APPENDIX F6
Air Quality

The Road to Change

Halton Region Transportation Master Plan

Air Quality

Halton REGION

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APPENDICES

1. Introduction and Background

Consideration of the impacts of transportation on Regional air quality is an ongoing matter of great importance to Halton Region.

The major sources of air pollution in Halton are:

- Transportation (combustion compounds from on-road and off-road vehicles (e.g. rail), and road dust due to vehicular traffic on paved and unpaved roadways);
- Industrial fossil fuel combustion;
- Residential and commercial heating using fossil fuels;
- Residential heating using wood burning stoves and fireplaces; and
- Transboundary air pollution (i.e., pollutants emitted outside Halton Region (neighbouring municipalities and the United States) that are transported into Halton).

The Halton Region Transportation Master Plan (2031) – *The Road to Change* (TMP), incorporates discussion on air quality that builds on the *Air Quality Management Strategy* that was part of the 2004 Transportation Master Plan, and reports on initiatives undertaken since the completion of that study. The key recommendations of the 2004 strategy include the following:

- Promote use of transit and Transportation Demand Management (TDM) measures (i.e., carpooling to reduce vehicle kilometres travelled and minimize road traffic congestion);
- Increase fuel efficiency in regional fleet management (e.g., alternative fuels, hybrid engines);
- Implement street sweeping and flushing near construction and industrial activities to minimize dirt trackout and subsequent suspension in the atmosphere;
- Maintain posted driving speeds (e.g., 50 - 80 km/h) to reduce tailpipe emissions, where possible;
- Promote on-street and off-street bicycle and walking trail networks, especially where public transit services are spatially or temporally inadequate;
- Develop design and roadway maintenance guidelines that improve air quality, such as wider paved shoulders and appropriate street and shoulder flushing to reduce dust emissions;
- Increase tree planting across the Region as an effective means of removing airborne contaminants ;
- Develop a corporate model, to lead by example, in the reduction of vehicle travel/emissions and the reduction of air quality impacts from transportation sources; and

- Develop an education campaign to promote air quality. Programmes such as commuter challenges, tree planting events and walk/cycle days to work have successfully been implemented in other municipalities.

Consideration of the potential for air quality impacts from transportation is crucial to formulating a comprehensive and effective Transportation Master Plan.

Poor air quality can result in health risks to susceptible community members in Halton and in Ontario in general. The February 2009 report produced by the Halton Region Health Department entitled "*Protecting Health: Air Quality and Land Use Compatibility*" indicates that local governments need to play a critical role in air quality management through appropriate transportation and land use planning.

Criteria air contaminants (CAC) are a set of air pollutants that cause smog, acid rain and other health hazards. They include nitrogen oxides (NOx), sulphur dioxide (SO2), carbon monoxide (CO), particulate matter (PM), volatile organic compounds (VOCs) and ammonia (NH3). Photochemical reactions between some of the CAC species result in formation of ground-level ozone (O3) and secondary PM. Criteria air contaminants are a subset of urban pollutants that may affect human health and contribute to air pollution problems and poor air quality such as smog. These emissions originate from a number of sources, including fossil fuel combustion, industrial processes, vehicular traffic, incineration, paved and unpaved roads, agricultural activities, and forest fires. Environment Canada, the Ontario Ministry of the Environment and Halton Region monitor and track these pollutants across Canada, Ontario and Halton, respectively..

A variety of airborne pollutants are usually present at trace levels in an urban environment. These pollutants include greenhouse gases (GHG) and criteria air contaminants (CAC). Greenhouse gases of carbon dioxide, methane, and nitrous oxide are emitted into the atmosphere primarily by fossil fuel combustion, agriculture and waste management. Other GHG are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoroide (SF6) which are emitted by industrial processes.

1.1 Existing Air Quality in Ontario and Halton

The Ministry of Environment (MOE) has been monitoring air quality in Ontario since 1970. The MOE maintains approximately 40 air quality monitoring stations and, of these, 20 were designated Canada-Wide Standard (CWS) reporting stations. There are two MOE/CWS stations located in Halton Region. These stations are in Burlington (Highway 2/North Shore Boulevard East, Station ID 44008) and in Oakville (Eighth Line/Glenashton Drive/Halton Reservoir, Station ID 44017) (MOE, 2008a). In 2008 Halton Region installed their own monitoring station in Milton to get a better sense of air quality in the northern part of the region.

According to the MOE, annual mean concentrations of ambient oxides of nitrogen (NO_X) have declined in the past few decades. NO_X is considered a CAC and results from fuel combustion in vehicles and industrial sources. A decreasing trend has also been observed in annual sulphur dioxide (SO_2) and carbon monoxide (CO) both of which are CACs and also originate from fuel combustion. A fourth CAC is fine particulate matter with a diameter of 2.5 micrometers ($PM_{2.5}$). It has also been decreasing but often still exceeds the Canada Wide Standard of 30 $\mu g/m^3$. Ground level ozone has continued to increase during the same time frame, although it can be lower in urban areas due to reactions with other airborne compounds. Details on air quality trends and emissions from the various sources in Halton are presented in ***Appendix A.*** Halton Region Health has also recently issued a modelling report that describes the regional emissions profile in Halton (Halton Region Health Department, 2011).

1.2 Vehicular Emission Trends

Vehicle tail-pipe emission rates are expected to decrease in the future due to existing and proposed improvements in control technology and more stringent fuel and emission regulations:

- Implementation of the Environmental Protection Agency (EPA) "Tier 2" emission regulations, which set new, more stringent exhaust emission standards. The Tier 2 standards were implemented between 2004 and 2009;
- Reduction in the maximum sulphur content in gasoline from 150 ppm to 30 ppm as of January 2005;
- Reduction in the maximum sulphur content in on-road diesel fuel from 500 ppm to 15 ppm;
- Ontario's Drive Clean Program: a mandatory vehicle emissions inspection and maintenance program that is reducing vehicle emissions of smog-causing pollutants, GHGs and VOCs; and
- Ontario Regulation 535/05 – Ethanol in Gasoline; gasoline to contain an annual average of 5% ethanol. This has also helped to reduce vehicle emissions of smog-causing pollutants, GHGs, and VOCs.

The annual vehicle-kilometres of travel within Halton's roadway network is expected to grow. Despite the increase in vehicle-kilometres travelled, vehicular emission modelling results (Region of Halton, 2004) indicate that by 2020, transportation emissions are expected to continue to decline despite the increase in the number of vehicles and vehicle use as follows:

- Tailpipe emissions of NO_X are expected to be reduced by 77 percent;
- Tailpipe emissions of SO_2 are expected to be reduced by 91 percent;
- Tailpipe emissions of CO are expected to be reduced by 51 percent; and
- Tailpipe emissions of Total Organic Compounds (i.e., VOCs, methane, and ethane) are expected to be reduced by 73 percent.

The reductions are due to the expected continued improvements in motor vehicle technology, vehicle emission control systems, and more stringent fuel and emission regulations. The future availability of other modes of transportation is also contributing to the predicted decline. Emission reductions will continue well into the future as technologies continue to improve and traditional internal combustion engines are displaced by alternative forms of power (e.g., hybrid technologies).

Regardless of the decreasing trends in certain emissions, there will continue to be a requirement to monitor air quality in the Region.

2. Guiding Documents

2.1 Transportation Master Plan Guiding Principles

At the core of the Halton Region Transportation Master Plan (2031) – *The Road to Change* there are five guiding principles driving the planning effort. They include *Balanced Needs*, *Healthy Communities, Economic Vitality, Sustainability* and *Well-Maintained Infrastructure*. Air quality is linked to each one of these principles.

2.2 Regional Official Plan Amendment 38

The Regional Official Plan gives clear direction as to how physical development should take place in Halton to meet current and future needs. An integral part of the Regional Official Plan is the management of air quality in Halton Region. This is related closely to transportation management due to the contribution of vehicular emissions to the airshed. In Part IV Section 142 of the Official Plan, there are a set of objectives for the Region specifically aimed at the continuous improvement of transportation related air quality. The objectives are:

142(1) "*To reduce, in concert with the Federal Government, the Province, other municipalities, public interest groups and the private sector, the emissions of greenhouse gases*."

142(2) "*To improve air quality and to address the impact of climate change*."

142(3) "*To reduce incrementally the overall greenhouse gas emissions and other air pollutants generated by the Region's own corporate activities and functions*."

142(4) "*To contribute to the overall improvement of air quality in Halton's airshed through facility management, land use planning, transportation management, roadway design, operation and maintenance, and other complementary programs*."

142(6) "*To promote trips made by active transportation and public transit*."

The Official Plan was amended in December 2009 (Regional Official Plan Amendment No 38 – ROPA 38) to incorporate the outcomes of the "Sustainable Halton" process. This process was Halton Region's growth management and land use response to a number of provincial initiatives including the Places to Grow Plan, the Provincial Policy Statement and the Greenbelt Plan. ROPA 38 lists a number of new Regional Council goals that require actions for achievement or continuous improvement. There are a number of specific air quality commitments which include:

143(1) "*Monitor and report regularly, in association with the Province, air quality at strategic locations in the Region and report on such results through the State of Sustainability Report*."

143(1.1) "*Undertake, in association with the Province, airshed modelling to predict future air quality in Halton and develop policies and programs to address future degradation of air quality.*"

143(2.1) "*Adopt Air Quality Impact Assessment Guidelines to ensure that development will not result in reduction in air quality in Halton, based on standards adopted by Council to protect the health of Halton residents.*"

143(3) "*Establish five year targets for, and monitor regularly the performance of, the reduction in greenhouse gas emissions and other air pollutants generated by Region's own corporate activities and functions.*"

143(4) "*Promote walking, cycling and public transit over other modes of transportation.*"

143(5) "*Require all new urban development to consider in its design the provision of safe and accessible active transportation facilities and access to public transit services, or transit stops where they are likely to be located, within a walking distance of 400m.*"

143(6) "*Require, in the reconstruction or improvement of Arterial Roads, that consideration be given to:*

a) the provision of facilities for active transportation where appropriate; and

b) tree planting and landscaping initiatives to improve air quality and reduce visual impact to adjacent land uses."

143(9) "*Require proposed development adjacent or in proximity to railway lines or railway yards to undertake, prior to development approval, the following studies by qualified consultants in accordance*

with Provincial policies, to the satisfaction of the Region, the Local Municipality and the Ministry of the Environment, and in consultation with the appropriate railway agency, and to implement the study recommendations, as approved, including the restriction of new residential and other sensitive land uses:

c) air quality studies, if the development is within 1,000m of a railway yard."

143(10) "*Develop, in consultation with the Local Municipalities, the Province, Federal government and the railway agencies, Land Use Compatibility Guidelines to minimize the adverse effects of noise, vibration, odour and air pollution from industrial, transportation and utility sources on sensitive land uses, including the application of separation distance between these non-compatible uses.*"

143(11) "*Encourage the Local Municipalities to permit in those areas adjacent to industrial, transportation and utility uses, primarily land uses that require minimal noise, vibration, odour and air pollution abatement measures and require the proponent of development in those areas to undertake, in accordance with Regional and Ministry of the Environment guidelines, the necessary impact analysis and implement, as a condition of approval, appropriate abatement measures.*"

143(12) "*Require the proponent of sensitive land uses in proximity to industrial, transportation and utility sources of noise, vibration, odour and air pollutants to complete appropriate studies and undertake necessary mitigating actions, in accordance with the Region's Land Use Compatibility Guidelines, Air Quality Impact Assessment Guidelines, and any applicable Ministry of the Environment guidelines. Specifically, an air quality study based on guidelines under Section 143(2.1) is required for such development proposals within 30m of a Major Arterial or Provincial Highway, or 150m of a Provincial Freeway, as defined by Map 3 of this Plan.*"

2.3 Sustainable Halton Phase 1 – Technical Report on Air Quality

As part of the Sustainable Halton initiative, a technical analysis of air quality and human health was completed. The report provides a number of recommendations including the following:

- encouraging development of "complete" communities that are characterized by mixed land uses, mixed housing types, grid road patterns, and are designed to encourage alternative modes of transportation such as walking, cycling and public transit;
- developing alternative modes of transportation such as public transit and bike paths that can be used within and between communities in Halton Region and the Greater Toronto Area;
- educating the public about the health, air quality, and climate benefits associated with "complete communities", alternative modes of transportation, high efficiency buildings, renewable energies and alternative energy systems.

2.4 Legislative Requirements

The Region's need to address air quality is also driven by the Provincial Policy Statement, Places to Grow and the Regional Official Plan Amendment 38. Each of these is discussed in further detail below.

2.4.1 Provincial Policy Statement

The Provincial Policy Statement was issued in March 2005 under Section 3 of The Planning Act. It requires the protection of human health and the improvement of air quality. Section 1.8 of the Statement stipulates that "Planning authorities shall support energy efficiency and improved air quality through land use and development patterns which:

a) Promote compact form and structure of nodes and corridors;
b) Promote the use of public transit and other alternative transportation modes in and between residential, employment and other areas where these exist or are to be developed;
c) Focus major employment, commercial and other travel-intensive land uses in sites which are well served by public transit;
d) Improve the mix of employment and housing uses to shorten commute journeys and decrease transportation congestion; and
e) Promote design and orientation which maximizes the use of alternative or renewable energy, such as solar and wind energy, and the mitigating effects of vegetation."

Finally, the Policy Statement says that active communities should be promoted by:

"…planning public streets, spaces and facilities to be safe, meet the needs of pedestrians, and facilitate pedestrian and non-motorized movement, included but not limited to, walking and cycling", "…connectivity within and among transportation systems and modes" and

"…a land use pattern, density and mix of uses …[that]…minimize the length and number of trips and support the development of viable choices and plans for public transit and other alternative transportation modes, including commuter rail and bus."

2.4.2 Proposed Growth Plan

The Places to Grow Plan (2005) for the Greater Golden Horseshoe states that:

"Municipalities will develop and implement official plan policies and other strategies in support of air quality protection including reductions in emissions from municipal and residential sources….".

2.4.3 Regional Official Plan Amendment 38

ROPA 38 addressed public health and the improvement of air quality. Section 25 identifies protection of the natural environment, enhancing economic competitiveness, and fostering a healthy, equitable society as the three planks upon which its vision of the Region is built.

2.5 Halton Region Air Quality Program

Halton Region has developed a comprehensive Halton Region air quality program consisting of the following five elements:

- Policy development related to air quality and the land use planning process;
- Airshed modelling;
- Stationary air monitoring;
- Portable air monitoring; and
- Health promotion directed at air quality and climate change.

These elements are key to informing the creation of Regional air quality initiatives and other policies which are discussed further in the next two sections.

3. Current Air Strategy Measures

The Region, through its Health Department, has initiated a number of programs and initiatives to address air quality and health impacts to the community. A number of these initiatives and programs can be found at the following website: http://www.halton.ca/cms/one.aspx?portalId=8310&pageId=13704, and include:

- Air quality programs which will provide:
  - air quality monitoring;
  - implementation of the Smog Alert, Heat Alert, and Cold Alert notification programs;
  - airshed modelling;
  - policy development directed at the planning and development process; and
  - health promotion directed at air quality and climate change as they relate to the built environment.
- Community partnerships:
  - Halton Partners for Clean Air Plan;
  - GTA Clean Air Council; and
  - 20/20 Way to Clean Air.
- Energy programs and initiatives:
  - Energy Reduction; and
  - Transportation Planning Programs (Smart Commute Program).
- Promotion of air quality programs such as:
  - Turn Your Engine Off (anti-idling);
  - Burn It Smart (residential wood burning);
  - Protection of natural areas and the Region's tree canopy to improve local air quality.

A comprehensive listing of various federal and provincial air quality initiatives is provided in Appendix B.

3.1 Air Quality Programs

3.1.1 Air Quality Monitoring

Figure 3.1–1 - Ambient Air Quality Monitoring Stations in Halton Region

The MOE operates two ambient air quality monitoring stations in Burlington and Oakville. In 2008, the Halton Region Health Department installed a stationary ambient air quality monitoring station in Milton. The locations of the three air quality monitoring stations are shown in Figure 3.1-1.

The station in Milton allows the Region to monitor the air quality in northern Halton Region. The air contaminants monitored are ozone (O_3), fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), and carbon monoxide (CO). A description of each of the compounds is provided in Appendix C. The recorded data allows for the calculation of hourly Air Quality Health Index (AQHI) readings for the community. The MOE stations in Burlington and Oakville also generate hourly AQHI as well as an hourly Air Quality Index (AQI). The AQI and AQHI, as well as detailed pollutant concentrations recorded at these stations, are posted online at the following website (http://www.halton.ca/health/services/air_quality/todays_air_quality.htm).

3.1.2 Smog Alert and Heat Alert

The MOE issues air quality advisories when the air quality becomes poor (i.e., the AQI reaches or exceeds 50). Residents in Ontario can subscribe to the Ministry's Smog Alert Network to receive email notification when an advisory is issued in their area. Residents of Halton can also visit the Region's Air Quality Monitoring Program's website to determine the current AQI and AQHI to plan activities accordingly.

Halton's Health Department will issue a Heat Alert if a humidex advisory is issued by Environment Canada. A humidex advisory is issued if the maximum daily humidex exceeds 40°C (104°F) and/or exceeds 36°C for three or more days.

3.1.3 Airshed Modelling

Halton Region has developed airshed modelling focused on O_3, $PM_{2.5}$, NO_2, SO_2, and CO based on the emission sources identified in the Region (Halton Region Health Department, 2011). The modelling will be updated in the future as required to incorporate or update growth and vehicle fleet characteristics in the Region, which are used by the model to forecast quality.

3.1.4 Policy Development

Halton Region recognizes the significant impact that air quality has on human health. The Health Department has been involved in developing policies related to land use planning to mitigate the impacts of poor air quality which are linked to growth and development in the Region. These policies include encouraging walkable communities, transit-supportive development, energy efficiency, renewable energy sources, and minimum separation distances between sensitive land uses and emission sources. The policy development work was used to guide the Halton Transportation Master Plan.

3.1.5 Health Promotion

The Halton Region Health Department is involved in educating the community about the impacts of air quality and climate change. Through education, social marketing, the Region's official website, and other forms of media, Halton's air quality initiatives and management strategy are being promoted.

3.2 Community Partnerships

3.2.1 Halton Partners for Clean Air Plan

The Partners for Clean Air Plan identifies actions that organizations and individuals can take to reduce air emissions. The objectives of the Clean Air Plan are to:

- increase awareness about air pollution within all community sectors;
- recognize the Region's collective role in contributing to air pollution;
- increase understanding of the impact of poor air quality on the environment and health;
- promote actions to achieve improved air quality throughout the year; and
- promote actions that can be taken on smog alert days.

3.2.2 GTA Clean Air Council

The GTA Clean Air Council is an inter-governmental group of representatives from all levels of government within the GTA. Its primary goal is to provide an opportunity for stakeholders to discuss issues of concern and participate in strategies to improve air quality and reduce the occurrence of smog. The Region is a member of the Clean Air Council and is represented at meetings by staff from the Health Department. The Town of Halton Hills, the Town of Oakville, the City of Burlington and 21 other communities are also members of the Clean Air Council.

3.2.3 20/20 Way to Clean Air

The Health Department is participating in the 20/20 program, which is supported by the Halton Partners for Clean Air. The 20/20 program is a social marketing campaign developed by Toronto Public Health which includes partners (health departments) from the surrounding GTA municipalities. This program is designed to provide residents with resources to help reduce home energy use and vehicle use by 20 percent.

3.3 Energy Programs and Initiatives

3.3.1 Energy Reduction

The Region has engaged in the following key energy reduction programs and initiatives to reduce the overall corporate and community energy usage as well as GHG and air contaminant emissions in the Region (Halton Region, 2011):

- Upgrading office equipment to Energy Star compliant equipment which has reduced energy consumption by over 1000 MWh per year.
- Replacing traffic and pedestrian signals with LED technology resulting in, to date, a reduction of over 1700 MWh per year.
- Greening of the Region corporate fleet by purchasing hybrid vehicles and using biodiesel.
- Promoting car-pooling for the Region's staff through the Smart Commute Program.
- The Comprehensive Housing Strategy for Halton encourages smarter, higher density housing development, and energy efficient dwellings.

3.3.2 Transportation Planning

Policies and strategies to reduce vehicular emissions and promote alternative modes of travel in Halton were developed as part of the Halton Region Transportation Master Plan (2031) – *The Road to Change*. These policies promote Active Transportation, transit, and Transportation Demand Management.

4. Future Direction

The impact on air quality associated with emissions in general and transportation in particular can be addressed in three ways to maintain a healthy and sustainable community:

- Reduce air emissions at the source;
- Ensure a minimum separation distance between the source and sensitive land uses for new emission sources or sensitive land use areas such as residential, outdoor recreation, hospitals and schools; and
- Remove contaminants from the air by increasing the amount of urban vegetation.

The Region will promote air quality-related initiatives through:

1. Promoting the use of active transportation, transit and transportation demand management measures (e.g., car-pooling and High Occupancy Vehicle (HOV) lanes) to reduce vehicle kilometres travelled and minimize road traffic congestion;
2. Increasing fuel efficiency in regional fleet management (e.g., alternative fuels, hybrid or electric vehicles);
3. Implementing street sweeping and flushing, especially near construction and industrial activities to minimize re-suspension of road dust;
4. Creating and promoting walkable and transit-supportive communities;
5. Promoting on-street and off-street bicycle and walking trail networks in coordination with the Local Municipalities, especially where public transit services are spatially or temporally inadequate;
6. Promoting mixed-use higher density neighbourhoods (proximity to schools, public transit, amenities and recreational areas) which promotes alternative modes, healthy communities and reduced air pollution emissions;
7. Undertaking design and maintenance of roadways that reduce air pollution, (e.g., wider paved shoulders (to reduce re-suspension of dust due to travelling vehicles) and appropriate street and shoulder flushing to reduce particulate matter emissions);

8. Promote washing sand applied for de-icing, prior to application to reduce the fine particulate fraction of the sand (that will potentially become re-suspended) without reducing the effectiveness of its anti-skidding properties;
9. Promoting tree planting across the Region as an effective means of removing airborne contaminants particularly along significant transportation corridors;
10. Maintaining and enhancing the Corporate lead-by-example model in the reduction of vehicle travel/emissions to reduce the air quality impacts from transportation sources; and
11. Maintaining and enhancing health promotion to promote air quality education.

Many of these programs/recommendations form part of the recommendations of the TMP and its associated technical documents as discussed in the next section.

5. Conclusions

The transportation sector in Halton is a significant contributor to NOx, CO, and PM2.5, and it is also a source of VOCs. In terms of existing air quality, Halton is similar to most cities in southern Ontario, and continues to experience levels in excess of the desirable targets for ground level ozone and fine particulate matter. Transportation emissions are projected to have a downward trend despite the projected increase in the number of vehicles and the expanded road network in the Region. This is due primarily to the improvements in vehicle technologies, and more stringent fuel and emission regulations.

Halton Region has been and continues to lead or be involved in multiple initiatives that aim to improve air quality and reduce the impact of Regional air pollution on personal health and the environment. Halton Region will continue to monitor air quality in the Region and actively manage the influence of transportation sources on overall air quality as vehicular traffic and other modes of transportation change in the future.

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APPENDIX A

Air Quality in Ontario and Halton Region

Air Quality Trends

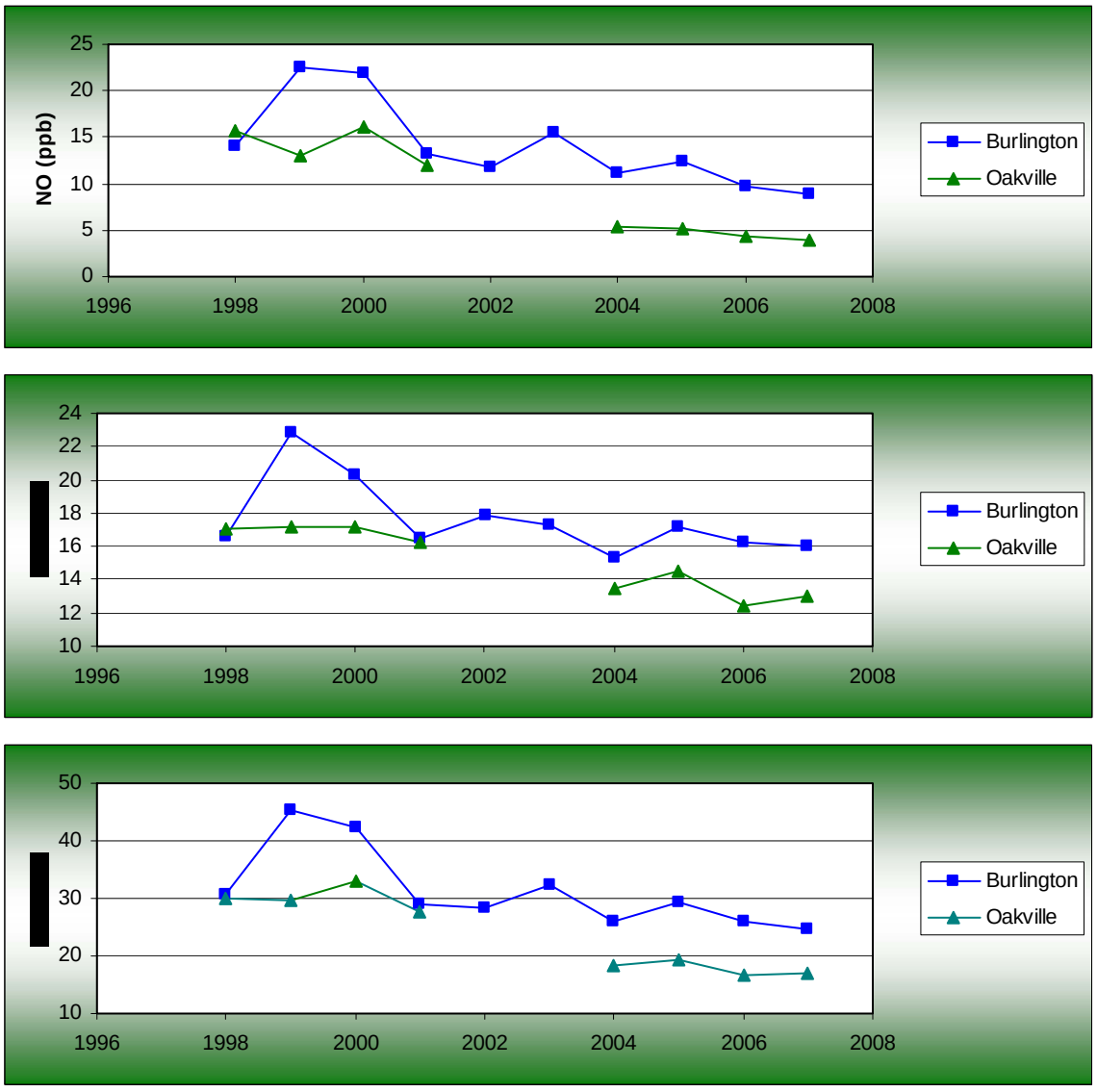
Nitrogen Oxides

The MOE (2008a) reported that over the past 33 years, there has been a steady decline in the annual mean concentrations of ambient NO_2. The overall decrease was approximately 36% over this monitoring period with an approximate 30% decline from 1998 to 2007.

In Halton Region, the station at Burlington reported a decrease in the annual mean NO concentrations by approximately 50% and the Oakville station recorded a decrease by approximately 63% over the period 1998 to 2007. Over the same period, the annual mean concentrations of NO_2 dropped by approximately 20 - 24% for the two stations and annual mean concentrations of NOx decreased by approximately 40% for the two stations. The mean annual concentration in NO_2 for 2007, the latest year of complete data, was approximately 16 ppb (32 $\mu g/m^3$) at Burlington and approximately 13 ppb (26 $\mu g/m^3$) at Oakville. It should be noted that in 2007, the Oakville station recorded the highest 24-hour average concentration in NO_2 of 51 ppb, however the 1-hour and 24-hour criteria for NO_2 were not exceeded at any of the air quality monitoring stations in Ontario (MOE, 2008a).

Figure A–1 illustrates the 10-year trends for the annually averaged NO, NO_2 and NO_X concentrations recorded at Burlington and Oakville ambient air quality monitoring stations.

Figure A–1 - Annually Averaged Ambient Concentrations of NO, NO_2 and NO_x



Note: Not enough data was available from the Oakville station to provide meaningful annual average concentrations of NOx for 2002 and 2003.

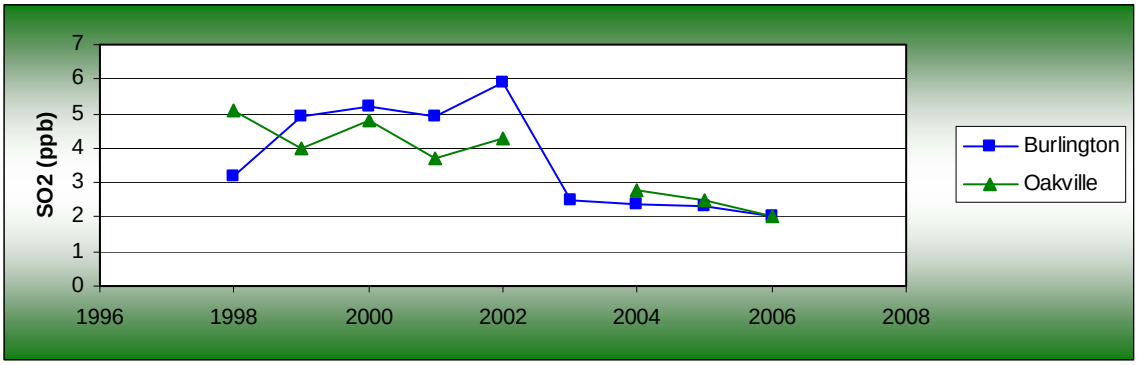
Sulphur Dioxide

The MOE (2008a) reported that over the 37 year period from 1971 – 2007 (inclusive), there has been a steady decrease in the average annual SO_2 concentrations with an overall drop of approximately 90% over this monitoring period. From 1998 – 2007 the decrease has been approximately 44%. The 1-hour criterion of

250 ppb was exceeded for 1-hour at Sudbury in 2007 however the 24-hour criterion of 100 ppb was not exceeded at any of the air quality monitoring stations in Ontario (MOE, 2008a).

From 1998 to 2007, both the Burlington and Oakville stations in Halton have recorded a decrease in the annual mean SO_2 concentrations by up to approximately 60%. The mean annual concentration in 2006, the latest year with good quality data, was approximately 2 ppb at both stations. Figure A–2 illustrates the 10-year trends for the annually averaged SO_2 concentrations recorded at Burlington and Oakville ambient air quality monitoring stations.

Figure A–2 - Annually Averaged Ambient Concentrations of SO_2



Note: Not enough data was available from the Oakville station to provide meaningful annual average concentrations of SO_2 for 2003.

Carbon Monoxide

Over the 37-year period from 1971–2007 (inclusive), there has been a steady decrease in the average 1-hour and 8-hour maxima by 90% and 95%, respectively (MOE, 2008a). The ambient CO concentrations in Ontario in 2007 were less than 5 ppm on average and no station recorded an exceedance of the 1-hour and 8-hour AAQC for CO.

Carbon monoxide was not measured at any of the Ministry's air quality monitoring stations in Halton. However the nearest station to Halton that recorded ambient CO concentrations is the Hamilton Downtown station. This station recorded the maximum 1-hour CO concentrations that ranged from approximately 2 ppm to 7 ppm over the period 1998 to 2007.

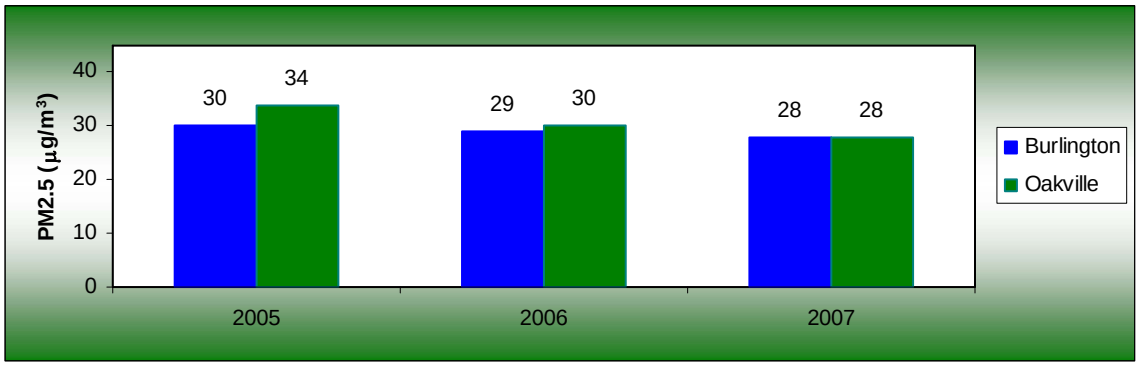
Fine Particulate Matter ($PM_{2.5}$)

A significant fraction of the ambient $PM_{2.5}$ levels in the southern half of Ontario are transboundary in nature. In 2007, the MOE (2008a) reported that 24-hour concentrations of $PM_{2.5}$ continue to exceed the 30 $\mu g/m^3$

concentration level across Ontario except at Thunder Bay and North Bay. The Burlington and Oakville stations reported six days each in 2007 that exceeded this level.

The CWS for $PM_{2.5}$ of 30 µg/m³ is calculated from the 24-hour, 98th percentile annual ambient measurement averaged over three consecutive years. For the years 2005 to 2007, the Burlington and Oakville CWS stations reported a general decrease in $PM_{2.5}$ levels from 34 µg/m³ to 28 µg/m³ (MOE, 2008a). Over the past three years, the CWS was only exceeded at the Oakville station for 2005 however the $PM_{2.5}$ concentrations remain very close to the standard for all years. Figure A-3 provides a summary of PM2.5 monitoring for the period 2005-2007 at Burlington and Oakville.

Figure A–3 - $PM_{2.5}$ Levels Based on the CWS for $PM_{2.5}$ of 30 µg/m³



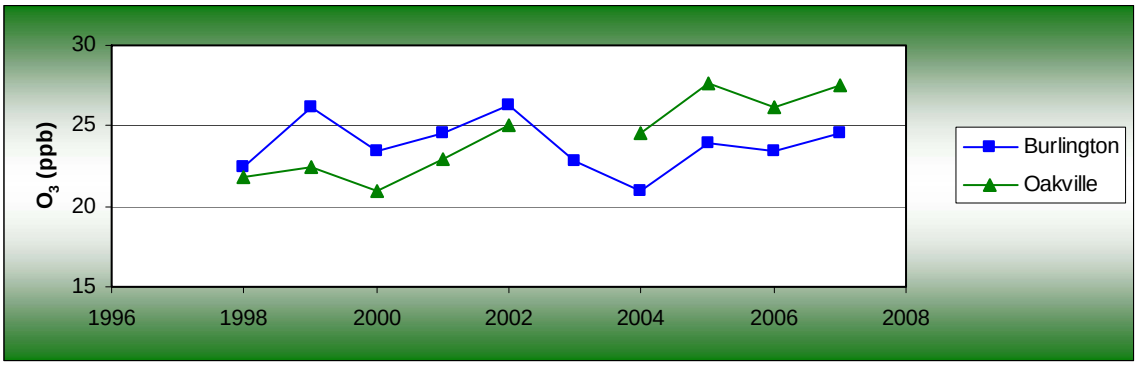
Ozone

Ground-level O_3 concentrations are typically lower in urban areas as a result of reactions with nitric oxide that is emitted by vehicles and other combustion sources. The MOE (2008a) reported that in 2007 O_3 concentrations continue to exceed the 1-hour AAQC of 80 ppb across Ontario. Higher numbers of exceedances were recorded at stations impacted by trans-boundary air pollution. These air quality monitoring stations were located on the north shores of Lake Ontario and Lake Erie, and on the eastern shores of Lake Huron and Georgian Bay.

From 1998 to 2007 the annual composite means of the 1-hour maximum concentrations of O_3 have decreased by approximately 12%. This decrease has been attributed to reductions in NO_x emissions in the United States and Ontario and to weather conditions that have not been conducive to the formation of ground-level O_3. However, the MOE (2008a) reports that the trend of the seasonal composite means of O_3 for the summer and winter over the period 1980 to 2007 have shown an increase of approximately 30% and 60%, respectively. These seasonal increases in the composite means are linked to the reductions in NOx emissions and the increase in global background concentrations of O_3. Meteorological factors and long-range transport of O_3 and its precursors from the United States are also responsible for the increases experienced in the summer.

The MOE (2008a) report presented the annual mean O_3 concentrations recorded at the Burlington and Oakville stations from 1998 to 2007. The data indicated that there was little change in the concentrations recorded at Burlington over this period; however, there was an approximately 17% increase in concentrations measured at the Oakville station over the corresponding period. Figure A–4 illustrates the 10-year trends for the annually averaged O_3 concentrations recorded at Burlington and Oakville ambient air quality monitoring stations.

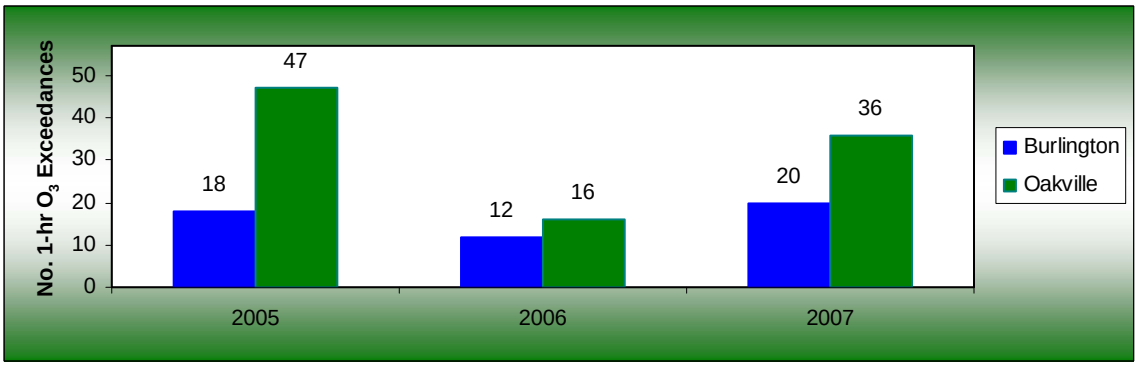
Figure A–4 - Annually Averaged Ambient Concentrations of O_3



Note: Not enough data was available from the Oakville station to provide meaningful annual average concentrations of O_3 for 2003.

The MOE (2008a) has also provided statistics on the frequency of exceedance of the 1-hour AAQC of 80 ppb for O_3 over the period 2005 to 2007. The ambient levels of O_3 recorded at the Oakville station had a greater number of exceedances of the 1-hour AAQC than the levels recorded at the Burlington station. Figure A–5 illustrates the number of 1-hour O_3 exceedances.

Figure A–5 - Frequency of Exceedance of 1-hr AAQC of 80 ppb for O_3



The CWS for O_3 is 65 ppb and is based on the 8-hour running average time of the 4th highest annual ambient measurement averaged over three consecutive years. Except for the Thunder Bay station, all of the CWS stations for O_3, including Burlington and Oakville, exceeded the CWS of 65 ppb for 2007 (period of 2005–2007).

Applicability of MOE Ambient Monitoring Data

Nearly all MOE ambient air monitoring stations have been cited in order to collect data that is representative of background or Regional air quality. While this information is important to managing our Regional air quality, the MOE does not currently have the capability to measure or predict local or street level air quality where human exposure is more likely affected by local sources of air pollution such as major roadways and industries, local air circulation patterns and ventilation in the presence of large buildings, etc. (ECO/RWDI, 2008).

Criteria Air Contaminant Emissions in Halton

Criteria air contaminant emissions of NO_x, SO_2, CO, $PM_{2.5}$, PM_{10} and Total VOCs from the source sectors located in Halton were estimated for 2001 and 2021 in the *Air Quality Management Strategy 2004* report (*Regional Transportation Master Plan Study, Strategies, Plans and Guidelines, June 2004, Appendix L*).

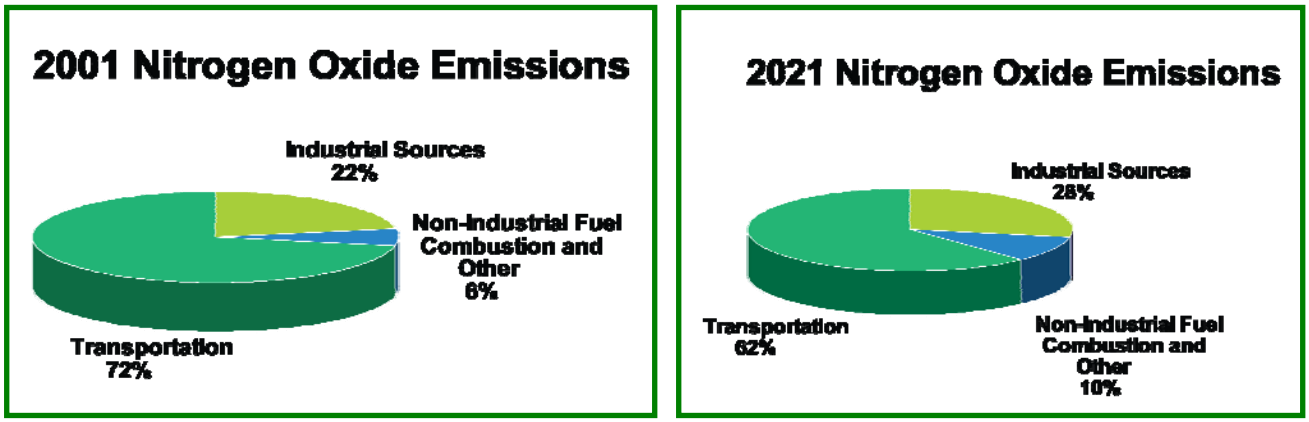
The source sectors were categorized as (1) industrial, (2) non-industrial fuel combustions and others, (3) transportation, and (4) road dust. The category of non-industrial fuel combustions and others would include residential and commercial heating using fossil fuels, residential heating using wood burning (stoves and fireplaces), and agriculture. The transportation sector included emissions from highway and off-highway, rail, aircraft and marine sources. Road dust emissions were a result of the re-suspension of particulate matter caused from road surfaces due to vehicular travel on all paved and unpaved roads in the Region.

It is important to note that emissions inventory data only represents a portion of the overall picture of how different emission sources contribute to air quality impacts. The other contributing factor is how the emissions are released to the atmosphere (tall stacks versus at low levels on roadways) and how they are dispersed once they are released (as affected by terrain and local meteorology). For example, an emission point that is low to the ground and located very close to a point of impact (i.e., a residential community) could have a greater potential to cause an adverse impact than a tall stack which may have emissions that are much greater. These types of impacts are typically investigated through a combination of ambient monitoring and/or modelling techniques and tools.

Nitrogen Oxide Emissions

The total anthropogenic NO_x emissions in Halton were *estimated* at approximately 18,600 tonnes (18.6 kt) in 2001 and were predicted to decrease by 33% to 12.5 kt in 2021. This reduction was primarily achieved by the transportation sector where emissions were predicted to decrease by more than 40% by 2021. The transportation sector was the major source of NO_x emissions contributing approximately 72% of the total NO_x emissions in 2001 and approximately 62% of the total emission in 2021. Despite a predicted future increase in vehicles and vehicle kilometres travelled in Halton, NO_x emissions were offset by the improvements in the standards governing vehicular emissions and fuel standards. Figure A–**6** illustrates the predicted change in NO_x emissions by source sectors in Halton for 2001 and 2021.

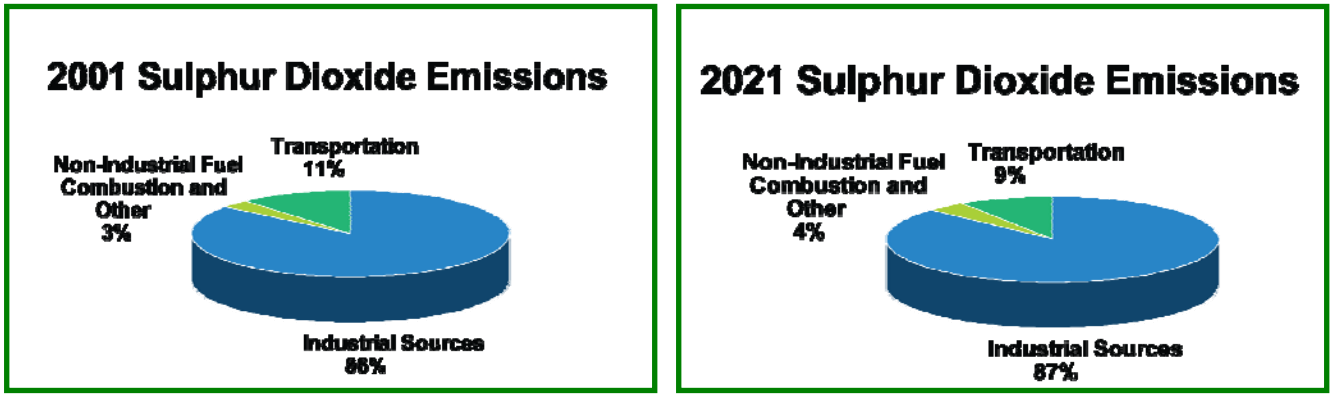
Figure A–6 - NO_x emissions by source sectors in Halton for 2001 and 2021



Sulphur Dioxide Emissions

Total anthropogenic SO_2 emissions in 2001 were estimated to be approximately 9.4 kt. The emissions were predicted to increase marginally by 3% by 2021 to 9.7 kt. The main source for SO_2 emissions was the industrial sector which emitted approximately 86–87 % of the total SO_2 emissions in Halton for the two assessment years. Emissions due to the transportation sector were predicted to decrease by approximately 15% in 2021 when compared to the emission in 2001. The transportation sector was predicted to contribute approximately 11% of the total SO_2 emissions in 2001 and 9% of the total emissions in 2021. As in the case for NO_x emissions, the improvements in the vehicular emission and fuel standards tended to offset the impact of future increases in the number of vehicles and vehicular kilometres travelled. The following Figure A–**7** illustrates the predicted change in SO_2 emissions by source sectors in Halton for 2001 and 2021.

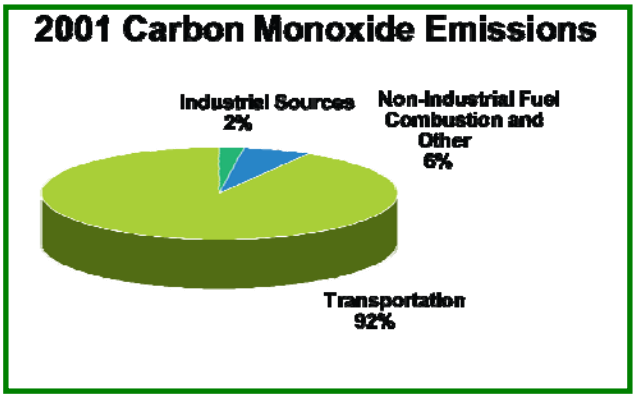
Figure A–7 - SO_2 emissions by source sectors in Halton for 2001 and 2021

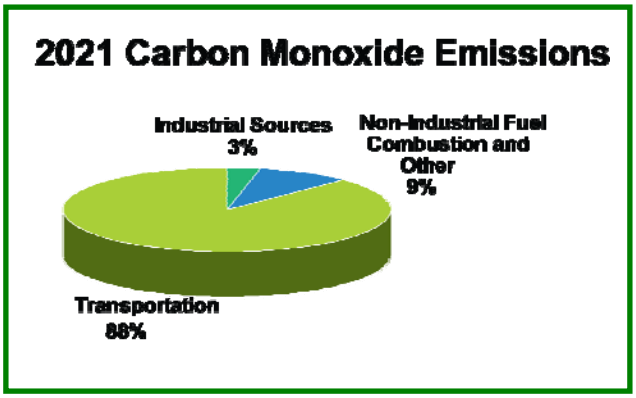


Carbon Monoxide Emissions

The total CO emissions were estimated to be approximately 101.7 kt in 2001 and were predicted to decrease by approximately 11% to 90.9 kt by 2021. The main source of emissions was the transportation sector, which contributed approximately 92% of the total CO emissions in 2001 and 88% of the total emissions in 2021. Emissions due to transportation decreased by 15% from the 2001 estimated emission of approximately 93.3 kt to approximately 79.4 kt predicted for 2021. As in the case for NO_x emissions, the improvements in the vehicular emission and fuel standards tended to offset the impact of future increases in the number of vehicles and vehicular kilometres travelled. Figure A–**8** illustrates the predicted change in CO emissions by source sectors in Halton for 2001 and 2021.

Figure A–8 - CO Emissions by source sectors in Halton for 2001 and 2021





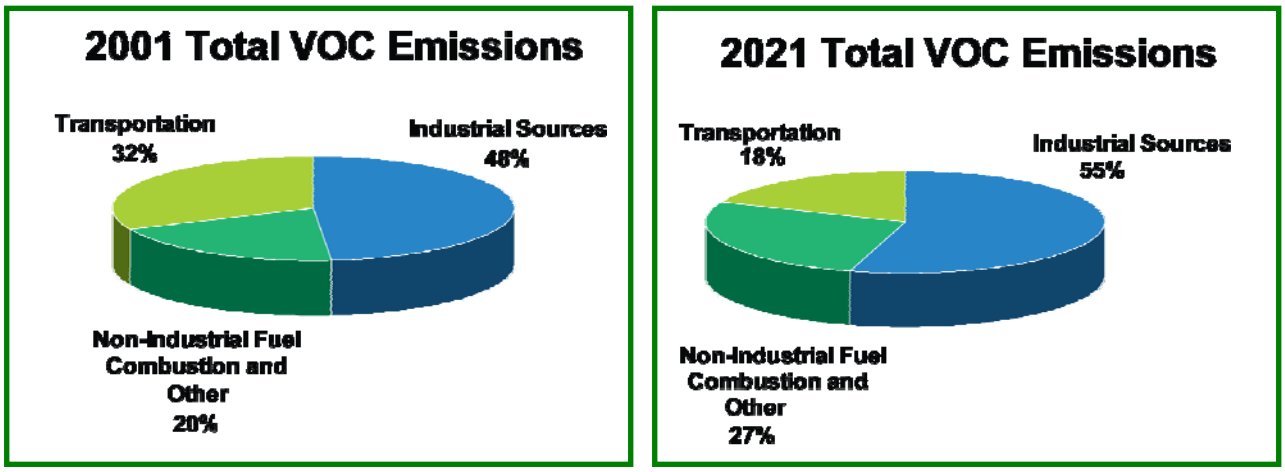
Fine Particulate Matter Emissions

The total fine (respirable) particulate matter ($PM_{2.5}$) emissions in Halton were estimated to be approximately 4.9 kt in 2001. The total $PM_{2.5}$ emissions were predicted to increase by approximately 32% to 6.5 kt by 2021. The transportation and road dust sources (which are linked) together contributed to the bulk of $PM_{2.5}$ emissions in Halton. In 2001 the estimated $PM_{2.5}$ emissions from these sources were approximately 51% of the total emissions and in 2021 the emissions were predicted to decrease marginally to approximately 50% of the total emissions.

The $PM_{2.5}$ emissions from transportation were predicted to decrease by 36% from 0.6 kt in 2001 to 0.4 kt in 2021. Road dust based $PM_{2.5}$ emissions were however predicted to increase by approximately 48% from 1.9 kt in 2001 to 2.9 kt in 2021. The increase in future road dust emissions is due to the predicted increase in vehicular traffic and road network. Despite the predicted increase in vehicles on Halton roads the future $PM_{2.5}$ emissions from the transportation sector is offset by improvements in the standards for vehicular emissions and fuel.

Figure A-9 illustrates the predicted change in $PM_{2.5}$ emissions by source sectors in Halton for 2001 and 2021.

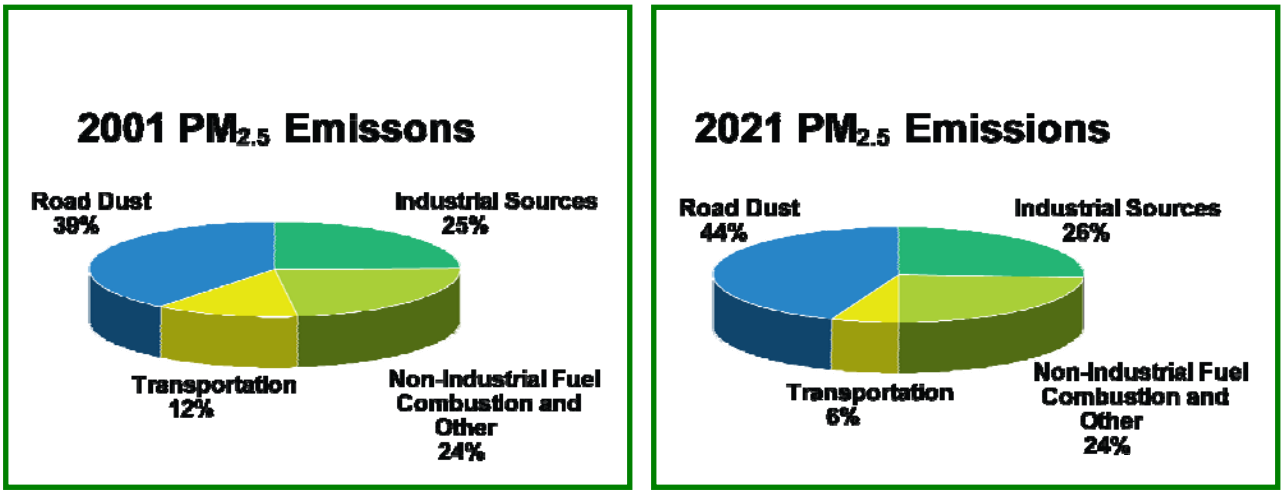
Figure A–9 - $PM_{2.5}$ emissions by source sectors in Halton for 2001 and 2021



Volatile Organic Compound Emissions

The total anthropogenic VOC emissions in Halton were estimated to be approximately 104.6 kt in 2001 and 103.7 kt in 2021. The main source of anthropogenic VOC was industry contributing approximately 48% of the total VOC in 2001 and approximately 55% of the total emissions in 2021. The estimated emissions from the transportation sector were approximately 32% and 18% of the total VOC emissions in 2001 and 2021, respectively. VOC emissions due to transportation were predicted to decrease by approximately 44% in 2021 from the 2001 estimated emissions. As in the case for NO_x emissions, the improvements in the vehicular emission and fuel standards tended to offset the impact of future increases in the number of vehicles and vehicular kilometres travelled. Figure A–**10** illustrates the predicted change in total VOC emissions by source sectors in Halton for 2001 and 2021.

Figure A–10 - Total VOC emissions by source sectors in Halton for 2001 and 2021



APPENDIX B

Federal and Provincial Policy Initiatives

Federal Regulations, Policies, Initiatives as of March 2011

Alternative Fuels Act

http://laws.justice.gc.ca/en/A-10.7/index.html

Act current to January 12th, 2010.

This act, taken into effect in 1997, serves to encourage the use of alternative fuels for federal government-owned vehicles (automobiles, light and medium duty trucks, vans and buses). The goal is for at least 75% of government driven cars to be alternative fuels cars by 2004. In this act, an alternative fuel refers to ethanol, methanol, propane, natural gas, hydrogen or electricity.

Benzene in Gasoline Regulations (SOR/97-493)

http://www.ec.gc.ca/CEPARegistry/regulations/detailReg.cfm?intReg=1

The objective of the Regulations is to reduce emissions of benzene from gasoline powered vehicles through controls on gasoline composition. The Regulations set limits for the amount of benzene in gasoline and for the benzene emissions number, a calculated parameter that relates gasoline composition to predicted emissions of benzene from vehicles. Manufacturers, blenders and importers of gasoline may opt for limits based on either a batch or on a yearly pool average. The Regulations also prohibit the sale of gasoline with a concentration of more than 1.5% benzene by volume.

Canada-U.S. Air Quality Agreement

http://www.ec.gc.ca/cleanair-airpur/default.asp?lang=En&n=83930AC3-1

The general objective of the Parties is to control trans-boundary air pollution between the two countries. Specific Air Quality Objectives: (1) Each Party shall establish specific objectives, which it undertakes to achieve, for emissions limitations or reductions of such air pollutants as the Parties agree to address. Such specific objectives will be set forth in annexes to this Agreement. (2) Each Party's specific objectives for emissions limitations or reductions of sulphur dioxide and nitrogen oxides, which will reduce trans-boundary flows of these acidic deposition precursors, are set forth in Annex 1. Specific objectives for such other air pollutants as the Parties agree to address should take into account, as appropriate, the activities undertaken pursuant to Article VI. (3) Each Party shall adopt the programs and other measures necessary to implement its specific objectives set forth in any annexes. (4) If either Party has concerns about the programs or other measures of the other Party referred to in paragraph 3, it may request consultations in accordance with Article XI.

Canada-Wide Standards - Canadian Council of Ministers of the Environment

http://www.ene.gov.on.ca/programs/3924b.pdf

Canada-wide Standards (CWSs) are developed under the Canada-wide Environmental Standards Sub-Agreement of the Canada-wide Accord on Environmental Harmonization. The Standards Sub-Agreement is a framework for federal, provincial, and territorial Environment Ministers to work together to address key environmental protection and health risk-reduction issues that require common environmental standards across the country. The Standards Sub-agreement sets out principles for governments to jointly agree on priorities, to develop standards, and to prepare complementary work plans to achieve those standards, based on the unique responsibilities and legislation of each government. Endorsed Canada-wide Standards:

- Benzene
- Dioxin and Furan Emissions from Conical Waste Combustion of Municipal Waste
- Dioxin and Furan Emissions from Incineration and Coastal Pulp and Paper Boilers Dioxin and Furan Emissions from Iron Sintering Plants
- Dioxin and Furan Emissions from Steel Manufacturing Electric Arc Furnaces
- Mercury Emissions
- Mercury Emissions from Coal-fired Electric Power Generation Plants
- Mercury-containing Lamps
- Mercury for Dental Amalgam Waste
- Particulate Matter & Ground-level Ozone
- Petroleum Hydrocarbons in Soil

Canadian Air and Precipitation Monitoring Network (CAPMoN)

http://www.msc-smc.ec.gc.ca/capmon/index_e.cfm

The Canadian Air and Precipitation Monitoring Network is managed by Environment Canada in consultation with the provinces/territories. Provinces and territories may run additional CAPMoN-like sites to meet their own needs. Objectives are to:

- determine spatial patterns and temporal trends of pollutants related to acid rain and smog;
- provide data for long-range transport model evaluations and terrestrial and aquatic effects research; and
- ensure compatibility of federal, provincial and US measurements.

Stations: 24 sites

Measurements: pH and major inorganic ions in precipitation; PM, $PM_{2.5}$ (speciated), PM_{10}, particulate ions, HNO_3, NH_3, SO_2, O_3, NO, NO_2, NO_Y, PAN

CORE Network Database

http://www.msc.ec.gc.ca/natchem/core/index_e.html

The CORE Network Database is managed by Environment Canada. Objectives are:

- to provide long-term, high quality observations of atmospheric chemicals and radiation, at locations representative of major atmospheric regimes (and geopolitical regions) across Canada; and
- to serve as a national facility which maintains standards, provides expertise, serves as a reference network for monitoring and research studies of other jurisdictions and universities, and fulfils international monitoring commitments.

Stations: 6 sites

Measurements: greenhouse gases, smog-related gases, aerosols, O_3, VOC's, aldehydes, precipitation, temperature, relative humidity, and $PM_{2.5,10}$)

The ecoENERGY Efficiency Initiatives

http://oee.nrcan.gc.ca/corporate/programs.cfm?attr=20

ecoENERGY for Biofuels

The ecoENERGY for Biofuels supports the production of renewable alternatives to gasoline and diesel and encourages the development of a competitive domestic industry for renewable fuels. The program provides an operating incentive to facilities that produce renewable alternatives to gasoline and diesel in Canada. ecoENERGY for Biofuels runs from April 1, 2008 to March 31, 2017, and invests up to $1.5 billion over nine years in support of biofuels production in Canada.

ecoENERGY for Personal Vehicles

The Personal Vehicles program provides Canadian motorists with helpful tips on buying, driving and maintaining their vehicles to reduce fuel consumption and greenhouse gas emissions that contribute to climate change.

ecoENERGY for Fleets

The ecoENERGY for Fleets – Benefiting trucking companies and other commercial fleet operations by helping them cut fuel costs and reduce harmful emissions. The ecoEnergy for Fleets Initiative will emphasize information-sharing, workshops and training to help fleets increase their fuel efficiency.

Transportation (manufacturers, federal and alternative fuels)

Federal Vehicles: The Federal Vehicles Initiative aims at helping Government of Canada departments cut costs by increasing the efficiency of their fleets and helping reduce the environmental impact of operating them.

Alternative Fuels: Initiatives inform the public and encourage the production and end-use of alternative fuels such as biodiesel, ethanol, natural gas and hydrogen as well as cleaner conventional fuels such as low-sulphur diesel and reformulated gasoline.

Gasoline and Gasoline Blend Dispensing Flow Rate Regulations (SOR/2000-43)

http://www.ec.gc.ca/CEPARegistry/regulations/detailReg.cfm?intReg=27

The Gasoline and Gasoline Blend Dispensing Flow Rate Regulations prohibit retailers and wholesale purchaser-consumers of benzene-containing gasoline and gasoline blends from using, or offering for use, any nozzle to dispense those fuels into on-road vehicles if the flow rate from the nozzle exceeds 38 litres per minute. The Regulations came into effect on February 1, 2001.

The Regulations protect the health of Canadians by reducing emissions of benzene and other volatile organic compounds (VOCs) into the environment during the refuelling of on-road vehicles. This is achieved by ensuring that in-use fuel dispensing flow rates do not exceed the design capacity of the filler pipes on the existing fleet of vehicles and of new on-board refuelling vapour recovery (ORVR) systems being introduced on Canadian vehicles. ORVR systems are designed to reduce refuelling vapour emissions of benzene and other VOCs by 95% and to perform effectively with fuel dispensing flow rates up to 38 litres per minute.

Integrated Atmospheric Deposition Network (IADN)

http://www.msc-smc.ec.gc.ca/iadn/index_e.html

Integrated Atmospheric Deposition Network is managed jointly by Environment Canada and the U.S. Environmental Protection Agency. Objectives are to:

- determine atmospheric loadings and trends of priority toxic chemicals to the Great Lakes basin;
- make air and precipitation concentration measurements; and
- help determine the sources of those chemicals.

Stations: 9 sites in Canada

Measurements: PCBs, OC pesticides, PAHs

Kyoto Protocol

http://unfccc.int/kyoto_protocol/items/2830.php

In December 1997, Canada and more than 160 other countries met in Kyoto, Japan, and agreed to targets to reduce GHG emissions. Canada's target is to reduce its GHG emissions to 6 percent below 1990 levels by the period between 2008 and 2012. Canada signed the Accord in 2003.

Marine Spark-Ignition Engine and Off-Road Recreational Vehicle Emission Regulations – proposed regulation

http://www.ec.gc.ca/CEPARegistry/regulations/detailReg.cfm?intReg=109

The proposed Marine Spark-Ignition Engine and Off-Road Recreational Vehicle Emission Regulations would introduce new regulated standards to reduce smog-forming emissions from outboard motors, personal watercraft, off-road motorcycles, snowmobiles, all-terrain vehicles and utility vehicles, in alignment with the U.S. Environmental Protection Agency's standards. The proposed Regulations, to be established under section 160 of the Canadian Environmental Protection Act (CEPA 1999), would apply to engines and vehicles of the 2008 and later model years that are manufactured after the planned coming into force date of January 1, 2008. [Note: The planned coming into force date is now targeted for mid-2009 and will be specified in the final regulations to be published in the Canada Gazette, Part II.]

The proposed Regulations would apply to persons in the business of manufacturing, distributing or importing these engines and vehicles for the purpose of sale in Canada, and to persons who import these engines and vehicles for their own use.

Memorandum of Understanding regarding locomotive emissions with the Railway Association of Canada

http://www.ec.gc.ca/epe-epa/default.asp?lang=En&n=22FD9C89-1

On April 26, 2007, the Government introduced mandatory reduction targets for all major industries that produce greenhouse gases (GHG). The transportation sector, as a major contributor to both air pollution and greenhouse gas emissions, will also have to meet stringent targets and standards. Regarding locomotive emissions, the Government will "support an MOU [Memorandum of Understanding] with the Railway Association of Canada that is consistent with the U.S. air pollution standards and that ensures that the rail industry continues to improve its greenhouse gas emission performance during the period 2006-2010. Once the MOU expires, the voluntary approach will be replaced with a regulatory regime. The Minister of Transport will implement new regulations, under the Railway Safety Act, to take effect in 2011."

National Air Pollution Surveillance (NAPS) Network

http://www.etc-cte.ec.gc.ca/napsstations/main.aspx

National Air Pollution Surveillance Network is managed cooperatively between Environment Canada and the provinces/territories. There is a clear delineation of roles and responsibilities. These are formalized in a Gazetted Memorandum of Understanding. Provinces and territories may operate additional NAPS-like sites for their own purposes. Objectives are to:

- determine the nature and extent of air pollutants;
- provide data for research including effects of air pollution on health;
- determine trends and predict emerging issues;
- verify estimates of emissions and provide a basis for issue management legislation and international agreements; and
- assess the effect of pollutants from local industry and mobile sources on nearby communities.

Stations: 177 sites

Measurements: SO_2, CO, NO_2, O_3, $PM_{2.5}$ (speciated), TSP, PM_{10}, VOCs (speciated), OC, EC

National Framework for Petroleum Refinery Emission Reductions (NFPRER)

http://www.ccme.ca/ourwork/air.html?category_id=69

CCME developed a new approach to reduce emissions from the petroleum-refining sector. The National Framework for Petroleum Refinery Emission Reductions is a unique example of an industry-proposed initiative, proposed in which all levels of government, industry, and non-governmental environmental and health organizations worked together.

The NFPRER provides the principles and methods for various jurisdictions to establish facility emissions caps for key air pollutants and air toxics from petroleum refineries. This initiative is intended to lead to better air quality and help reduce negative health impacts such as respiratory and chronic illnesses that are caused by criteria air contaminants and air toxics.

On-Road Vehicle and Engine Emission Regulations (SOR/2003-2)

http://www.ec.gc.ca/CEPARegistry/regulations/detailReg.cfm?intReg=65

The On-Road Vehicle and Engine Emission Regulations introduce more stringent national emission standards for on-road vehicles and engines and a new regulatory framework under the Canadian Environmental

Protection Act, 1999 (CEPA, 1999). These Regulations for controlling emissions from on-road vehicles and engines came into effect on January 1, 2004 (Canada Gazette, 2003).

Ozone Annex to the Canada-U.S. Air Quality Agreement; - December 7, 2000

http://www.ec.gc.ca/cleanair-airpur/CAOL/air/can_usa_e.html

The objective of the annex is to control and reduce, in accordance with the provisions herein, the anthropogenic emissions of nitrogen oxides (NO_X) and volatile organic compounds (VOC) that are precursors to the formation of ground-level ozone and that contribute to trans-boundary air pollution. The Parties' goal is that in the long term, and in a stepwise approach, taking into account advances in scientific knowledge, atmospheric concentrations not exceed: (1) for Canada, the Canada Wide Standard (CWS) for Ozone; and (2) for the United States, the National Ambient Air Quality Standards for Ozone. There are also many specific obligations that each party must adhere to. The United States will reduce NO_X emissions by 35 percent by 2007, representing a 70 percent reduction in U.S. emissions from power plants and major industrial sources during the summer months when smog creates the greatest health risk. In Canada, we have put an annual cap of 39 kilotonnes on nitrogen dioxide (NO_2) emissions from fossil fuel power plants in central and southern Ontario, and a five-kilotonne cap on NO_2 emissions from southern Quebec by 2007. For Ontario, this represents a 50 per cent reduction in power plant emissions of NO2.

Particulate Matter Annex to Canada-U.S. Air Quality Agreement

http://www.ec.gc.ca/cleanair-airpur/default.asp?lang=En&n=AF1043BE-1

Canada and the United States are committed to negotiating the addition of a PM Annex to the United States–Canada AQA while actively developing and implementing emission reduction programs to reduce fine particle concentrations. The United States and Canada have held two negotiating sessions on a PM Annex under the United States–Canada AQA: one in November 2007 and one in May 2008. Substantial progress was made during the most recent session, and inter-sessional work is continuing.

Sulphur in Diesel Fuel Regulations (SOR/2002-254)

http://www.ec.gc.ca/ceparegistry/Regulations/DetailReg.cfm?intReg=63

The goal of the *Sulphur in Diesel Fuel Regulations* (hereinafter referred to as the Regulations) is to ensure that the level of sulphur in diesel fuel used in on-road vehicles in Canada will not impede the effective operation of advanced emission control technologies planned to be introduced on 2007 and later model year vehicles (i.e., in mid-2006) to comply with stringent new exhaust emission standards. This is accomplished by reducing the maximum allowable limit for sulphur in on-road diesel fuel to 15 milligrams per kilogram of the fuel, which is equivalent to 15 parts per million (p.p.m.), commencing June 1, 2006.

Regulations Amending the Sulphur in Diesel Fuel Regulations (SOR/2006-163)

http://www.ec.gc.ca/CEPARegistry/Regulations/DetailReg.cfm?intReg=100

The purpose of the Regulations Amending the Sulphur in Diesel Fuel Regulations is to provide additional flexibility to facilitate the introduction of 15 milligrams per kilogram (mg/kg)-sulphur diesel fuel for on-road use in 2006. The amendments allow a slightly higher sulphur limit of 22 mg/kg for sales of on-road diesel fuel during a period of 45 days, from September 1, 2006 to October 15, 2006, after which the final sales limit of 15 mg/kg takes effect.

Sulphur in Gasoline Regulations

http://www.ec.gc.ca/CEPARegistry/Regulations/DetailReg.cfm?intReg=18

The Regulations set limits on the amount of sulphur in gasoline produced, imported or sold. The Regulations limit sulphur in gasoline to an average level of 30 mg/kg with a never-to-be-exceeded maximum of 80 mg/kg.

Regulations Amending the Sulphur in Gasoline Regulations (Miscellaneous Program) (SOR/2009-93)

http://www.ec.gc.ca/CEPARegistry/Regulations/DetailReg.cfm?intReg=112

The Regulations Amending the Sulphur in Gasoline Regulations, made pursuant to section 140 of the Canadian Environmental Protection Act of 1999 (CEPA 1999), were developed to address recommendations made by the Standing Joint Committee for the Scrutiny of Regulations. While the proposed Amendments are of an administrative nature, they are required to improve the clarity of the Sulphur in Gasoline Regulations (hereinafter referred to as the "Regulations") as well as to achieve consistency between the English and French versions of the Regulations.

Ontario Regulations, Policies, Initiatives as of August 2009

Anti-Smog Action Plan

http://www.ene.gov.on.ca/envision/air/smog/asap2000.htm

Key components of the Plan include:

- Ontario's Smog Accord – the commitment of more than 50 signatory associations to cleaner air;
- A commitment of signatories to a target of a 75 percent reduction by 2015 in the number of times the one-hour ozone criterion of 80 parts per billion is exceeded;
- A 45 percent reduction in total NO_X and VOC emissions from the 1990 Ontario baseline;
- A commitment to develop a particulate matter strategy for Ontario;
- "Quick start" actions to achieve immediate short-term reductions for identified initiatives;
- Longer-term emission reduction plans and updating long-term plans on a 5-year cycle; and
- Implementation of a disciplined management process and organizational structure.

Emissions Trading and New Emission Limits for NO_X and SO_2

http://www.ene.gov.on.ca/envision/air/etr/index.htm

Covering nitrogen oxides (NO_x) and sulphur dioxide (SO_2), Ontario's emission trading program has been in place since December 2001. Stringent emissions caps reduce air pollution and mean cleaner air for the people of Ontario. Emissions reduction trading is a supplementary tool that provides broad incentives to reduce air emissions in all sectors. Ontario's emissions trading system is of the "cap, credit and trade" variety, a hybrid that incorporates the best features of a pure "cap-and-trade" with those of a "baseline-and-credit" system.

Go Green: Ontario's Action Plan on Climate Change

http://www.ene.gov.on.ca/en/air/climatechange/ourplan.php

Go Green is a five-point action plan:

- Green Targets – We have set short-, medium- and long-term targets for reducing Ontario's greenhouse gas emissions, starting now and continuing through mid-century. And we're setting out the measures to achieve these targets – new regulations, conservation, a phase-out of coal-fired power plants and much more renewable energy. From phasing out inefficient light bulbs to rebates for energy audits to provincial sales tax breaks for energy

efficient products, there are new programs and incentives for Ontario consumers, businesses, and municipalities to get green.

- MoveOntario 2020 – We're launching the largest transit investment in Canadian history – a $17.5 billion plan that includes 52 rapid transit projects in the GTA and Hamilton, the country's largest urban area.
- Creating Jobs by Going Green – The *Next Generation Jobs Fund*, a new $650-million program, will secure the next generation of high-paying jobs for Ontarians by supporting businesses' commercial development, use and sale of clean and green technologies and businesses right here in Ontario.
- Green Power – A $150 million investment will help Ontario homeowners fight climate change, conserve energy and adopt green technologies. In addition to a world leading standard offer for renewable energy, we have set long-term targets to double the amount of electricity from renewable sources by 2025. In the short term, we have gone from 10 to nearly 700 windmills, in place or planned. And we now have a standard offer for clean energy to enable power users to improve their efficiency through cogeneration (combined heat and power electricity production). We are removing other barriers that prevent more widespread use of cogeneration.

Go Green: Ontario's Action Plan on Climate Change sets ambitious but realistic targets:

- by 2014 to reduce Ontario's greenhouse gas emissions to 6 percent below 1990 levels– a reduction of 61 megatonnes relative to business-as-usual.
- By 2020 Ontario will reduce greenhouse gas emissions to 15 percent below 1990 levels – a reduction of 99 megatonnes relative to business-as-usual.
- By 2050 we will reduce greenhouse gas emissions to 80 percent below 1990 levels.

Green Energy and Green Economy Act, 2009

http://www.mei.gov.on.ca/english/energy/gea/
http://www.ebr.gov.on.ca/ERS-WEB-External/displaynoticecontent.do?noticeId=MTA2NDQ5&statusId=MTU5NjQ1&language=en

The Green Energy and Green Economy Act, 2009, was passed in the Legislature on May 14, 2009. The Act places a priority on expanding Ontario's use of clean and renewable sources of energy including wind, water, solar, biomass and biogas power.

Ontario Drive Clean Program

http://www.ene.gov.on.ca/en/air/driveclean/index.php

Drive Clean is Ontario's mandatory vehicle emissions inspection and maintenance program that is reducing vehicle emissions of smog-causing pollutants by requiring vehicles to undergo an emissions test to identify emissions problems and have them repaired. In addition to smog-causing pollutants, Drive Clean is also reducing vehicle emissions of other chemicals, including greenhouse gases that damage our health and our environment.

Ontario Regulation 535/05 - Ethanol in Gasoline

http://www.ene.gov.on.ca/envision/ethanol/index.htm

The Ontario government passed regulation Ontario Regulation 535/05 – Ethanol in Gasoline. The regulation calls for an annual average of five percent ethanol in gasoline, beginning in January 2007. Regulating the use of ethanol in gasoline will lead to cleaner air in Ontario and play a key role in reducing greenhouse gases. Ontario's 2007 target for ethanol will reduce annual greenhouse gas emissions by about 800,000 tonnes, equivalent to removing 200,000 cars from the road.

Ontario's Air Quality Index

http://www.ene.gov.on.ca/programs/3958e02.pdf

The Air Quality Index (AQI), introduced in 1988, currently measures and reports on six key urban air pollutants: ozone (O_3), fine particulate matter ($PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2). In communities where odours may be an issue, total reduced sulphur (TRS) compounds are also measured and reported.

Ontario's Smog Alert: A municipal response guide

http://www.ene.gov.on.ca/envision/air/smog/alert.htm

The Ministry of the Environment consulted with over 25 municipalities to develop Smog Alert Response: A Municipal Guide to Action. This guide is a comprehensive resource containing information on smog and health impacts and smog-reducing initiatives. It contains information on: (1) Initiatives already underway in municipalities across Ontario; (2) Current information on the science of smog, including health impacts; and (3) Sample plans municipalities can use to create or improve smog response strategies. This includes examples of by-laws, contract clauses, communication materials and examples of education and outreach programs.

Pollution Hotline

http://www.ene.gov.on.ca/envision/org/hotline.htm

The Ministry of the Environment has a toll-free, 24-hour public hotline for reporting acts of pollution.

Smog Patrol

http://www.ene.gov.on.ca/programs/3678e01.pdf

http://www.ene.gov.on.ca/envision/scb/story/program.htm

Ontario's Vehicle Emissions Enforcement Unit (VEEU) - the Smog Patrol - was formed in 1998 to support the Drive Clean program by conducting province-wide roadside inspections of both heavy duty and light duty vehicles to ensure compliance with Ontario's motor vehicle emission standards. The program uses a risk-based approach in order to focus inspections on specific transportation sectors that present the greatest risk to air quality.

The Toxics Reduction Act, 2009

http://www.ene.gov.on.ca/en/toxics/index.php

Bill 167, the Toxics Reduction Act, 2009 passed by the Ontario Legislature on June 3, 2009 is at the core of Ontario's Toxics Reduction Strategy. The goal of the Toxics Reduction Strategy is to help protect the health and environment of Ontarians by reducing the use of toxic substances in air, land, water and consumer products while supporting the transition of industry to a green economy.

APPENDIX C

Criteria Air Contaminants and Related Pollutants

Nitrogen Oxides

Nitrogen oxides (NO_x) are present in the atmosphere as the sum of nitrogen dioxide (NO_2) and nitric oxide (NO). Nitric oxide is a sharp sweet smelling gas and NO_2 is a reddish brown gas with a pungent and irritating odour. Nitrogen oxides readily react photochemically in the atmosphere with VOCs to produce ground level ozone (O_3) and respirable particulate matter with aerodynamic diameter less than 2.5 microns ($PM_{2.5}$).

Similar to O_3 and $PM_{2.5}$, NO_2 also causes health problems as it can irritate the lungs and adversely impact the respiratory system. It is also a contributor to acid rain formation through transformation of the nitrogen oxides to nitric acid. Combustion is the main source of anthropogenic nitrogen oxides and these include the utility, transportation, and manufacturing sectors. In Ontario, transportation emissions account for approximately 68% of the total NO_x emissions (MOE, 2008a).

Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless gas that smells like burnt matches. It also contributes to the formation of acid rain through transformation of the sulphur oxides to sulphuric acid. It is a precursor to $PM_{2.5}$ through the transformation to sulphates (secondary particulate matter). Health effects caused by exposure to high levels of SO_2 include breathing problems, respiratory illness, changes in the lung's defences, and worsening respiratory and cardiovascular disease. People with asthma, chronic lung or heart disease are the most sensitive to SO_2.

Based on a 2006 emissions inventory, the MOE (2008a) estimated that the major sources of SO_2 in Ontario are from the combustion of coal and oil in the smelting, utilities and cement manufacturing sectors. Together these emit approximately 75% of the anthropogenic emissions of SO_2. Other sectors which contribute to the remaining 25% of emissions include the petroleum refining, transportation and other industry, with the transportation sector being responsible for approximately 4% of the total SO_2 emissions.

Carbon Monoxide

Carbon monoxide (CO) is produced primarily through the combustion of fossil fuels. It is colourless and odourless, and is toxic by inhalation as it readily replaces oxygen take-up by haemoglobin. Exposure to CO can impair vision, work capacity, learning ability, and performance of difficult tasks. At high concentrations it can cause death.

Based on a 2006 emissions inventory, the MOE (2008a) estimates that approximately 85% of the CO produced in Ontario is from the transportation sector. The remaining 15% is from other sources of fossil fuel combustion such as comfort heating, and commercial and industrial operations.

Particulate Matter

The make-up of particulate matter includes, aerosols, smoke, dust, ash and pollen. Anthropogenic sources of emissions are primarily from combustion (e.g., industrial facilities, power plants, smelters, transportation, residential fireplaces and woodstove, agricultural burning and forest fires), transportations (tire and break wear, re-suspension of road dust) and wind erosion of exposed surfaces. Total Suspended Particulate (TSP) matter is a measure of particulate matter, with particle aerodynamic diameters less than 44 μm (micrometres or microns), suspended in the air. PM_{10} is the fraction of TSP with particle aerodynamic diameter of less than 10 μm. TSP and PM_{10} are no longer measured by the MOE (since 2000) as the focus has shifted to fine particulate matter of aerodynamic diameter of less than 2.5 μm ($PM_{2.5}$). This fraction of PM is respirable resulting in adverse health effects for people with asthma, cardiovascular or lung diseases, children and the elderly and can result in premature death. Similar to O_3, exposure to $PM_{2.5}$ is associated with an increase in hospital admissions. Fine particulate matter can also negatively impact the environment through corrosion, soiling and smog episodes.

A significant fraction of the ambient $PM_{2.5}$ levels are trans-boundary in nature. This is especially the case in border communities of southern Ontario and during south to southwesterly wind conditions (MOE, 2008a). Based on a 2006 emissions inventory of sources located in Ontario, primary sources are due to fossil fuel combustion and the MOE (2008a) estimates that approximately 24% of the $PM_{2.5}$ produced in Ontario is from the transportation sector.

Ozone

Ground level ozone (O_3) is not typically emitted directly into the atmosphere, rather it is a gas formed when NO_x and VOCs react in the presence of sunlight. It is a major component of smog and is different from the ozone in the layer high above the earth that protects us from the sun's harmful ultra-violet (UV) rays. The reactions associated with the formation of ozone take place over hours and are strongly dependent on meteorological conditions. The chemicals in photochemical reactions may have been emitted into the atmosphere by local and distant sources several hundred kilometres upwind. Consequently, the local emissions of the precursor substances, such as NO, NO_2, and VOCs, play only a partial role in the formation of ground level ozone locally.

Ozone irritates the respiratory tract and eyes. Exposure to high levels of ozone may result in chest tightness, coughing and wheezing. Children that are active outdoors during the summer when ozone levels are at their highest are most at risk of experiencing such effects. Studies have shown that there is a correlation between ground level O_3 concentrations and increased hospital admissions and premature deaths. Losses in the agriculture and forestry sectors due to crop foliage damage (caused by ground level ozone) are significant in Ontario and the dollar cost loss has been estimated to be approximately $280 million dollars per year (MOE, 2006).

Volatile Organic Compounds

Volatile organic compounds (VOCs) are defined technically as organic compounds having a saturation vapour pressure greater than 10^{-1} Torr at 25°C and at standard atmosphere pressure. A significant number of VOCs are known or suspected to be neurotoxins and carcinogens. Certain VOCs warrant special concern because they are capable of being transported very long distances in the atmosphere and react photochemically with other atmospheric pollutants to form ground level O_3 and $PM_{2.5}$.

VOCs are emitted into the atmosphere from a variety of sources, including, combustion of fossil fuels, petroleum refining, industrial and residential solvent use, and paint application. The MOE (2008a) has estimated the 2006 VOC emissions from point, area and transportation sources. The transportation sector was estimated to be the most significant source of VOC emissions and accounted for approximately 38% of the total VOC emissions in 2006. Other significant sources included general solvent use at 18%, printing and surface coating sources at 19% and other industrial processes at approximately 14%.

Ammonia

Ammonia (NH_3) is a toxic, colourless gas with a pungent odour. It is corrosive to eyes, respiratory system and skin. Exposure to high concentrations can cause lung damage and death. Ammonia is a precursor to $PM_{2.5}$ formation in the atmosphere by reacting with nitrates and sulphates. The major sources of NH_3 emissions are livestock, waste management and fertilizer production. Environment Canada classifies NH_3 as a CAC and monitors its atmospheric concentration at 28 sites across Canada through the Canadian Air and Precipitation Monitoring Network (CAPMoN). There are no CAPMoN sites in Halton Region. The Ontario Ministry of Environment currently does not monitor NH_3 concentrations in the atmosphere.