



## STAFF REPORT ACTION REQUIRED

### Air Pollution Burden of Illness from Traffic in Toronto

<b>Date:</b>	October 29, 2007
<b>To:</b>	Board of Health
<b>From:</b>	Medical Officer of Health
<b>Wards:</b>	All
<b>Reference Number:</b>	

#### **SUMMARY**

---

This report responds to the Board of Health's request to estimate the burden of illness and economic impact attributable to air pollution from motor vehicle traffic in Toronto.

This report describes a new study which estimates that traffic pollution gives rise to about 440 premature deaths and 1,700 hospitalizations per year in Toronto. While the majority of hospitalizations involve the elderly, traffic-related pollution also has significant adverse effects on children. Children experience more than 1,200 acute bronchitis episodes per year as a result of air pollution from traffic. Children are also likely to experience the majority of asthma symptom days (about 68,000 per year) given that asthma prevalence and asthma hospitalization rates are approximately twice as high in children as adults. This study shows that traffic-related pollution affects a very large number of people. Impacts such as the 200,000 restricted activity days per year due to days spent in bed or days when people cut back on usual activities are disruptive, affect quality of life and pose preventable health risk.

This study estimates that mortality-related costs associated with traffic pollution in Toronto are \$2.2 billion each year. Based on policies in place in other jurisdictions, implementation of comprehensive, integrated policies and programs could reduce total vehicle travel by 30 to 50%. A 30% reduction in motor vehicle emissions in Toronto could save nearly 200 lives and result in 900 million dollars in health benefits annually.

Enabling greater use of public transit and active modes of transportation such as walking and cycling are of significant benefit to the public's health and safety. This study provides a compelling health rationale for investing in City Council's action plan to combat smog and climate change, and for vigorously pursuing implementation of sustainable transportation policies and programs in Toronto.

## RECOMMENDATIONS

---

The Medical Officer of Health recommends that:

1. The Board of Health request that City Council direct the Deputy City Manager of Cluster B who is the City's senior lead for the Climate Change, Clean Air and Renewable Energy Action Plan and the Sustainable Transportation Plan to ensure that:
  - a. Implementation of the Sustainable Transportation Plan includes consultation with the Medical Officer of Health to ensure that it takes into account the health implications and benefits of policy options and programs to reduce vehicle emissions, enhance public transit and increase active transportation in the city;
  - b. this report is distributed to appropriate senior staff in the Toronto Public Service for their consideration;
2. The Board of Health forward this report to the Executive Committee for their information as they oversee implementation of Council's Climate Change, Clean Air and Sustainable Energy Action Plan;
3. The Board of Health endorse the expansion of infrastructure for walking, cycling and on-road public transit (such as dedicated bus and streetcar lanes) so as to accelerate the modal shift from motor vehicles to more sustainable transportation modes that give priority to pedestrians, cyclists and transit users;
4. The Board of Health commend the Federal Minister of Health for the development of the innovative Air Quality Benefits Assessment Tool (AQBAT), and to recommend further refinement of the tool by:
  - a. incorporating additional risk coefficients that link pollutant exposure with health outcomes into the AQBAT computer-based program; and
  - b. making the tool simpler to use by the public health community; and
5. The Board of Health request the Medical Officer of Health to forward this report to the Ontario Ministry of Health and Long Term Care, Ministry of Health Promotion, Ministry of Children and Youth, Ministry of Transportation, Toronto Cycling Committee, Toronto Pedestrian Committee, GTA Clean Air Partnership, Toronto Atmospheric Fund, Ontario Medical Association, Ontario College of Family Physicians, Ontario Lung Association, Heart and Stroke Foundation, and the Ontario Public Health Association for their information and consideration.

## **Financial Impact**

There are no financial impacts resulting from adoption of this report.

## **DECISION HISTORY**

At its April 10, 2006 meeting, the Toronto Board of Health received the report *Impacts of Traffic on Health* which summarized the current knowledge of the adverse health effects of traffic. The previous report took a broad approach to describing the health effects of traffic, including the effects of air pollution, injuries and death from accidents, decreased physical activity, and increased stress and social isolation. The Board requested the Medical Officer of Health to report further on the burden of illness and economic impact attributable to air pollution from traffic in Toronto.

## **ISSUE BACKGROUND**

Traffic-related pollution poses a significant health risk to the Toronto population. In July 2004, Toronto Public Health released the report, *Air Pollution Burden of Illness in Toronto*. This study estimated that exposure to five common air pollutants contributed to approximately 1,700 premature deaths and 6,000 hospitalizations of Toronto residents each year. Although the 2004 report identified traffic as an important contributor to air pollution, the health effects of this source of pollution could not be quantified at that time.

In July 2004, Toronto Public Health released a companion document *Agenda for Action on Air and Health* that provided a comprehensive plan for provincial action to improve air quality in the region. The report identified key strategies for action including curbing urban sprawl, reducing emissions from point sources including power plants, improving air quality standards, reducing emissions from vehicles and supporting public education programs to reduce vehicle dependency.

In July 2007, City Council adopted the *Climate Change, Clean Air and Sustainable Energy Action Plan*. Council's action plan includes many important strategic directions that the City can undertake to advance a sustainable transportation system for Toronto. The Plan also includes several of the actions directed at the province previously identified in Public Health's *Agenda for Action on Air and Health*.

Toronto Public Health has completed a new study *Air Pollution Burden of Illness from Traffic in Toronto* (Attachment 1) with assistance from the Toronto Environment Office. The report has two major components: a comprehensive review of published scientific studies on the health effects of vehicle pollution; and a quantitative assessment of the burden of illness and economic costs from traffic pollution in Toronto. The report also examines air pollution and traffic trends in Toronto, outlines the health benefits of walking, cycling and other active modes of transportation, and provides an overview of initiatives underway or planned by the City to further combat vehicle-related air pollution.

This summary report highlights the findings of the new study to quantify the contribution of traffic to the burden of illness from air pollution in Toronto. Both reports were prepared in consultation with the Toronto Environment Office, Transportation Services and City Planning. Although it is recognized that bicycles are also vehicles, both reports use the term ‘vehicles’ to refer to motorized vehicles such as cars, vans, sport utility vehicles and trucks.

## COMMENTS

### Scientific Concern about Harm from Traffic Pollution is Increasing

A rapidly growing body of evidence from scientific studies around the world links air pollution at the levels commonly experienced in major urban centres to important adverse impacts on health. Most affected are seniors, and people of all ages with underlying breathing and heart problems. Vehicles are an important source of air pollutants in urban areas, and hence a major contributor to health problems. There is substantial evidence that shows that people living or working close to high-traffic areas experience more adverse effects than people who are further away.

Health effects from the common pollutants found in smog range from premature death and hospitalization for respiratory and cardiovascular illnesses, to less serious but more frequent effects such as chronic bronchitis and asthma symptoms. Although the adverse impact of air pollution on the lung has been known for some time, newer research shows that air pollution also contributes to cardiovascular problems such as heart attack and stroke. Many of these health effects are attributable to acute and chronic exposures to common smog-forming air pollutants.

Chronic exposure to ‘air toxics’ (toxic chemicals in the air) is also of growing concern. There is increasing evidence that vehicle emissions are associated with the development of cancer, especially lung cancer. Diesel exhaust, benzene and 1,3-butadiene are known carcinogens that are emitted by vehicles. Also of concern is the potential link between vehicle exhaust and reproductive effects, such as reduced fertility and low birth weight.

### Traffic-Related Pollution Is a Major Contributor to Illness and Death in Toronto

Motor vehicles generate three types of air pollutants: criteria pollutants (common smog-causing pollutants); air toxics; and greenhouse gases (GHGs). The health impacts associated with pollutant levels in Toronto, based on 2004 data, are summarized below.

#### Common Smog-Causing Pollutants

In Toronto, as in most major urban centres in North America, vehicles are a significant source of ‘criteria’ (common) air pollutants of health concern. These common pollutants include nitrogen dioxide (NO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), carbon monoxide (CO) and particles of various sizes. Smaller particles, such as respirable particles (PM<sub>2.5</sub>) are of

greatest health concern because they are small enough to be inhaled deeply into the lungs. Vehicles also emit pollutants such as nitrogen oxides (including nitrogen dioxide) and volatile organic compounds (VOCs) that enable ozone to form in the presence of sunlight.

Vehicles are the largest source of CO (85%) and NO<sub>x</sub> (69%) emissions within Toronto. They are also a significant source of PM<sub>2.5</sub> (16%). While vehicles do not emit ozone directly from the tailpipe, they emit precursor chemicals (such as NO<sub>x</sub>) which give rise to large amounts of ozone that form in the air and are of substantial health concern.

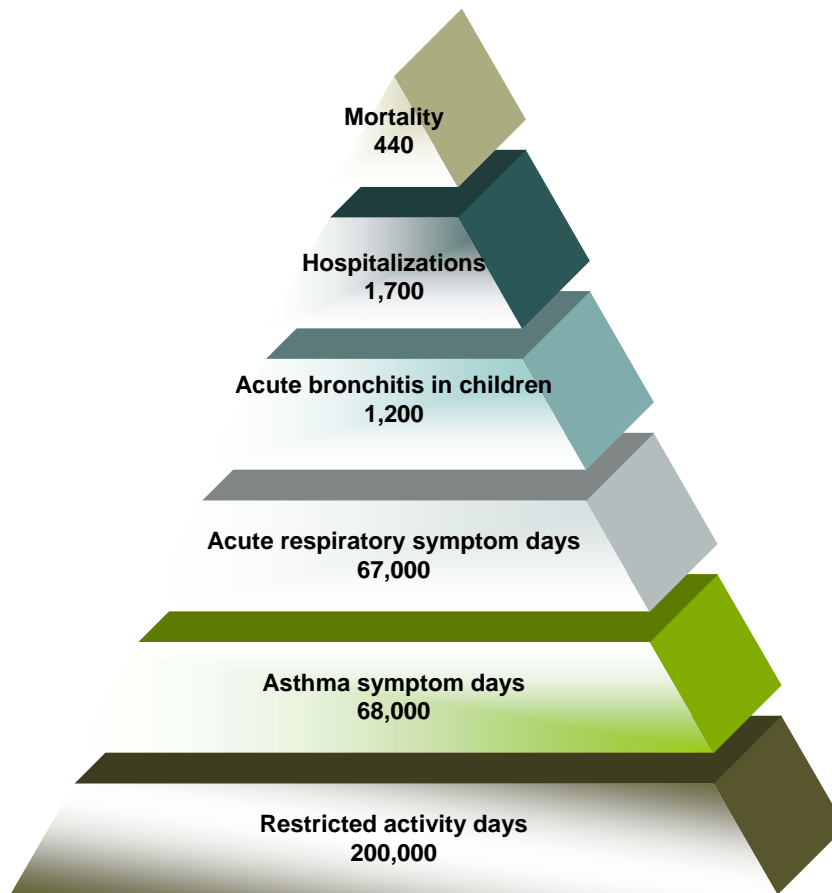
### **Burden of Illness from Traffic-Related Pollution**

Burden of illness studies provide a reliable and cost-effective mechanism by which local health authorities can estimate the magnitude of adverse health impacts from criteria air pollutants. Health Canada has developed a computer-based tool, called the *Air Quality Benefits Assessment Tool (AQBAT)* which can be used to calculate burden of illness estimates. Toronto Public Health used this tool in the current study to quantify the burden of illness from traffic-related air pollution.

Toronto Public Health collaborated with air modelling specialists at the Toronto Environment Office to determine the specific contribution of traffic-related pollutants to overall pollution levels. Data on traffic counts and flow, vehicle classification and vehicle emission factors were analysed by Toronto Environment Office and Transportation Services for input into a sophisticated air quality model. The air model takes into account the dispersion, transport and transformation of compounds emitted from motor vehicles. Other major sources of air pollution in Toronto are space heating, commercial and industrial sources, power generation and transboundary pollution.

Figure 1 provides highlights of the new study through a graphic depicting the pyramid of health effects attributable to air pollution from traffic in Toronto. The study determined that traffic pollution gives rise to about 440 premature deaths and 1,700 hospitalizations per year in Toronto. \*(Note: the 2004 report Air Pollution Burden of Illness Report estimated 1,700 premature deaths and 6,000 hospitalizations as a result of exposure to five common air pollutants. This report attributes 440 of those premature deaths and 1,700 hospitalizations specifically to air pollution caused by traffic.) While the majority of hospitalizations involve the elderly, traffic-related pollution also has significant adverse effects on children. Children experience more than 1,200 acute bronchitis episodes per year. Children are also likely to experience the majority of asthma symptom days (about 68,000) given that asthma prevalence and asthma hospitalization rates are about twice as high in children as adults.

Figure 1. Pyramid of Health Effects from Traffic Pollution in Toronto:  
Annual Illness Outcomes for Toronto in 2004 (rounded)



Health Outcome	Description
Mortality	Number of premature deaths from short-term and chronic exposures to air pollution
Hospitalizations	Number of admissions to hospital for breathing problems (e.g. asthma, COPD, respiratory infections) and heart problems (e.g. angina, heart attack, irregular heart beat).
Acute bronchitis in children	Number of episodes of acute bronchitis involving children
Asthma symptom days	Total number of days that people with asthma experience symptoms or an asthma attack
Acute respiratory symptom days	Total number of days when respiratory symptoms are reported, including chest discomfort, coughing, wheezing, sore throat, sinus trouble, eye irritation etc.
Restricted activity days	Total number of days spent in bed or days when people cut down on usual activities.

In addition to asthma symptom days, traffic pollution gives rise each year to about 67,000 acute respiratory symptom days. These are the total number of days when respiratory symptoms or related conditions are reported. Symptoms include chest discomfort, coughing, wheezing, sore throat, headache and eye irritation.

This study shows that traffic-related pollution affects a very large number of people. Even relatively minor impacts, such as the more than 200,000 restricted activity days are disruptive, affect quality of life, and are a preventable health risk to Toronto residents.

This study estimates that mortality-related costs associated with traffic pollution in Toronto are about \$2.2 billion each year. A 30% reduction in vehicle emissions in Toronto could save nearly 200 lives and result in 900 million dollars of health benefits annually. This study indicates that investments in sustainable transportation have considerable potential to reduce health-related costs.

The Victoria Transport Policy Institute has assessed a range of policy options and programs in place in other jurisdictions. It estimates that compared with traditional planning and pricing practices the implementation of comprehensive combination of integrated policies and programs could reduce total motor vehicle travel by 30 to 50% in a given community. Table 1 provides examples of such policy options implemented in other jurisdictions and their capacity to reduce overall vehicle use.

Table 1. Capacity of Selected Policy Options to Reduce Vehicle Use

Policy Option	Description	Reduction in Total Vehicle Use (%) <sup>a</sup>
Transportation Planning	Adoption of options that consider all direct and indirect costs and benefits	10 - 20
Mobility Management Programs	Local Transportation Demand Management (TDM) programs that support and encourage use of alternative modes	4 - 8
Commute Trip Reduction	Programs by employers to promote alternative commuting options	1 - 3
Fuel Taxes – Tax Shifting	Increases fuel taxes and other vehicle taxes	5 - 15
Parking Management	More efficient use of parking facilities	2 - 8
Parking Pricing	Direct charges for using for parking facilities, with rates that may vary by location	3 - 10
Transit and Rideshare Improvements	Enhances public transit and car-sharing services	2 - 12
Smart Growth Policies	More accessible, multi-modal land use development patterns	3 - 15

(a) Refers to expected reduction as a % of total vehicle travel in the community

Source: Todd Litman. *Win-Win Transportation Solutions*. Victoria Transport Policy Institute. September 2007.

Several of the policy options identified by the Victoria Transport Policy Institute are similar to options under consideration by the City of Toronto staff as part of the Sustainable Transportation Implementation Strategy. Achieving significant reductions in motor vehicle use will require time, substantial financial investment, and strong support

by decision makers and the public for alternate modes of transportation to single occupancy vehicle use.

### **Improving AQBAT**

The use of Health Canada's AQBAT enabled Toronto Public Health to estimate the burden of illness associated with more health outcomes than its previous studies, which could quantify only the number of premature deaths and hospitalizations. As such, the current study gives a more complete picture of the toll that air pollution takes on health of Toronto residents. However, it is likely that even this new study with its improved methodology underestimates the full impact of traffic pollution on health because of gaps in the availability of 'risk coefficients' for all the pollutants in the model.

Further improvements in the tool would be beneficial to users. It is recommended that Health Canada incorporate additional risk coefficients that link pollutant exposure with health outcomes into AQBAT, and that AQBAT be configured to become a more user-friendly and simpler to use tool.

### **Air Toxics**

Vehicles are a significant source of air toxics. Air toxics are substances that occur in the air in much smaller amounts than criteria pollutants, but which are much more potent in terms of adverse impacts. In general, air toxics are of most concern because of long-term (chronic) exposure. They are associated with many serious health outcomes, including cancer and reproductive effects.

Toronto does not have an emissions inventory for air toxics at this time. Hence, it is not possible to quantify the contribution of air toxics from vehicles relative to other sources.

By comparing Environment Canada's data on ambient levels of trace toxics in Toronto's air with health benchmarks, Toronto Public Health was able to identify several pollutants of priority health concern. Vehicle-related exposures to chromium, benzene, polycyclic aromatic hydrocarbons (PAHs), 1,3-butadiene, formaldehyde, acrolein and acetaldehyde are of concern because these pollutants occur routinely in Toronto's outdoor air at levels above health benchmarks. For many of these pollutants, industrial and commercial facilities also contribute to ambient levels.

### **Greenhouse Gases**

Vehicles are a large source of greenhouse gases (GHGs) in Toronto. The transportation sector contributes about 35% of the total GHGs emitted as a result of activities in Toronto. Of the GHG emissions produced by vehicles, about 25% are attributable to transport trucks and 75% are generated by personal vehicles (cars and light trucks).

Unlike criteria pollutants and air toxics, which have direct adverse impacts on health, GHGs are of health concern because of secondary effects such as global warming and climate disruption. In a previous research study, Toronto Public Health determined that on average (over the 46 year study period), about 120 people die prematurely from heat-

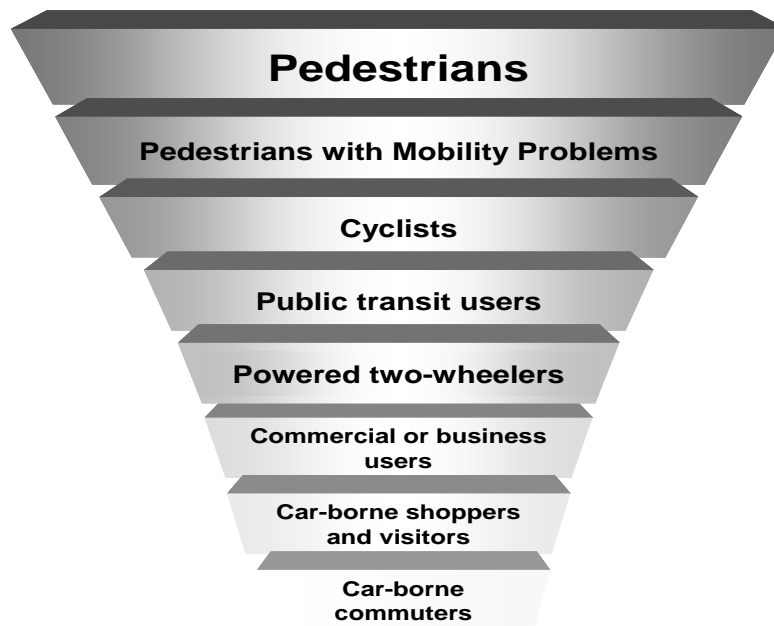
related causes in Toronto each year. Furthermore, it is projected that global warming would result in a doubling of heat-related deaths by 2050, and a tripling by 2080.

## Implementing Sustainable Transportation Strategies Improves Health

Trend data for Toronto show that the number of vehicles traveling into and out of the city each morning has increased by about 75% over the last two decades. In 2006, 67% of trips into the city were made by single occupant vehicles. About 14% of trips were made by multiple occupant vehicles. Only 20% of trips into the city were made by public transit (including GO bus, GO train, regional bus and TTC). For people living and working within Toronto, the proportion using public transit, cycling or walking is much higher than for those commuting from outside the city.

The implementation of a sustainable transportation approach should support a shift in vehicle travel to more environmentally sustainable and healthy choices such as public transit, cycling and walking. The World Health Organization promotes designing cities around people, not cars. This can be done by ensuring land use and transportation decisions are made in a way that gives priority to the travel needs of people in the following order: pedestrians, people with mobility problems, cyclists, transit users, powered two-wheelers, commercial and business users, car-borne shoppers and visitors, and lastly, car-borne commuters (as illustrated in Figure 2).

Figure 2. Hierarchy of Transportation Users (In Descending Order of Priority)



Adapted from: World Health Organization. 2006. *Promoting Physical Activity and Active Living in Urban Environments*.

## Health Benefits of Active Transportation

‘Active transportation’ refers to modes of travel that rely on using one’s own energy to get from one place to another. Examples include walking and cycling. Modes of transportation that are alternatives to vehicles provide benefits to both individuals and the community. Active transportation reduces greenhouse gas emissions and other air pollutants, reduces congestion on roads, and results in improved fitness and good health.

Increased cycling and walking are good forms of moderate-intensity physical activity to improve health. Incorporating just thirty minutes per day of moderate activity such as walking or cycling helps to maintain or improve muscular strength, flexibility and healthy bones, and contributes towards healthy weights. Other benefits of being physically active include improved concentration and increased self-confidence. Active transportation becomes part of a healthy lifestyle when it is integrated into regular routines such as getting to and from work and school, social activities and running errands.

Among older people, even modest increases in physical activity can make a major difference in their well-being, and in their ability to remain independent and actively contribute to civic life. Enabling and encouraging increased physical activity among this population is an effective means of lowering the high costs associated with health and social services.

Increased levels of participation in physical activity can contribute to social cohesion, neighbourhood vitalization and a greater sense of community identity. Green spaces, skateboarding parks, trails, and sports facilities provide a social focus and enhance people’s perception of the quality of their neighbourhood. Providing equitable and safe opportunities for active living may also encourage the expansion of social networks, which is especially important for members of minority ethnic, racial and religious groups and for older residents.

### Enabling Active Transportation

The low-walkability of sprawling neighbourhoods, and the corresponding increase in car use is thought to contribute to the growing obesity epidemic, especially in children. People who live in low-density car-dependant neighbourhoods suffer from more obesity, high blood pressure, diabetes and cardiovascular diseases than people who live in higher density, “walkable” communities.

Design elements in the built environment, such as street layout, land use, public transport, and the location of recreational facilities, parks and public buildings, are all components of a community that can either encourage or discourage active living. Overall, an integrated approach to land use and transportation planning is essential in order to reduce the burden of illness associated with vehicle traffic.

A key barrier to engaging in physical activity involves concerns about safety and security. We cannot expect Torontonians to engage in outdoor physical activity if air

quality is poor. People will not cycle or walk if they believe it is dangerous. Shared road use by vehicles, pedestrians and cyclists increases the risk of a traffic injury among walkers and cyclists. This is especially true for children and seniors. The speed of vehicle traffic is a concern for both cyclists who share the road with motorists and pedestrians who need to cross the road safely. The Agence de la santé et des services sociaux de Montreal reports that 82% of Canadians want to walk more regularly and 66% have a desire to cycle (or cycle more) but safety concerns prevent them from being more active.

Efforts that increase physical safety are important to increase the public's uptake of active transportation. For cyclists in Toronto, this means completing the 1,000 km bikeway network of bicycle lanes, routes and trails recommended by the Toronto Bike Plan as quickly as possible. Other important cycling improvements include more and higher security bicycle parking at work places and other destinations and better integration with public transit for longer trips. For pedestrians, this means implementing measures that encourage Toronto residents to make more walking trips, including wider and more continuous sidewalks and walkways, enhancements to pedestrian crossings and traffic signal timing, narrowing pavements where feasible, and promoting a culture of walking.

Many current cyclists and people who would like to cycle are also concerned about breathing vehicle emissions on roads with heavy traffic. The closer one is to the tailpipe of vehicles, the greater the exposure to pollutants and the greater the health risk. As the popularity of cycling increases across the city, more must be done to reduce the volume of motor vehicles travelling beside bicycle routes.

Given there is a finite amount of public space in the city for all modes of transportation, there is a need to reassess how road space can be used more effectively to enable the shift to more sustainable transportation modes. Toronto Public Health strongly supports the increased allocation of road space towards development of expanded infrastructure for walking, cycling and on-road public transit (such as dedicated bus and streetcar lanes) so as to accelerate the modal shift from motor vehicles to sustainable transportation modes that give more priority to pedestrians, cyclists and transit users.

Expanding and improving the infrastructure for sustainable transportation modes will enable more people to make the switch from vehicle dependency to other travel modes. This will also benefit motorists as it would reduce traffic congestion, commuting times and stress for those for whom driving is a necessity. Creating expanded infrastructure for sustainable transportation modes through reductions in road capacity for single occupancy vehicle use will require a new way of thinking about travelling within Toronto and beyond. To be successful, it will require increased public awareness and acceptance of sharing the road in more healthy and sustainable ways, as well implementation of progressive policies and programs by City Council.

## Combating Smog and Climate Change

In July 2007, City Council adopted the Climate Change, Clean Air and Sustainable Energy Action Plan. This comprehensive and ambitious plan targets the following air quality improvements: a reduction in greenhouse (GHG) emissions from 1990 levels of 6% by 2012, 30% by 2020 and 80% by 2080; and a reduction in locally-generated smog-causing pollutants from 2004 levels of 20% by 2012. Council's action plan includes many important strategic directions to advance a sustainable transportation system for Toronto.

Furthermore, in October 2007, City Council endorsed the staff report Sustainable Transportation Initiatives: Short-term Proposals. This report identifies a number of sustainable transportation initiatives that could be implemented fairly quickly, and in most cases, at relatively little expense.

Other major policy directions that support sustainable transportation are the City's Official Plan and recent plans to increase transit ridership through the Ridership Growth Strategy and the Transit City Plan.

Toronto Public Health's new study demonstrates the significant burden of illness and health-related costs associated with current levels of smog-generating pollutants, greenhouse gases and air toxics that are emitted by vehicles in Toronto. The study also highlights the health and economic benefits of preventing traffic-related air pollution. This study provides a compelling health rationale for investing in Council's plan to combat smog and climate change, and for renewing the vigour with which sustainable transportation is pursued.

Toronto Public Health recommends that implementation of the Sustainable Transportation Plan includes consultation with the Medical Officer of Health to ensure that it takes into account the health implications and benefits of policy options and programs to reduce vehicle emissions, enhance public transit and increase active transportation in the city.

## CONTACT

Monica Campbell, Ph.D.  
Manager, Health Promotion & Environmental Protection  
Planning & Policy  
Toronto Public Health  
Tel: 416-338-8091  
Fax: 416-392-7418  
Email: [mcampbe2@toronto.ca](mailto:mcampbe2@toronto.ca)

Dr. Rosana Pellizzari  
Director, Planning & Policy and  
Associate Medical Officer of Health  
Toronto Public Health  
Tel: 416-392-7463  
Fax: 416-392-0713  
Email: [rpelliz@toronto.ca](mailto:rpelliz@toronto.ca)

**SIGNATURE**



---

Dr. David McKeown  
Medical Officer of Health

**ATTACHMENT 1:**

*Air Pollution Burden of Illness from Traffic in Toronto.* Toronto Public Health.  
November 2007.