TORONTO STAFF REPORT

January 28, 2005

To: Board of Health

From: Dr. David McKeown, Medical Officer of Health

Subject: Actions and Policy Initiatives to Improve Air Quality in the City of Toronto

Purpose:

To advise the Board of Health of the City of Toronto Comprehensive Air Quality Strategy and Toronto Public Health's role in further actions and policy initiatives to improve air quality in the City of Toronto.

Financial Implications and Impact Statement:

There are no financial implications or impacts arising directly from this report. Financial implications arising from actions and policies in support of clean energy initiatives will be reported in the future by the affected agencies and departments.

Recommendation:

It is recommended that this report be received for information.

Background:

At its meeting of July 12, 2004, the Toronto Board of Health considered a report (June 29, 2004) from the Acting Medical Officer of Health reporting on a new study by Toronto Public Health on outdoor air pollution and human health impacts. The Board requested that the Acting Medical Officer of Health, in consultation with City departments and agencies, boards and commissions report back on further actions and policy initiatives to improve air quality that Toronto could undertake. These initiatives included enhancing the commitment of agencies, boards and commissions to purchase clean energy and identifying possible policies, which could be implemented municipally.

Comments:

In 2000 City Council adopted in principle the Environmental Plan - "Clean, Green and Healthy: A Plan for an Environmentally Sustainable Toronto". The Plan consists of 66 recommendations, subdivided into the areas of pollution prevention, land, water, air, sustainable transportation, sustainable energy use, green economic development, public education and awareness, governance, measuring and reporting progress, and implementation.

The Environmental Plan includes recommendations that support several broad-based areas of municipal action to improve air quality, including the development of a comprehensive air quality strategy, reducing air emissions, monitoring air quality, standard setting and integrating City efforts with other jurisdictions.

In September 2004, the Toronto Interdepartmental Environment team (TIE) prepared a Status Report on the implementation of the Environmental Plan recommendations that included an update on the Comprehensive Air Quality Strategy. An interdepartmental working group, including representatives from Toronto Public Health, Urban Development Services, Works and Emergency Services and the Chief Administrator's Office have completed a "Findings Report" that identifies key areas for Toronto to move forward on improving air quality (see Attachment A – "Improving Toronto's Air Quality: Areas for Priority Action"). This report has been presented to TIE, Toronto Atmospheric Fund (TAF) and the Roundtable on the Environment. The report was also sent to city councillors by the TIE Chair.

The report proposes a framework for coordinated, effective action on the part of the City of Toronto to achieve air quality improvements through City operations, outreach to the community and by connecting with other jurisdictions and other levels of government. In preparation for this coordinated action, the report identifies priority actions, some directed at completing components of the framework, others at air quality issues where action is most warranted. These priority actions are:

(1) identifying the ambient levels, local sources and health effects of key air pollutants and carcinogens and developing action plans to address these air quality problems;

(2) enhancing and coordinating current initiatives in the community and within City operations (including clean energy) to achieve even greater emissions reductions; and

(3) developing a common monitoring and evaluation mechanism to be used by all City departments when they develop and assess programs to improve air quality.

In support of the priorities identified in the report, work will begin immediately on an action plan to achieve improvements in Toronto's air quality in the short, medium and long term. Included among these actions will be enhancing the commitment of agencies, boards and commissions to purchase clean energy.

The final appendix in the attached report provides a list of air quality initiatives planned and underway in the City of Toronto. While current only to July 2004, it provides an indication of the amount of work already being done.

Toronto Public Health has been and will continue to be engaged in these activities within the Environmental Plan and particularly the Comprehensive Air Quality Strategy.

Conclusion:

The coordination, development and implementation of broad-based municipal action on improving air quality in the City of Toronto will proceed within the framework of Toronto's Comprehensive Air Quality Strategy. Toronto Public Health has been actively involved in the development of the strategy and will continue to provide leadership on healthy public policy, program development and program implementation.

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Attachment:

Attachment A: Improving Toronto's Air Quality: Areas for Priority Action, January 2005

Attachment A

Improving Toronto's Air Quality:
Areas for Priority Action

January 2005

TORONTO Atmospheric Fund

TORONTO

This project has been funded by the Toronto Atmospheric Fund.

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Executive Summary

The City of Toronto needs to improve air quality to address the economic, environmental and human health costs of air pollution, to achieve targeted reductions in greenhouse gas emissions and to achieve the vision of the City's Official Plan as well as its Environmental and Strategic Plans.

This report describes a conceptual framework for municipal action on air quality improvement. The framework includes:

- data, information and analysis to understand ambient air quality problems, their effects on human health and to propose ways to address these problems;
- interjurisdictional action to achieve air quality improvements including emissions reductions that are demonstrably valuable for Toronto where the City does not have the jurisdiction to act alone;
- programs to achieve emissions reductions in City operations;
- programs to achieve emissions reductions in the Toronto community as a whole and
- a means to monitor and evaluate the effectiveness of programs and initiatives to improve air quality.

Toronto currently has a significant number of initiatives that fit within the framework but that also fall short because they:

- are not supported by adequate data, information and analysis about ambient air quality conditions in Toronto or human health effects and exposures;
- need to be reassessed and refocused to make the most of opportunities at the provincial and federal level for action on energy policies (including conservation and alternative energy), municipal finance, transit funding, waterfront development, fuel regulation and matters of shared involvement, especially transboundary air pollution
- are not uniformly monitored and evaluated (many are neither monitored nor evaluated);
- track only CO_2 emission reductions and not the other contaminants of concern including other greenhouse gases;
- are not currently sufficient in their extent or reach to achieve the City's target set to achieve a city-wide 20% reduction in CO_2 emissions from 1990 levels by 2005.

The City of Toronto's array of initiatives are consistent with the overall framework for air quality improvement. In other words, the City does not need to start from scratch or drastically change its course. However, Toronto's efforts require additional focus and commitment to achieve city-wide improvements in air quality.

Next Steps

It is beyond the scope of this report to make "who does what" recommendations regarding an action plan. However, here are several areas for priority action.

Data, Information and Analysis

Better data, information and analysis is required to understand Toronto's ambient air quality and the attendant health effects on Toronto residents. Better data would include the occasional collection of ambient air quality levels and local health data where provincial and federal data do not represent local conditions in Toronto. Better information would include the estimation of present and future air quality conditions and health consequences that are not, or cannot, be otherwise cost-effectively measured. Better analysis would include in-depth assessment of all data, information, future scenarios, policies and improvement measures. Data, information and analysis is required to provide the scientific basis for City actions. Gaining knowledge of local air quality and local health impacts is not a job undertaken by, nor is it the responsibility of, other levels of government.

Priority should be given to improving our knowledge of particulate pollution (PM_{10} and $PM_{2.5}$), oxides of nitrogen (NO_x) and carcinogens – their ambient levels, the local sources and health effects and the best mechanisms for their abatement.

Interjurisdictional Action

Other jurisdictions are important to Toronto's air quality. The provincial and federal governments are important because they have jurisdiction over major sources of pollution within the city and in the regions beyond. The provincial government is also important because it is responsible for the air quality alert system, energy policy and energy efficiency provisions in new development. The federal government is important because it regulates fuels and car emissions. Both levels of government provide resources to public transit.

An area for priority action would be the development of a plan, in keeping with the direction of this document, to engage other levels of government to address Toronto's air quality problems.

City Operations

The City is already a leader in air quality improvement through initiatives such as the low-sulphur fuel purchase program and others. City operations have reduced CO_2 "equivalent" ("equivalent" CO_2 are combined emissions reductions of carbon dioxide and methane) emissions between 1990 and 1998 by approximately 4 to 5%. City operational goals should be established to achieve a range of specific air contaminant emission reductions over a given period of time, similar to the City's 20% CO_2 reduction goal from 1990 to 2005.

Community Action

The City of Toronto has well-developed programs that achieve emission reductions in the community as a whole. However, these initiatives – many of which are not evaluated or monitored for their impact on air quality – appear to fall short of achieving the City's emission reduction goals. Goals for community emissions reductions should be established to achieve a range of emission reductions over a given period of time to reach the City's 20% CO_2 reduction goal from 1990 to 2005.

Program Monitoring and Evaluation

Without a comprehensive means to measure its progress, Toronto cannot really be said to have a defined strategy to improve air quality. The City needs to improve the methods by which it monitors, measures and reports on its progress in air quality improvement and greenhouse gas emissions reductions.

A priority action toward improving air quality is to develop a common monitoring and evaluation mechanism to be used by all City departments when they develop and assess programs to improve air quality.

About This Report

This report has been prepared by an interdepartmental working group, with funding assistance from the Toronto Atmospheric Fund, towards fulfilling the City of Toronto Environmental Plan recommendation #21, that Toronto develop a comprehensive air quality improvement strategy. Representatives from the Chief Administrator's Office, Toronto Public Health, Urban Development Services and Works and Emergency Services plus other City staff worked together, commencing in December 2002, to review the challenges confronting the City of Toronto and to identify a path forward for ongoing efforts to improve air quality.

The report that follows this executive summary provides a discussion of the air quality challenges in Toronto and the barriers to addressing those challenges. It describes a proposed framework for action to improve air quality in Toronto and describes how current initiatives fall within the framework. The discussion concludes with proposed areas for priority action.

The analysis in the report is supported by information in several appendixes to the report:

Appendix A – Air Quality Information
Appendix B – Air Quality Standards
Appendix C – External Influences on Toronto's Air
Appendix D – Other Levels of Government
Appendix E – General Air Pollutants
Appendix F – Air Quality Initiatives in the City of Toronto

1.0 – Overview of Needs, Challenges and Barriers

1.1 Why Does the City of Toronto Need to Improve its Air Quality?

The City needs to improve air quality to reduce the health risks, environmental damage and economic costs linked to air pollution

Poor air quality is bad for human health, the environment and the economy. Every day residents of Toronto breathe in complex mixtures of air-borne toxics, other contaminants and particulate pollution – many of which are associated with a wide range of adverse health effects. Poor air quality is bad for Toronto's economy because of productive days lost to air-pollution-related illness and lost tourist revenue. Air pollution is also bad for Toronto's river valleys, urban forest, gardens and green spaces, as well as Toronto's natural water bodies.

The City needs to improve air quality to meet its greenhouse gas reduction targets

The City has commitments to reduce its greenhouse gas emissions. The City of Toronto set a target of 20% reduction in City and community CO_2 emissions by 2005 from 1990 levels. The City in its own operations has surpassed its 20% reduction goal. However, emissions reductions in the community of about 4% are still short of the goal. Furthermore, some experts suggest that the western world should be aiming for CO_2 emissions reductions as high as 80%. The 6% Kyoto and 20% reduction goals for CO_2 should be considered as stepping stones towards even greater reductions of CO_2 emissions.

The City needs to improve air quality to achieve the vision of the City's Official Plan and its Environmental and Strategic Plans

The City of Toronto Official Plan, Environmental Plan and Strategic Plan all envision a city with clean and healthy air. The Official Plan envisions and seeks to achieve through its policies a city with clean air, land and water. The Environmental Plan sees a future where: "Air quality in Toronto is good: air quality advisories are a thing of the past and the air no longer makes people sick." The Strategic Plan makes the vision statement: "Toronto is a clean, green and sustainable city."

1.2 What are Toronto's Key Air Quality Challenges?

The working group has identified three primary air quality challenges for Toronto

Challenge #1 – Most of Toronto's Air Quality Problems Can Be Traced to Fossil Fuel Combustion

The key air pollution problems for Toronto are the burning of gasoline and diesel in on- and off-road vehicles, coal in power plants and natural gas in furnaces and emissions of particulates from vehicles including asphaltic concrete dust, tire rubber and dust from brake pad and disk wear. The burning of fossil fuels releases into Toronto's air significant amounts of almost all of the contaminants of concern described in this report: greenhouse gases, general air contaminants and carcinogens.

Challenge #2 – Important Sources of Air Pollution Are Both Inside and Outside Toronto

Within Toronto, there are point sources (smokestacks) that significantly contribute to poor air quality in Toronto. Toronto's air is also affected by sources elsewhere in the region, in the province and outside of the country.

Challenge #3 – Air Quality Alerts do not Adequately Inform the Public About the Health Risks of Poor Air Quality

The provincial system for announcing smog alerts has led to most people equating "smog" with "air pollution," but air quality problems are not just about smog. Air pollution is a year-round problem and air quality in Toronto can be a threat to human health and the environment even when the province has not called a smog alert.

1.3 What are the Barriers to Addressing the Challenges?

This section describes the barriers Toronto faces in its efforts to improve air quality in the city. The barriers are assessed with reference to the key challenges described in Part 1.2 of this report.

Barrier #1 -- Knowledge

Inadequate data, limited information and analysis are barriers both to effective action and to assessing progress in efforts to improve air quality. Better local information will increase the City's ability to deal with local air quality problems.

Improving local air quality requires local knowledge. The City needs to understand local conditions: sources of pollution, dispersion and concentrations of air contaminants and an understanding of human exposures to these contaminants and the potential health impacts arising from these exposures.[1] Gaining knowledge of local air quality and local health impacts is not a job undertaken by, nor is it the responsibility of, other levels of government.

> *Challenge #1: Air Quality Challenges Traced to Fossil Fuel Combustion*
> *Challenge #2: Important Sources of Air Pollution Are Both Inside and Outside the City*

A key air pollution problem for Toronto is the burning of fossil fuels in on- and off-road vehicles (gasoline and diesel) and in power plants (coal) and furnaces (natural gas). Sources inside and outside of the City contribute to the City's air quality. Better information will provide stronger guidance on the question of what emission reductions are the most important to pursue.

Tracking present contaminant dispersions and predicting future scenarios from outside of the City requires considerable co-operation with other government bodies and sharing of basic data regarding those sources beyond the City's boundaries.

The City needs to better understand what are its own emissions and those of the community and how much they can and do change as a result of City and community policies and air quality improvement measures. These also need to be assessed in light of both the overall contaminant emissions and ambient air quality and greenhouse gas emission reduction targets.

> *Challenge #3: Air Quality Alerts Do Not Inform the Public Adequately About the Health Risks of Poor Air Quality*

The Air Quality Index that provides information about air quality to Toronto residents is a program of the Ontario government. It relies on data collected in municipalities from across Ontario. The purpose of the data collected is not to identify or address local issues. It is also a "first past the post" index and does not reflect cumulative impacts.

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[1] See L.D. Pengelly and J. Sommerfreund, Air Pollution-Related Burden of Illness in Toronto: 2004 Update, (Toronto: Toronto Public Health, 2004).

Barrier #2 -- Jurisdiction

The City of Toronto has limited jurisdiction and limited powers to increase its revenue to act alone in response to the air pollution challenges described above. Other levels of government, other municipal governments and governments of other countries all have a role in improving air quality in Toronto.

> *Challenge #1:Jurisdictional Barriers to Addressing Air Quality Challenges Traced to Fossil Fuel Combustion*

The City promotes reductions in vehicle use through policies in its Official Plan and controls vehicle emissions through its anti-idling by-law. In terms of its own operations, the City of Toronto Green Fleet Transition Plan (2004) has been developed by Fleet Services to reduce the negative environmental impacts of all its operations and not just emissions from vehicles and equipment. Over the four years of the plan, eCO_2 emissions have been forecast to be reduced by as much as 23% (measured in the context of the city as a whole, this amounts to 0.003% of all eCO_2 emissions). The City also provides public transit as an alternative to private vehicle use.

However, from a city-wide perspective, the priority area for emissions reduction is in emissions and fuel standards for the hundreds of thousands of vehicles driven in the city every day. Fuel and emissions standards are under the jurisdiction of the federal government. The City may work to reduce its energy consumption, but energy regulation and the operation of the province's major power facilities, including the coal-powered plants, are under provincial jurisdiction. In 2004, major changes are pending from federal regulation of fuels and automobile emissions and from significant shifts in provincial energy policy.

> *Challenge #2: Jurisdictional Barriers to Addressing Air Pollution Sources Inside and Outside Toronto*

Toronto residents breathe pollution originating from point sources (smokestacks) inside the city boundaries as well as sources outside the city and outside the country.

Toronto is a member of the Greater Toronto Area Clean Air Council, recognising that co-operation with other municipalities in the region is a crucial component of action to improve air quality.

However, the City's (limited) capacity to regulate stops at the municipal boundary. The regulation of industrial sources of air pollution inside and outside the city is a matter of provincial and federal jurisdiction.

Challenge #3: Jurisdictional Barriers Relating to the fact that Air Quality Alerts Do Not Inform the Public Adequately About the Health Risks of Poor Air Quality

The City of Toronto responds when air quality conditions are poor. On June 5, 1998, Toronto City Council adopted a Corporate Smog Alert Response Plan. When the provincial ministry of the environment forecasts a smog event, City staff modify some municipal activities to reduce emissions that contribute to poor air quality.

A significant challenge is that air quality can affect health even on days where there is not a smog warning. The air quality index currently does not provide adequate signals to the public about the potential health risks of air pollution. The air quality index, however, is a program of the Ontario government. Furthermore, the City does not have the power or ability to require resolution of the air quality complaints and concerns within its own boundaries received from its own citizens.

The concerns that relate to jurisdictional areas of other governments are often concerns that significantly impact air quality in Toronto. The City's limited ability to address inter-jurisdictional and transboundary issues is a barrier to properly addressing the challenges.

Barrier #3 -- Resources

The term "resources" incorporates, among other things, funds, expertise, technology, information and people. The City of Toronto presently (2004) has limited resources to devote to new initiatives to improve air quality. Furthermore, the provincial government has set limits on how the City may raise revenue. Both the provincial and federal governments provide less support to Canadian cities than is commonly the case in many other countries. These financial constraints are a barrier to developing new programming. Notwithstanding these restrictions, the City is making significant efforts within its own operations to increase building energy efficiency and fleet fuel efficiency and is assessing how, through its street cleaning operations, it can reduce particulate concentrations in the air.

Challenge #1: Resource Issues Relating to Air Quality Challenges Traced to Fossil Fuel Combustion

The best information currently available helps us understand that fossil fuel combustion is a leading air quality concern in Toronto.

But, monitored air quality data represents only a limited geography (height and location of monitors are not street related) and does not accurately portray the distribution and concentrations of pollutants everywhere in the city. Nor does it contribute to an understanding of human exposures or of the impact of programs aimed at reducing emissions and exposures.

Inadequate data, limited information and inadequately informed analysis are barriers both to effective action and to assessing progress in an air quality improvement strategy. Better information would increase the City's ability to deal with air quality problems.

> *Challenge #2: Resource Issues Relating to Air Pollution Sources Both Inside and Outside Toronto*;
> *Challenge #3: Resource Issues Relating to Air Quality Alerts Do Not Adequately Inform the Public About the Health Risks of Poor Air Quality*

A review of City air quality initiatives shows that most of the emphasis -- at the level of City operations and programming within the community -- is on energy efficiency and vehicle-based pollution prevention efforts such as the low sulphur fuel purchase program. No City resources are devoted to monitoring or abating major point sources within the City. There is very little work on transboundary air issues. Because these issues are under the jurisdiction of other levels of government, the City has tended to focus fewer resources on them than it has on energy efficiency and alternative energy projects. However, in light of recent changes at the provincial and federal levels of government, there may be new opportunities to seek provincial and federal help in solving air pollution problems. Now may be the time to increase the City's focus on interjurisdictional action.

2.0 – Dealing with the Challenges and Overcoming the Barriers

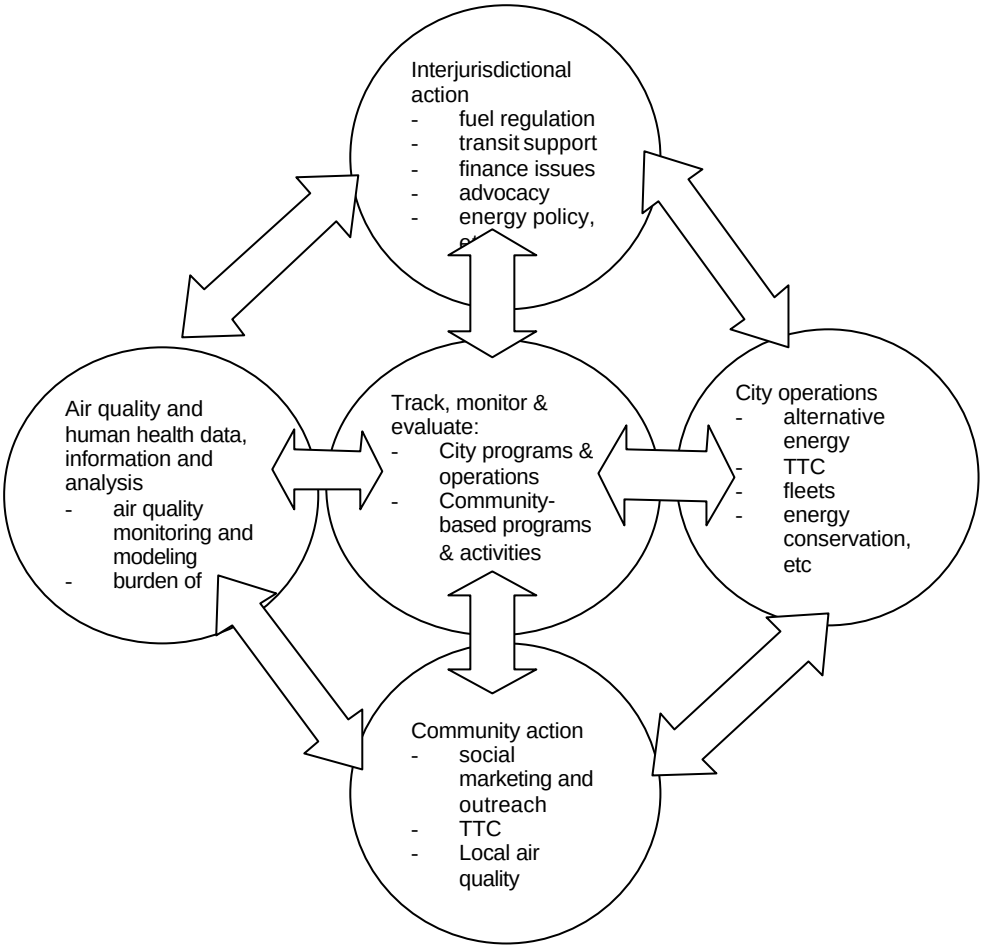
Addressing the challenges and barriers to improve air quality in Toronto will require comprehensive action. Acknowledging the barriers described above, the action plan would need to seek opportunities to share resources and focus activities to fit within the City's jurisdiction and within the City's means. It would need to actively seek opportunities to work with other levels of government and other municipalities.

2.1 Conceptual Framework for Action

The diagram following this section illustrates a conceptual framework for municipal action to improve air quality. The structure includes:

- Data, Information and Analysis -- Actions taken to improve air quality must be built on a foundation of data, information and analysis.
- Interjurisdictional Action -- Toronto's air quality strategy must include work with other municipal governments and other levels of government.
- City Operations -- The City has a unique leadership role to play in reducing its own emissions.
- Community Action -- The City needs to support emissions reductions throughout the city as a whole.
- Program Monitoring and Evaluation -- Toronto's actions to achieve reductions in the contaminants of concern identified in this report must be measured.

A Conceptual Framework for Municipal Action on Air Quality Improvement



This diagram illustrates several crucial aspects of the conceptual framework:

- all the parts are equally important
- all the parts are interdependent and share information
- monitoring and evaluation is not seen as a sub-component of individual programs, but a significant element of the strategy as a whole
- all parts are necessary to the coherence and integrity of the whole.

2.2 Current Activities to Improve Air Quality in Toronto

The discussion below assesses Toronto's current efforts that either directly or indirectly improve air quality against the conceptual framework proposed here.

The discussion below supports the observation that the City of Toronto's array of programs, initiatives and policies are consistent with overall air quality improvement. In other words, the City does not need to start from scratch or drastically change its course. However, Toronto's efforts require additional focus and commitment to achieve city-wide improvements in air quality.

Data, Information and Analysis

The City of Toronto needs to improve its understanding of how air pollution affects the health of Toronto residents and how current programs are addressing the problem.

The City collects data and estimates of its emissions from its own operations including sewage treatment and water purification, landfill gas releases and building and vehicle fuel use. The City has maintained a database of fuels used and energy consumed to estimate emissions since 1990. The data has been collected annually since 2000. The database is used to estimate overall eCO_2 and criteria air contaminant emissions.

The City has obtained data from Toronto Hydro, Enbridge Consumers Gas and the City's traffic flow data (in the absence of gas supplier data) to similarly estimate eCO_2 and criteria air contaminant emissions for the community. The data is being collected annually since 2000. The database can also be used to help identify major consumer end-users for improvement opportunities.

Understanding the relative contribution of the various sources and their actual impacts in Toronto is only achievable with modelling air quality dispersion of source inputs, modelling resultant geography of (receptor) concentration and assessing specific health related impacts and risks by location. While it can truly be said that all pollutant reduction is desirable, simply addressing the sources rather than the resulting impacts, and on the basis of "biggest emitters" will not result in measurable improvements in air quality. What must also be addressed is Toronto's increasing population and increasing building and transportation related emissions.

All emissions are not equal. A tonne of a contaminant emitted at the top of a smokestack does not have the same impact on human health as a tonne emitted at ground or nose level. For example, less than ten town-homes heated with gas furnaces that emit NO_X will have as much impact on nose-level air quality as a 60 metre high smokestack emitting a kilo-tonne of the same pollutant over the same period of time. Therefore, seeking reductions from the big emitters alone may not always be the best way to proceed.

Interjurisdictional Action

The City needs to find a new focus on interjurisdictional action. Activity at the intergovernmental level appears, right now and for the foreseeable future, to offer more opportunities than has been the case in the recent past. Provincial changes in energy policy and recent federal attention on a "New Deal for Cities" indicate that the time for Toronto to act on these issues with other levels of government is now.

City Operations

The City of Toronto is and has been for many years a true leader in the field of air quality improvement programming. It has achieved between 4-5% reductions in its operational emissions of CO_2 (equivalent) since 1990. However, as well as continuing to reduce greenhouse gas emissions, focus should be placed on defined reductions of other air contaminant emissions from City operations.

Community Action

Toronto has also shown leadership in the development of community-level programs such as 20/20 – The Way to Clean Air that help residents achieve emissions reductions. However, the programs have been limited in their scope and are also currently insufficient to get Toronto to its adopted 20% reduction target. There are no programs currently addressing local air quality issues where human health may be affected by local emissions.

Program Monitoring & Evaluation

The City accounts for the greenhouse gas emissions reductions achieved through some of its programs but not reductions in other contaminants of concern. As well, while City eCO_2[2] reduction programs are for the most part monitored and assessed for their effectiveness, many other air quality improvement initiatives (city operations and community initiatives) have no evaluation mechanism at all. As well, the health of Toronto's population is still at risk from the other contaminants described in this report: NO_X, SO_X, VOCs, CO, O_3, particulates and carcinogens. Therefore, more needs to be done to address these pollutants.

Better information will increase the City's ability to develop and evaluate air quality programs -- including evaluating programs according to their costs and benefits -- that achieve real improvements to air quality.

[2] The short form "eCO_2" means "CO_2 equivalent" and signifies all the City's reductions in emissions of carbon dioxide and methane.

2.3 Areas for Priority Action

It is beyond the scope of this report to make detailed "who does what" recommendations regarding an action plan. However, the working group has identified areas for priority action. The working group proposes that these could be used as the basis for the development of action plans by the relevant City agencies, boards, commissions and departments.

Data, Information and Analysis

Priority should be given to improving our knowledge of particulate pollution (PM_{10} and $PM_{2.5}$), oxides of nitrogen (NO_x) and carcinogens – their ambient levels, the local sources and health effects and the best mechanisms for their improvement.

Interjurisdictional Action

Other jurisdictions are important to Toronto's air quality. Right now (2004) the City needs to ensure it makes the most of opportunities at the provincial and federal level for action on energy policies, municipal finance, transit funding, waterfront development, fuel regulation and other matters of shared involvement and responsibility, especially transboundary air pollution.

City Operations

The City is already a leader in air quality improvement through initiatives such as the low-sulphur fuel purchase program and others. However, the City's efforts are not achieving sufficient reductions.

It is an area for priority action that all City offices, agencies, departments or commissions responsible for developing or implementing air quality improvement initiatives pertaining to City operations identify means by which to increase their impact and achieve the City's CO_2 emission reduction targets and air quality improvement objectives.

Community Action

The City of Toronto has well-developed programs that achieve emission reductions in the community as a whole. However, as with similar programs pertaining to City operations, these initiatives are falling short of achieving the City's emission reduction goals.

It is an area for priority action that all City offices, agencies, departments or commissions responsible for developing or implementing air quality improvement initiatives involving the Toronto community identify means by which to increase their impact and achieve the City's CO_2 emission reduction targets and air quality improvement objectives.

Program Monitoring and Evaluation

Without a comprehensive means to measure its progress, Toronto cannot really be said to have a defined strategy to improve air quality. The City needs to improve the methods by which it monitors, measures and reports on its progress in air quality improvement.

A priority action toward the creation of an air quality improvement strategy is to develop a common monitoring and evaluation mechanism to be used by all City departments whenever they develop and assess programs to improve air quality, either at the level of City operations or in the community. The mechanism would measure emissions reductions and provide information to enable cost/benefit analysis of air quality improvement initiatives.

3.0 – Conclusion

This report has been prepared by an interdepartmental working group, with funding assistance from the Toronto Atmospheric Fund, toward the fulfilment of Environmental Plan Recommendation #21 that Toronto develop a comprehensive air quality strategy.

Toronto needs to improve air quality to address the health, economic and environmental costs of air pollution. Toronto also needs to achieve targeted reductions in greenhouse gas emissions, to provide a framework for working with the provincial and federal governments to build the City's capacity to act on air quality improvement. Finally, Toronto needs to take action to improve air quality to achieve the vision of the City's Official, Environmental and Strategic Plans.

Toronto already has a significant number of initiatives consistent with air quality improvement. However, these initiatives and programs need to be better supported by air quality and human health effects and exposure information. Right now (2004) the City needs to ensure it makes the most of opportunities at the provincial and federal level for action on energy policies, municipal finance, transit funding, waterfront development, fuel regulation and other matters of shared involvement and responsibility, especially transboundary air pollution. The City's air quality initiatives need to be enhanced and amplified in order to meet the City's emission reduction commitments and to protect the health of its citizens and the environment. They also need a common monitoring and evaluation mechanism to account for reductions in emissions of contaminants of concern as well as greenhouse gases.

Toronto has long been a leader in developing and implementing initiatives to improve air quality. This report reflects the understanding of the Working Group that the City does not need to change its course so much as it needs to keep up the good work supported with better information, data and analysis. As well, the City needs to monitor and evaluate the work that it is doing and leverage what opportunities it has to do more with other levels of government.

APPENDIX A – Air Quality Information

Air Quality Data, Information and Analysis

A plan of action to improve air quality in Toronto should be built on a strong foundation of good data about the air quality in the city. The data should be reliable, consistent and accurate. Reliability is concerned with how the data is gathered, in other words, what is its source. Consistency involves whether data is regularly updated and readily available. Accuracy is concerned with the applicability of the data to the city. The most readily available data about Toronto's air comes from the provincial and federal governments. The limitations of this data are discussed below.

Federal Emissions Data

A readily available source of data about Toronto's air is Environment Canada's National Pollutant Release Inventory (NPRI) – referred to subsequently as "the Inventory". This Inventory provides geographically aggregated data about reported air emissions from selected facilities, such as power plants and large factories, across Canada. The NPRI regulations require companies to report information about their pollutant releases every year, so data about industrial releases within Toronto can be considered reliable for use within the limitations of the manner in which it is collected, aggregated and reported.

Environment Canada, in conjunction with their Provincial counterparts, also provides *estimates* of emissions from "non-reporting" sources such as residential homes and vehicles.[3] The fact that facilities are required to report each year makes NPRI a reliable and consistent source of information of aggregated industrial air emissions certainly for larger operations. However, the estimates reported by Environment Canada are designed to reflect emissions at the *national* level, which affects the applicability of the estimates to a geographical area the size of Toronto.[4] In addition, smaller operations, such as auto body shops and dry cleaners, are not reflected in the data but yet may have a significant local impact.

While the NPRI data on individual facilities can be considered reliable, the *estimates* of emissions from "non-reporting" sources can be questioned as to both their reliability and accuracy for the Toronto situation. For example, the Inventory indicates that Construction

[3] Unless otherwise noted, in this report emission estimates come from the Criteria Air Contaminant (CAC) "emissions inventory" provided by Environment Canada on the NPRI website. Emissions estimates are those from the 1995 Criteria Air Contaminants Inventory, updated in 2001, for Toronto, postal code "M". Environment Canada's NPRI website (www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm), visited July 2003. The estimates provided on the NPRI web site are a re-categorization and simplification of estimates originally created for use by Federal and Provincial air quality modelers and is referred to subsequently and for simplicity in this report, as AQIB data – as AQIB posses that data, rather than being the creators of it.).

[4] Environment Canada advises on its web site that emissions estimates are less accurate for areas such as a single municipality.

accounts for 50% of the PM_{10} in Toronto's air. This estimate of construction emissions is based in large part on the number of construction workers in the City.

Other limitations of the data include the fact that the numbers do not reflect the height or temperature at which pollutants are released and so do not improve our understanding of where the impact of the emissions may be felt.[5] Essentially, the Inventory results as reported lack the accuracy for determining the impact on the City. However, through analysis of the more specific data sets, greater relevance of the Inventory results specifically for the City can be achieved.

Provincial Air Quality Monitoring Data

The Ontario Ministry of the Environment (MOE) publishes data and information about regional air quality gathered from monitoring stations positioned in several locations about Toronto and elsewhere in the province.[6] The provincial monitoring network is designed to tell the air quality story for the province as a whole, which can limit the applicability of the data to Toronto.[7] Data from the provincial monitoring network can accurately reflect the concentrations in Toronto of ground level ozone (O_3), for example, because ozone concentrations tend to be similar both locally and at the regional level. Alternatively, NO_X is more likely to display varying local concentrations as a function of its chemistry and because of its varied sources, such as power generation stacks versus road vehicle tail pipe emissions.

Given the location of the MOE's four AQI monitoring stations in Toronto, the data from them are unable to accurately reflect the potential disparities in air quality conditions throughout the urban environment. The City's complex landscape, with everything from highways, to high-rise canyons to river valleys, can permit pooling of contaminants. Winds blow pollution around and rain brings air pollutants back to earth. Without the wind, pollutants can "pool" near sources and make localised poor air quality events. "Heavy" particulate, such as $PM_{10,}$ can exist in high concentrations along busy roadways but may settle back to earth before they reach the height where they would be detected by a standard monitoring station. Such standard monitoring station data do not reflect these fine details about local air quality conditions in Toronto.

Selected monitoring data can be purchased separately from the MOE (as is done by AQIB), to permit further analysis at the City scale. Point source (smokestack) data from other municipalities is needed in combination with traffic and area emission sources and Ministry of the Environment monitoring data to fully understand the transboundary influence on Toronto's local air quality issues. This data is not currently available to the City.

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[5] For example, vehicle tailpipe emissions at ground level may have a greater impact on air breathed by pedestrians, while a tall smokestack may have a greater impact in the region downwind.

[6] The MOE currently operates four air quality monitoring stations in Toronto, located in the north, east, south and west parts of the city. This report references the most recently available MOE monitoring data from 2000, which are based on three to six Toronto monitoring stations, depending on the pollutant Ontario Ministry of Environment, 2003. *Air Quality in Ontario 2000 Report*

[7] Another weakness in the provincial data is that there is a two-year lag time between when the data is collected and when it is reported. For example, the MOE released in November 2003 its Air Quality report for 2001.

Modeling

The limitations in the available air quality monitoring data and emissions source data can be partially addressed through air quality "modeling," a computer-based technology using pollutant emission estimates, to calculate their physical dispersion and chemical transformation from all sources throughout Toronto. Modeling is an important tool for gaining understanding of air quality in the City. Computer modeling makes it possible to include the missing "local dimension" in provincial and federal data by adding, among other things, data about local weather patterns and the natural and built components of the urban landscape. Modeling is best understood as a predictive tool that turns data into information, to show where there may be localized air quality problems. Modeling may also predict how effective proposed improvement measures may be. Model predictions should always be verified with monitoring information.

The Air Quality Improvement Branch (AQIB), an office within the Works and Emergency Services Department, models the geography of pollution concentration exposure across the City. AQIB uses provincial and federal inventory and monitoring and meteorological data in conjunction with the City's own "municipal data" to model what happens to the pollutants reported and estimated to be emitted from all sources in the City.[8] The results of this work are referenced in the relevant sections of the report. More importantly, this technique demonstrates how, at relatively low cost, the geography of air pollutant concentrations in Toronto might be estimated to bring information to a local understanding of pollution issues.

For example, AQIB's modeling has already shown that PM_{10} is the contaminant that most often and most widely exceeds the AAQC criteria in Toronto. AQIB's monitoring shows that while the modeling results appear "high" and most probably due to the overestimate of the contribution from construction, it also appears to show that MOE standard station monitoring is "low" and consistently underestimates street level PM_{10} exposure concentrations. The same monitoring also reveals a much higher portion of PM_{10} is comprised of $PM_{2.5}$ than reported elsewhere.

Local Air Quality and Human Exposure Issues

Air quality and health-related information are crucial components of an air quality improvement strategy. It should be a fundamental component of the strategy that Toronto-specific human health exposure and air quality data be gathered and analysed on an on-going basis.

The City is currently engaged in research that partially achieves this objective. For example, the reported emissions of individual industries and their associated emission parameters are also available under confidentiality agreements with the Ontario Ministry of Environment and Environment Canada. Through this process, the City has acquired access to Toronto specific data from Environment Canada's 1995 Criteria Air Contaminant (CAC) database and will have data

[8] Land use-based emission estimates for Toronto are from the City of Toronto Air Quality Improvement Branch (AQIB), produced from data provided by the OMOE and Environment Canada.

from the recent 2000 CAC data release. This data can be relied on to better understand through further analysis using a modeling program how air emission impacts might vary within the City.

Similarly, by examining the provincial monitoring station data a better understanding of local air quality issues can be gained. It is possible to receive data from the four stations located in the City by way of agreement. This data is entered into a computer modeling program for further analysis. However, it is also necessary to have some information available from the monitoring stations located in the immediately adjacent municipalities. An initiative with the Clean Air Partnership and the City is currently underway to secure the involvement of surrounding municipalities.

Modeling data may also predict the impact on Toronto's air quality of new federal fuel and vehicle emissions regulations (see discussion on other jurisdictions, below), impacts of provincial energy policies (see below) and the impacts of local initiatives to reduce emissions and improve air quality.

With reference to health effects and exposure information, the City requires more information about personal exposure in those places and at those times where modeling data suggests there is an elevated health risk. One exposure monitoring study is currently under development by Toronto Public Health.

With this type of analysis it is possible to consider creating local improvement strategies. These local air quality improvement strategies could take the form of remedial action plans, designed to establish smaller, localised initiatives that would also benefit the City as a whole.

APPENDIX B – Air Quality Standards

Air quality improvement activities within Toronto must account for the provincial air quality Air Quality Index (AQI) (based on provincial air quality standards) that under-communicates the risk posed to public health by poor air quality. The provincial system, while providing alerts to the public during times of very poor air quality, presents some key challenges when considering improving air quality in Toronto.

This report refers to the Provincial Ambient Air Quality Criterion (AAQC) for many of the pollutants described. The purpose of the AAQC is to set a standard for acceptable air quality. To state it simply, if concentrations of a pollutant are lower than the level set by the AAQC for a given period of time (for example, one hour), then the corresponding value in the Air Quality Index (AQI) is "very good" or "good." If levels of one of the six pollutants monitored by the province moves past the AAQC, then the air quality index will show that air quality is "poor."[9]

Toronto's Medical Officer of Health has released research that shows health effects associated with poor air quality occur in the Toronto population even when provincial standards indicate that air quality is "good."[10] One of the reasons for this discrepancy is that some of the standards do not reflect current medical knowledge. The AAQS for ozone (O_3) and fine particulate ($PM_{2.5}$) have recently been updated (and now are the leading triggers for air quality warnings), but the standards for NO_2, SO_2 and CO are quite out of date.

Another reason the human health impacts are higher than ambient air quality information would suggest is that the provincial monitoring stations readings do not represent what Toronto residents are actually breathing. The air quality in the vicinity of provincial monitoring stations is not necessarily the same as in Toronto's neighbourhoods and high rise canyons. It is reasonable to believe that on a day where the provincial monitoring stations are showing low levels of $PM_{2.5}$, for example, people in certain parts of the city are breathing much higher levels, to the possible detriment of their health.

[9] For a more detailed description of what the air quality index is and how it works, see Toronto Public Health, 2001. Condition Critical: Fixing Our Smog Warning System (Toronto, Ontario) at pp 3-7.

[10] See Toronto Public Health, 2000. Air Pollution Burden of Illness in Toronto, (Toronto, Ontario) and Toronto Public Health, 2001. Condition Critical: Fixing Our Smog Warning System (Toronto, Ontario).

APPENDIX C – External Influences on Toronto's Air Quality

However well air quality initiatives address local air quality conditions, they must also recognise the fact that significant quantities of pollution – especially ozone and $PM_{2.5}$ – come to Toronto from sources far outside the city and outside of the country. Transboundary air pollution is a major challenge for Toronto.

Toronto's air quality is strongly influenced by wind-borne pollution from sources in the Greater Toronto Area (GTA), the province and nearby U.S. states (see illustration on the following page). Sources outside of Toronto have significant influence on the city's air quality.

NO_X and SO_X emissions from electric power generation are not particularly high within Toronto, but are significantly greater when measurements include the whole GTA.[11] It may be a reasonable assumption that these emissions have an impact on Toronto's air quality. Industry is an important source of SO_X and CO from emissions within the City and emissions measured for the province as a whole. Again, it may follow that some of the SO_X and CO in Toronto's air arrives here from elsewhere in the province. At the provincial level unpaved roads become an important source of PM_{10} and $PM_{2.5}$; forest fires also contribute to emissions of $PM_{2.5}$.[12] As non-reactive pollutants and very fine particles ($PM_{2.5}$) are able to travel long distances on the wind these provincially significant emissions may also affect the air quality in Toronto.

Prevailing wind patterns bring air pollution to Toronto from the United States (see illustration on next page). The MOE often makes the statement that transboundary airflow from the U.S. is responsible for as much as 50% of ozone during smog events in certain locations in southern Ontario.[13] When airflows from the U.S. bring high concentrations of ozone -- whatever the percentage -- there is a significant impact on Toronto's air quality.[14]

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[11] Data are from the 1995 Criteria Air Contaminant (CAC) inventory for sources located within the Toronto Census Metropolitan Area (Pickering to Mississauga, inclusive). Environment Canada's NPRI website (www.ec.gc.ca/pdb/npri/npri_home_e.cfm), visited June 2003.

[12] Data are from the 1995 Criteria Air Contaminant (CAC) inventory for sources in Ontario. Environment Canada's NPRI website (www.ec.gc.ca/pdb/npri/npri_home_e.cfm), visited June 2003.

[13] Ontario Ministry of Environment, 2003. Air Quality in Ontario 2000 Report.

[14] To address the transboundary movement of smog-causing air pollutants, the Ozone Annex to the Canada – U.S. Air Quality Agreement was established in 2000 and the International Joint Commission (IJC) was formed between Canada and the United States to work cooperatively on preventative measures.

(from Ontario Ministry of the Environment, 2002. *Air Quality in Ontario 1999 Report)*

Smog Episodes, Transboundary Pollution and the AQI

Many times a year in Toronto emissions, weather and wind patterns combine to create especially high concentrations of ozone and other pollutants. When this happens, it is called a smog episode. In Toronto, concentrations of $PM_{2.5}$, PM_{10} and ozone show particularly dramatic increases on smog alert days and concentrations of SO_2 and NO_2 also rise substantially.[15]

These smog episodes are also the days when a provincial smog warning will go into effect and the AQI will move into the "poor" zone. It is a logical outcome from this process that these days and the term "smog" are equated in the public mind with air pollution.

It is necessary that Toronto's air quality improvement strategy recognise that smog is a special kind of air pollution event but also that it is certainly not the only kind of air pollution in the city that affects people's health. As described elsewhere in this report, air pollutants can give rise to health impacts in the population even when it is not a smog day. Finally, if transboundary pollution helps create the specific air quality event called a smog episode, then home-grown pollution from vehicles, point sources and open sources presents a year-round challenge for the air quality strategy to address.

[15] Toronto Public Health, 2003. Air Pollution and Physical Activity: Examination of Toronto Air Data to Guide Public Advice on Smog and Exercise. Toronto, Ontario.

APPENDIX D – Other Levels of Government

Another issue relevant to improving Toronto's air quality is what is happening at other levels of government. The leading source of most of the priority pollutants in Toronto's air is fossil fuel combustion for the purposes of transportation and production of energy. Fuels and vehicle emissions are under federal control although the City's purchasing policies and procedures can tender out for higher standards of goods and services as was done with the City's low-sulphur purchase. Energy policy is under provincial control. It may go without saying that Toronto needs to work with other levels of government to improve its own air.

The City of Toronto air quality improvement strategy needs to account for the capacities of other levels of government in two ways. First, the strategy needs to understand and assess the impacts of provincial and federal policies on Toronto air quality. The strategy needs to include an action plan to work with other levels of government on issues that will improve Toronto's air.

The Provincial Role and Selected Relevant Initiatives

Major provincial air quality initiatives include its new emissions reporting regime (under O.Reg.127) and its Strategic Attack on Air Pollution, which sets caps on NO_X and SO_X emissions. The province's major transportation initiative is Drive Clean, an emissions testing program designed to ensure drivers keep their vehicles serviced at the manufacturer's emission specifications.

In June 2004, the province announced a five-point "Clean Air Action Plan" that proposes to update modeling programs used to assess air quality impacts of point sources, to set new standards for 29 pollutants, to impose stricter NO_X and SO_2 emission limits on selected industrial sectors and to implement a "risk-based" approach to implementing new air standards.[16]

In October 2003, the provincial government promised to phase out all coal-powered electricity in the province by 2007. The province has created a Conservation Action Team tasked to develop energy conservation strategies to help achieve reductions in energy consumption necessary to make the coal phase-out possible.[17] Two other very recent reports have noted that "to avoid major supply risks, coal plants may need to be kept in operation…"[18] and that new nuclear facilities may be the key to Ontario energy self-sufficiency in the future.[19]

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[16] See http://www.ene.gov.on.ca/envregistry/022874ep.htm; http://www.ene.gov.on.ca/envregistry/019514ep.htm; and http://www.ene.gov.on.ca/envision/env_reg/er/documents/2004/air%20standards/PA04E0011.pdf.

[17] See http://www.energy.gov.on.ca/index.cfm?fuseaction=conservation.actionteam

[18] Electricity Conservation and Supply Task Force, 2004, Tough Choices: Addressing Ontario's Power Needs. Final Report to the Minister, January 2004. Toronto, Ontario, at iv.
At: http://www.energy.gov.on.ca/english/pdf/electricity/TaskForceReport.pdf

[19] OPG Review Committee, 2004, Transforming Ontario's Power Generation Company, Toronto, Ontario. At: http://www.opgreview.org/eng/Reports/TransformingOPG.asp

The Ontario government recently announced that it will be issuing a Request for Proposal (RFP) for up to 2,500 megawatts (MW) of new electrical generation capacity and/or demand-side management initiatives to be developed as early as 2005. This would represent one-third of the government's plan to replace coal-fired generation with cleaner sources of energy or demand-side measures. This RFP would also support the government's electricity conservation target of 5% by 2007, which represents approximately 1,350 MW at peak demand. The government has also announced that it will be issuing another RFP for up to 300 MW of renewable energy capacity to be in service as soon as possible. This will help the government meet its target that 5% (1,350 MW) of all generating capacity come from renewable energy by 2007. [20]

Given the important changes being considered, the City needs to work with the province to also explore ways in which the province can build municipal capacity to act on air quality improvement and seek opportunities to cooperate on energy demand reduction and energy conservation programs.

Toronto Public Health recently released a report setting out recommendations for priority action on the part of the provincial government. The following excerpt from the report's executive summary highlights the recommended areas for action:

> For the transportation sector, two goals were deemed most significant for air quality. The first is increasing ridership on public transit within the Greater Toronto Area. The second is 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. …
>
> 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 use of renewable energy. To meet short-falls in generating capacity that may be experienced over the next two decades the provincial government should facilitate the development of high efficiency natural gas generators and co-generation. …
>
> 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.

[20] See http://www.ontarioelectricityrfp.ca/

[The report also makes recommendations in support of:]

- 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."[21]

Federal Role and Selected Relevant Initiatives

Major initiatives at the federal level are included in the Government of Canada's 10-year Action Plan on Clean Air. The most important federal law pertaining to air quality is The Canadian Environmental Protection Act (CEPA) 1999. The goal of the Act is to prevent pollution by managing emissions of toxic substances. Under CEPA, both the Minister of the Environment and the Minister of Health are responsible for developing the 'List of Toxic Substances', where substances must be assessed to determine whether they are toxic or are capable of becoming toxic. The Government added PM_{10} to the 'List of Toxic Substances' under CEPA in May 2001.

Environment Canada is implementing new standards for exhaust emissions and the chemical content of vehicle fuels. All types of internal combustion engines – including cars, sport utility vehicles, light-duty trucks, small engines for off-road equipment (lawnmowers, snowblowers, chainsaws, etc.) and diesel engines – will be affected.

Environment Canada has mandated a reduction of sulphur in gasoline to 150 parts per million (ppm) starting in July 2002 and a further reduction to 30 ppm starting in January 2005. Environment Canada has announced plans to reduce sulphur in on-road diesel fuel by June 2006 that will result in a 95 per cent reduction in the regulated level of sulphur from 500 parts per million (ppm) to 15 ppm. Environment Canada has also proposed reducing the allowable level of sulphur in on-road diesel to 15 ppm by 2010. Sulphur in off-road diesel is currently not regulated.

The Government of Canada, all provinces (except Quebec) and the territories agreed on Canada-Wide Standards for PM and Ozone in June 2000. The Standards set ambient air quality concentration targets for ground-level ozone and PM for the year 2010. The Government of Canada is working with provinces and territories to develop comprehensive emission-reduction strategies for a number of major industrial sectors in Canada. Other Canada-Wide air quality standards include those for mercury, benzene, dioxins and furans.

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[21] See Perrotta, K., et. al. Toronto Public Health. *Agenda for Action on Air and Health*, Toronto, Ontario: July 2004. at http://www.city.toronto.on.ca/health/hphe/air_and_health.htm.

A regulatory action plan for the reduction of emissions of VOCs from consumer products and from the use of paints, solvents and other products in industrial and commercial processes is also being developed under the Canada-Wide Standards process. New degreaser regulations focusing on the two carcinogens trichloroethylene and tetrachloroethylene came into effect in July 2003.[22]

The federal government role includes international action on clean air, including the Ozone Annex to the Canada-U.S. Air Quality Agreement, which was signed and came into force in December 2000. The agreement commits the two countries to reducing NO_X emissions by as much as 44 per cent in central and eastern Canada and 43 per cent in parts of the U.S. by 2010. The Kyoto Protocol will commit industrialised countries that ratify the agreement to cut greenhouse gas emissions between 2008 and 2012 to an average of 5.2 per cent below 1990 levels. Canada's target is 6 per cent below 1990 levels.[23] Municipal government operations and urban areas are significant sources of GHG emissions. Cities have been doing some work in this area, but municipal capacity to make significant contributions to Canada's Kyoto commitments is constrained. The City needs to work with the federal government on a new deal for cities that enhances municipal capacity to respond to a range of urban issues including air quality and Kyoto implementation.

[22] Solvent Degreasing Regulations under the Canadian Environmental Protection Act 1999. See http://laws.justice.gc.ca/en/C-15.31/SOR-2003-283/70454.html

[23] See Environment Canada website: http://www.ec.gc.ca/climate/kyoto-e.html

APPENDIX E – General Air Pollutants

The "pollutants of concern" discussed here do not comprise all of the contaminants in Toronto's air. They have been selected because they give rise to the greatest need for action to achieve improved air quality in the City of Toronto.

The following provides descriptions of the pollutants in Toronto's air that are of most concern. The pollutants are described separately because that is how they are dealt with in the research literature, not because it is a recommendation of this report that strategies be created for individual contaminants. People breathe these pollutants in complex mixtures; many of the pollutants are emitted in combination as the by-products of combustion and industrial processes. It is as mixtures that these contaminants pose the greatest human health risk. The air quality improvement strategy should address these contaminants as mixtures from major sources and not on a chemical-by-chemical basis.

For each pollutant of concern, the text describes the health effects associated with the contaminants and describes common sources for the contaminant. Each section includes a discussion, based on monitoring data and emissions estimates, about each contaminant in Toronto's air.[24]

Pollutants of Concern Discussed in this Report

General Air Pollutants
Oxides of Nitrogen: NO_X
Oxides of Sulphur: SO_X
Particulates: PM_{10} and $PM_{2.5}$
Volatile Organic Compounds: VOCs
Carbon Monoxide: CO
Ozone: O_3

Greenhouse Gases
Carbon Dioxide: CO_2
Methane: CH_4

Carcinogens
Asbestos
Benzene
1, 3-Butadiene
Cadmium
Chromium
Dioxins and Furans
Formaldehyde
Polycyclic Aromatic Hydrocarbons
Tetrachloroethylene
Trichloroethylene

[24] See Appendix A.

NO_X – Oxides of Nitrogen

Oxides of nitrogen are gases produced as a result of high temperature combustion and therefore vehicles and engines are important

"NO_X" refers to the group of oxides of nitrogen, of which nitrogen dioxide (NO_2) is the compound of greatest health concern. NO_X is a key ingredient in smog formation, producing ground-level ozone when it reacts with VOCs in the presence of sunlight. NO_X can also impact health directly. NO_X can irritate the lungs and is associated with bronchitis, pneumonia, pulmonary edema and lower resistance to respiratory infections such as influenza.

The one-hour provincial Ambient Air Quality Criterion (AAQC) for NO_X (based on NO_2) is 200 parts per billion (ppb). Air quality monitoring data indicate that this criterion was not exceeded at the five Toronto NO_2 monitoring stations in 2000.[25] This means that average NO_2 levels in the vicinity of provincial monitoring stations stayed below the AAQC.

However, in certain locations and under certain conditions within the city of Toronto, people are breathing levels of NO_X potentially sufficiently high to impact their health. For example, general air quality modeling undertaken by the City in 2001 showed higher-than-average concentrations of NO_X in the vicinity of the interchange of highways 401 and 427, along highway 401 in the vicinity of highway 404, an area along highway 401 in Scarborough and in downtown Toronto.[26] This corroborates the understanding that vehicular traffic is a significant source of NO_X.

The top ten estimated sources of NO_X in Toronto can be characterised as activities involving the combustion of fossil fuel for the purposes of transportation and energy.[27] Industrial point sources are also important. The land uses in Toronto responsible for the greatest NO_X emissions are transportation, followed by industrial and residential land uses.

Major Sources of NO_X Outside of Toronto

Gaseous pollutants such as NO_X can move great distances on the wind. The major sources of NO_X in the GTA[28] and Ontario[29] are largely in the same source categories as for Toronto, except that electric power generation becomes a more important source in the GTA. The introduction of

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[25] Ontario Ministry of Environment, 2003. Air Quality in Ontario 2000 Report. *Appendix*. See: http://www.ene.gov.on.ca/envision/air/AirQuality/2000report.htm

[26] City of Toronto Works and Emergency Services and SENES Consultants, March 2003. Opportunities from Past to Present: Waterfront Scan and Environmental Improvement Strategy Study, at p. 7-12.

[27] See Appendix A.

[28] GTA emissions estimates are from the 1995 Criteria Air Contaminant Inventory, for the Toronto Census Metropolitan Area (CMA) (Pickering to Mississauga, inclusive). Environment Canada's NPRI website (http://www.ec.gc.ca/pdb/npri/npri_home_e.cfm) visited June 13, 2003.

[29] Ontario emissions estimates come from the 1995 Criteria Air Contaminant Inventory. Environment Canada's NPRI website (http://www.ec.gc.ca/pdb/npri/npri_home_e.cfm) visited June 25, 2003.

the Portlands Energy Centre natural gas co-generation facility may make electric power generation a more important Toronto source of NO_X in the near future. However, if, as originally proposed, the project is successfully linked to a district energy system, then it should lead to an overall reduction in "nose-level" NO_X exposures.

SO_X – Oxides of Sulphur

Oxides of sulphur (SO_X) are formed when fuel containing sulphur is burned and during industrial processes.

Oxides of sulphur form a group of air pollutants that includes sulphur dioxide (SO_2). Exposures to high concentrations of SO_2 can result in temporary breathing impairment for asthmatic children and adults who are active outdoors. Short-term exposures of asthmatic individuals to elevated SO_2 levels may result in reduced lung function with symptoms such as wheezing, chest tightness or shortness of breath. Healthy people can also be affected.

SO_X is also of concern because the chemicals can react in the atmosphere to form sulphates (SO_4), a component of particulate air pollution.

The one-hour Ontario AAQC for sulphur dioxide (SO_2) is 250 ppb.[30] No exceedences were reported for 2000 in Toronto.[31]

However, in certain locations under certain conditions, people are breathing levels of SO_2 potentially sufficiently high to impact their health. General air quality modeling undertaken by the City's Air Quality Improvement Branch in 2001 showed higher-than-average concentrations of SO_X in the vicinity of the interchange of highways 401 and 427, along highway 401 in the vicinity of highway 404, an area along highway 401 in Scarborough and in downtown Toronto.[32]

The top ten sources in Toronto as estimated by Environment Canada[33] suggest that the greatest Toronto source of SO_X in Toronto is industry, followed by fossil fuel combustion for transportation and energy production.[34] The Toronto land use releasing the greatest quantities of SO_X is industry followed by transportation.

[30] An AAQC and provincial monitoring data do not exist for total oxides of sulphur (SO_X).
[31] Ontario Ministry of Environment, 2003. Air Quality in Ontario 2000 Report. *Appendix*. See: http://www.ene.gov.on.ca/envision/air/AirQuality/2000report.htm

[32] City of Toronto Works and Emergency Services and SENES Consultants, March 2003. Opportunities from Past to Present: Waterfront Scan and Environmental Improvement Strategy Study, at p. 7-12.
[33] Emissions estimates are those from the 1995 Criteria Air Contaminants Inventory, for Toronto, postal code "M". Environment Canada's NPRI website (www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm), visited July 2003.
[34] See Appendix A.

Major Sources of SO_X Outside of Toronto

Estimates show that the important SO_X source categories in the GTA and Ontario are industry, fuel combustion and transportation. GTA and Ontario sources of SO_X appear to be fairly similar to each other. However, in the GTA, electric power generation may be a more important source of SO_X than in Toronto. Looking at SO_X sources province-wide, industrial emissions appear to be most important.

PM_{10} and $PM_{2.5}$– Inhalable & Respirable Particles

Particulate matter (PM) is the general term used to describe solid particles and liquid droplets found in the air. PM_{10}, or inhalable particulate matter, refers to particles less than or equal to 10 microns (10 millionths of a meter) in diameter. PM_{10} includes all smaller particles, including $PM_{2.5}$ and PM_1.

These particles and droplets can contain toxic and acidic chemicals that impact health. Particles themselves may also impact health. The smaller the particle, the greater the health concern. Health effects have been seen at any concentration of particles in the air, meaning there is no completely safe level. Particulate pollution has been linked to heart disease. It can decrease lung function in healthy people and exacerbate symptoms of asthma and other lung diseases. Children, the elderly and those with respiratory and cardiac problems are most vulnerable to particulate pollution. Particles emitted from vehicles have also been linked to cancer.[35]

The Provincial 24-hour interim AAQC for PM_{10}, established in 1997, is 50 $\mu g/m^3$. In 2000, monitoring stations detected a few exceedences (four at one station, one at another and none at the third). Levels of PM_{10} can be higher than these level recorded by provincial monitoring stations, especially at nose level along roadways and in high-rise canyons.

Environment Canada estimates the major Toronto sources of PM_{10} are Construction, Paved Roads and Residential Fuelwood Combustion. [36] However, these estimates may distort the actual conditions in the City. [37] For example, preliminary results from a new City study suggest that less than 1% of the PM_{10} in Toronto's air comes from construction dust.

Many of the top ten PM_{10} sources identified by Environment Canada fall into the general category of "open sources." "Open sources" collectively represent many small, often impermanent sources (Construction, Structural Fires). The general categories of fuel combustion and industrial sources also appear to be important for PM_{10}, as was observed for NO_X and SO_X.[38]

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[35] Toronto Public Health, 2000. Toronto's Air: Let's Make It Healthy. Toronto, Ontario.
[36] Emissions estimates are those from the 1995 Criteria Air Contaminants Inventory, for Toronto, postal code "M". Environment Canada's NPRI website (www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm), visited July 2003.
[37] See Appendix A.
[38] City research estimates that paved road dust and transportation in Toronto are responsible for the greatest PM_{10} emissions. Land use-based emission estimates are from the City of Toronto Air Quality Improvement Branch (AQIB), produced from data provided by the MOE and Environment Canada. AQIB estimates that paved roads are

Major Sources of PM_{10} Outside of Toronto

PM_{10} particles are large and heavy compared with the gaseous pollutants and finer particles and they do not travel as far on the wind. It is still possible for some PM_{10}, including "natural" PM_{10} such as tree pollen, to flow into Toronto from sources outside the city. In the GTA, construction appears to be the greatest source of PM_{10}. Paved roads are another important source of PM_{10} in the GTA and unpaved roads are an important source from a province-wide perspective.

$PM_{2.5}$ – Respirable Particles

Incomplete fuel combustion is a major source of $PM_{2.5}$

Respirable particles ($PM_{2.5}$, or particles of diameter less than or equal to 2.5 microns) are the finer fraction of PM_{10}. $PM_{2.5}$ is of greater health concern than PM_{10} because it can be breathed deep into the lung and remain lodged in lung tissue. The particles can contain acidic chemicals or toxic compounds. Once in the lung, these chemicals cause discomfort and other health problems.

The 24-hour Canada-wide Standard for $PM_{2.5}$ is 30 µg/m^3 (established in 2000). The province reports that in 2000, a few (3) exceedences of the standard were detected in Toronto.[39] $PM_{2.5}$ levels can also reach above the air quality standard along major arteries in the City.

Incomplete fuel combustion is a major source of $PM_{2.5}$. Some respirable particles are emitted directly from their sources, such as smokestacks and vehicles. In other cases, gases such as SO_X and NO_X interact with moisture and other compounds in the air to form sulphates (SO_4) and nitrates (NO_3) that form fine particles.[40]

Environment Canada estimates[41] indicate that the greatest Toronto source of $PM_{2.5}$ is Residential Fuelwood Combustion, followed by Paved Roads and Industrial sources.[42] The top ten $PM_{2.5}$ sources fall into the general categories of fuel combustion, open sources and transportation.[43]

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an important Toronto source of PM_{10}, which is consistent with CAC estimates. AQIB analyses indicate that airborne paved road dust and PM_{10} can exist in very high concentrations in high-rise canyons and along major roadways.

[39] Ontario Ministry of Environment, 2003. Air Quality in Ontario 2000 Report. *Appendix*. See: http://www.ene.gov.on.ca/envision/air/AirQuality/2000report.htm
Early results from AQIB ongoing analysis of $PM_{2.5}$ concentrations show levels close to or above the Canada-wide standard along some arterial streets.

[40] It should also be noted that when fuels are burned indoors, such as in a wood-burning fireplace, the impact on indoor air quality can be significant.

[41] Emissions estimates are those from the 1995 Criteria Air Contaminants Inventory, for Toronto, postal code "M". Environment Canada's NPRI website (www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm), visited July 2003.

[42] See Appendix A.

[43] However, new research indicates that the emissions inventory may overestimate the importance of Residential Fuelwood Combustion as a source of $PM_{2.5}$. See Lee, P.K.H., J.R. Brook, E. Dabek-Zlotorzynska and Mabury, S.A. In press. "Identification of the major sources contributing to $PM_{2.5}$ observed in Toronto." *Environmental Science and Technology*. The AQIB estimates that the Toronto land use responsible for the greatest $PM_{2.5}$ emissions is residential (including residential fuelwood combustion), followed by transportation and industrial land uses.

There are significant health concerns associated with particulate pollution. However, there is little Toronto-specific data about major sources. It will be an important component of the air quality improvement strategy to increase our understanding of this category of pollutant both in terms of sources and health impacts.

Major Sources of $PM_{2.5}$ Outside of Toronto

In the GTA the top emission sources appear very similar to those in Toronto. Residential fuelwood combustion appears to be the most important source of $PM_{2.5}$ in the region, but this may be an overestimation. In Ontario, unpaved roads and forest fires appear to be the largest sources of $PM_{2.5}$.

VOCs – Volatile Organic Compounds

VOCs readily evaporate into the air from solvents and fuels and they may also be released in large quantities from burning.

VOCs form a large group of volatile (rapidly evaporating) pollutants that includes benzene, 1,3-butadiene, freons and propane.[44] Ground-level ozone, a key component of smog, forms when NO_X and VOCs react in the presence of sunlight. VOCs can also affect health directly. The degree of harm caused by VOCs varies depending on the individual substance. Exposure to VOCs can cause eye, nose and throat irritation, headaches, nausea and loss of co-ordination. Damage to the liver, kidney and central nervous system can result. Some VOCs are suspected or known to cause cancer in humans.

In 2000, Environment Canada measured the levels of 143 individual VOCs in Toronto.[45] A complete analysis of each of these substances is beyond the scope of this report. Benzene is one of the monitored substances and is discussed below in the section dealing with carcinogens. Average annual benzene concentrations were approximately 1.3 and 1.5 $\mu g/m^3$. Ontario does not have an AAQC for benzene. None of the other monitored pollutants levels exceeded existing Ministry criteria.[46]

Estimates show that the greatest Toronto source of anthropogenic (made or caused by humans) VOCs is General Solvent Use, followed by Residential Fuelwood Combustion and Surface Coatings. [47] The general category of Light Duty Gasoline Vehicles is also an important source.[48]

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[44] Large quantities of certain VOCs are released naturally from vegetation. However, because the more toxic VOCs are generally released from human activities, only the anthropogenic (man-made) VOCs are addressed in this report.
[45] Ontario Ministry of Environment, 2003. Air Quality in Ontario 2000 Report. *Appendix*. See: http://www.ene.gov.on.ca/envision/air/AirQuality/2000report.htm
[46] Ontario Ministry of Environment, 2003. Air Quality in Ontario 2000 Report. Chapter 6: Selected Volatile Organic Compounds (VOCs). p. 33.
[47] See Appendix A. Emissions estimates are those from the 1995 Criteria Air Contaminants Inventory, for Toronto, postal code "M". Environment Canada's NPRI website (www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm), visited July 2003.

Major Sources of VOCs Outside of Toronto

In the GTA and Ontario, general solvent use, surface coatings and gasoline-related transportation are among the greatest sources of anthropogenic VOCs. Residential fuelwood combustion also remains an important source in the GTA.

CO – Carbon Monoxide

Carbon monoxide is emitted whenever fuels are burned.

CO is closely associated with adverse effects on the heart and people with existing heart disease are most vulnerable to CO. Other people who may be vulnerable to CO are pregnant women and the fetus, children, the elderly, those with anemia and those with respiratory problems.

The one-hour Ontario AAQC for CO is 30 ppm. Levels measured in Toronto did not exceed the AAQC in 2000.[49] City research also showed no exceedences of the 1-hour AAQC in Toronto but does suggest higher concentrations of CO in some parts of the city. CO concentrations can be high in enclosed spaces, particularly in urban high-rise canyons. Potential for exposure may be higher for pedestrians in these areas and motorists waiting in traffic.

Environment Canada[50] estimates Off-road Use of Gasoline, Light-duty Gasoline Vehicles and Residential Fuelwood Combustion as the most important Toronto sources of CO.[51] Many of the top sources of CO fall within the general categories of transportation (particularly gasoline-related) and fuel combustion sources.[52]

Major Sources of CO Outside of Toronto

Gasoline-related transportation appears to be the greatest source of CO in the GTA and Ontario. Industry makes a larger contribution to CO emissions province-wide.

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[48] The City's AQIB estimates that the Toronto land uses releasing the greatest amounts of anthropogenic VOCs are transportation followed by solvent use and residential wood combustion. Land use-based emission estimates are from the City of Toronto Air Quality Improvement Branch (AQIB), produced from data provided by the MOE and Environment Canada. Both the AQIB and the NPRI estimates identify solvent use, residential wood combustion and transportation as important Toronto sources of VOCs.

[49] Ontario Ministry of Environment, 2003. Air Quality in Ontario 2000 Report. *Appendix*. See: http://www.ene.gov.on.ca/envision/air/AirQuality/2000report.htm

[50] Emissions estimates are those from the 1995 Criteria Air Contaminants Inventory, for Toronto, postal code "M". Environment Canada's NPRI website (www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm), visited July 2003.

[51] See Appendix A.

[52] The AQIB estimates that the Toronto land uses producing the greatest CO emissions are transportation followed by residential land uses, including residential fuelwood combustion. Land use-based emission estimates are from the City of Toronto Air Quality Improvement Branch (AQIB), produced from data provided by the MOE and Environment Canada.

O_3 – Ground-level Ozone

Ground level ozone is a pollutant of concern, but it is not emitted as are the others described in this report. Ground-level ozone is created by a chemical reaction between NO_X and VOCs in the presence of heat and sunlight. Ozone concentrations in Toronto's air can rise on any day of the year that these conditions exist, whether it is a smog alert day or not.

Ground-level ozone can adversely affect people's health, even at low levels. It can also have detrimental effects on plants and ecosystems. Ozone can irritate the lung passages and cause inflammation. Symptoms include wheezing, coughing and breathing difficulties during exercise or outdoor activities. People with respiratory problems are most vulnerable, but even healthy people who are active outdoors can be affected when ozone levels are high. Even at very low levels, ground-level ozone triggers a variety of health problems including aggravated asthma, reduced lung capacity and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

The 8-hour Canada-wide Standard for ozone is 65 ppb (established in 2000). The most recent ozone monitoring data available are for 2000 and at that time, the air quality standard was a 1-hour AAQC of 80 ppb ozone. In 2000, at the six Toronto ozone monitoring stations, the 80 ppb AAQC was exceeded at all sites, with a maximum of 24 exceedences at one site. Average annual ozone levels varied at the six sites and ranged from 17.4 to 20.6 ppb.

Carcinogens

The contaminants discussed below have all been identified by Toronto Public Health as carcinogens known to be present in Toronto's air.[53] In its research, Toronto Public Health noted that nine of the ten carcinogens discussed below are anticipated to be present in outdoor air at levels that closely approach or exceed "reference levels." A "reference level" is an exposure that is predicted to result in a lifetime cancer risk of one additional cancer case per one million people. Below are summaries of key information about each of the ten carcinogens. For more information, refer to the Ten Carcinogens report.[53]

Of the ten key carcinogens, eight are either directly or indirectly associated with the combustion of fossil fuels (benzene, 1,3 butadiene, cadmium, chromium, dioxins and furans, formaldehyde, PAHs are all by-products of fossil fuel combustion; asbestos, still found in some brake shoe materials, is associated with transportation). There is very little Toronto-specific information about these contaminants.

Asbestos

Inhalation is the most significant route of exposure for asbestos

[53] Toronto Public Health, 2002. *Ten Key Carcinogens in Toronto Workplaces and Environment: Assessing the Potential for Exposure*. Toronto, Ontario.

Reference level (expressed as ambient air level): 0.000004 fibres/mL per day[54]

Asbestos is known to produce lung cancer, asbestosis and mesothelioma (cancer of the membrane that surrounds the lungs and other internal organs) in individuals exposed on the job. Workplace exposure can occur in any sector where asbestos-containing products are manufactured, used or handled. This includes when old asbestos-containing products such as ceiling tiles or insulation are removed or disturbed without proper precautions taken. Inhalation is the most significant route of exposure for asbestos.

The ambient level of asbestos in Toronto's air is not known. However, in other major North American urban centres, asbestos has been reported in outdoor air at levels ranging from 0.000003 to 0.003 fibres/mL. The "high end" estimates are a thousand times greater than the reference level.

Benzene

The most significant ambient exposure to benzene is from the exhaust of gasoline-powered vehicles

Reference level[55] (expressed as ambient air level): 0.24 $\mu g/m^3$

Long-term exposure to low levels of benzene is associated with blood disorders including leukemia, reproductive effects, dermal effects and depression of the immune system. Benzene is classified by the USEPA as a known human carcinogen.

Many industries use benzene to make other chemicals. Benzene is also found in cigarette smoke, crude oil and gasoline. Benzene can enter the body by inhalation, ingestion and absorption through the skin. The most significant ambient exposure to benzene is from the exhaust of gasoline-powered vehicles.

Ambient levels in Toronto air range between 1.3 to 3.1$\mu g/m^3$ with an average of 2.2 $\mu g/m^3$. The average level is ten times greater than the reference level.

[54] Established by the US EPA for cancer effects.
[55] Established by the US EPA for cancer effects.

1,3-Butadiene

Gasoline and diesel-powered vehicles are significant sources as are fuel combustion for home heating and industrial activities

Reference level[56] (expressed as ambient air level): 0.16 µg/m^3.

1,3-Butadiene is classified as a probable human carcinogen linked to cancers of the blood and lymph systems (new evidence supports it being changed to "known human carcinogen"). It has also been linked to disorders of the heart, blood and lungs and to reproductive and developmental problems.

1,3-Butadiene is a combustion by-product and is also used in the production of polymers such as rubber and latex. Gasoline and diesel-powered vehicles are significant sources as are fuel combustion for home heating and industrial activities. Inhalation is the predominant route of exposure.

In Toronto, 1,3-butadiene levels range between 0.03 to 2.20 µg/m^3. The average level is 0.32 µg/m^3 which exceeds the reference level by a factor of 2.

Cadmium

Sources of cadmium include emissions from coal-fired power plants, oil-fueled space heaters, gasoline-powered vehicles and solid waste

Reference level[57] (expressed as ambient air level): 0.00056 µg/m^3

Cadmium is most clearly linked to lung cancer. The USEPA and Health Canada have classified cadmium as probably carcinogenic to humans by inhalation.

Base metal smelting and refining operations are considered the most significant sources of cadmium arising from human activities. Other sources include emissions from coal-fired power plants, oil- fueled space heaters, gasoline-powered vehicles and solid waste incineration. Inhalation is the predominant route of exposure.

There are no figures for ambient levels of cadmium in Toronto air, but the average outdoor air concentration of cadmium in southern Ontario has been reported to be 0.00042 µg/m^3, which hovers around the reference level. The range is 0.00024 to 0.00072 µg/m^3.

[56] Established by the US EPA for cancer effects.
[57] established by the US EPA for cancer effects

Chromium

Chromium is released to the air when fossil fuels are burned

Reference level[58] (expressed as ambient air level): 0.000024 μg/m^3 for chromium (VI)

Chromium exists in three forms, only one of which – chromium (VI) – is classified as carcinogenic to humans by inhalation. High level occupational exposures are associated with nasal irritation, nosebleeds, holes in the septum and other respiratory effects. Sensitive people may experience allergic skin reactions to low level exposures to any form of chromium. Reproductive problems may also be associated with exposure to chromium (VI).

Chromium is released to the air when fossil fuels are burned. Fuel consumption accounts for about 63% of the chromium released to air, while industrial processes account for about 29%. Electrical generating stations are responsible for about 24% of all chromium air emissions. Inhalation is a predominant route of exposure.

There are no figures for ambient levels of chromium in Toronto, but total chromium levels in outdoor air in 12 Ontario cities range between 0.003 and 0.009 (corresponds to 0.00009 and 0.00072 μg/m^3 of chromium (IV)). The high end of the chromium (IV) estimates is ten times greater than the reference level.

Dioxins and Furans

In Toronto, diesel fuel combustion, residential burning of wood and garbage are estimated to be important local sources of airborne dioxins

Reference level: Exposure levels for dioxins and furans are expressed as toxic equivalents (TEQs) and in units of trillionths of a gram (picograms) per kilogram body weight per day. The World Health Organization has developed a reference level for dioxins of 1-4 pg TEQ/kg/day, on the basis of their reproductive and developmental effects. Under the Canadian Environmental Protection Act (1993), a reference level for dioxins of 10 pg TEQ/kg/day was established based on cancer effects.

Dioxins, furans and related compounds are associated with a wide range of health effects including cancer, severe acne-like conditions, reproductive and developmental problems, immune system suppression and hormonal disruption.

Dioxins are taken up into food crops or consumed by animals that are subsequently eaten by people. Emissions to air are a concern because they settle to the ground or to surface waters and enter the food chain. In Toronto, diesel fuel combustion, residential burning of wood and garbage are estimated to be important local sources of airborne dioxins. Ingestion is the predominant route of exposure.

[58] Established by the World Health Organization for cancer effects.

There are no figures for Toronto, but age-specific exposure estimates for Great Lakes basin residents range from 1.20 pg TEQ/kg/day in adults 20 years and older to 4.25 pg TEQ/kg/day in adults who eat sports fish, to 12.56 pg TEQ/kg/day in infants who are not breast fed to 57.05 pg TEQ/kg/day in breast-fed infants.

Formaldehyde

Motor vehicle exhaust is by far the most significant source of formaldehyde outdoor emissions.

Reference level[59] (expressed as ambient air level): 3.6 $\mu g/m^3$

Formaldehyde is classified as a probable human carcinogen and a "strong promoter" of cancer (that is, while formaldehyde exposures may not initiate cancerous cell growth, formaldehyde exposures will promote the growth of pre-existing cancerous cells). It is also a highly reactive substance that can be irritating to the nose, eyes, skin and lungs at low levels of exposure.

People can also be exposed to high indoor levels of formaldehyde that "off-gases" from materials and products such as pressed-wood used in indoor environments. Inhalation is the predominant route of exposure.

There are no figures for Toronto, but formaldehyde levels measured in outdoor air in Canada between 1989 and 1995 average about 3.3 $\mu g/m^3$, very close to the reference levels.

Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are produced whenever organic materials such as wood, paper, coal, oil or gasoline are burned.

Reference level, exposure by inhalation[60] (expressed in terms of the most toxic member of the PAH family of compounds, benzo[*a*]pyrene): 0.000043 μg B[*a*]P/m^3

PAHs are a large family of complex and diverse compounds, some of which are carcinogenic. Exposures to PAHs have also been associated with reproductive problems in men and women and with impaired fetal development.

Forest fires are a significant source of PAHs. Human activities that create the most PAHs are the operation of gasoline and diesel-operated vehicles, wood, paper and trash combustion in residential fireplaces and industrial facilities. Exposures can arise through inhalation, ingestion and dermal absorption.

[59] Recently proposed by the US EPA for cancer effects.
[60] As recommended by the MOE, for cancer effects.

The average concentration of PAHs in outdoor air in Toronto is approximately 0.0003 µg B[*a*]P/m^3, ten times greater than the reference level.

Tetrachloroethylene

Reference level, inhalation:[61] 250 µg/m^3

Tetrachloroethylene is recognized by major agencies as an animal carcinogen, but they disagree about whether or not it is a human carcinogen. Until there is greater agreement, Toronto Public Health recommends treating tetrachloroethylene as a contaminant that can produce cancer in humans. Tetrachloroethylene has also been associated with health effects such as neurological and kidney effects in people exposed on the job and liver effects in animals subjected to experimental exposures.

Tetrachloroethylene is used for dry cleaning and textile processing. It can be found in products including adhesives, aerosols, paints, printing inks, glues, sealants, polishes, lubricants, paint removers, rug and upholstery cleaners and stain, spot and rust removers. In Toronto, it is expected that dry cleaning and textile processing are important sources of environmental emissions. Inhalation is the predominant route of exposure.

Tetrachloroethylene levels in outdoor air in Toronto range from 2 to 5 µg/m^3, well below the reference level.

Trichloroethylene

Reference level[62] (expressed as ambient air level): 1.6 µg/m^3

Trichloroethylene has been classified as a probable human carcinogen and has also been associated with depression of the central nervous system, liver and kidney damage and development effects in animals.

Trichloroethylene is used primarily as a solvent for vapour degreasing and cold cleaning metal parts in industry. To a lesser extent, it is used in dry-cleaning operations, paints, paint removers and household products such as adhesives, rug-cleaning fluids and spot removers. Degreasing operations present the greatest potential for exposure in the workplace and are the largest source of emissions to the environment. Inhalation is the predominant route of exposure. Indoor air is expected to be the major source of exposure.

In Toronto, outdoor air levels of trichloroethylene range from 0.32 to 2.8 µg/m^3, which hovers around the reference level.

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[61] Established by WHO based on non-cancer effects.
[62] Established by Health Canada for cancer effects.

Greenhouse Gases

Greenhouse gases (GHGs) are those that trap the sun's heat energy in the earth's atmosphere as part of a natural process called the greenhouse effect. An overabundance of GHGs produced through human activities has accelerated the greenhouse effect and led to global climate change.

The Kyoto Protocol is an international agreement to meet the challenge of climate change by reducing emissions of carbon dioxide equivalents (eCO_2).[63] In 2002, the Canadian federal government ratified its commitment under the Kyoto protocol and set a target to reduce national greenhouse gas emissions by 6% relative to 1990 levels, between 2008-2012. The Kyoto Protocol includes flexibility mechanisms such as emissions trading that will assist countries in reaching their reduction targets.

Before Canada signed the Kyoto Protocol, the City of Toronto set a target of 20% reduction in its CO_2 emissions by 2005 from 1990 levels. In 1998, total city-wide greenhouse gas emissions, including City operations, were 26.6 million tonnes of eCO_2. Of this quantity, approximately 1.3 million tonnes was estimated to come from City operations.[64] In 1990, the City emitted an estimated 657,943 tonnes of eCO_2 from building, fleet and other operations. By 1998, the City's emissions from the same sources had been reduced to 627,343 tonnes, a 4.65% decrease.[65]

CO_2 – Carbon Dioxide

Carbon dioxide is released whenever organic (carbon-containing) materials decay or are burned. In cities, vehicle exhaust, home heating and electricity generation are all major sources of CO_2.

CH_4 – Methane

Methane is a powerful greenhouse gas, with 21 times the heat-trapping ability of CO_2. It is released from decaying materials in wetlands and landfills among other sources. In Ontario, the MOE issues certificates of approval that require landfill sites to include gas capture systems. Where required, the City's landfill sites capture escaping landfill gases that are then destroyed through flaring or used to generate electricity.

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[63] The six greenhouse gases addressed by the Kyoto Protocol are: Carbon dioxide (CO_2) Methane (CH_4) Nitrous oxide (N_2O)Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs) Sulphur hexafluoride (SF_6).

[64] Toronto Atmospheric Fund. 2003. Moving Towards Kyoto: Toronto's Emission Reductions 1990-1998. Policy Report.

[65] City of Toronto Environmental Services, "Greenhouse Gas Reduction in Toronto: Achievement and Challenges," (2004)

APPENDIX F – Toronto Air Quality Initiatives[66]

At the fifth annual Smog Summit, held at Metro Hall in Toronto on June 21 2004, Mayor David Miller announced the City of Toronto's latest commitments to reducing energy use and reducing smog. The City has launched the Energy Retrofit Program, which will increase the funding available to retrofit City buildings and facilities to $25 million. The Federation of Canadian Municipalities (FCM) has provided an $8.75 million low-interest loan to help finance these retrofit initiatives. The City also announced a $10.2 million retrofit of 100 City arenas, partly financed by $2.52 million of the FCM loan. These retrofits are expected to pay for themselves over approximately eight years as energy use declines.

In May, 2004, the City of Toronto hosted the Conference of the Reducers. The Conference of the Reducers is a forum of leading companies and national, state and city governments sharing best practices on reducing greenhouse gas emissions. In hosting the conference, Toronto has announced to the world that it is a leader in initiatives to reduce greenhouse gas emissions.

At the conference, Mayor David Miller announced several major projects including:

- A $6.4-million appliance renewal plan for Toronto Community Housing Corporation, to replace old appliances with new cost-saving, energy efficient ones.
- A multi-year plan to install advanced energy-reducing light emitting diode (LED) lamps in the City's 2,000 traffic signal intersections, with the first $1 million phase ready to outfit 250 intersections this year. LED's slash electricity use in traffic signals by 84%.
- A $4.2 million plan to install energy efficiency measures at civic centres and corporate facilities.

These recent announcements and the many initiatives described below, show that Toronto is on the vanguard of emissions reductions. It is as important to recognise Toronto's leadership as it is to identify areas where efforts could be improved.

As can be seen from the programs described on the following pages, Toronto boasts an extensive range of initiatives, programs and policies that target the major sources of contaminants of concern – activities related to the combustion of fossil fuels for the purposes of transportation and energy production.

Including capturing and burning for fuel the methane emitted from three City landfill sites, the total equivalent CO_2 emissions in the City as a whole have been reduced from approximately 22,500,000 tonnes/year (1990) to approximately 21,500,000 tonnes/year (1998).

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[66] The Environmental Plan recommends that air quality programming be incorporated and consolidated into the overall strategy. (City of Toronto: February, 2000) at p. 46 and the Toronto Atmospheric Fund grant requires that this report include an inventory of clean air initiatives. The Greater Toronto Area Clean Air Council maintains and annually updates a list of air quality improvement initiatives.

While these reductions are a significant accomplishment, the city-wide figure (including City of Toronto operations) of 4-5% is still short of the target the City set for itself (20% reduction of 1990 levels by 2005).

If the City still has most of the way to go to reach its target, then it has to do more to reduce its greenhouse gas emissions. As well, if the health of Toronto's population is still at risk from the other contaminants described in this report, then more needs to be done to address emissions of these pollutants as well.

The initiatives described in the following sections are organised according to the five components of the Conceptual Framework for Municipal Action to Improve Air Quality described in the main report. As there is presently no evaluation and monitoring mechanism as part of Toronto's overall air quality activities, there are no activities identified for this component.

Also described below are the City departments, offices and agencies that, because of their unique areas of activity, are centres of the expertise and innovation required to bring about the improvements to Toronto's air quality activities.

Data, Information and Analysis

City departments such as the Air Quality Improvement Branch, Toronto Public Health and the Energy Efficiency Office are involved in empirical studies, literature reviews and other investigations such as computer-based modeling to improve our understanding of Toronto's air quality problems and how to respond to them. Gathering data and information can involve the testing of technology such as the "Clean Roads to Clean Air" project and interjurisdictional initiatives such as the Smog/Heat project undertaken by Toronto Public Health, Health Canada and Environment Canada.

The City collects data and estimates of its emissions from its own operations including sewage treatment and water purification, landfill gas releases and building and vehicle fuel use. The City has maintained a database of fuels used and energy consumed to estimate emissions since 1990. The data has been collected annually since 2000. The database is used to estimate overall eCO_2 and criteria air contaminant emissions.

The City has obtained data from Toronto Hydro, Enbridge Consumers Gas and the City's traffic flow data (in the absence of gas supplier data) to similarly estimate eCO_2 and criteria air contaminant emissions for the community. The data has been collected annually since 2000. The database can also be used to help identify major consumer end-users for improvement opportunities.

Each of the departments mentioned above brings unique and necessary expertise to the different aspects of the complex problem of improving air quality. For example, the AQIB brings technical expertise with air quality data and monitoring and Toronto Public Health brings special

knowledge about the health effects of air pollution on populations in the City. The Energy Efficiency Office has hands on expertise and unparalleled experience with energy efficiency solutions in the community.

Described below are some of the major projects and areas of enquiry for these departments:

- Green Power – The Energy Efficiency Office (EEO) undertakes policy analyses to assess and identify benefits of low-impact and green sources of power. The EEO conducts qualitative and quantitative research on energy and functions as an information clearinghouse. The EEO maintains a current resource centre collection and databases.
- Health and Air Quality – Toronto Public Health, Environment Canada and Health Canada are undertaking a collaborative, three-year investigation into smog-heat interactions to improve the accuracy of the smog and heat alert systems. The overall purpose of this study is to evaluate the impacts of weather, climate and air pollution on human health and mortality. This information will improve the City of Toronto's ability to issue health risk warnings to the public and develop better air quality and health policies.
- Air Quality Information, Data and Analysis – The Air Quality Improvement Branch undertakes air quality data collection, analysis, monitoring, modeling, assessing best strategic directions and monitoring progress.
- Reporting on the Burden of Illness Associated with Air Pollution – Toronto Public Health released in July 2004 its most recent analysis of mortality and morbidity figures – 1700 annual premature deaths and 6000 hospital admissions -- associated with air pollution.

Other air-quality related studies undertaken recently by the City include:
- "Clean Roads to Clean Air," an evaluation of new technology sweepers that remove PM_{10} and $PM_{2.5}$ from the streets and the air.
- A study to determine environmental and economic impacts of phasing-out the City's purchase of coal-fired electricity.
- Environmental Assessment Studies planned and/or underway to examine reserved transit facility in the following areas: Yonge St., north of Finch Ave. E.; St. Clair Ave, west of Yonge St. and between Downsview Subway Station and York University.
- A Carcinogen reduction study.
- A Policy and Legal Study: A review of legislative structures and air policy framework.
- An Emissions Trading Study to assess the role of emission trading by municipalities as a cost-effective means to reduce emissions.
- A study on air quality and physical activity in order to develop public communications to will help Toronto residents perform outdoor exercise during times of optimal air quality.
- A Don Valley Corridor Study is being undertaken by the City to maximise the person carrying capacity of the Don Valley Parkway Corridor.

Interjurisdictional Action

Toronto's air quality is affected by both local emissions and emissions from far outside the City. The provincial and federal levels of government regulate many of the important sources of

pollution in Toronto's air. As well, the provincial and federal governments have a very important role to play in supporting Toronto's efforts to improve its air quality through financial support for transit and infrastructure projects such as the renewal of Toronto's waterfront. For these and other reasons, the conceptual framework for municipal action to improve air quality identifies interjurisdictional action as a crucial component. Listed below are some of the activities the City of Toronto has engaged in to involve other levels of government in improving local air quality.

- Toronto is leading the initiative with the federal government to develop a "New Deal for Cities" that will potentially leads to reforms in municipal finance and improved federal support for municipal infrastructure including transit systems.
- Toronto advocates for provincial, federal and U.S. government actions to reduce air emissions so as to better protect health of Toronto residents. For example, the City participates in policy analysis and formulation directed at limiting harmful emissions from Ontario and U.S. coal-fired power plants and comments on regulations respecting air emissions caps for Ontario's electricity and industrial sectors.
- Participate in provincial and federal processes related to standard setting. For example, Toronto Public Health recently participated in a provincial public consultation on an air standard information draft for a suite of toxic air contaminants.
- Toronto fosters linkages with other health units in Ontario, particularly the GTA to facilitate collaborative action on air-quality improvement measures, information sharing and program adoption.
- Toronto is, with the MOE, a member of Clean Air Canada Inc., which replaced the Pilot Emissions Reduction Trading group (PERT).
- Waterfront Revitalization Project with the Federal and Provincial governments.
- Toronto participates on the Environment Canada committee to implement a health-based Air Quality Index (AQI). Environment Canada, in collaboration with Health Canada and under the auspices of the AQI Management Committee, including Toronto Public Health, continues to develop and refine the health-based AQI tool. This tool integrates the health risk of the 5 key criteria air pollutants into a single value in the new AQI. Once done, this health-based AQI will provide a more accurate and scientifically defensible warning system for members of the public to use to lessen their health risk when AQI values are high.
- Promotion of higher energy efficiency standards for new buildings.
- Toronto advocates for changes to the federal taxation laws to encourage the City Corporation to provide subsidised employee transit passes.
- Toronto and its GTA partners were successful in the Transportation Demand Management application for funding to develop new Transportation Management Associations (TMA) in the GTA (2 in Toronto and 8 more throughout the GTA). The project will achieve an estimated annual 20,000 tonnes in CO_2 reductions.
- Agenda for Action on Air and Health, July 2004 -- Toronto Public Health released a major report outlining provincial action required to improve air quality in July 2004.

Corporate Operations

The Conceptual Framework for Municipal Action to Improve Air Quality distinguishes between actions the City of Toronto can take to reduce its own emissions and actions it can take to reduce emissions in the community (see next section) but occasionally these spheres overlap. For example, the Toronto Transit Commission (TTC) works to reduce its own emissions and is itself an essential tool in reducing automobile emissions within the community. The following descriptions highlight the major initiatives of the TTC, the City Fleet, City energy efficiency policies and initiatives, the City's Smog Alert Response Plan and the City's low-sulphur fuel purchase program.

The Toronto Transit Commission

- The TTC has had an anti-idling policy since 1993.
- All vehicles are annually tested and compliant with Provincial "Drive Clean Program."
- All buses are kept in "Class A" condition.
- TTC is currently using diesel fuel with 500ppm and is planning to purchase "ultra low sulphur diesel" 15ppm when it is commercially available in Canada.
- TTC monitors bus engine technology developments and is evaluating hybrid bus technology that has the potential for lower emissions and better fuel economy.
- The TTC employs a wide range of programs to increase transit use including:
  - investment in new transit facilities and vehicles,
  - road treatments and technology improvements to improve service speed and reliability such as signal priority for transit vehicles and exclusive transit-only right-of-ways.
- In September 2004, the TTC launched a nine month bio-fuel test on 180 buses. The project, testing a bio-diesel fuel that is a mixture of vegetable oil and diesel, focuses on two areas: environmental performance in TTC service conditions and evaluation of test results from other transit properties. This test is needed to consider expanded use of bio-diesel across the entire bus fleet.

Fleets

- The City's Green Fleet Transition Plan (2004) sets out a 4-year plan that will reduce fleet emissions and other negative environmental impacts.
- The City's Fleet Services division completed the largest test of B50 biodiesel in Canada in 2003 and through the Green Fleet Transition Plan proposes to use over 5 million litres of biodiesel between 2005-2007.
- The City has 138 natural gas powered vehicles in its fleet (2004).
- Better Transportation Partnership (BTP) for City fleet. BTP is a public-private partnership created to support the City's initiatives to acquire low emissions vehicles to reduce environmental pollutants in the City.
- Through the Green Fleet Transition Plan (2004), Fleet Services proposes to replace 84% of its new vehicle replacements over the next 4 years with hybrid-electric vehicles.
- Conducting an employee anti-idling training program in 2003 and participating in the 2003 Repair our Air Anti-Idling Fleet Challenge and will participate in the National Fleet Challenge (2004).

- Green Fleet Technical Testing Program (2003) that proactively seeks out alternative fuels, vehicles and retrofit technology to reduce emissions and improve fuel efficiency.
- FASST (Fleet Acquisition Specifications Support Team) to develop new standard specifications. One goal of FASST is to develop specifications that support the City's targets of CO_2 reductions and reduce other emissions. Actions taken to date include light fleet truck and van engine size specification for most applications reduced from 8 cylinders to 6, purchasing 4-stroke motorised equipment used in lawn mowers, trimmers and so on.

Energy Efficiency and Alternative Energy

- The City has a target to purchase 25 per cent of the City's electricity requirements from Green Power sources by 2005.
- Energy Management Program (EMP) for City Facilities. A plan to improve the energy efficiency of City facilities.
- A 3-year corporate program to provide opportunities for City employees to undertake energy improvements to reduce greenhouse gases and smog-producing emissions both at home and around the workplace.
- Capturing Methane from 3 landfill sites and turning it into electricity.
- Since 1999, there has been a Sustainable Energy Plan for Toronto.

SMOG Alerts

- In May 1998, Toronto City Council adopted a comprehensive smog action plan. One element of this strategy is the Corporate Smog Alert Response Plan, where City departments develop smog alert response plans specific to their functions. These Divisional Response Plans include modification of smog-producing activities on smog alert days such as suspending non-essential use of vehicles and mowing equipment, suspending asphalt work and refuelling vehicles and equipment after sundown/before sunrise. Unlike many other City initiatives, the Smog Response Plan is regularly evaluated.

Fuel

- Low sulphur fuels purchasing — endorsed by Council (December 1998). A low-sulphur fuel purchasing practice allows municipalities to use their purchasing power to select cleaner fuels to improve air quality and health. Toronto's approach requires that in addition to cost, the level of sulphur in the fuel be considered when evaluating bids for bulk gasoline and diesel fuel. The City of Toronto selects the supplier offering the lowest-sulphur gasoline or diesel fuel at a reasonable price. The majority of the emission reductions from the fuel purchase are achieved by purchasing cleaner on-road diesel fuel for the City of Toronto's off-road applications.
- Sustainable transportation as a part of the new Official Plan policy development and implementation.

Community Action

Toronto has a population of 2.5 million people many of whom have the capacity in one way or another to make decisions that reduce energy consumption and car use, the two leading causes of

air pollution in the City. The conceptual framework for municipal action to improve air quality identifies actions in the community as a vital component. These actions can include social marketing programs, promotional activities, education and outreach, community partnerships, by-laws and City support for alternative transportation such as transit use, cycling and walking. Listed below are some of the major undertakings by the City of Toronto to encourage energy conservation and reduced car use and vehicle emissions in the Toronto community, including programs supported by the Toronto Atmospheric Fund.

The City of Toronto also has the capacity to improve air quality in the Toronto community by preserving, restoring and expanding green spaces, ravines and the urban forest. Some of these activities are also listed below

- The City has initiated E^3@Work a 3-year corporate program to provide opportunities for City employees to undertake energy improvements to reduce greenhouse gases and smog-producing emissions both at home and around the workplace
- Sustainable transportation is a part of the new Official Plan policy development and implementation
- Partnership in the Black Creek Regional Transportation Management Association (TMA). The TMA Steering Committee was formed in 1999 by the City and has broad GTA representation from both the private and public sectors. The steering committee guided the formation of the first TMA in the GTA, the Black Creek Regional TMA and is also integral to the GTA Urban Showcase proposal.
- The 2003 New Mobility Industry Forum focused on the latest service, product and technology developments in the global New Mobility market. The Forum also featured a unique Virtual Trade Show showcasing the latest in Canadian New Mobility products and services.
- Toronto and its GTA partners were successful in the Transportation Demand Management application for funding to develop new Transportation Management Associations (TMA) in the GTA (2 in Toronto and 8 more throughout the GTA). The project will achieve an estimated annual 20,000 tonnes in CO_2 reductions.
- Moving the Economy, a City supported initiative that works to promote and develop economic benefits, opportunities and innovations in sustainable transportation.
- The 2003 New Mobility Industry Forum focused on the latest service, product and technology developments in the global New Mobility market. The Forum also featured a unique Virtual Trade Show showcasing the latest in Canadian New Mobility products and services.
- Transit pass discount programs and customer information services.
- Toronto City Council enacted an anti-idling by-law in 1998.
- Network of High Occupancy Vehicle (HOV) Lanes throughout the City of Toronto.
- Providing transit priority throughout the City by giving buses and streetcars priority at intersections.
- Intelligent Transportation (IT) Systems used to monitor expressway operations and optimisation of traffic signal timings that minimise traffic congestion, thereby reducing vehicle idling and vehicle emissions.

- Active advocate for changes to the federal taxation laws to encourage the City Corporation to provide subsidised employee transit passes.
- Operation Gridlock — Keeping Traffic Moving, an enforcement campaign to reduce congestion at intersections reducing idling and vehicle emissions.

Bicycles

- 2004 is year 3 of the 10-year Toronto Bike Plan implementation.
- Approximately 180 km of the 1,000 km Bikeway Network completed.
- New bicycle lanes and off-road trails included in 2004 Capital Program.
- 11,000 bicycle parking stands installed to date.
- 1,500 new bicycle stands were installed in 2003
- Promoting cycling, especially commuter cycling, through Bike Week and other events.
- Toronto Atmospheric Fund has supported creating legislation for power assisted bicycles.
- Safety and education courses.
- Bicycle User Group Network.
- Bicycle Friendly Business Awards.
- The Road and Trail Safety Ambassadors, started in 1995, provide the City with a group of young trained individuals who reach out to communities with programs and campaigns to deliver safety messages and encourage cycling.

Pedestrians

- City Council adopted the Pedestrian Charter in 2002.
- Council adopted a new sidewalk policy in 2002 to construct sidewalks on both sides of all arterial and collector roads. Two million dollars per year has been committed to completing these missing sidewalks over 10 years beginning in 2003.
- Beginning development of a Pedestrian Master Plan for the City.

Fuel

- Encourage other large organisations within the City to implement a low-sulphur fuel corporate purchasing practice.

Energy Conservation and Alternative Energy

- The Better Buildings Partnership is a public-private partnership to promote and implement energy efficient retrofits of existing commercial, institutional and multi-residential buildings.
- Promotion of higher energy efficiency standards for new buildings.
- A program to introduce higher energy performance standards for new construction.
- Support expanded use of Green Power to reduce adverse impacts on air quality and human health.
- Promotion of solar-energy to heat domestic hot water.
- Facilitation of wind-turbine development.
- Promotion of Fuel Cell Demonstrations.
- Promote energy conservation at household level with *20/20 The Way to Clean Air* campaign.
- Integrated Energy Concept for Central Waterfront — The Waterfront Integrated Energy Concept is part of the proposed waterfront revitalization project. The integrated component

of the project would consist of deep lake water cooling, anaerobic digestion, district and distributed energy systems, natural gas cogeneration, high energy efficiency buildings and a variety of green energy systems (i.e. wind power, solar).

TAF — Toronto Atmospheric Fund

- Lead sponsor of Green$aver's Home Rewards audit and retrofit program, realising average household reductions of 3.3 tonnes CO2 per year per house and reductions in home heating costs of 30 - 40 per cent.
- Provided $495,000 in financing for the wind turbine now operating at Exhibition Place. A joint venture of Toronto Renewable Energy Co-operative and Toronto Hydro, the turbine has projected annual power output of 1,800,000 kWh.

Planning

- Plan for and implement the protection, enhancement and restoration of the City's natural heritage system as part of the new Official Plan implementation.
- Toronto's Official Plan supports the integration of land use and transportation by developing a pattern of growth that is supportive of transit, bicycling and walking.
- A new harmonized Ravine Protection By-law, passed by City Council in 2003, regulates the injury and destruction of trees and the dumping of fill or refuse and alteration of grade. The by-law replaces the existing ravine by-laws of the former municipalities of Toronto, East York and Scarborough and expands the area of protection to include all the ravines.

Urban Forestry and Natural Environment

- In conjunction with the Tree Advocacy Planting Program, 41,200 trees and shrubs and 17,000 native herbaceous plants were planted in 2002, expanding the urban forest and natural areas in parkland throughout the City of Toronto.
- Over 3,500 volunteers participated in 133 school and community planting events in 2002.
- Forty two per cent of the City's parkland area is comprised of and is managed as natural areas, including forests, meadows and wetlands which contribute to air quality in Toronto.

Education and Outreach

- Promoting a GTA-based social marketing campaign – *20/20 The Way to Clean Air* – to encourage an individual and community-wide 20 per cent reduction in vehicle and home energy use.
- Publication of brochures and web pages on smog and health and other air quality issues.
- Increase awareness of health impacts and protection measures related to poor air quality. For example, the City of Toronto is working with the federal government's "Burn it Smart" campaign to distribute educational materials to the public on the health impacts of woodburning fireplaces and mitigative measures.
- Community outreach activities on smog and air quality, including presentations and workshops for City divisions, day camps, professional and community groups.
- Partnerships with the Toronto Regional Conservation Authority and the Toronto Environmental Volunteers Program.

- Toronto Public Health staff are working with the Toronto District School Board to promote *20/20 The Way to Clean Air* in conjunction with their EcoSchools program.
- Toronto Environmental Volunteers. Program that provides 40 hours of detailed training to residents of Toronto on environmental issues (waste reduction, water conservation, energy efficiency and air quality) and 40 hours of supervised field work in their community.
- Posting the results of the Technology Testing Program (2003) at www. toronto.ca/fleet.
- Support for Civic Garden Centre, Humber Arboretum and High Park Nature Centre.
- Green Roof demonstration projects at Eastview Neighbourhood Community Centre and City Hall.
- Reduce/Reuse/Recycle communication program for City employees.
- Clean Air Transportation Show.
- The City of Toronto participates in the Pollution Probe Clean Air Commute.
- "Enviro-Fest". Annual festival to celebrate Earth Day and encourage residents, particularly youth to learn about environmental sustainability issues and to become more actively involved in making Toronto Clean, Green and Healthy.
- The Corporate Smog Alert Response Plan serves as a platform to educate and motivate staff and residents of the City of Toronto on the need to take action to reduce smog and improve air quality.

Centres of Expertise and Innovation

This section briefly describes the mandates and areas of expertise of departments, agencies and offices within the City that, by applying their own unique expertise, participate in, contribute to and potentially could make major improvements in air quality initiatives in the City. City Council has also approved the creation of a Round Table on the Environment, scheduled to meet in October 2004, which may also be influential in the improvement of Toronto's air quality.

The Air Quality Improvement Branch (AQIB) – The AQIB is an office established within the Works and Emergency Services Department in 1998. AQIB assesses the Toronto's air quality in keeping with established health standards and acts. AQIB deals with technical matters of outdoor air quality and undertakes to understand the city's present and future air quality. The office advocates for and implements efficient and effective air quality improvements. AQIB collects and analyses pertinent secondary data from available sources as well as monitors and models the spatial concentration and diffusion of criteria contaminates across the city.

The Toronto Atmospheric Fund -- Toronto City Council established the Toronto Atmospheric Fund (TAF) in 1991 to finance local initiatives to combat global warming and improve air quality in Toronto. TAF's mandate is to promote, among other things, global climate stabilization through the reduction of greenhouse gas emissions such as CO_2 and methane; local air quality; energy conservation and efficiency; TAF's endowment has financed CO_2 emission reductions totaling approximately 225,000 tonnes. The Toronto Atmospheric Fund supports, through grants and loans, projects that address its mandate. TAF's priority interests for the period 2003-2006 are in the areas of: renewable energy; energy conservation and efficiency; and reducing the fossil fuel content of energy sources.

The Energy Efficiency Office (EEO) -- established in 1990 by the former Toronto Council with a mandate to develop a comprehensive energy efficiency and conservation strategy for the City, toward the goal of achieving Toronto's commitment to reduce its carbon dioxide emissions by 20 per cent. Following the recommendation of the 2000 Environmental Plan the EEO is also expected to co-ordinate the City of Toronto's energy efficiency efforts.

The Energy and Waste Management Office -- provides a number of energy services to the City and most of its agencies, boards and commissions (ABCs) by, among other things, coordinating the City's energy purchases, tracking and monitoring energy use and costs, co-ordinating energy efficiency retrofit programs in order to reduce energy use, steering the City's purchase of "green" power and promoting itself as the City's point of contact for corporate energy management expertise.

Fleet Services Division – Fleet Services is a division of Corporate Services and manages the procurement, maintenance and disposal of vehicles and equipment used by many City departments. In 2003 it released a Technology Testing Report on the outcomes of on-road evaluations of hybrid electric vehicles, natural gas vehicles and biodiesel, recommending expanded use of all three alternatives to reduce engine exhaust emissions. This report is the first of its kind for a Canadian municipality. As one of the country's largest fleet operators, the City of Toronto is actively working to promote the development of new vehicle technology such as hybrids and fuel cells and to expand the supply of cleaner alternative fuels through its Green Fleet Transition Plan (2004).

The Toronto Interdepartmental Environment Team – The Toronto Interdepartmental Environment Team (TIE) is an interdepartmental staff group that provides a corporate-wide, coordinated approach to environmental issues and initiatives. TIE is recognized as an important mechanism to help departments and ABC's communicate with one another about emerging environmental issues, serves as a forum for information sharing and develops interdepartmental environmental strategies and priorities. TIE also facilitates interdepartmental review of progress on the City's environmental goals.

Toronto Public Health, Health Promotion & Environmental Protection Office – Toronto Public Health has an evolving goal of making Toronto the healthiest city possible, where all people enjoy the highest achievable level of health. One of the ways TPH has sought to achieve this goal is to research extensively into the health effects of air pollutants. Since amalgamation, TPH has released two signal reports on the Burden of Illness (Toronto Public Health, 2000, 2004) in Toronto from air pollution, a report on ten key carcinogens found in Toronto's air and Condition Critical, an examination of how the provincial Air Quality Index system is not adequately communicating the risks associated with poor air quality. TPH is currently pursuing studies in the relationship between heat, smog and health. TPH has developed policy and programming solutions – notably 20/20 The Way to Clean Air – to improve air quality in the City.