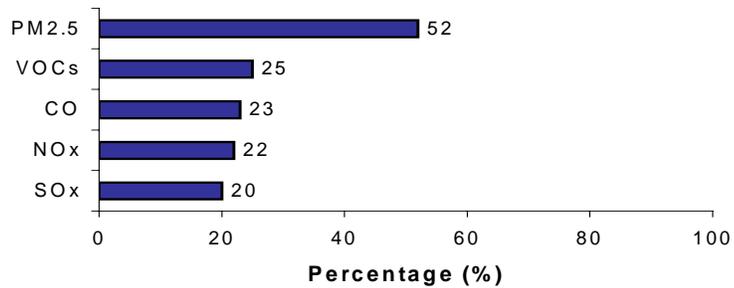
The available data, which represent an underestimate of emissions from this sector, suggest that it is responsible for 38% of SO_x, 10% of PM_{2.5}, 12% of NO_x and 4% of VOC emissions within the City. It is also likely that the industrial sector is responsible for a significant portion of the VOCs that are reported under “miscellaneous” sources (i.e. 51%)(see Figure 1 and Appendix A).

Figure 1: % of Total Air Pollutants Emitted within Toronto

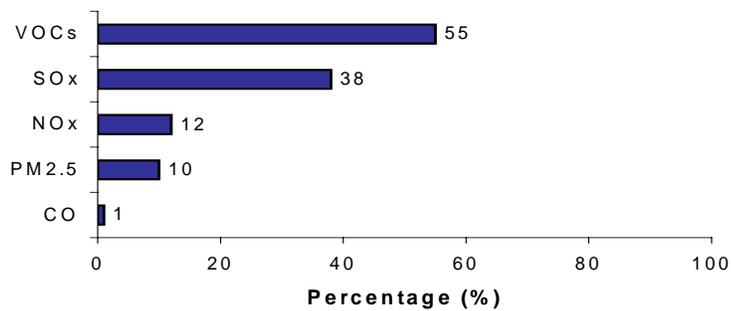
Transportation



Fuel Combustion



Industrial



1.6 Emission Sources Outside the City

Ozone is a gas that is formed in the atmosphere when NO_x react with VOCs in the presence of sunlight. Because ozone can take several hours to form in the atmosphere and can travel hundreds of kilometers, distant sources of NO_x can have a significant impact on ozone levels experienced by any community.

PM_{10} and $\text{PM}_{2.5}$ are also composed of a large percentage of secondary air pollutants such as sulphates that can be formed in the atmosphere from precursors such as SO_2 and NO_x . Consequently, distant sources of the SO_x and NO_x can also have a substantial impact on air levels of fine particulate matter in Toronto's air.

This suggests that large point sources such as coal-fired power plants, steel plants, refineries and cement plants in southwestern Ontario may be important contributors of the precursors of ozone and $\text{PM}_{10/2.5}$ that affect Toronto and the rest of southern Ontario during regional smog episodes. It also suggests that Toronto in turn, may be an important contributor of the precursors of ozone and $\text{PM}_{10/2.5}$ that affect communities downwind of Toronto.

Modeling conducted by the Canada-U.S. Air Quality Committee has demonstrated that a significant percentage of the ozone that affects southern Ontario during smog episodes is emitted from sources in the mid-western United States as well (Canada-US, 1999). The Acidifying Emissions Task Group has estimated that 90 to 95% of the sulphates that are deposited on southwestern Ontario, originate in the United States, suggesting that transboundary air pollution is a significant source of the fine particulate matter that affects air quality in southern Ontario as well (AETG, 1997). Coal-fired power plants are the most significant sources of NO_x and SO_x emissions in the mid-western United States.

Distant sources of the SO_x and NO_x can have a substantial impact on "smog" experienced in Toronto.

2.0 Reduce Use of, and Emissions from, the Transportation Sector

As indicated in Section 1, the transportation sector is the most significant source of air emissions within the City of Toronto. There are three major ways in which the Province can reduce emissions from the transportation sector. It can:

- Reduce traffic by supporting the development of public transit;
- Reduce traffic by supporting “smart growth” strategies; and
- Reduce emissions from existing vehicles and off-road equipment.

2.1 Reduce Vehicle Use by Funding Public Transit

Air Quality & Transit are Inextricably Linked

In Atlanta, efforts to reduce traffic congestion were associated with significantly lower rates of childhood asthma events.

At least one intervention study has indicated that reduced traffic congestion can produce substantial improvements in health outcomes. For example, a study of Atlanta has demonstrated that efforts to reduce traffic congestion during the Olympic Games were associated with:

- Decreased traffic density (i.e. 22.5% decrease in 1-hour morning peak);
- Reductions in air levels of ozone (i.e. from 81.3 ppb to 58.6 ppb); and
- Significantly lower rates of childhood asthma events (i.e. 41.6% decrease)(Friedman, 2001).

To reduce air emissions from the transportation sector in Toronto, there must be a significant shift from single-passenger vehicles to public transit. In 2003, the National Round Table on the Environment and the Economy (NRTEE) released a report entitled, *Environmental Quality in Canadian Cities: The Federal Role*, that identifies “shifting automobile travel to transit” as the most significant way to improve the environment of Canadian cities and to reduce their impact on the global environment. It recommended that the federal government invest \$1 billion per year for 10 years on public transit in growing urban regions where there are opportunities to increase the number of transit riders (NTREE, 2003).

In 2001, the Toronto Board of Trade released a report entitled, *A Strategy for Rail-Based Transit in the GTA*, which estimated that the implementation of a “comprehensive rail-based transit strategy” combined with policies and incentives designed to produce more concentrated mixed-used development throughout the Greater Toronto Area (GTA), would:

- Double transit modal share in the GTA by 2021;
- Reduce travel by automobiles and light-duty trucks by 15 to 30%;
- Reduce air emissions from vehicles by 10 to 30%;
- Reduce greenhouse gas emissions by 3.5 to 8%; and
- Increase the region's annual Gross Domestic Product by 3.2% (or \$8.4 billion/year during the investment period) (Toronto Board of Trade, 2001).

Transit is the Centre Piece in Toronto's Official Plan

Toronto's Official Plan clearly recognizes public transit as both, central to the development of Toronto's economy, and essential to the improvement of air quality and environmental conditions within the City:

The TTC transports about 1.4 million riders per day.

"Traffic does not stop at our border. The region's prosperity depends on an excellent integrated regional transportation system, featuring direct, transfer-free, inter-regional transit service..." and

"By shaping the urban fabric of the GTA into a system of mixed use centres and corridors linked by good transit services, we will build better communities, strengthen economic conditions, and improve air and water quality" (Toronto, 2002).

Public Transit in the GTA has been Underfunded

The Toronto Transit Commission (TTC) and GO Transit provide a significant level of service that is essential to the economy of the Greater Toronto Area. The TTC, which is the second largest transit authority in North America, transports about 1.4 million riders per day, while GO Transit transports about 170,000 riders per day (Rodo, 2003; Stewart, 2004). And yet, these two organizations are currently among the least supported transit systems in North America.

TTC and GO Transit are among the least supported transit systems in North America...

For both TTC and GO Transit, the fare box represents over 80% of operating revenues, while transit systems in the United States rely on the fare box for, on average, 40% of their revenues. In the United States, the federal and state governments provide the rest of the revenues through financial grants for both operating and capital expenses (TPH, 2000).

Public transit has not always been so poorly supported in Ontario. Between 1971 and 1992, the Province was responsible for 75% of TTC's capital costs and up to as much as 50% of TTC's operating subsidy. During these two decades, TTC ridership grew by 70%, from 275 to 465 million riders/year, even though the population of the City grew by only 9%. Then in the 1990s, TTC's operating

subsidies were cut in half, fares were increased by 50% over the rate of inflation, the bus fleet was cut by 22%, employment fell by 15%, and ridership fell to 372 million in 1996, a 20% reduction relative to the highs in the 1980s (Rodo, 2003).

The story is much the same for GO Transit. In 1992, the provincial government was responsible for 80% of the revenue for GO Transit while the fare box was responsible for 20%, whereas in 2003, the provincial government was responsible for about 20% of the revenue while the fare box was responsible for about 80% of total costs (Stewart, 2004).

Sustained Funding Needed to Maintain and Build Public Transit

Many organizations agree that the public transit system in the Greater Toronto Area cannot be maintained in a state of good repair or expanded without a significant and sustainable source of funding. Some have suggested that a fuel tax should be used to provide sustainable funding to the transit system.

*The TTC will
require \$6.5
billion over the
next 10 years...*

In the Greater Vancouver Region, where the development and maintenance of public transit and roads are handled in an integrated way by the Greater Vancouver Transportation Authority, fuel taxes provide a considerable portion of the funding used for both public transit and roads. Each year, about 38% of the \$636 million collected for roads and public transit comes from a 12 cent per litre tax on motive fuel sold in the Region. Public transit fares and property taxes account for about 39% and 19% respectively of the funds collected for both roads and public transit. About 70% of these funds are directed towards the Region's public transit system (Leicester, 2003).

TTC's Funding Needs

It has been estimated that TTC will require \$6.5 billion over the next 10 years to maintain facilities and service at current levels, increase service, accessibility and ridership, and expand the subway system:

- Nearly \$4 billion will be needed over the next 10 years to meet base capital needs, most of which (i.e. about 90%) would be used to maintain TTC in a "state of good repair". It is estimated that \$2.3 billion of this \$4 billion will be needed over the next 5 years (Rodo, 2003; Graham, 2004);
- To undertake a "ridership growth strategy" that could increase ridership by 45 to 50 million new riders per year, it is estimated that TTC would require an additional \$504 million in capital funding over the next 10 years. This plan, which has not yet been approved by City Council, would be used to expand bus service, extend commuter parking, construct a new low-cost rapid transit system, among other things (Rodo, 2003; Graham, 2004);

- An additional \$1.88 billion will be required over the next 10 years to implement a plan to expand the subway system north on the Spadina line and east from the Sheppard subway station (Rodo, 2003; Graham, 2004); and
- To increase accessibility of the transit system and implement other projects not included in the base capital program, an additional \$120 million will be needed over the next 10 years (Graham, 2004; Rodo, 2003).

On March 30th, the Governments of Canada and Ontario and the City of Toronto announced that each of the three governments would commit, on average, \$70 million a year over 5 years to improve and expand the TTC (News Release, March 30, 2004). This works out to about \$1 billion over 5 years.

While this announcement represents an important step in the right direction by all three levels of government, it falls far short of providing the funding that is needed to maintain TTC and expand ridership. This commitment will provide only 45% of the funding that will be needed to maintain the system in a “state of good repair” over the next 5 years. And it provides no funding for the TTC’s “ridership growth strategy” or for the subway expansion plan. The immediate challenge for TTC is to find funding to cover the base capital requirements that will be directed almost exclusively at maintaining TTC in a “state of good repair”. The TTC will not undertake growth-related projects until it has secured funding to maintain the existing system (Graham, 2004).

In the provincial budget delivered May 19, 2004, a commitment was made by the Province to provide \$448 million to transit needs in Ontario. This funding does not represent an increase in the funding announced for TTC in March, although it does include the funding announced in March (Ministry of Finance, May 18, 2004; Fox Gray, May 2004).

Recommendation

It is recommended that the Premier commit the Province of Ontario to contribute one-third of the long-term funding needed for TTC's "state of good repair" plan and "ridership growth strategy" to both, rehabilitate and renew the existing infrastructure, and increase transit service and ridership.

The commitment made by the 3 levels of government falls far short of the funding needed to maintain TTC and expand ridership.

2.2 Reduce Vehicle Use by Curbing Urban Sprawl

Land-use Planning Impacts on Transportation

Increased funding for public transit is only one factor in the equation needed to reduce transportation-related air emissions within the Toronto area. Action must also be taken to: curb urban sprawl that

encourages heavy reliance on cars and trucks; encourage compact urban development that is conducive to public transit and alternate modes of transportation; and promote mixed land use development that allows people to live, work and recreate in their communities without needing cars and trucks for passengers and goods.

A landmark study prepared by Smart Growth America in collaboration with academics from Rutgers University and Cornell University, has documented the strong correlation between urban sprawl, the number of kilometres travelled by individuals within a community, and air quality. Using the following four factors as indicators of urban sprawl -- residential density; neighbourhood mix of homes, jobs and services; strength of activity centres and downtowns; and accessibility of street network – these researchers were able to demonstrate that U.S. communities that ranked high for urban sprawl were characterized by:

Peak ozone levels ranged from 98 ppb in the most sprawling cities to 69 ppb in the most compact cities.

- Higher rates of vehicle ownership;
- Greater number of miles travelled by individuals each day;
- Increased rates of traffic-related fatalities;
- Greater air levels of ground-level ozone; and
- Decreased numbers of commuters who walk, bike or take public transit (Smart Growth, 2002).

For several of these parameters, the differences between communities were quite marked. For example, when the 8 to 10 most sprawling cities were compared to the 8 to 10 least sprawling cities, the following differences were noted:

- Individuals travelled on average 27 miles per day compared to 21;
- 2% of commuters took public transportation compared to 7%;
- 15 fatal accidents occurred per 100,000 each year compared to 9;
- 8-hour maximums for ozone were 97.6 ppb compared to 68.9 ppb; and
- 180 vehicles were owned per 100 households compared to 162 (Smart Growth, 2002).

Canadian Cities Moving in the Wrong Direction

When the National Round Table on the Environment and the Economy (NRTEE) examined several indicators associated with environmental quality, it found that Canadian cities appear to be moving in the wrong direction:

- Starting in 1981, growth of urbanized land began to outstrip population growth;

- Although transit ridership has been growing steadily since 1960, there has been a marked downturn in ridership since 1990; and
- Passenger-kilometers travelled by car (including light trucks and sports utility vehicles) has grown very quickly and has significantly outpaced population growth (NRTEE, 2003).

The NRTEE identified density of urban areas, urban structure, mixing of land uses, and street patterns as factors that affect the number, length, and mode of trips made by people living in a community (NRTEE, 2003).

When the Centre for Sustainable Transportation analysed vehicle use in the Toronto area, it found a clear and direct correlation between urban form and vehicle-kilometers travelled (VKT). It demonstrated that people living in the downtown core of Toronto travelled on average about 7 kilometers per day by vehicle compared with those living in the outer suburbs who traveled on average about 22 kilometers by vehicle per day (NRTEE, 2003).

Toronto's Official Plan Encourages Compact Urban Form

Toronto's Official Plan, adopted by City Council in November 2002, contains a number of policies designed to encourage compact urban form and mixed land-use development. For example, the Plan's policies states that Toronto will work with neighbouring municipalities and the Province of Ontario to address mutual challenges and to develop a framework for dealing with growth across the GTA which:

Toronto's Official Plan encourages mixed land uses to create greater opportunities for people to live and work locally.

- Focuses urban growth into a pattern of compact centres and corridors connected by an integrated regional transportation system featuring frequent, direct, transfer-free, inter-regional transit service;
- Makes better use of existing urban infrastructure and services;
- Reduces auto dependency and improves air quality;
- Increases the supply of housing in mixed use environments to create greater opportunities for people to live and work locally; and
- Protects, enhances and restores the region's system of green spaces and natural heritage features, the natural ecosystem, and the natural corridors that connects these features and protects the region's prime agricultural land (Toronto, 2002).

Smart Growth Panel – Inconsistent Recommendations

In February 2002, the Ontario Government established a Central Ontario Smart Growth Panel to provide the Province with a long-term growth strategy. The Panel's final report entitled *Shape the Future* was released in April 2003. It contains 44 recommendations

The Smart Growth Panel's report contains a number of inconsistencies.

directed at achieving sound regional growth in Central Ontario, many of which are based on principles advocated by Toronto City Council. For example, the Panel supports compact development, the protection of green space and other natural assets, optimizing the use of infrastructure, increasing affordable housing, promoting development in existing urban areas, preserving employment in existing urban areas, priority investment for inter-regional and local transit, rethinking how waste is managed, and building energy efficiency into the planning process. These principles are consistent with policies articulated in Toronto's Official Plan and Council's Strategic Plan. They are also reflected in the City's Economic Development and Social Development Strategies and Waste Diversion Program (Toronto UDS, 2003).

There are however, a few inconsistencies within the Panel's report that concern the City. While the Panel's report repeatedly identifies the need to direct growth to existing urban and settlement areas, it fails to clearly and consistently support the need to establish strict urban boundaries beyond which development will not be allowed. The concept of directing growth to existing urban areas is supported by Toronto City Council, and is considered essential to the preservation of irreplaceable agricultural land, natural assets such as the Oak Ridges Moraine, and other natural resources in the region (Toronto UDS, 2003). Another seemingly inconsistent message contained in the Panel's report is support for major transportation projects such as the Mid-Peninsula Transportation Corridor and extensions to some of the 400 series highways. These recommendations seem to contradict those recommendations that are directed at protecting rural lands, promoting public transit, and directing growth to existing urban areas (Toronto UDS, 2003).

Smart Growth Panel – Process Recommendations

The Smart Growth Panel report also proposes a framework and timeline for the implementation of its recommendations. For example, it recommends that the Province:

- Establish an accountable stakeholder advisory body with the authority and resources to co-ordinate implementation of elements of a provincial smart growth strategy that crosses municipal boundaries;
- Establish a body/provincial facilitator within the provincial government with the authority and resources to co-ordinate and ensure that the policies of all provincial government ministries support smart growth goals and strategic directions;
- Identify legislation to give appropriate status to the smart growth strategy;
- Invest in transit and implement the GO Transit bus rapid transit proposals; and

- Carry out further research, mapping and analysis to support implementation of the smart growth strategy (Toronto UDS, 2003).

Toronto City Council has considered the Panel's report and recommended, among other things, that the Province consult with municipalities before implementing the Panel's recommendations, address specific geographical areas such as Toronto in order to ensure effective implementation, and include only elected officials, based on representation proportional to population, on any accountable advisory body that is established to co-ordinate implementation of the Panel's recommendations (Toronto UDS, 2003).

Positive First Steps from Provincial Government

The new provincial government has made several important moves on issues related to urban sprawl since coming into power:

- It has shifted the "Smart Growth" group out of the Ministry of Municipal Affairs and Housing into the newly created Ministry of Public Infrastructure and Renewal;
- It has proposed Bill 27, an Act that would put a moratorium on development outside urban settlement areas, with a view to establishing a greenbelt;
- It has adopted Regulation 432/03 to temporarily freeze development on all rural lands contained in the "greenbelt study area"; and
- Established a Task Force to determine the geography to be included in the protected greenbelt (Bill 27/2003; Ontario Regulation 432/03).

The Province has also proposed Bill 26, the Strong Communities Act, as an amendment to the Planning Act. This Bill, if passed, would prevent appeals to the Ontario Municipal Board (OMB) for urban expansions that are opposed by municipal governments, require land-use planning decisions to be "consistent with" provincial policies, and enable the Minister of Municipal Affairs and Housing to advise the OMB when an official plan, zoning by-law or related amendment is a matter of provincial interest (Bill 26/2003).

While it is too early to determine the impact of these initiatives on development in central southern Ontario, they are seen as positive first steps to preserve natural resources and contain urban development in central southern Ontario.

Recommendation

It is recommended that the Premier of Ontario move quickly on the recommendations of City Council to establish a Smart Growth process within the Greater Toronto Area that promotes healthy

communities, protects natural resources, addresses gridlock and improves air quality.

2.3 Reduce Emissions from Existing Vehicles & Equipment

As noted in Section 1, the emissions inventory for Toronto indicates that heavy-duty off-road equipment, light-duty gasoline vehicles, and heavy-duty diesel vehicles are particularly important contributors of air pollutants within the City of Toronto.

New Fuel & Vehicle Emission Standards Coming

Federal standards will reduce air emissions from new cars, trucks and buses by about 90% between 2004 & 2010.

Emissions from vehicles and off-road equipment are affected by the fuel burned and the technology employed, as well as by vehicle maintenance. In 1999, the federal government passed the *Sulphur in Gasoline Regulations*, which will limit sulphur content in gasoline to an average of 30 ppm starting in January 2005, and to an interim average of 150 ppm between July 2002 and December 2004. In July 2002, the federal government established the *Sulphur in Diesel Fuel Regulations*, which will reduce the maximum limit for sulphur in on-road diesel from 500 ppm to 15 ppm by the middle of 2006 (McEwen, 2004). When sulphur levels in fuels are reduced, vehicle emissions can be reduced in three different ways: emissions of sulphur oxides are reduced directly, the efficiency of existing emission control devices is increased, and the use of advanced emission control devices such as diesel particulate filters and NO_x absorbers is enabled (OPHA, 2003).

In January 2003, the federal government published *On-Road Vehicle and Engine Emission Regulations* that will phase in more stringent emission standards for new vehicles effective January 1, 2004. These new emission standards, which are being phased-in:

- Between 2007 and 2010 for new on-road heavy-duty diesel vehicles, are expected to reduce emissions of fine particulate matter and NO_x from heavy-duty diesel vehicles by 90% and 95% respectively; and
- Between 2004 and 2009 for new light-duty vehicles are expected to reduce emissions of fine particulate matter, NO_x, and VOCs from cars and light-duty trucks by about 91%, 90%, and 71 to 84% respectively (Crupi, 2004).

There are currently no federal regulations limiting sulphur levels in off-road diesel fuels. In May 2004, the U.S. EPA finalized new rules that will reduce emissions from off-road engines and equipment by about 90%. These new rules will cut sulphur content in off-road diesel to 500 ppm by 2007 and to 15 ppm by 2012 while giving engine and equipment manufacturers until 2014 to comply with the new emission standards. The federal government has signaled its

intent to align its standards for off-road equipment and off-road diesel fuel with those adopted by the United States (Crupi, 2004; McEwen, 2004; Pegg, 2004). In 2001, sulphur levels in off-road diesel fuel in Ontario ranged from 1,287 to 3,676 ppm while sulphur levels in on-road diesel ranged from 278 to 437 ppm (OPHA, 2003).

While the new and pending regulations promise significant reductions in emissions from on-road vehicles and off-road equipment in the coming years, emissions from heavy-duty diesel vehicles and equipment will continue to be significant until existing vehicles and equipment are replaced with new vehicles and equipment after 2007 and 2014 respectively.

***Drive Clean* Ensures that Existing Vehicles are Well Maintained**

The Province established the *Drive Clean* program under the *Environmental Protection Act* with Ontario Regulation 361 in 1998 to mandate the inspection and maintenance of vehicles registered for use on the road in Ontario. While originally, the program was directed at light-duty vehicles in the Greater Toronto Area and Hamilton only, the light-duty portion of the *Drive Clean* program has since been extended to most of southern Ontario. An assessment of the program conducted for the Ontario Ministry of the Environment in 2002 estimated that in the first three years, the *Drive Clean* program reduced smog-forming precursors, CO, and greenhouse gas emissions from light-duty vehicles by about 18,300 tonnes, 139,000 tonnes, and about 47,000 tonnes respectively (Ontario, 2002).

In September 1999, the *Drive Clean* program was extended to all heavy-duty diesel vehicles registered for use anywhere in the province and to any heavy-duty non-diesel vehicles operating in southern Ontario. While there was a \$200 repair cost limit applied for the first two years when the program was applied to light-duty vehicles, and then a \$450 repair cost limit after the first two years, there is no repair cost limit applied to heavy-duty vehicles (MOE, website). Owners of heavy-duty vehicles must pay whatever is necessary to ensure that they pass the emissions tests. An analysis conducted for the Ministry estimated that the *Drive Clean* program reduced PM emissions from heavy-duty diesel vehicles in Ontario by about 1,100 tonnes during the first two years (MOE, website).

In March 2004, the Ministry announced that new emissions testing standards would be applied to heavy-duty diesel trucks and buses in Ontario beginning in April 2004 (see Table 1 below). While these standards, which are to be tightened once more in April 2005, are among the most stringent on the continent, they are not expected to force retirement of older vehicles or retrofits of others (MOE, website).

While the *Drive Clean* program appears to be effective at ensuring that existing vehicles are well maintained, it does not address off-

road equipment, nor was it designed to improve the emissions performance of vehicles beyond the emission standards that applied the year the vehicle was produced.

Table 1: Heavy-Duty Diesel Opacity Standards

	1990 & Older	1991 & Newer	School Buses
Before April 2004	55%	40%	Based on age
April 1, 2004	45%	35%	35%
April 1, 2005	40%	30%	30%

(MOE, website)

Urban Air Could be Improved by Eliminating Off-Road Diesel Fuel

Health benefits worth about \$98 million could be realized in Toronto if sulphur levels in off-road diesel were reduced to 400 ppm.

The Province could effectively eliminate the use of off-road diesel in large urban centres by aligning limits for sulphur levels in off-road diesel fuel with those applied to on-road diesel fuel. This could have a very positive impact on air quality and human health.

In June 1997, the Health and Environmental Impact Assessment Panel (HEIAP) estimated that health benefits worth about \$98 million in 2001 could be realized in the City of Toronto if sulphur levels in off-road diesel were reduced to an average of 400 ppm (HEIAP, 1997). The Province could realize these health benefits by aligning sulphur levels in off-road diesel, which averaged about 2,890 ppm in 2001, with those in on-road diesel, which averaged about 360 ppm in 2001.

This regulation would not require the production of a new product. Suppliers could provide off-road diesel fuel for large urban centres by dying on-road diesel red to meet the taxation requirements that apply to off-road diesel. When on-road diesel is used in off-road equipment, the on-road taxes do not apply, and the cost differential between the two products is quite modest (OPHA, 2003). The Province has established more rigorous sulphur standards for heavy and light fuel oils used for specified purposes, it is possible that the Province could do the same for off-road diesel fuel (Env Can, 2003).

Urban Air Could be Improved by Funding Upgrades in Buses

Vehicle emission standards for heavy-duty diesel vehicles have been substantially improved since 1990 suggesting that significant emission reductions could be achieved by replacing older transit buses with new ones that meet current emission standards. Emission standards for PM and NO_x for urban buses in 2004 are 10 times and 3 times more stringent respectively than emission standards that applied to buses built in 1990 (Canada Gazette, 2003).

Emissions from existing buses could be substantially reduced in a cost-effective way if the buses were retrofitted with oxidation

catalysts similar to those used on cars. Emission studies demonstrate that oxidation catalysts can reduce emissions of PM and CO from buses by 23% and 39% respectively for a relatively modest investment (i.e. \$3,000 to \$5,000 per bus). The emissions from these retrofitted buses could be further reduced (e.g. by an additional 29%) if the buses were fuelled with “ultra low sulphur diesel” (i.e. diesel containing 30 ppm or less of sulphur)(OPHA, 2003).

More significant emission reductions could be realized if newer buses were equipped with advanced emission control devices such as diesel particulate filters. Diesel particulate filters, which must be used with “ultra low sulphur diesel”, can reduce emissions of a broad array of toxic air pollutants by about 90% (Chatterjee, 2002). The Region of Waterloo found that it cost about \$15,000 more to have a new 2004 bus equipped with a diesel particulate filter (OPHA, 2003).

The provincial government could establish special funds to encourage transit authorities and school boards to reduce emissions from diesel-fuelled buses. These programs could be used to promote the accelerated replacement of older buses with new buses, the retrofitting of newer buses with emission control devices, and/or the use of “cleaner” fuels.

Recommendations

It is recommended that the Minister of the Environment:

- *Align limits for sulphur levels in off-road diesel fuel with those for on-road diesel fuel when sold in large urban centres; and*
- *Establish special funds to encourage transit authorities and school boards to reduce emissions from diesel-fuelled buses by promoting the replacement of older buses, retrofitting with emission control devices, and/or the use of cleaner fuels.*

Diesel particulate filters, which must be used with “ultra low sulphur diesel”, can reduce emissions of a broad array of toxic air pollutants by about 90%.

3.0 Reduce Emissions associated with Fuel Consumption

As indicated in Section 1 of this report, fuel consumption for activities such as home heating, electricity generation and wood burning is a significant source of air emissions within the City. In addition, coal-fired power plants in southern Ontario and in the mid-western United States are significant sources of the precursors that contribute to the smog experienced by all of southern Ontario.

3.1 Phase-out Coal-Fired Power Plants

The phase-out of coal plants will strengthen Canada's hand when discussing transboundary air pollution with the United States.

The five coal-fired power plants in Ontario are significant contributors of the precursors of ozone and fine particulate matter. In 2001, these five plants were responsible for 23% of the SO₂ and 14% of NO_x emitted from all sources in the province (MOE, 2001d). Three of these plants, Nanticoke, Lambton and Lakeview, are upwind of the City of Toronto. The Lakeview Generating Station, located just west of Toronto in Mississauga, has a direct impact on Toronto because of its close proximity. In 2001, it emitted 19,000 tonnes of sulphur dioxide and 5,050 tonnes of nitrogen oxides (reported as nitric oxide).

While these five plants are a significant source of the air pollutants that contribute to smog, they are also very significant contributors of mercury and greenhouse gases. They were responsible for 20% of the greenhouse gases emitted in Ontario in 2001 and 23% of the mercury released in 1999 (OPHA, 2002).

The decision by the Ontario government to phase-out the five coal-fired power plants by 2007 is one that will produce many direct and indirect health and environmental benefits for the province. It will help the Province to achieve:

- The 6% reduction in greenhouse gases envisioned by the Kyoto Protocol;
- The 90% reduction in mercury emissions envisioned by the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem;
- Ontario's commitment under the Ozone Annex to cut NO_x emissions from all fossil-fuelled power plants in southern Ontario to 39 kilotonnes (NO₂) by 2007; and
- Ontario's commitment to cap SO₂ emissions at 442.5 kilotonnes per year by 2015 under the Canada-Wide Acid Rain Strategy for Post-2000.

The phase-out will also strengthen Canada's hand when negotiating with the United States for reductions in air emissions from coal-fired

power plants in the mid-western United States that are significant contributors of the smog experienced in southern Ontario.

The Province should capture its phase-out commitment with a regulation that mandates the closure of the coal-fired power plants by 2007. This regulation would provide the clarity and certainty needed within the electrical sector to stimulate development of new sources of electricity. It would also provide the Province and the federal government with a regulatory package that could be used in bi-national negotiations when discussing transboundary emissions of SO_x, NO_x, mercury and greenhouse gases.

Recommendation

It is recommended that the Ministers of the Environment and Energy develop a regulation that mandates the phase-out of the coal-fired plants by 2007.

3.2 Aggressively Promote Energy Conservation

The Province should meet the coal plant phase-out by:

- Aggressively promoting energy conservation/efficiency;
- Aggressively promoting the development and utilization of renewable energies; and
- Encouraging the development of high-efficiency natural gas generators and co-generation to meet short-falls in generating capacity over the next two decades.

Electricity demand could be reduced by 40% by 2020.

The Province should aggressively promote energy conservation and energy efficiency to reduce electrical demand throughout the province. Ontario's Select Committee on Alternative Fuel Sources concluded that the reduction of energy demand is more important to Ontario's energy supply than is the creation of new supply (Select Committee, 2002).

In 2002, energy consultants, Torrie Smith Associates estimated that electricity demand in Ontario could be reduced by about 35,000 gigawatt-hours (GWh) annually by 2012 with systematic efforts to realize those reductions, and that an additional 10,000 GWh of electricity could be generated by industrial and commercial co-generators by 2012 (Torrie Smith, 2002). Combined, these estimates represent almost 8,000 GWh of electricity more than was generated with Ontario's five coal-fired power plants in 2001 (i.e. 37,185 GWh). The 35,000 GWh estimate represents about 23% of the electricity that was generated in Ontario from all sources in 2001 (i.e. about 149,000 GWh) (OPG, 2002).

In May 2004, the Pembina Institute estimated that electricity consumption in 2020 in Ontario could be reduced by 40% relative to

a business-as-usual forecast with policies that promote energy efficiency, the expansion of co-generation, and a shift from electricity to natural gas for heating in the residential and commercial/institutional sectors (see Table 2 below). It was estimated that these reductions would require about \$18.2 billion in investments by energy consumers; 96% of which would be recovered through savings in energy consumption (Pembina, 2004).

Table 2: Forecast Electricity Consumption in Ontario, 2005-2020, Business-as-Usual vs. Energy Efficient Case (GWh/Year)

	2005	2010	2015	2020
Business-as-Usual	138,890	147,761	163,105	180,775
Energy Efficient	138,890	120,895	110,104	107,276
Difference		-19%	-33%	-40%

Source: Pembina, 2004

In 2002, Ontario's Select Committee for Alternative Fuel Sources made twelve recommendations on the policy changes needed to encourage energy efficiency measures in Ontario. For example, it recommended that:

This reduced demand would require about \$18.2 billion in investments; 96% of which would be recovered through savings.

- The Ontario Energy Board require all local distribution utilities to develop energy efficiency programs...and develop a system of incentives and penalties identical to those applied to the natural gas sector to encourage them (i.e. shared savings mechanism);
- The Ontario government review, update and expand the application of the *Ontario Energy Efficiency Act* to a broader range of electrical appliances and equipment within 12 months; and
- The Ontario government revise the *Ontario Building Code* to incorporate the most advanced science with respect to energy generation and energy conservation (Select Committee, 2002).

Reductions in energy demand achieved with changes to the *Ontario Building Code* would be expected to reduce emissions associated with the use of natural gas and oil for space heating as well as reducing emissions associated with electrical generation.

These recommendations outlined above would have an impact on new buildings or upon those organizations that have the financial resources to invest in future energy savings. It may therefore, be necessary to establish an Energy Efficiency Fund to promote energy efficiency in existing schools, low income housing units, hospitals and other institutions that do not have the reserves needed to reduce long-term energy consumption.

Promising First Steps

The Minister of Energy and/or the Premier have made several promising announcements related to energy conservation/efficiency:

- In January, the Minister announced the formation of a Conservation Action Team, composed of eight Parliamentary Assistants, to identify and remove barriers to conservation in existing government policies and programs;
- In January, the Minister announced that the Province was seeking 2,500 megawatts (MW) of electrical generation capacity with new generation and/or demand-side management initiatives by 2007;
- In March, the Minister announced a new regulation filed under Ontario's *Energy Efficiency Act* that would establish high energy efficiency standards for two new products and new standards for seven products that are already covered by the Act; and
- In April, the Premier announced that the Province would be striving to reduce energy demand within the province as a whole by 5% by 2007 and to reduce the government's own electricity consumption by 10% by 2007 (News Releases, Jan 16; Jan 20; March 26; April 19, 2004).

It is not yet apparent that the Province intends to establish the policies needed to fully realize the potential presented by reduced demand.

While the Province does appear to be moving in the right direction on energy efficiency/conservation, it is not yet apparent that the Ministry of Energy intends to establish the policies and resources needed to fully realize the potential presented by reduced electricity demand.

Recommendations

It is recommended that the Ministers of the Environment, Energy, and Municipal Affairs and Housing:

- *Establish an ambitious schedule of targets of electricity demand to be reduced with energy efficiency/ conservation (e.g. 10% reduction by 2007, 20% by 2010, 30% by 2015, 40% by 2020);*
- *Instruct the Ontario Energy Board to adopt a policy that makes it profitable for utilities to effectively reduce electricity use among their customers;*
- *Revise the Ontario Building Code to maximize energy efficiency, encourage co-generation, and promote utilization of renewable technologies such as solar-heated water tanks; and*
- *Establish an Energy Efficiency Fund to be used to increase energy efficiency in existing schools, low income housing units, hospitals and other appropriate institutions.*

3.3 Aggressively Promote Renewable Energies

*Renewable
energies could
provide about
31% of the
electricity
needed by
2020...*

The Province should aggressively promote the development and utilization of renewable energy supplies. The Commission for Environmental Cooperation (CEC), Ontario's Select Committee for Alternative Fuels, and the Federal Liberal Caucus Working Group on Environmental Technologies have all concluded that renewable energies have a huge potential from both a technological and an economic perspective to provide a significant share of clean and secure energy for North America. Renewable energy supplies could be developed to replace electricity currently generated with high impact technologies such as coal-fired power plants and nuclear generators. They could also be developed to displace the use of oil and natural gas for purposes such as space heating and water heating.

In countries that have shifted their public policies to support the development of renewable energies, the results have been impressive. For example, in Germany, which began to invest in wind power in 1990, had developed 8,000 Megawatts of wind-generated electrical capacity by 2001, and is on track to meet its target of 22,000 MW of wind-powered electrical capacity by 2010 (CEC, 2002). Compare this to Ontario where, in 2003, coal-fired and nuclear power plants provided 7,500 and 10,800 MW of electrical capacity respectively.

The Pembina Institute estimates that hydro, wind and biomass¹ could provide about 33,000 GWh of electricity per year in Ontario by 2020 (see Table 3). This estimate suggests that renewables could provide about 31% of the electricity needs forecast for 2020 under an "energy efficient" scenario. The estimate represents about 18% of the electricity forecast for 2020 under a business-as-usual scenario (Pembina, 2004).

Table 3: Potential Renewable Energy Supply, 2010-2020, Ontario (GWh/Year)

	2010	2015	2020
New Hydro	4,380	6,570	8,760
Wind	7,884	12,208	18,396
Biomass	3,504	4,205	5,606
Total	15,768	22,983	32,762

Source: Pembina 2004

A number of jurisdictions around the world have used Renewable Portfolio Standards (RPS) as a regulatory tool to effectively encourage the development of renewable energy capacity. A RPS

¹ Biomass refers to methane generated in landfills and from the anaerobic digestion of sewage sludge, municipal and agricultural wastes, that can be burned as fuel to generate electricity.

can dictate to energy producers or retailers the percentage of energy that must be sourced from renewable energy in a given time period. For example, in 2002, California passed a Bill that requires utilities to ensure that 20% of their electricity is generated with renewable sources by 2017 (OPHA, 2002).

Encouraging Announcements

The Province has made several promising announcements related to renewable energy supplies:

- The Minister of Energy has indicated that the Province intends to ensure that 5% of the province's electricity comes from renewable sources by 2007 (i.e. 1,350 MW) and 10% by 2010 (i.e. 2,700 MW);
- On April 28 2004, a Request for Proposal was initiated seeking 300 MW of new, renewable electricity capacity for Ontario; and
- In April, the Minister of Energy indicated that his Ministry would be establishing targets for renewable energies to direct the work of the newly announced Ontario Power Authority (Speech, April 15, 2004; New Releases Jan 20, 2004; April 28, 2004).

The Province's first steps on renewable energies are promising...

Once again, while it is too early in the new government's mandate to know whether its commitment to renewable energies will be sufficient to shift the province's energy future away from high impact energy sources, the first steps suggest a strong commitment.

Recommendation

It is recommended that the Ministers of the Environment and Energy establish an ambitious schedule of Renewable Portfolio Standards that mandates the minimum percentage of electricity that must be sourced from new renewable sources by utilities (e.g. 10% by 2010, 20% by 2015, 30% by 2020.)

3.4 Managing the Transition

The Pembina Institute estimates that, even with an ambitious investment in energy efficiency and renewables, an additional 24,000 to 26,000 GWh of electricity will have to be generated with some other technology between 2010 and 2020 if coal-fired power plants are closed in 2007. When Pembina considered the generation technologies available -- nuclear, combined cycle natural gas (CCNG) and integrated gasification combined cycle (IGCC) that is based on coal -- it concluded that CCNG was the preferred technology both in terms of costs and in terms of health, safety and the environment (see Table 4 below).

Regarding the additional capacity, combined cycle natural gas generation is the preferred technology in terms of health, costs and the environment.

While nuclear generation eliminates smog precursors and greenhouse gas emissions, it creates other health (e.g. low level releases of radioactive materials), safety (e.g. major accident), environmental (e.g. long-term waste management) and cost concerns (e.g. decommissioning and liability) that are not associated with CCNG or IGCC (Pembina, 2004). The Pembina study reports that while the IGCC option is comparable to CCNG generation in terms of smog precursors, IGCC can only reduce greenhouse gases (GHG) by 25% relative to coal-fired power plants (Pembina, 2004). CCNG reduces greenhouse gas emissions by 60% relative to coal-fired power plants, while reducing NO_x emissions by 90%, and virtually eliminating emissions of SO_x, mercury and other toxic air emissions (Pembina, 2004; OPHA, 2003).

Table 4: Electrical Generation Technologies for Transition, Cost Comparison

Technology	Capital Costs (per MW)	Electricity Costs (per kWh)
CCNG (gas)	\$ 1.0 million	\$0.0518
IGCC (coal)	\$ 1.8 million	\$0.046-0.051
Nuclear (new) (Refurbished)	\$ 2.1 million \$1.125-1.52 million	\$0.078

Source: Pembina, 2004

Co-generation, which allows the generation of both electricity and heat from facilities that must generate one or the other, should also be encouraged where appropriate. Co-generation has the potential to dramatically increase operating efficiencies which reduces emissions of both air pollutants and greenhouse gases while providing financial benefits to the generators. Where a traditional coal-fired power plant operates at about approximately 34% fuel efficiency and a CCNG generator operates at about 58% fuel efficiency, co-generators can operate at 80% fuel efficiency (OCAA, 2004; TPH, 2000a).

Recommendations

It is recommended that the Ministers of the Environment and Energy:

- *Develop a regulation that ensures that all new electrical generating facilities providing electricity to the province meet or exceed the emissions performance of combined cycle natural gas (CCNG) generators for SO_x, NO_x, mercury and carbon dioxide; and*
- *Develop policies that encourage the establishment of high-efficiency natural gas generators (i.e. CCNG) and co-generation to maximize fuel efficiencies and minimize emissions of air pollutants and greenhouse gases.*

3.5 Reduce Emissions from Residential Wood-Burning

The emissions inventory in Appendix A identifies home heating as an important source of air pollution within the City and wood-burning fireplaces as a particularly significant source of particulate matter and VOCs. Wood-burning fireplaces can also have an impact on indoor air quality by releasing toxic compounds such as polycyclic aromatic hydrocarbons (PAHs) into the indoor environment.

Emissions from residential wood-burning can be reduced in a few different ways. Traditional wood-burning fireplaces and stoves can be replaced with low-emission wood-burning appliances that are certified by the U.S. Environmental Protection Agency (EPA) and the Canadian Standards Association (CSA) as having low emissions. These appliances can reduce emissions of PM, VOCs and PAHs by 94%, 80% and 85% respectively relative to traditional wood-burning fireplaces and stoves. They can also reduce emissions into the indoor environment. Traditional wood-burning fireplaces and stoves can also be converted to natural-gas burning fireplaces that release even less PM than certified low-emission wood-burning appliances (TPH, 2002).

Conventional fireplaces and stoves can be replaced with low-emission fireplaces and stoves...

In 2003, the Toronto Board of Health recommended that the Ontario Minister of Municipal Affairs and Housing include provisions in the Ontario Building Code that require newly installed residential wood fireplaces and stoves to meet the low-emission certification requirements of the CSA and/or EPA.

Recommendation

It is recommended that the Minister of Municipal Affairs and Housing revise the Ontario Building Code to ensure that all newly installed residential wood and gas fireplaces and stoves meet the low-emission certification requirements of the CSA and/or EPA.

4.0 Reduce Emissions from Point Sources

Point sources are those sources of air emissions that are both stationary and fairly significant in terms of volume. Point sources can include industrial facilities, municipal facilities such as waste treatment plants, and institutional facilities such as hospital incinerators.

Point sources can include industrial, municipal and institutional facilities...

As noted in Section 1, industrial sources can be an important source of air emissions within the City. The available data, which underestimate the contribution of industrial sources, suggest that industrial sources are responsible for about 38% of SO_x, 10% of PM_{2.5}, 12% of NO_x and 4% of the VOCs emitted within the City. It is also expected that a significant percentage of the VOCs attributed to miscellaneous sources (i.e. 51%) are emitted from industrial, commercial or institutional point sources within the City. While VOCs can act as precursors of smog, they can also be toxic and impact directly on human health.

As noted earlier, there are also a number of point sources outside of Toronto including steel plants, refineries, and cement manufacturers in south-western Ontario, and coal-fired power plants in Ontario and the United States, that are likely contributing to the excessive levels of smog and fine particulate matter experienced by Toronto and the rest of southern Ontario during smog episodes.

4.1 Improve Regulatory System for Local Point Sources

In Ontario, emitters of air pollutants that can have an impact on local air quality are regulated by the *Environmental Protection Act* and Regulation 346 which requires, among other things, that emitters obtain the necessary Certificates of Approval (CofAs) for emissions to ensure compliance with all air standards while not causing an adverse effect.

In order to demonstrate compliance, emitters must estimate the maximum ground level concentrations for contaminants emitted at locations around their facilities using mathematical air dispersion models. These ground level concentrations are then compared to the Ministry's Point of Impingement (POI) standards/guidelines that have been mathematically derived from the province's Ambient Air Quality Criteria (AAQC)(MOE, 2001a). AAQC are used for assessing general air quality and the potential for causing an adverse effect, while POI limits are used primarily to assess compliance with Ontario Regulation 346.

The Ministry currently has a list of over 300 air contaminant guidelines and standards. These limits are used in the approvals

process as well as in the Ministry's auditing program (i.e. Selected Targets for Air Compliance (STAC)). In addition to this list of standards, the Ministry requires facilities to submit information on ground level concentrations for any air contaminants for which there are no criteria. For these contaminants, the Ministry's Standards Development Branch will review criteria used by other jurisdictions and current toxicological information to assess whether an emitter may be "causing harm". The CofA process and STAC are based on requirements outlined in Regulation 346, which focuses on the protection of local air quality, human health and the environment from specific contaminants. Regulation 346 has not been designed to address regional air quality. While there are POI standards/guidelines for SO₂, NO_x, total suspended particles (TSP) and CO, these values are intended to address adverse effects, not commitments to improve regional air quality (Grant, 2004).

Concerns with Historical Approach

A number of concerns have been expressed by staff within the City of Toronto with the regulatory system used to control local point sources in Ontario:

- Prior to 1998, CofAs were issued one stack at a time without assessing all of the emissions from a facility;

Since 1998, the Ministry requires that all CofA applications include plant-wide emissions for common contaminants emitted every time an emitter makes any modification to the plant or process that could affect emissions. While emitters are not required to submit new CofAs when the Regulation or a standard is revised, they do have to be in compliance with the amendments to the Regulation and with the new or revised standards. Compliance auditing under STAC complements the approvals process by ensuring that aggregate emissions from facilities comply with the Ministry's air standards and guidelines.

- The air dispersion models enshrined in Regulation 346 have been in place for over 30 years and do not reflect current scientific tools that are available for assessing compliance with air standards;

To address this concern, the Ministry has proposed replacing the air dispersion models currently legislated by Regulation 346 with the suite of air dispersion models currently used by the U.S. Environmental Protection Agency. These U.S. EPA models incorporate the latest science and can be used with effects-based standards that have widely ranging averaging times (i.e. 1-hour to 24-hour) (MOE, 2001a).

- When CofAs are issued, emissions from individual facilities are examined in isolation from other sources in

The air dispersion models used by the Ministry have been in place for over 30 years...

the community, and there is no examination of the cumulative impact of all sources on air quality within a localized community.

Toronto Public Health has expressed concern to the Ministry of the Environment on a number of occasions about the assessment of CofAs for facilities in localized communities that experience higher levels of exposure due to a concentration of emission sources. If the Ministry established the use of a regional air dispersion model, CofAs could be assessed in terms of their cumulative impacts on the community.

- The existing ½-hour POI standards are based on an outdated approach. The air dispersion models enshrined in Regulation 346 have been in place for over 30 years and do not reflect current scientific tools that are available for assessing compliance with air standards;

To address this concern, the Ministry has proposed replacing the air dispersion models currently legislated by Regulation 346 with the suite of air dispersion models currently used by the U.S. Environmental Protection Agency. These U.S. EPA models incorporate the latest science and can model ambient air concentrations over varying averaging times (i.e. 1-hour to 24-hour) (MOE, 2001a). The use of these models will allow the ½-hour POI standards to be replaced with effects-based AAQC that have appropriate averaging times.

- Many of the air standards in Regulation 346 were established over 20 years ago and do not reflect current scientific knowledge about health impacts;

The Ministry has been working to address this problem. Between 1996 and 2001, the Standards Development Branch screened all air standards to determine the priority that should be given to them for review, completed risk assessment processes for at least 9 air standards, published risk assessments for 18 air standards, began work on risk assessment processes for more than 40 others, and recommended reaffirming the current values for 75 air standards on the basis of comparisons to standards in other jurisdictions (MOE, 2001c);

- Traditionally, many of the air standards used to derive POI standards and guidelines were based on technical and economic considerations as well as health impacts;

This practice meant that air standards were not necessarily protective of health. It also meant that air standards could be driven by the facilities that had the greatest challenges with emissions. This practice could result in situations where emissions from some facilities were higher than they needed to be. In 1999, the Ministry

Many of the air standards were established over 20 years ago and do not reflect current scientific knowledge about health impacts.

proposed that: Effects-based air standards be developed which are protective of human health and the environment; and A new process be developed to deal with those facilities that have difficulties complying with the new effects-based standards for technical or economic reasons (MOE, 2001a).

- The standard development and CofA approval processes provides too little opportunity for meaningful consultation with the community, public health units, and/or local governments;

While all new standards and CofA applications are posted on the Environmental Registry for a minimum 30-day comment period, the process is not conducive to participation by public health units, municipalities and members of the community.

- CofA records have not been computerized, nor filed in a way that makes them accessible.

This has made it difficult for the Ministry to properly assess aggregate emissions and for officials in public health units and municipalities to collect information about emissions sources within their communities that might inform air quality planning.

New Risk Management Framework being Developed

In 2001, the Ministry proposed a “risk management framework” that was intended to bring greater clarity, consistency and transparency to risk management decisions, while providing increased flexibility and decreased paper-work to emitters. That framework originally involved four steps:

- The Ministry would develop an effects-based air quality standard and conduct research on the need for risk management decisions based on timing, economic and/or technology considerations;
- If no implementation issues were identified by affected facilities, the Ministry would finalize the new or revised air standard which would come into effect within 6 months;
- Where implementation issues were identified for new or revised air standards, a 4-year phase-in period would be allowed for the air standard;
- Facilities that could not commit to complying with the new or revised air standards within the 4-year window because of economic or technological barriers that would make it “unduly difficult” would be required to compile and submit the information needed to support their position in an “Alternate Ramp Down” option. In this option, the proof would be posted on the Environmental Registry for public review and comment (MOE, 2001a).

The new Risk Management Framework should be subjected to a comprehensive public consultation process.

The *Risk Management Framework for Air* has evolved since 2001. The Ministry has been piloting the Framework with selected industry stakeholders and one non-governmental organization to test practices identified in a report entitled, *Managing the Environment: A Review of Best Practices*. These practices include the adoption of formal environmental management systems and risk-based decision-making processes as alternatives to traditional compliance approaches.

Given the impact that this framework could have on air quality in communities across the province, it is important that the technical details be subjected to a comprehensive public consultation.

Recommendations

It is recommended that the Minister of the Environment:

- *Accelerate efforts to update air standards;*
- *Replace existing air dispersion models in Regulation 346 with the new U.S. EPA models;*
- *Replace the 1/2-hour Point of Impingement (POI) standards with appropriate effect-based standards and averaging times;*
- *Utilize regional air dispersion modeling to assess cumulative impacts;*
- *Continue to review Certificates of Approval (CofA) and audit facilities to ensure that facilities are operating in compliance with air standards;*
- *Give high priority to greater transparency in the development of, and full public consultation on, the Risk Management Framework for Air;*
- *Establish consultation processes that allow meaningful input from public health units and/or local governments and the broader community on:*
 - *Proposed air standards and guidelines;*
 - *The approval of CofAs; and*
 - *Compliance related information for air standards;**and*
- *Establish accessible databases that contain air emissions data that can be used by public health departments and/or local governments for air quality planning purposes; and*
- *Work towards the development of a regulatory process that allows consideration of cumulative impacts.*

4.2 Establish an Air Quality Plan to Address Regional Air Quality

Regional Commitments re: Air Pollutants

The Province has made a number of commitments that have the potential to substantially improve regional air quality in southern Ontario:

- In 1996, it committed to reducing emissions of NO_x and VOCs in Ontario by 45% of 1990 levels by 2015 in order to reduce by 75% the number of times each year that ozone readings in the province exceed the AAQC of 80 ppb (MOE, 2000). Under this commitment, provincial emissions of NO_x would be reduced to 363 kilotonnes per year by 2015;
- Under the Canada-Wide Acid Rain Strategy for Post-2000, Ontario committed to reducing emissions of SO₂ by an additional 50% by the year 2015 to 442.5 kilotonnes per year by 2015 (MOE, 2002). While this commitment is designed to address the issue of acid rain, it provides benefits for air quality;
- Under the Ozone Annex of the Canada-U.S. Air Quality Agreement, the Province is committed to capping NO_x emissions from the electrical sector in southern Ontario to 25 kilotonnes NO (or 39 kT NO₂) by 2007 ;
- In June 2000, Ontario endorsed the Canada-Wide Standards (CWS) for fine particulate matter (PM_{2.5}) and ozone to be achieved by 2010 (MOE, 2002).

Emissions Trading Proposed to Address Regional Air Quality

While CofAs are the regulatory tools used by the Ministry of the Environment to control local air quality impacts associated with emissions from point sources, the Emissions Trading Regulation and the Clean Air Plan for Industry (CAPI) represent the Ministry's attempt to address regional air quality issues associated with point sources.

In October 2001, the Ministry established the Emissions Trading Regulation under the Environmental Protection Act that outlined the emission trading framework for the province that:

- Includes a schedule of decreasing emission caps for NO_x and SO₂ for the six coal- and oil-fired power plants in Ontario;
- Indicates that the Ministry would allocate allowances to individual plants and allow facilities to sell surplus allowances to other facilities; and
- Indicates that emission reduction credits could be created by non-capped sectors, sold to capped entities, or banked for future use.

The emissions trading proposal was criticized by a number of public health, health and governmental organizations.

Concerns Related to Emissions Trading Framework

This proposal was criticized by a number of public health, health and governmental organizations, including Toronto Public Health, on the following grounds:

- The leniency of the caps for NO_x. For example, the NO_x caps do not ensure that the Province complies with the 39 kilotonne commitment made under the Ozone Annex;
- The leniency of the caps for SO₂. For example, the caps for SO₂ would allow SO₂ emissions from the electrical sector to remain about 70% higher than they were in 1996 until at least 2009;
- For allowing trading between capped and uncapped sectors, without establishing any rules to limit increased emissions from the uncapped sectors, which could result in increases in overall emissions within the regional airshed; and
- Between the emission caps and trading rules, there is too little in the proposal to encourage the development of renewable and low impact electrical generation (TPH, 2001a; TPH, 2001b).

Within the public health sector, there is an understanding that an emissions trading framework, if properly designed, could motivate continuous improvements in emissions reductions by creating the funds to fuel on-going reductions in air emissions. For greenhouse gases that do not present immediate environmental or health concerns at a local or regional level, emissions trading is viewed as a regulatory framework that can offer many benefits. However, when emissions trading is applied to air pollutants such as NO₂ and SO₂ that have been associated with local health impacts as well as regional health impacts, there is a greater level of uneasiness. There are concerns about a regulatory framework that allows a large point source in one community to maintain higher levels of emissions by “buying” credits or allowances from another source in a distant community if the “buying” point source puts the local community at greater risk of health impacts. Concerns about local air quality impacts would not be so great if there was confidence in the standards that apply to air pollutants and in the CofA process that applies to local point sources.

There are also concerns about an emissions trading framework that allows emissions trading between point sources and mobile sources. Air monitoring studies have demonstrated that air levels of PM₁₀ and PM_{2.5} can be much higher along high-traffic corridors and in urban “canyons” than indicated by ambient air levels in the community as a whole (Morgan, 2004). These studies indicate that a tonne of NO_x or SO_x released at ground-level from mobile sources can produce very different exposure scenarios for individuals than a tonne of NO_x or SO_x released from the tall stack of a point source. This evidence of

varying exposure conditions would make it difficult to accept a regulatory framework that might allow emission trading between point sources and mobile sources.

Regional Air Quality Could be Addressed Without Emissions Trading

While we agree that a regional air quality plan is needed to reduce emissions of smog-forming precursors in large areas of Ontario, we do not believe that the air quality plan has to be based on an emissions trading framework. Ontario's Acid Rain Action Plan, which has successfully achieved significant reductions in emissions of SO₂ over the last 25 years, was developed and implemented with a traditional "command and control". While we could support an emissions trading framework if it was driven by stringent air emission caps and rules that guarantee significant improvements in air quality over time, we would rather see the Ministry use a traditional regulatory framework for its regional air quality plan than an emissions trading framework that is flawed in design and/or driven by weak emission caps.

Clean Air Plan for Industry

In December 2001, the Ministry of the Environment released a report entitled, *Discussion Paper on Ontario's Clean Air Plan for Industry: Developing NO_x and SO₂ Emissions Limits* or CAPI for short. This consultation document was seeking advice on a number of issues related to extending caps under the Emissions Trading Framework to other industrial sectors in Ontario, including:

- Whether Ontario's commitment to reduce NO_x emissions and SO₂ emissions by 45% and 50% respectively of 1990 levels should be moved up to 2010 from 2015;
- The emission reductions that should be asked of the various industrial sectors in Ontario;
- The basis for emission reductions (e.g. tonnage based or intensity based); and
- The structure of the Province's emissions trading framework and how it should apply to the industrial sector.

The Ministry should identify the emission reductions needed to attain the new Canada-Wide Standards for ozone and PM_{2.5}.

Regional Air Quality Goals Need to be Protective of Health

The 45% reduction goal for NO_x articulated by the provincial government was established to reduce the number of times each year that ozone levels exceed the Province's air quality criterion of 80 ppb. Given that it has been well documented that health impacts occur well below the 80 ppb limit, Toronto Public Health views the achievement of the 45% emission reduction target for NO_x by 2010 as an essential first step in the process to improve air quality in southern Ontario.

It is likely however, that emissions in Ontario may have to be reduced well beyond this target in order to comply with the new CWS for ozone by 2010. We believe that the Ministry should make it a priority to identify the emission reductions that would be needed, both within Ontario and the United States, in order to attain the new CWS for ozone and PM_{2.5}. We also believe that the long-term goal of the program should be to reduce air levels below the health-based reference levels of 20 ppb for ozone (1-hour) and 15 ug/m³ (24-hour) for PM_{2.5}, recognizing that this goal may be beyond reach.

Industrial Sector Should Do its Share to Meet Goals

Regulatory actions taken by the federal and provincial governments in recent years are expected to produce significant reductions in emissions from the transportation sector. Emissions of NO_x and SO₂ from the transportation sector are expected to be reduced by 45-50% and 73% respectively between 1999 and 2010, while NO_x and SO₂ emissions from the industrial sector are expected to be reduced by 0% and 0.4% respectively for the same time period (see Table 5 below). This suggests that there is room for increased reductions from the industrial sector.

Work towards achieving air levels that are below the health-based reference levels for PM_{2.5} and ozone...

There are a number of ways in which the provincial government could achieve reductions from the industrial sector. It could establish emission rates for certain processes, set tonnage caps for certain sub-sectors, and/or establish process-specific regulations for specific technologies or sub-sectors. Within Toronto Public Health, there is less concern with the means by which emissions are reduced from various industrial sectors, than there is with the actual reductions achieved, and the period of time in which they are achieved. We can accept that different regulatory approaches may be required for different industrial sub-sectors, as long as the overall reduction requirements for each sub-sector and facility are measured in tonnes.

Recommendations

It is recommended that the Minister of the Environment:

- *Develop a regional air quality plan that identifies the reductions in smog-forming precursors that will be needed over time from Ontario's industrial and electrical sectors;*
- *Clearly commit to the attainment of the 45% and 50% emission reduction targets for NO_x and SO₂ by 2010 as the first targets for regional air quality in Ontario;*
- *Target the attainment of the 2010 Canada Wide Standards for PM_{2.5} and ozone as the second targets;*

- *Work towards achieving air levels that are below the health-based reference levels for PM_{2.5} and ozone as the long-term goal;*
- *Develop a strategy that clearly identifies how emissions, measured in tonnes, will be reduced over time from the industrial sector as a whole and from industrial sub-sectors; and*
- *Ensure that the emission reduction strategy for the industrial sector is translated into regulations that are mandatory and enforceable at a facility level.*

Table 5: NO_x & SO_x Emission Trends in Ontario (kilotonnes)

Source	NO _x 1990	NO _x 1999	NO _x 2010	NO _x 2015	Reduction 1999-2010	SO ₂ 1990	SO ₂ 1999	SO ₂ 2010	SO ₂ 2015	Reduction 1999-2010
Industry	151	89	89	90	0%	896	401	385	386	-0.04%
Electrical	78	82	43	43	-47%	197	144	131	131	-0.09%
Transportation	270	194	96-106	55-80	-45% to -50%	21	15	4	4	-73%
Off-Road	130	153	137-169	129-178	-10% to +11%	30	21	18-23	17-25	-14 to +0.10%
Residential/ Commercial	24	25	27	28	+0.08%	13	7	6-8	6-8	-0.14 to +0.14%
Total	652	543	396-434	345-420	-27 to -20%	1158	588	544-551	544-554	-0.75 to 0.06%
Target			363	363				442	442	
Gap			33-71	-18-17				102-109	102-112	

(Data, MOE, 2002)

5.0 Enhancing the Support Systems Needed for Air Quality Improvements

5.1 Need Health Protective Air Standards

The premature deaths and hospital admissions estimated for the five air pollutants in the Toronto Air Pollution Burden of Illness study are associated with air levels that are well below both, Ontario's existing ambient air quality criteria (AAQC) and the new Canada-wide Standards (CWS) developed by the Canadian Council of Ministers of the Environment (CCME).

Premature deaths and hospital admissions occur at air levels well below Ontario's existing air standards and the new Canada-Wide Standards.

While we recognize that it is difficult to develop air standards for these five air pollutants because they impact on health in a synergistic way, and while we also recognize that the best way to deal with PM_{2.5} and ozone pollution is through broad-based emission reduction strategies, we also believe that health protective air standards are needed for each of them for regulatory, enforcement and educational reasons.

We believe that it is important for the Province to participate in national processes to address air standards. However, we do not believe that the Province should wait for the national process to move on air standards that would benefit public health in Ontario.

More Protective Ozone Standard Needed

Ozone is a secondary air pollutant that is formed when NO_x react with volatile organic compounds in the presence of sunlight. Ozone is the air pollutant responsible for most of the smog alerts issued in Ontario. It is also one of the air pollutants that is present in Toronto's air, and in most of southern Ontario, at greater concentrations today than 20 years ago (TPH, 2004). Air levels of ozone measured at Ministry monitoring stations in Toronto, and associated with a significant burden of illness in Toronto, are well below both the provincial air quality objective of 80 ppb (1-hour) and the new CWS of 65 ppb (8-hour)(see Table 6 below).

In 1999, the Federal Provincial Working Group on Air Quality Objectives and Guidelines identified 20 ppb and 25 ppb (1-hour) as the lowest air levels clearly and consistently associated with premature deaths and respiratory hospitalizations respectively (NAAQO, 1999a).

In 2000, the Toronto Board of Health recommended that the CCME should establish 8-hour ozone standards of 60 ppb and 50 ppb to be achieved by 2010 and 2015 respectively, and that the standard should be reviewed on a regular basis to move it towards the lowest adverse effect and/or background levels (TPH, 2000; TPH, 1999).

In 2000, the CCME adopted a new CWS for ozone of 65 ppb averaged over an 8-hour period, based on the 4th highest annual ambient measurement and averaged over 3 years.

More Protective PM Standard Needed

Fine particulate matter (PM) are solid and liquid particles composed of acid aerosols, organic chemicals, smoke, metal fumes, fly ash, dust and pollen. PM that is smaller than 10 microns in diameter is called PM₁₀, while PM that is smaller than 2.5 microns in diameter is called PM_{2.5}. While PM can be emitted directly from vehicle tailpipes and smokestacks, much of the PM₁₀ and most of the PM_{2.5} in Ontario's air is formed in the atmosphere from reactions involving air pollutants such as SO₂ and NO_x (MOE, 2003).

Air levels of PM_{2.5} measured at Ministry sampling stations in Toronto, associated with a significant burden of illness in Toronto, are well below both the province's 24-hour interim air quality objective of 50 ug/m³ for PM₁₀ and the new 24-hour CWS of 30 ug/m³ for PM_{2.5} (see Table 6 below).

Premature deaths and hospitalizations occur at levels as low as 15 ug/m³ for PM_{2.5} (24-hour).

In 1999, the Federal Provincial Working Group on Air Quality Objectives and Guidelines identified 25 ug/m³ for PM₁₀ (24-hour) and 15 ug/m³ for PM_{2.5} (24-hour) as the lowest air levels that have been clearly and consistently associated with premature deaths and hospitalizations (NAAQO, 1999b).

In 2000, the Toronto Board of Health recommended that 24-hour standards of 25 ug/m³ and 20 ug/m³ be established for PM_{2.5} to be attained by 2010 and 2015 respectively, and that the standard be reviewed on a regular basis to move it towards the lowest adverse effect and/or background levels (TPH, 2000; TPH 1999).

In 2000, the CCME adopted a new 24-hour CWS for PM_{2.5} of 30 ug/m³ which is to be based on the 98th percentile measurement and averaged over three consecutive years.

Health Protective Standards for CO, NO₂ & SO₂

In Toronto, air levels of NO₂, SO₂ and CO measured at the Ministry monitoring stations, associated with a significant burden of illness, are well below the province's respective air quality criteria for these three air pollutants (see Table 6 below).

In May 2000, the Toronto Board of Health recommended that the Federal Ministers of Health and the Environment and the Canadian Council of Ministers of the Environment (CCME) establish health protective CWSs for NO₂, SO₂ and CO (TPH, 2000).

Recommendations

It is recommended that the Minister of the Environment, in consultation with the Minister of Health and Long-Term Care:

- *Update the ambient air quality criteria for CO, SO₂ and NO₂ and ensure that they are protective of human health;*
- *Establish 8-hour air standards of 60 ppb and 50 ppb for ozone to be achieved by 2010 and 2015 respectively; and*
- *Establish 24-hour standards of 25 ug/m³ and 20 ug/m³ for PM_{2.5} to be achieved by 2010 and 2015 respectively; and*
- *Review the standards for ozone and PM_{2.5} on a regular basis to move them towards the lowest adverse effect and/or background levels.*

Table 6: Air Levels, Six Air Pollutants, Toronto Monitoring Stations, and Applicable Air Standards

Air Pollutant	Range – Annual Averages, Toronto, 1999 ^c	Ontario Air Quality Criteria (AAQC)	New Canada Wide Standards	Health Based Reference Level	Previously Recommended by the Toronto Board of Health
NO ₂ (ppb)	15.8-26.9 (24-hr)	200 (1-hr)			
CO (ppb)	600 – 1,200 (24-hr)	13,000 (8-hr)			
O ₃ (ppb)	21.6 – 23.4 (24-hr)	80 (1-hr)	65 (8-hr) 2010 ^a	20/25 (1-hr)	60 (8-hr) 2010
SO ₂ (ppb)	4.7-5.5 (24-hr)	100 (24-hr)			
PM ₁₀ (ug/m ³)	13.4-19.1 (24-hr)	50 (24-hr)	[60] (24-hr) ^b	25 (24-hr)	50 (24-hr) 2010 40 (24-hr) 2015
PM _{2.5} (ug/m ³)	12.7-14.2 (24-hr)	NA	30 (24-hr) ^b	15 (24-hr)	25 (24-hr) 2010 20 (24-hr) 2015
SO ₄ (ug/m ³)	4.5 (24-hr)	NA			

a An 8-hr standard of 65 ppb for ozone is approximately equivalent to 1-hr standard of 87 ppb

b A PM_{2.5} standard of 30 ug/m³ is approximately equivalent to a PM₁₀ standard of 60 ug/m³

c Data drawn from Pengelly and Sommerfreund, 2004

5.2 Enhance Air Quality Planning Capacity

Currently, it is very difficult for municipalities and public health units to identify air policy priorities within their communities or to measure progress in addressing regional air quality. In large part, this is due to a lack of information regarding air emissions and air quality. The information needed includes:

- Specific data on emission sources and quantities of pollutants emitted within communities;
- Specific data on emission sources and quantities of pollutants released upwind of communities;
- Data on the flow of air pollutants across communities;
- Information about the formation of secondary air pollutants across regions; and
- Air quality monitoring data for localized areas within communities.

In the Greater Vancouver Region District (GVRD), where substantial improvements in air quality have been achieved, substantial resources are dedicated to air quality planning. This function includes the development and maintenance of a current emissions inventory for the region, monitoring air quality, modeling the movement and formation of air pollutants, and assessing and evaluating emission reduction strategies.

In Ontario, the documentation of air emissions, the measurement of air quality, and the study of air quality is the responsibility of the provincial government. While it is recognized that the Ministry of the Environment has the expertise needed to conduct these air quality planning functions, there is a need to enhance the resources available for developing and maintaining emission inventories, monitoring air quality, modeling air pollution, and assessing and evaluating emission reduction strategies. There is also a need to ensure that these functions are conducted in an integrated and coordinated fashion across the Ministry.

At the same time, the Ministry's air quality planning staff should work closely with municipalities and public health units across the province to ensure that the necessary information is being collected, shared, and analyzed and that resources at all levels of government are being efficiently allocated.

Recommendations

It is recommended that the Minister:

- *Ensure that air quality planning functions are adequately resourced, integrated and coordinated across the Ministry; and*
- *Ensure that air quality planning information is made accessible to the public and shared openly with public health units and/or local governments across the province.*

It is very difficult for municipalities to identify air policy priorities within their communities or to measure progress on regional air quality due, in large part, to a lack of information.

5.3 Improve Public Consultation Processes

Over the last ten years, there has been a shift away from broad-based consultation processes for regulatory initiatives, standards, and certificates of approval that can have an impact on local and/or regional air quality in Ontario. There has been greater reliance on the Environmental Registry established under the Environmental Bill of Rights (EBR) and meetings with selected stakeholders, and less emphasis on consultation processes that include a broad cross-section of interests within a community.

Consultation processes must allow meaningful and equitable participation...

When proposals are posted on the Environmental Registry, there is usually very little time to provide feedback (i.e. usually 30 days) which can make it difficult for organizations such as public health units and municipalities that need to consult internally and/or seek approval through formalized channels, to respond. In addition, unless an individual or organization has a job that involves checking the Environmental Registry on a regular basis, one can easily miss the posting of a proposal, and hence the opportunity to comment on a regulatory proposal.

There are many challenges to ensuring an effective, efficient, and representative consultation process. Reliance on the EBR posting as the main mechanism for formal consultation does not however ensure that individuals and organizations with the appropriate expertise or a balanced cross-section of interests review proposals.

Given that many initiatives undertaken by the Ministry of the Environment require balancing economic impacts for some parties against the health benefits for others, it is very important that consultations related to them be undertaken in a way that is fair to all parties, balanced in terms of the interests that are consulted and considered, and transparent in terms of the assumptions used, the health and economic impacts assessed, and the criteria to be applied in the ultimate decisions.

For these reasons, it is important to establish consultation processes on air quality initiatives that allow meaningful and equitable participation by public health units and/or municipal governments, community groups, and industry-based organizations. These consultation processes must recognize and address the resource differentials that exist between these different stakeholders.

Recommendation

It is recommended that the Minister of the Environment examine different models of public consultation and ensure that consultation processes conducted on future Ministry regulations, standards, and certificates of approval are fair, transparent and equitable.

5.4 Enhance Environmental Health Capacity in the Public Health Sector

Over the last decade, there has been growing evidence of the need to build specialized environmental health capacity within the public health sector on air quality and other environmental health issues.

A growing body of scientific research has demonstrated that air pollutants are responsible for a significant number of acute and chronic health impacts in our communities. Investigations directed at well-recognized toxics such as lead, mercury and PCBs have demonstrated health effects at ever-decreasing levels of exposure, particularly among fetuses and children. There has been an increase in heat waves and other extreme weather events as a result of global climate change. In addition, we have experienced the introduction and rapid spread of an insect-borne disease, West Nile Virus.

Structural and Resource Constraints in Public Health

The public health sector in Ontario is not optimally structured or resourced to assess, monitor, prevent, and respond to new and emerging environmental health issues.

First of all, within Ontario, public health is largely a decentralized function. Historically, the Public Health Division within the Ministry of Health and Long-Term Care has not been well developed or resourced because authority and responsibility for public health has been delegated to public health units and Boards of Health situated within local and regional governments across the province.

Secondly, while environmental issues have traditionally been dealt with by the Ministry of the Environment at the provincial level, at the municipal level, environmental health issues are often dealt with by public health units and Boards of Health that get their authority, mandate and a portion of their resources from the Ministry of Health and Long-Term Care. The Ministry of Health and Long-term Care also houses a small Environmental Health and Toxicology Unit that provides advice on environmental health issues, including air quality and pesticides, to government and public health units. However, this unit has relatively few resources with which to respond to a broad array of environmental health issues.

Thirdly, the Mandatory Health Programs and Services Guidelines, which specify the minimal level of programming and services that public health units must provide under the *Health Protection and Promotion Act (HPPA)*, make little mention of air quality and other emerging environmental health issues. Health units that are doing specialized work on air quality and other environmental health issues are doing so under existing program areas such as Health Hazard Investigation or specific disease prevention activities such as Cancer

While the Ministry of Health and Long-term Care does have programs dedicated to water quality, food safety and West Nile Virus, it has no mandatory program for air quality.

Prevention. However, this can limit a more comprehensive and integrated approach to environmental health programming.

While the HPPA acknowledges that boards of health can deliver additional programs and services in response to local needs, there are no guarantees that the province will fund non-mandatory programs. Nor is it likely that public health units in most municipalities will be able to offer programs or services that are not identified as Mandatory Programs given the many priorities competing for their limited resources.

If the public health sector is to respond in a more effective way to local and regional air quality issues and to other existing and emerging environmental health concerns, specialized environmental health capacity must be enhanced both within the Public Health Division and within public health units across the province. This capacity must enable the public health sector to identify, monitor, assess, mitigate, prevent, and otherwise respond to threats to human health that arise from the biophysical or built environment.

Recommendations

It is recommended that the Minister of Health and Long-Term Care:

20/20 The Way to Clean Air is a social marketing campaign designed to encourage residents to reduce home energy use and vehicle use by 20%.

- *Enhance the capacity of the Public Health Division to address environmental health issues with a focus on air quality;*
- *Adequately resource and enhance the capacity of local health units across the province to address air pollution and other environmental risks to human health; and*
- *Revise the Mandatory Health Programs and Services Guidelines to ensure enhancement of program requirements related to protection of health from environmental hazards, including an explicit focus on air pollution.*

5.5 Support Public Education to Shift Behaviour

Governments have an important role to play when it comes to educating residents about the links between poor air quality, climate change and energy consumption patterns. Community-based social marketing can be used to encourage behavioural shifts among residents in a cost effective manner.

Municipalities in the Greater Toronto Area and the Government of Canada are in the process of implementing outreach campaigns that encourage residents to reduce energy use at home and on the road.

20/20 The Way to Clean Air is a social marketing campaign developed by Greater Toronto Area public health units to encourage

residents to reduce home energy use and vehicle use by 20%. The campaign uses advertising, targeted outreach, and social marketing tools to promote a shift in long-term behaviours that affect energy use, among homeowners and those who drive. 20/20 works in partnership with numerous community organizations, schools, and workplaces to educate and engage residents.

The Smart Commute Initiative is a GTA-wide program that will use major social marketing and education campaigns to make residents and workers across the GTA aware of the benefits to be gained by reducing auto travel in terms of congestion, pollution and energy consumption. Supported by five full-time staff, the Initiative will link local and regional campaigns to a *Smart Commute* brand and build on-going, support for the pursuit of sustainable transportation options through the application of travel demand management (TDM) measures.

As part of Canada's Climate Change Plan, the Government of Canada has launched a *One-Tonne Challenge* campaign that encourages Canadians to reduce their greenhouse gas emissions by one tonne (i.e. by about 20% of the annual average for individual Canadians). 20/20 is currently working with several groups in the GTA to bring the federal "one-tonne challenge" message to residents in this region.

The Ontario Government recently struck the Conservation Action Team, which consists of Parliamentary Assistants to nine Ontario Ministers, to "engage stakeholders from a variety of sectors across the province to seek out and promote the best in conservation ideas and practices". Through this Conservation Action Team, the Province has an opportunity to collaborate with other levels of government currently engaged in campaigns to reduce energy use.

Recommendations

It is recommended that the Ministers represented on the Conservation Action Team:

- *Collaborate with 20/20 The Way to Clean Air, the One-Tonne Challenge, and Smart Commute campaigns to strengthen and support existing efforts to engage residents in energy conservation activities; and*
- *The Government of Ontario involve 20/20 The Way to Clean Air, the One-Tonne Challenge, and Smart Commute campaigns in the provincial energy conservation strategy.*

5.6 Improve the AQI & Smog Messaging System

...92% of the health outcomes were occurring when air quality was classified as "good" or "very good" by Ontario's AQI.

The AQI is a valuable communications tool that can educate the public about the need for shifts in behaviour year round and to inform sensitive populations about the times when precautions should be taken because of increased air pollution levels. However, in 2001, Toronto Public Health released a policy report, *Condition Critical: Fixing Our Smog Warning System* that estimated that about 92% of the premature deaths and hospitalizations attributable to air pollution in Toronto were occurring when air quality was classified as "good" or "very good" by Ontario's Air Quality Index (AQI)(TPH, 2001).

Weaknesses in the AQI System

This situation was occurring for several reasons. First of all, in 2001, Ontario's AQI did not include fine particulate matter (PM₁₀ or PM_{2.5}), the particles in smog that are responsible for a significant portion of the health outcomes attributed to poor air quality in Ontario. In 2001, the AQI included total reduced sulphur (TRS), which is an indicator of odour, and suspended particulate (SP), which is an indicator of visibility and soiling. While both of these are important indicators, neither was designed to reflect the health outcomes associated with PM₁₀ or PM_{2.5} (TPH, 2001).

Secondly, the AQI uses the ambient air quality criteria (AAQC) for the health-based air pollutants included in the AQI to rate the air levels associated with them. This would not be a significant concern if the AAQC were current and health protective. However, as discussed in section 1, the AAQC for NO₂, SO₂ and CO are dated, while the ones for PM_{2.5} and ozone reflect technological and economic considerations as well as health concerns (TPH, 2001).

A Toronto survey indicate that 90% of people were aware of smog alerts...

Thirdly, the AQI public reporting mechanism is based on a single "driver" pollutant and does not reflect the health effects that can occur when people are exposed to increased levels of several smog-related air pollutants simultaneously. The current system reports AQI values based on the one pollutant with the highest hourly reading, rather than taking into account the additional health effects that result from co-exposure to other pollutants present at that time. By calculating the hourly AQI values in a way that takes into account the sum of pollutant contributions for a given hour, the AQI could better predict health risk and therefore function as a better warning system (TPH, 2001).

Fourthly, by using discrete categories and value-laden descriptors such as "good" and "poor" to describe air quality, the AQI may be misrepresenting the health risks associated with air quality. A growing body of scientific evidence is challenging the notion that there is a 'safe' level of exposure to smog-related air pollutants. It is

therefore important to reconsider the structure of the AQI messaging system. One option to consider is the development of a continuous scale similar to the UV-scale which more accurately conveys the varying levels of risk associated with varying levels of air quality (TPH, 2001).

Further, the MOE does not issue a smog alert when the AQI reaches or exceeds 50, unless this value is expected to be widespread and persistent (lasting six hours or more). A survey conducted on 1000 Toronto residents in December 2001 indicated that most members of the public (i.e. more than 90% of those surveyed) were aware of smog alerts, while only about half were aware of the AQI information provided by the MOE. These numbers confirm that smog alerts are a very effective way of informing people that they should take action to reduce emissions and to protect themselves. They also indicate that the Ministry should not rely on AQI values alone as a means of reaching people.

While peak times when the AQI is 50 or greater may be short-lived, they are generally accompanied by longer stretches of time when the AQI approaches 50. Toronto Public Health believes the public must be notified of these events through the issuance of a smog alert. To that end, in June 2003, the Toronto Board of Health requested that the Minister of Environment issue a smog alert whenever the AQI is forecast to, or unexpectedly reaches, a value of 50 or greater (TPH, 2003).

In August 2002, the Ministry added $PM_{2.5}$ to Ontario's AQI using a 3-hour criterion of $45 \mu\text{g}/\text{m}^3$ for $PM_{2.5}$ to trigger a "poor" rating for air quality.

Progress Being Made on AQI

Since Toronto Public Health released its report in 2001, considerable resources have been directed at the AQI and smog messaging systems by both the provincial and federal governments. Environment Canada struck an ad hoc committee with representatives from provincial and federal governments, public health agencies and non-governmental organizations to address the formulations used to derive air quality indices, and the systems used to convey the messages to the public. The ad hoc committee has recommended that the federal government prepare a report that examines the current health evidence, the options for addressing the synergistic impacts of the different air pollutants, and the ramifications of these options on the monitoring and forecasting systems that support air quality indices across the country. Environment Canada hopes to have a concrete proposal to submit to the Deputy Minister Committee of the CCME by January 2005 (Blagden, 2004).

Progress has been made at the provincial level as well. In August 2002, the Ministry of the Environment added $PM_{2.5}$ to Ontario's AQI using a 3-hour criterion of $45 \mu\text{g}/\text{m}^3$ for $PM_{2.5}$ to trigger a "poor" rating for air quality. This criterion was developed as a short-term equivalent of the 24-hour CWS for $PM_{2.5}$ of $30 \mu\text{g}/\text{m}^3$. When the

Ministry added PM_{2.5} to the AQI, it included smog messaging for PM_{2.5} that indicates that sensitive individuals can experience health symptoms when PM_{2.5} levels are rated as “good” or “moderate” to reflect the evidence which suggests that there is no threshold of exposure for PM_{2.5} that is without health impacts (see Appendix B)(Yap, 2004).

Recommendations

It is recommended that the Minister of the Environment:

- *Continue to collaborate with, and actively support, the federal government’s development of a formulation for the AQI that reflects the combined health effects of simultaneous exposure to key AQI air pollutants;*
- *Continue to support the federal/provincial process to develop an effective smog messaging system for air quality indices used across the country; and*
- *Revise Ontario’s AQI notification system to ensure that smog alerts are issued whenever the AQI is forecast to reach, or unexpectedly reaches, a value of 50 or greater.*

6.0 Conclusions

In Toronto, air quality continues to present a significant concern for public health. The updated estimates indicate that the five key air pollutants contribute to about 1,700 premature deaths and 6,000 hospitalizations each year in Toronto. The transportation sector is the most significant source of emissions within the City. Fuel consumption for activities such as home heating and electricity generation and the industrial sector are important sources of air pollution as well. In addition, Toronto's air quality is affected by large point sources that are upwind in southwestern Ontario and the midwestern United States.

This report, which is directed at the actions that could be taken by the provincial government, has identified several priority areas:

- 1) Reducing use of, and emissions from, the transportation sector;
- 2) Reducing emissions from fuel consumption for activities such as home heating and electrical generation;
- 3) Reducing emissions from point sources that contribute to local and regional air quality concerns; and
- 4) Enhancing the support systems needed for air quality improvements.

Key among the recommendations for the transportation sector are those directed at providing significant and sustainable funding to expand ridership on public transit across the GTA and establishing an effective "smart growth" process to curb urban sprawl and integrate land-use and transportation planning across the GTA.

To reduce air emissions associated with fuel consumption for activities such as home heating and electrical generation, the provincial government is encouraged to phase out coal-fired power plants, aggressively promote energy efficiency and renewable energies, and utilize high efficiency natural gas generators and co-generation to meet short-falls in electricity capacity. The phase-out of coal-fired power plants is also seen as an action that will strengthen the Province's hand when negotiating agreements on transboundary air pollution with the United States.

To reduce emissions from point sources that contribute to local and regional air quality concerns, the province is encouraged to improve the Certificate of Approval process, and establish a regional air quality plan that mandates aggressive reductions over time in smog-forming precursors from Ontario's industrial sector.

To enhance the support systems needed for air quality improvements, the province is encouraged to:

- Establish health-protective air quality criteria;
- Enhance the air quality planning capacity of the Ministry of the Environment;
- Ensure that consultation processes are transparent and equitable;
- Enhance environmental health capacity in the public health sector;
- Collaborate on social marketing campaigns; and
- Improve the AQI system in Ontario.

7.0 Summary of Recommendation

The recommendations made throughout the report have been reorganized according to the individuals or organizations to whom they are directed. It is recommended that:

1. The Premier of Ontario commit the Province of Ontario to contribute one-third of the long-term funding needed for TTC's "state of good repair" plan and "ridership growth strategy" to both rehabilitate and renew the existing infrastructure and increase transit service and ridership.
2. The Premier of Ontario move quickly on the recommendations of City Council to establish a Smart Growth process within the Greater Toronto Area that promotes healthy communities, protects natural resources, addresses gridlock, and improves air quality;
3. The Ministers of Energy, the Environment, and Housing and Municipal Affairs:
 - a. Develop a regulation that mandates the phase-out of coal-fired plants by 2007;
 - b. Establish an ambitious schedule of targets of electricity demand to be reduced with energy efficiency/conservation (e.g. 10% reduction by 2007, 20% by 2010, 30% by 2015, 40% by 2020);
 - c. Instruct the Ontario Energy Board to adopt a policy that makes it profitable for utilities to effectively reduce electricity use among their customers;
 - d. Establish an Energy Efficiency Fund to be used to increase energy efficiency in existing schools, low income housing units, hospitals and other appropriate institutions;
 - e. Revise the *Ontario Building Code* to maximize energy efficiency, encourage co-generation, and promote utilization of renewable technologies such as solar-heated water tanks;
 - f. Establish an ambitious schedule of Renewable Portfolio Standards (RPS) that mandates the minimum percentage of electricity that must be sourced from renewable sources by all utilities (e.g. 10% by 2010, 20% by 2015, 30% by 2020);
 - g. Develop a regulation that ensures that all new electrical generating facilities providing electricity to the province

meet or exceed the emissions performance of combined cycle natural gas (CCNG) generators for SO_x, NO_x, mercury and carbon dioxide;

- h. Develop policies that encourage the establishment of high efficiency natural gas generators and co-generation to maximize fuel efficiencies and minimize emissions of air pollutants and greenhouse gases;
- i. Ensure that all newly installed residential gas and wood fireplaces and stoves meet the low-emission certification requirements of the CSA and/or EPA;

4. The Minister of the Environment:

- a. In consultation with the Minister of Health and Long-Term Care and with respect to ambient air quality criteria (AAQC):
 - Update the AAQC for carbon monoxide, sulphur dioxide and nitrogen dioxide and ensure that they are protective of human health;
 - Establish 8-hour air standards of 60 ppb and 50 ppb for ozone to be achieved by 2010 and 2015 respectively;
 - Establish 24-hour standards of 25 ug/m³ and 20 ug/m³ for PM_{2.5} to be achieved by 2010 and 2015 respectively
 - Review the standards for ozone and PM_{2.5} on a regular basis to move them towards the lowest adverse effect and/or background levels; and
- b. With respect to point sources that contribute to local air quality concerns:
 - Accelerate efforts to update air standards;
 - Replace existing air dispersion models in Regulation 346 with the new U.S. EPA models;
 - Replace the ½-hour Point of Impingement (POI) standards with appropriate effects-based standards and averaging times;
 - Utilize regional air dispersion modeling to assess cumulative impacts;

- Continue to review Certificates of Approval (CofA) and audit facilities to ensure that facilities are operating in compliance with air standards;
 - Give high priority to greater transparency in the development of, and full public consultation on, the Risk Management Framework for Air;
 - Establish consultation processes that allow meaningful input from public health units and/or local governments and the broader community on:
 - Proposed air standards and guidelines;
 - The approval of CofAs; and
 - Compliance related information for air standards;
 - Establish accessible databases that contain air emissions data that can be used by public health units and/or local governments for air quality planning purposes; and
 - Work towards the development of a regulatory process that allows consideration of cumulative impacts;
- c. With respect to point sources that contribute to regional air quality concerns:
- Develop a regional air quality plan that identifies the reductions in smog-forming precursors that will be needed over time from Ontario's industrial and electrical sectors;
 - Clearly commit to the attainment of the 45% and 50% emission reduction targets for NO_x and SO₂ by 2010 as the first targets for regional air quality in Ontario;
 - Target the attainment of the 2010 Canada Wide Standards for PM_{2.5} and ozone as the second targets;
 - Work towards achieving air levels that are below the health-based reference levels for PM_{2.5} and ozone as the long-term goal;
 - Develop a strategy that clearly identifies how emissions, measured in tonnes, will be reduced over time from the industrial sector as a whole and from industrial sub-sectors; and

- Ensure that the emission reduction strategy for the industrial sector is translated into regulations that are mandatory and enforceable at a facility level;
- d. With respect to emissions from on-road vehicles and off-road equipment:
- Align limits for sulphur levels in off-road diesel fuel with those for on-road diesel fuel when sold in large urban centres such as Toronto; and
 - Establish special funds to encourage transit authorities and school boards to reduce emissions from diesel-fuelled buses by promoting the replacement of older buses, retrofitting with emission control devices, and/or the use of cleaner fuels;
- e. Ensure that air quality planning functions are adequately resourced, integrated and coordinated across the Ministry and that air quality planning information is made accessible to the public and shared openly with public health units and/or local governments across the province;
- f. Examine different models of public consultation and ensure that consultation processes conducted on future Ministry regulations, standards and CofAs are fair, transparent and equitable;
5. With respect to the Air Quality Index (AQI) and smog messaging system:
- a. Collaborate with, and actively support, the federal government's development of a formulation for the AQI that reflects the combined health effects of simultaneous exposure to the key air pollutants;
 - b. Continue to support the federal/provincial process to develop an effective smog messaging system for air quality indices used across the country; and
 - c. Revise Ontario's AQI notification system to ensure that smog alerts are issued whenever the AQI is forecast to reach, or unexpectedly reaches, a value of 50 or greater;
6. The Ministers represented on the Conservation Action Team:
- a. Collaborate with *20/20 The Way to Clean Air*, the *One-Tonne Challenge*, and the *Smart Commute* campaigns to strengthen and support existing efforts to engage residents in energy conservation activities; and

- b. The Government of Ontario involve *20/20 The Way to Clean Air*, the *One-Tonne Challenge*, and the *Smart Commute* campaigns in the provincial energy conservation strategy;
7. The Minister of Health and Long-Term Care:
 - a. Enhance the capacity of the Public Health Division to address environmental health issues including a focus on air pollution;
 - b. Adequately resource and enhance the capacity of local public health units across the province to address air pollution and other environmental risks to human health; and
 - c. Revise the Mandatory Health Programs and Services Guidelines to ensure enhancement of program requirements related to protection of health from environmental hazards, including an explicit focus on air pollution; and
8. This report be sent to the Ontario Public Health Association (OPHA), the Ontario Medical Association (OMA), the Ontario College of Family Physicians (OCFP), the Association of Local Public Health Agencies (ALPHA) and every public health unit in Ontario for information.

8.0 References

Acidifying Emissions Task Group (AETG). 1997. "Towards a National Acid Rain Strategy". Submitted to the National Air Issues Coordinating Committee. Canada: 1997.

Bill 27, 2003. An Act to Establish a Greenbelt Study Area and to Amend the Oak Ridges Moraine Conservation Act, 2001. December 2003.

Bill 26, 2003. An Act to amend the Planning Act. December 2003.

Blagden, Phil, 2004. Personal Communication. Senior Science Policy Advisor
Policy and International Affairs, Environment Canada. March 2004.

Brook, R.D., Brook, J.R., Urch, B., Vincent, R., Rajagopalan, S., Silverman, F., 2002. Inhalation of fine particulate air pollution and ozone causes acute arterial vasoconstriction in healthy adults. American Heart Association. *Circulation* April 2002; 1534-1536. Available from: www.circulationaha.org.

Burnett, R.T., Brook, J.R., Yung, W.T., Dales, R.E., Krewski, D., 1997a. Association between ozone and hospitalization for respiratory diseases in 16 Canadian cities. *Environmental Research*. Academic Press 1997; 72: 24-31.

Burnett, R.T., Dales, R.E., Brook, J.R., Raizenne, M.E., Krewski, D., 1997b. Association between ambient carbon monoxide levels and hospitalizations for congestive heart failure in the elderly in 10 Canadian cities. *Epidemiology* 1997; 8(2):162-167.

Burnett, R.T., Cakmak, S., Brook, J.R., 1998. The effect of the urban ambient air pollution mix on daily mortality rates in 11 Canadian cities. *Revue Canadienne de Sante Publique* 1998; 89(3): 152-156.

Burnett, R.T., Smith-Doiron, M., Stieb, D., Cakmak, S., Brook, J.R., 1999. Effects of particulate and gaseous air pollution on cardiorespiratory hospitalization. *Archives of Environmental Health* 1999; 54(2): 130-139.

Canada Gazette Part II. 2003. *On-Road Vehicle and Engine Emission Regulations*. January 1, 2003.

Canada-United States Air Quality Committee (Canada-US). 1999. "Ground Level Ozone: Occurrence and Transport in Eastern North America", Prepared by Subcommittee 1: Program Monitoring and Reporting. March 1999.

Chatterjee S., Conway R., Lanni T., Frank B., Tang S., Rosenblatt D., Bush C., Lowell D., Evans J., McLean R., Levy S., 2002. "Performance and Durability Evaluation of Continuously Regenerating Particle Filters on Diesel Powered Urban Buses at NY City Transit – Part II". *Society of Automotive Engineers*. Technical Paper 2002-01-1430.

Commission for Environmental Cooperation (CEC). 2002. "Assessing Barriers and Opportunities for Renewable Energy in North America". Background paper prepared by Professor William Moomaw, Tufts University. June 2002.

Crupi, Ed. 2004. Personal Communication. Head, Vehicle Regulations, Environment Canada, March 2004.

Dawson, Bill. 2003. Presentation to the CUTA Conference. Superintendent - Service Planning, Toronto Transit Commission, November 2003.

Environment Canada, 2003. *Setting Canadian Standards for Sulphur in Heavy and Light Fuel Oils*, Oil, Gas and Energy Branch, February 2003.

Environmental Task Force, Toronto, 2000. *Clean, Green and Healthy: A Plan for an Environmentally Sustainable Toronto*. February 2000.

Friedman, M., Powel, K., Hutwanger, L., Graham, L., Teague, W.G., 2001. Impact of Changes in Transportation and Commuting Behaviours During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma. *Journal of American Medical Association*. Vol. 285, No. 7. February 2001.

Fox Gray, Boni, 2004. Personal Communication. Communications & Corporate Affairs Branch, Ministry of Finance. May 27, 2004.

Gauderman, J.W., McConnell, R. Gilliland, F., London, S., et al., 2000. Association between Air Pollution and Lung Function Growth in Southern California Children. *American Journal of Respiratory and Critical Care Medicine*. Vol. 162: p. 1383-1390.

Gent, J.F., Triche, E.W., Holford, T.R., Belanger, K., Bracken, M.B., Beckett, W.S., et.al., 2003. Association of low-level ozone and fine particles with respiratory symptoms in children with asthma. *JAMA* 2003; 290(14): 1859-1867.

Gong, H., Shamoo, D.A., Anderson, K.R., Linn, W.S., 1997. Responses of older men with and without chronic obstructive pulmonary disease to prolonged ozone exposure. *Archives of Environmental Health* 1997; 52(1): 18-25.

Graham, Rob. 2004. Personal Communication, May 4, 2004. Financial Planning, Finance, City of Toronto.

Grant, Cathy. 2004. Personal Communication, March 16, 2004. Engineer Specialist – Air Pollution, Standards Development Branch.

Health Effects Institute (HEI), 2000. Reanalysis of the Harvard six cities study and the American Cancer Society study of particulate air pollution and mortality: A special report of the Institute's particle epidemiology reanalysis project. Health Effects Institute, Cambridge MA. 2000.

Health and Environmental Impact Assessment Panel Report (HEIAP), 1997. "Joint Industry/Government Study: Sulphur in Gasoline and Diesel Fuels", June 25, 1997.

Healthy City Office, City of Toronto, 1999. *Smog Prevention and Reduction: Detailed Status Report and Work Plan*. May 18, 1999.

Hoek, G., Brunekreef, B., Goldbohm, S., Fischer, P., van den Brandt, P.A., 2002. Association between mortality and indicators of traffic-related air pollution in the Netherlands: a cohort study. *The Lancet* 2002; 360: 1203-1209.

Lanni T., Chatterjee S., Conway R, Windawi H., Rosenblatt D., Bush C., Lowell D., Evans J., McLean R., 2001. Performance and Durability Evaluation of Continuously Regenerating Particulate Filters on Diesel Power Powered Urban Buses at NY City Transit, *Society of Automotive Engineers*. Technical Paper 2001-01-0511.

Leicester, Glen. 2003. Presentation to the CUTA Conference, Manager, Maintenance Planning, Translink, Greater Vancouver Transportation Authority. November 2003.

Lin, C.A., Pereiraa, L.A.A., de Souza Conceiaoa, G.M., Kishia, H.S., Milani, R. Jr., Bragaa, A.L.F., et al.. 2003. Association between air pollution and ischemic cardiovascular emergency room visits. *Environmental Research* 2003; 92(1): 57-63.

McConnell, R., Berchane, K., Gilliland, F., Molitor, J., Thomas, D., Lurmann, F., et. al., 2003. Prospective study of air pollution and bronchitic symptoms in children with asthma. *American Journal of Respiratory and Critical Care Medicine* 2003; 168: 790-797.

McEwen, Bruce. 2004. Personal Communication. Chief, Fuels Division, Environment Canada.

McNeil, Gary. 2003. Presentation to the CUTA Conference. Managing Director & Chief Executive Officer, GO Transit, November 2003.

Ministry of the Environment (MOE), 2004. *Drive Clean* Website. www.ene.govn.on.ca/envision/news/2004

Ministry of the Environment (MOE), 2000. *Ontario's Anti-Smog Action Plan*. Progress Report, August 2000.

Ministry of the Environment (MOE), 2001a. *A Proposed Risk Management Framework for the Air Standard Setting Process in Ontario*, Discussion paper, March 2001.

Ministry of the Environment (MOE), 2001b. *Updating Ontario's Air Dispersion Models*, Discussion paper, March 2001.

Ministry of the Environment (MOE), 2001c. *Setting Environmental Quality Standards in Ontario: The Ministry of the Environments Standard Plan*, March 2001.

Ministry of the Environment (MOE), 2001d. *Innovative Clean Air Initiatives and Hard Emission Caps*. Media Backgrounder.

Ministry of the Environment (MOE), 2002. *Discussion Paper on Ontario's Clean Air Plan For Industry*. Dec 2002.

Ministry of Finance. 2004. *New Deal for Municipalities Supports Safe and Vital Communities*. Media Backgrounder. May 18, 2004.

Ministry of Health (MOH). 1997. *Mandatory Health Programs and Services Guidelines*, Prepared by the Public Health Branch. December 1997.

Morgan, Christopher. 2004. Personal Communication. Air Quality Improvement Branch, Works & Emergency Services, Jan 2004.

Moore, Peter. 2004. Personal Communication, Urban Development Services, March 2004.

Ontario Government, 2002. *Ontario's Drive Clean: A Summary of the first three years of light-duty vehicle data (1999-2001)*. Toronto, Ontario: 2002.

National Round Table on the Environment and the Economy (NRTEE), 2003. *Environmental Quality in Canadian Cities: The Federal Role*.

National Ambient Air Quality Objectives (NAAQO), 1999a. *National Ambient Air Quality Objectives for Ozone*, Science Assessment Document. Report by the Federal Provincial Working Group on Air Quality Objectives and Guidelines. Environment Canada, July 1999.

National Ambient Air Quality Objectives (NAAQO), 1999b. *National Ambient Air Quality Objectives for Particulate Matter*, Science Assessment Document. Report by the Federal Provincial Working Group on Air Quality Objectives and Guidelines. Environment Canada, April 1999.

News Release, January 16, 2004. McGuinty Government Takes Action on Conservation. Released by the Ministry of Energy, Ontario.

News Release, January 20, 2004. Energy Minister Announces Plan to Address First Third of Coal Commitment. Released by the Ministry of Energy, Ontario.

News Release, March 26, 2004. Tough New Energy Efficiency Standards Help Protect the Environment and Save Consumers Money. Released by the Ministry of Energy, Ontario.

News Release, March 30, 2004. Renewing the Toronto Transit Commission – Government Invest \$1 Billion. Released by Ontario Government.

News Release, March 31, 2004. McGuinty Government Creates Renewable Energy Opportunities. Released by Ministry of Natural Resources, Ontario.

News Release, April 19, 2004. McGuinty Government Building Culture of Conservation. Premier's Office.

News Release, April 28, 2004. McGuinty Government to Increase Supply of Renewable Energy. Minister of Energy.

News Release, May 12, 2004. Toronto Announces \$35 Million Clean Air Plan. Released by the Mayor's Office.

Ontario Clean Air Alliance (OCAA), 2004. *New Energy Directions: A Low-Cost, Low-Risk Electricity Supply Strategy for Ontario*. Prepared for OCAA et al., March 8, 2004.

Ontario Public Health Association (OPHA), 2002. *Beyond Coal: Power, Public Health and the Environment*. November 2002. www.opha.on.ca/resources/coal.pdf

Ontario Public Health Association (OPHA), 2003. *Fuelling Clean Air: Municipal Fuel Purchasing Policies that Reduce Emissions Contributing to Poor Air Quality & Climate Change*, March 2003. www.opha.on.ca/resources/fuel.pdf.

Ontario Smart Growth, 2003. *Shape the Future*, Prepared by the central Ontario Smart Growth panel. April 2003.

Ontario Power Generation (OPG), 2002. *Towards Sustainable Development: 2001 Progress Report*.

Parent, Marcel. 2004. Personal Communication. Heavy-Duty Vehicle Policy Analyst, *Drive Clean* Program, Ministry of the Environment. April 2004.

Pegg, J.R. 2004. Tough Non-Road Diesel Rule Cuts Sulphur 99 Percent, *Environment News Service*. May 11, 2004.

Pembina Institute & Canadian Environmental Law Association. 2004. *Power for the Future – Towards a Sustainable Electricity System for Ontario*. Prepared by Mark Winfield, Matt Horne, Theresa McClenaghan & Roger Peters. May 2004.

Pengelly, D., M. Campbell, S. Ennis, F. Ursitti, A. Li-Muller. 2000. *Air Pollution Burden of Illness in Toronto*. Toronto: City of Toronto, May 2000.

Pengelly, D. and J. Sommerfreund. 2004. *Air Pollution-Related Burden of Illness in Toronto: 2004 Update*, Prepared for Toronto Public Health. January 2004.

Pope, C.A III., Burnett, R.T., Thun, M.J., Calle, E.E., Krewski, D., Ito, K., et al., 2002. Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA* 2002; 287: 1132-1141.

Regulation 432/03. 2003. *Ontario Regulation 432/03 Amended to O.Reg. 435/03 “Zoning Area – Golden Horseshoe” under the Planning Act*. December 2003.

Ritz, B., Yu, F., Fruin, S., Chapa, G., Shaw, G.M., Harris, J.A., 2002. Ambient air pollution and risk of birth defects in Southern California. *Am J Epidemiol* 2002; 155(1): 17-25. 2002.

Rodo, Vincent, 2003. Presentation by Executive General Secretary, Toronto Transit Commission to the House of Commons Standing Committee on Finance Hearing, Nov 7, 2003.

Samet, J.M., Zeger, S.L., Dominici, F., Curriero, F., Coursac, I., Dockery, D.W., et al., 2000. The national morbidity, mortality, and air pollution study, Part II: morbidity and mortality from air pollution in the United States. Research Report 94. *Health Effects Institute*. Cambridge MA. 2000c.

Select Committee on Alternative Fuel Sources, 2002. *Final Report of the Select Committee on Alternative Fuel Sources*, Prepared by an all-party Committee of the Ontario Legislature. June 2002.

Smart Growth America, 2002, *Measuring Sprawl and Its Impact*, Prepared by Reid Ewing, Rutgers University, Rolf Pendall, Cornell University, Don Chen, Smart Growth America.

Speech, April 15, 2004. Choosing What Works for a Change. Speech given by the Honourable Dwight Duncan, Minister of Energy, Ontario.

Steib, D.M., Judek, S., Burnett, R.T., 2002. Meta-analysis of time-series studies of air pollution and mortality: effects of gases and particles and the influence of cause of death, age and season. *Journal of the Air and Waste Management Association* 2002; 52: 470-484.

Stewart, Greg. 2004. Personal Communication. Program Manager, Transportation Planning, Urban Development Services, March 2004.

Select Committee on Alternative Fuel Sources (Select Committee), 2002. *Final Report of the Select Committee on Alternative Fuel Sources*, Prepared by an all-party Committee of the Ontario Legislature. June 2002.

Toronto. 2002. *Toronto Official Plan*, Prepared by Paula Dill, Commissioner of Urban Development Services & Paul Bedford, Chief Planner & Executive Director, City Planning Division. Adopted by City Council, November 2002.

Toronto. 2001. *Moving Towards Cleaner Air*. Prepared by inter-divisional committee of staff in the City of Toronto. Toronto, June: 2001.

Toronto Board of Trade. 2001. *A Strategy for Rail-Based Transit in the GTA*. Funded by the Toronto Atmospheric Fund.

Toronto Public Health (TPH), 1999. *Comments on the Consultation Discussion Document on the Development of CWS for PM and Ozone*. Letter submitted to Secretary of the CWS Development Committee by Dr. Sheela Basrur, June 16, 1999.

Toronto Public Health (TPH), 2000. *Air Pollution Burden of Illness in Toronto – Summary Report*, Report to the Board of Health.

Toronto Public Health (TPH), 2000a. *Lakeview Generating Station – Health and Environmental Impacts*. Report to Board of Health, July 7, 2000.

Toronto Public Health (TPH), 2001a. *Air Emissions Caps and Emissions Trading Framework Announced by the Ontario Minister of the Environment*. Report to the Toronto Board of Health, March 23, 2001.

Toronto Public Health (TPH), 2001b. *Comments on Emissions Trading and NO_x and SO₂ Emission Limits for the Electricity Sector – EBR Registry Number RA0110020*. Letter to the Honourable Elizabeth Witmer from Dr. Sheela Basrur, August 2001.

Toronto Public Health (TPH), 2001c. *Condition Critical: Fixing Our Smog Warning System*. Toronto, Ontario: 2001.

Toronto Public Health (TPH), 2002. *Reducing Emissions from Residential Wood-burning Appliances*, Report to the Board of Health.

Toronto Public Health (TPH), 2003. *Air Pollution and Physical Activity*. Report for Toronto Board of Health. June 2003.

Toronto Public Health (TPH), 2004. *Air Pollution Burden of Illness in Toronto: Summary of 2004 Update*. Report for Toronto Board of Health. June 2004.

Toronto Urban Development Services (TUDS), 2003. *Central Ontario Smart Growth Panel's Final Report*. Report to the Toronto Planning and Transportation Committee, May 8, 2003.

Torrie Smith Associates, 2002. *Kyoto and Beyond: The Low Emission Path to Innovation and Efficiency*. Prepared for the David Suzuki Foundation and the Climate Change Action Network..

U.S. Environmental Protection Agency, 2003. Fourth external review draft of air quality criteria for particulate matter. Volume 1. Available from: www.usepa.gov.

Vedal, S., Brauer, M., White, R., Petkau, J., 2003. Air pollution and daily mortality in a City with low levels of pollution. *Environmental Health Perspectives* 2003; 111(1): 45-51.

Yap, Dr. Dave. 2004. Personal Communication. Senior Scientific Adviser, Air Quality & Meteorology, Ministry of the Environment. March 2004.

Appendix A

Table A: Estimated Top Ten Sources for Each Air Pollutant from Human Activities Conducted inside Toronto

	VOC ^d	NO _x ^d	SO _x ^c	PM ₁₀ ^b	PM _{2.5} ^b	CO
Fuel Combustion:	25%	22%	20%	15%	52%	23%
Residential Wood Combust. ^g	25%			14%	48%	22%
Residential Fuel Combust.		9%	9%	1%	3%	1%
Commercial Fuel Combust.		5%	5%		1%	
Electrical Power Generation		8%	6%			
Transportation:	15%	65%	38%	3%	9%	74%
Light-Duty Gasoline Vehicles & Trucks	7%	14%	3%			34%
Heavy-Duty Gasoline Trucks		4%				1%
Off-Road Use of Gasoline	6%	4%		1%	2%	33%
Heavy-Duty Diesel Vehicles		10%	6%	1%	3%	1%
Off-road Use of Diesel		31%	11%	1%	4%	2%
Marine Transport.	2%	2%	18%			3%
Industrial:	4%	12%	38%	5%	10%	1%
Miscellaneous: Sub-Total	51%					
Fuel Marketing	8%					
General Solvent Use	28%					
Surface Coatings	12%					
Printing	3%					
Incineration: Sub-Total			1%			
Open Sources: Sub-Total				75%	23%	
Construction ^f				50%	4%	
Paved Roads ^e				21%	17%	
Agricultural Operations				3%		
Structural Fires				1%	2%	
Other Sources^a	4%	5%	3%	3%	5%	2%

Source: Environment Canada's National Pollutant Release Inventory website, 2002 data. 1995 Criteria Air Contaminants Inventory for Toronto, postal code "M"

Note: The NPRI CAC Inventory includes air emissions reported from selected facilities such as generating stations and large factories and it includes estimates of non-reporting sources such as residential homes, vehicles and open sources.

- a Includes other sources not itemized because of comparatively small contribution
- b Includes directly emitted PM₁₀ & PM_{2.5} only
- c Significant precursor of PM_{2.5}
- d Precursors of ground level ozone
- e Paved roads includes dust from brakes, clutch, tire and asphalt wear and accumulated particulate fallout from exhaust emissions (Morgan, 2004)
- f Construction emissions are over-estimated for Toronto (Morgan, 2004)
- g Research indicates that fuel wood estimates for PM_{2.5} are overestimated for Toronto (Morgan, 2004)

Appendix B

Table B: MOE Break Points, AQI Value, Rating and Advice for PM_{2.5}

PM _{2.5} Air Level ug/m ³ *	AQI Value	AQI Rating	Advice to Public
1-11	1-15	Very good	Sensitive populations may want to exercise caution
12-22	16-31	Good	Sensitive populations may want to exercise caution
23-45	32-49	Moderate	People with respiratory disease at some risk
46-90	50-99	Poor	People with respiratory disease should limit prolonged exertion; general population at some risk
91+	100+	Very Poor	Serious respiratory effects, even during light physical activity; people with heart disease, the elderly and children at high risk; increased risk for general population

(Yap, 2004)

* Levels are based on 3-hour running averages.