



Capital Region Ozone Management Plan

Prepared by

Capital Airshed Partnership

for

Alberta Environment

December, 2008

ISBN No.: 978-0-7785-8526-8 (Printed)

ISBN No.: 978-0-7785-8527-5 (On-line)

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EXECUTIVE SUMMARY

The Edmonton Census Metropolitan Area (CMA) is a 9,418 square kilometer area with a population of over one million people. The Edmonton CMA encompasses the whole or a portion of three airsheds in the Capital Region; the Alberta Capital Airshed Alliance (ACAA), a portion of the West Central Airshed Society (WCAS) and a portion of the Fort Air Partnership (FAP). These three airsheds form the Capital Airshed Partnership (CAP).

Ozone (O₃) concentrations have been measured in the Edmonton CMA at levels that trigger the requirement for an O₃ management plan. Therefore, Alberta Environment (AENV) has requested that the CAP develop and submit a plan to AENV by December 31, 2008. The CAP has conducted a series of consultations with stakeholders and based upon their input, has developed the Capital Region Ozone Management Plan.

The main focus of the Capital Ozone Management Plan is to ensure there are no exceedances of the Canada Wide Standard (CWS) for O₃ and to avoid future exceedances of O₃ concentrations over the planning trigger. Unlike other pollutants, O₃ is not directly emitted to the atmosphere by human activities. Instead it is formed in the lower atmosphere through a complicated set of chemical reactions involving oxides of nitrogen (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight.

This Ozone Management Plan focuses on addressing the anthropogenic (human-made) sources of O₃ and more specifically, directs its actions towards the contribution of NO_x emissions. VOC emissions also contribute to the formation of ground-level O₃ but this plan is currently focusing on managing O₃ through decreasing NO_x emissions based on our current understanding that NO_x is the limiting factor in O₃ production.

The *Objectives* of the Capital Region Ozone Management Plan, in order of priority, are to:

1. **Prevent exceedance of the Canada Wide Standard for O₃;**
2. **Ensure that ambient levels remain below the management planning trigger for O₃; and**
3. **Encourage continuous improvement of air quality in the Edmonton CMA.**

The *Logic* that underpins the management plan is based on the US Environmental Protection Agency finding that:

Areas with the greatest decline in ozone concentrations are near, and downwind of, areas with the greatest reductions in NO_x emissions.

Therefore, the *Strategy* of the Capital Region Ozone Management Plan is to:

Manage regional NO_x emissions to ensure Ozone levels do not exceed the CWS or management planning trigger.

NO_x emissions largely result from three major sectors including industry, electrical energy generation, and transportation in the urban municipalities, as well as a complex array of other sources.

Recommendations for managing NO_x emissions in the Edmonton CMA are as follows:

Industry Sector

1. Efforts already initiated to reduce NO_x in the industrial sector should continue as outlined in the Cumulative Effects Management Framework.
2. The results of O₃ modeling completed for the Industrial Air Management Area Air Working Group (IAMAAG) should be communicated to CAP.
3. CAP should review the effect of emissions targets under the Cumulative Effects Management (CEM) Framework as it relates to management of O₃.
4. Industrial facilities should be encouraged to consider NO_x reductions in their continuous improvement plans.
5. Alberta Environment should develop a process to build an inventory of continuous improvement projects in the industrial sector as they are implemented.

Electrical Sector

6. Efforts already initiated to reduce NO_x in the electrical sector should continue as outlined in the CASA Electricity Emissions Management Framework.
7. Electricity generation facilities should be encouraged to consider NO_x reductions in their continuous improvement plans.
8. Alberta Environment should develop a process to build an inventory of continuous improvement projects in the electrical sector as they are implemented.

Transportation Sector

9. Regional planning should be encouraged to choose designs that promote a denser, more sustainable urban form.
10. The Government of Alberta should explore methods to reduce emissions from roadway traffic.
11. The GOA should explore methods to reduce emissions from small engines such as those used in lawn mowers, ATVs, boats, etc., as well as emissions from construction vehicles.
12. Municipalities throughout the Edmonton CMA should consider the implementation of consistent anti-idling legislation.

Measuring, Monitoring and Modeling

13. Improvements to the ambient monitoring networks should be initiated by AENV, through the support of the respective airsheds where appropriate, to:
 - i. ensure that management plan initiatives are achieving the expected air quality outcomes.
 - ii. ensure ambient monitoring networks are providing the necessary information.
 - iii. to better understand reasons for ozone exceedances.
14. Expanded modeling should be conducted to predict whether management plan initiatives will achieve the expected air quality outcomes.
15. A complete emissions inventory should be developed by Alberta Environment to improve estimates of O₃ precursor emissions.
16. Increased monitoring and analysis should be implemented to attempt to better understand reasons for O₃ exceedances.

17. Alberta Environment should promote greater awareness of efforts made to reduce NOx emissions.

Evaluation

18. The Capital Region Ozone Management Plan should be reviewed in 5 years, unless events occur that warrant an earlier review.
19. CAP will develop a contingency plan to address the possibility that current and proposed management actions are insufficient to avoid an exceedance of the planning trigger or CWS limit.

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STATEMENT OF COMMITMENT

The Capital Airshed Partnership is submitting the Capital Region Ozone Management Plan in fulfillment of its obligations under the Clean Air Strategic Alliance (CASA) Particulate Matter & Ozone Management Framework. This management plan represents the combined commitments the members of the three airsheds that make up the Capital Airshed Partnership.

As signatories representing our respective organizations, we commit to seek the endorsement for this Management Plan by our organizations by March 31, 2009.

Alberta Environment

Alberta Capital Airshed Alliance

Fort Air Partnership

West Central Airshed Society

1.0 INTRODUCTION

The formation of ozone (O₃) at ground level is a complex problem. Ozone is not emitted by ground sources as a primary pollutant, but forms as a result of the interaction between various compounds of nitrous oxides (NO_x) and volatile organic compounds (VOCs). Nitrous oxides are combinations of nitrogen and oxygen, usually in the form of nitrogen oxide or nitrogen dioxide. Volatile organic compounds are lightweight compounds that contain carbon and are easily transported by the wind. The interaction of these primary pollutants leads not only to the formation of O₃ but to a combination of pollutants and fine particulate matter collectively referred to as ozone smog. The nitrogen dioxide component of this mix comprises the brownish discolouration of the lower atmosphere we normally associate with smog. Ozone poses significant negative effects on human health and the natural environment and as such a stakeholder commitment was made through the CASA PM and O₃ Management Framework to develop an O₃ Management Plan to monitor and manage ground-level O₃ concentrations in areas of Alberta where O₃ concentrations exceeded the CASA Management Planning Trigger.

Ozone concentrations have been measured in the Edmonton Census Metropolitan Area at levels that trigger the requirement for an O₃ management plan, and therefore, Alberta Environment (AENV) has requested that the Capital Airshed Partnership (CAP) develop and submit a plan to AENV by December 31, 2008. The CAP has conducted a series of consultations with stakeholders and based upon their input, has developed the Capital Region Ozone Management Plan.

The main focus of the Capital Ozone Management Plan is to ensure there are no exceedances of the Canada Wide Standard (CWS) for O₃ and to avoid future exceedances of O₃ concentrations over the planning trigger. This Ozone Management Plan will focus on addressing the anthropogenic (human-made) sources of O₃ and more specifically, direct its actions towards the contribution of NO_x emissions. VOC emissions also contribute to the formation of ground-level O₃ but this plan is currently focusing on managing O₃ through decreasing NO_x emissions based on the current understanding that NO_x is the limiting factor in O₃ production.

1.1 *Edmonton Census Metropolitan Area*

The Edmonton Census Metropolitan Area (CMA) is a 9,418 square kilometer area in North Central Alberta, with a population of 1,034,945. The Edmonton CMA encompasses all or part of three airsheds: the entire Alberta Capital Airshed Alliance (ACAA), a portion of the West Central Airshed Society (WCAS), and a portion of the Fort Air Partnership (FAP).

The West Central Airshed Society (WCAS) encompasses an area of about 46,000 square kilometers, and operates a network of eleven continuous on-line air quality monitoring stations within the west central region of Alberta, six of which monitor for ambient ozone.¹

The Fort Air Partnership (FAP) is approximately 4,500 square kilometers in size. It includes Elk Island Park and the communities of Fort Saskatchewan, Gibbons, Bon Accord, Bruderheim, Lamont, Redwater, Waskatenau, and Thorhild. The FAP operates eight continuous air monitoring stations, three of which monitor for ambient ozone.²

The Alberta Capital Airshed Alliance³ encompasses the Edmonton Capital Region and is approximately 699 square kilometers in size. There are 10 continuous monitors located in the

1 www.wcas.ca

2 www.fortair.org

3 www.capitalairshed.ca

airshed. These are operated by Alberta Environment (3), Lehigh Cement (2) and the Strathcona Industrial Association (5). Three of these continuous monitoring stations currently monitor for ambient ozone.⁴

1.2 The Canada Wide Standard (CWS)

Particulate matter (PM_{2.5}) and O₃ negatively impact air quality in Alberta and across Canada. Studies demonstrate that there are significant health and environmental effects associated with these pollutants. By reducing levels of PM_{2.5} and O₃, and ensuring that areas with low ambient levels are maintained or improved, human health and environmental risks can be reduced or eliminated.

In June of 2000 the federal, provincial and territorial governments (except Quebec) signed the Canada-Wide Standard (CWS) for PM_{2.5} and O₃, thereby agreeing to national ambient standards for PM_{2.5} and O₃. Each jurisdiction is responsible for meeting the CWS and reporting on achievement once the target dates are reached.⁵ The CWS for PM_{2.5} and O₃ must be achieved by 2010. The CWS calls for the development and implementation of jurisdictional implementation plans as the primary mechanism for achieving the CWS, as well as the development of programs for pollution prevention, keeping clean areas clean, and continuous improvement to manage ambient levels below the CWS.

1.3 A Provincial Framework

After the CWS was signed, the Clean Air Strategic Alliance (CASA) was asked by AENV to form a multi-stakeholder project team to make recommendations on implementation of the CWS in the province. The CASA project team developed a Particulate Matter & Ozone Management Framework that addresses the CWS, with the goal of ensuring that ambient air quality for all Albertans remains as clean as possible. The Particulate Matter & Ozone Management Framework was accepted by the CASA Board of Directors and published in September 2003. It incorporates a balance of minimizing risks to human health and the environment, and the costs of reducing emissions. The success of the framework depends on the active participation of stakeholders.

The framework has four action levels associated with three action triggers, including surveillance, management planning and CWS exceedance triggers as illustrated in Figure 1. The PM_{2.5} and O₃ management plans are aimed at preventing future exceedances of the planning trigger.

⁴ www.capitalairshed.ca/monitoring.htm#sites

⁵ environment.alberta.ca/1970.html

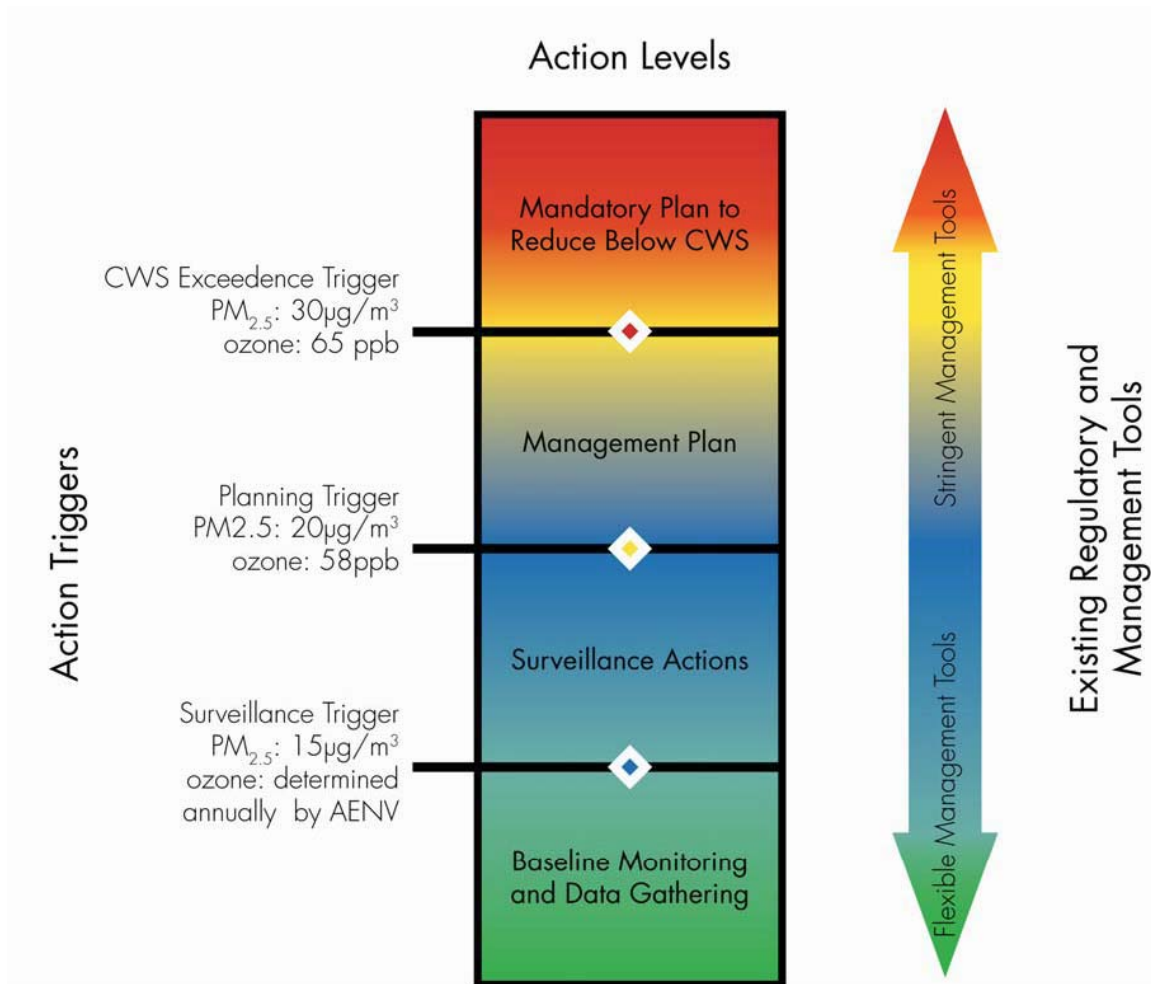


Figure 1: Action Levels⁶

Concentrations of PM_{2.5} have not reached the management planning trigger in the Edmonton CMA and thus are not included in this management plan.

1.4 Summary of Emission Sources in the Capital Region (Edmonton CMA)

An air emissions inventory was completed in August 2008 for the five Alberta airsheds that required the development of PM_{2.5} and O₃ Management Action Plans, due to exceedances of the management planning trigger for O₃. The Capital Region Ozone Management Plan addresses emissions within the ACAA, FAP and WCAS airsheds. Although the Edmonton CMA includes all of ACAA, it only includes a portion of WCAS and FAP. The source data, however, incorporates all emission sources within all of WCAS and FAP. As these two airsheds extend beyond the Edmonton CMA, this may result in a small amount of overestimating of the emissions in the Edmonton CMA.

The inventory of the three airsheds included in the Edmonton CMA was prepared by the consulting firm AMEC Earth and Environmental and is based on emissions data provided by Environment Canada, Statistics Canada, Alberta Environment, Alberta Agriculture, the Energy

⁶ Guidance Document for the Management of Fine Particulate Matter and Ozone in Alberta, CASA Particulate Matter and Ozone Project Team, 2003

Resources Conservation Board and the National Pollutant Release Inventory. The following NOx and VOC data was adapted from the report: “Particulate Matter and Ozone Management Project Preliminary Emission Inventories and Triggering Events” and the accompanying data file.

1.5 Oxides of Nitrogen (NOx)

NOx is the sum of nitrogen dioxide (NO₂) and nitric oxide (NO). NOx can combine with VOCs in the presence of sunlight to form ground-level O₃. NO is formed during high temperature combustion, as in the burning of natural gas, coal, oil and gasoline, or when atmospheric nitrogen combines with molecular oxygen.

Transportation, including cars, trucks, rail and aircraft, is the major source of NOx in Alberta. Other major sources include industrial sources (e.g., oil and gas industries) and power plants. Smaller sources of NOx include natural gas combustion, heating fuel combustion, and forest fires. The largest urban source of NOx is emissions from motor vehicles. Smaller sources of NOx include natural gas combustion (i.e., residential and commercial heating), heating fuel combustion, lightning storms and forest fires.

Of the 140 kilotonnes (kt) of NOx emissions in the combined ACAA, FAP and WCAS area, 41% came from the power generation sector, primarily coal-fired power plants. The fossil fuel industry, including upstream and downstream oil and gas, was the second largest source with 33% of NOx emissions. This sector would include gas plants, compressor stations, oil batteries, petroleum refineries, bulk fuel storage terminals and bitumen upgraders. Transport vehicles, excluding air and rail, accounted for 9% of NOx emissions while 8% was attributable to other industries. Air and rail accounted for 6% of NOx emissions, while residential homes accounted for 2% of NOx emissions. Commercial sources and livestock accounted for 1% and less than 1% of NOx emissions respectively.

The emission profiles of each of the three airsheds vary from that of the combined total of the three due to differences in the mix of industrial, urban and agricultural activities occurring in each airshed zone.

Figure 2 shows the sources of NOx emissions in the ACAA, FAP and WCAS.

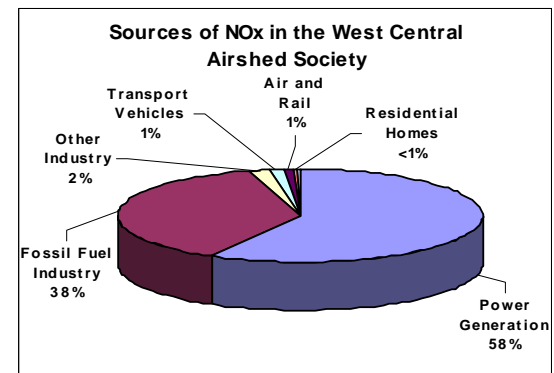
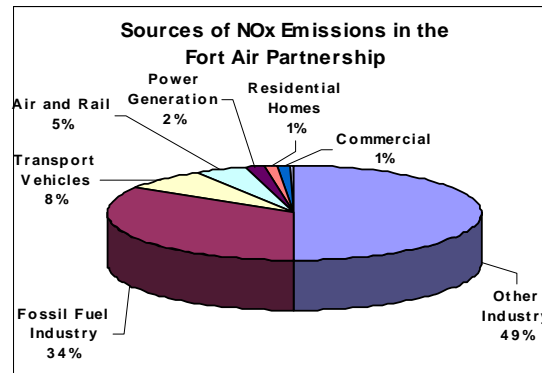
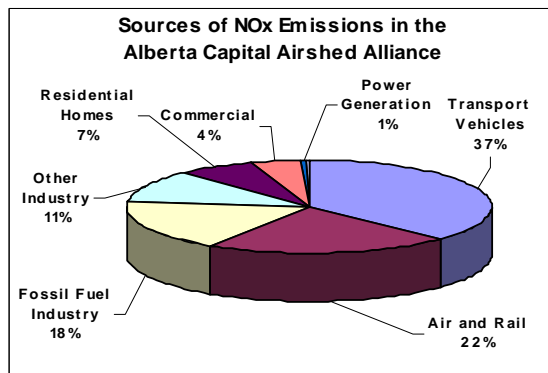
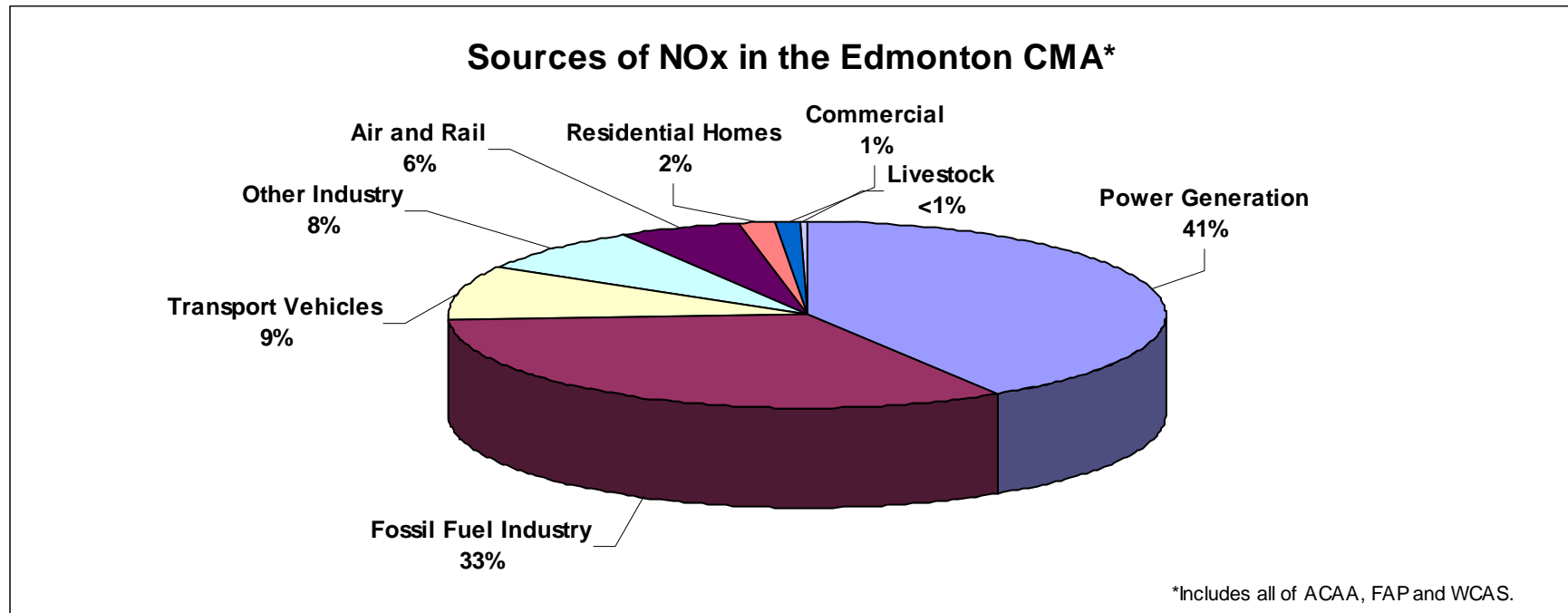


Figure 2: Sources of NOx emissions in the Edmonton CMA.

1.6 Volatile Organic Compounds (VOCs)

Volatile Organic Compounds include a large group of chemicals containing carbon and hydrogen atoms that can react quickly to form other chemicals in the atmosphere. VOCs are important because they can react with NO_x in the presence of sunlight to form ozone and photochemical smog.

The major sources of VOCs are vegetation, automobile emissions, gasoline marketing and storage tanks, petroleum and chemical industries, dry cleaning, fireplaces, natural gas combustion and aircraft. Individual VOCs are also produced from the evaporation of solvents and organic chemicals as well as from leaking valves, flanges, pumps and compressors at industrial facilities. The major source of VOCs in most urban areas is vehicle exhaust emissions.

Of the 71 kt of VOC emissions in the combined ACAA, FAP and WCAS area, 52% came from livestock. Solvents and products, and the fossil fuel industry were the second largest sources, contributing 14% each to total VOC emissions. Transport vehicles were responsible for 11% of VOC emissions while other industries were the source of 5%. Residential fuel wood combustion accounted for 2% of VOC emissions, while air and rail and the power generation sector each were the source of 1% of VOC emissions.

Figure 3 shows the sources of VOC emissions in the ACAA, FAP and WCAS.

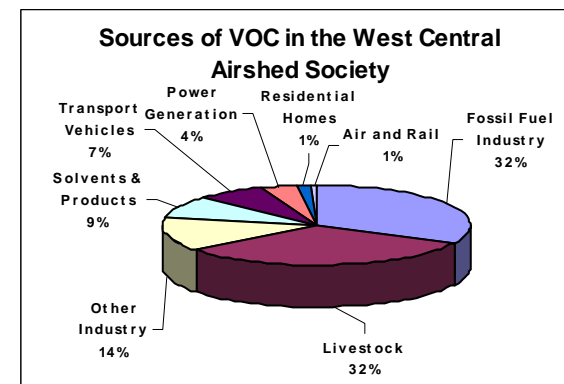
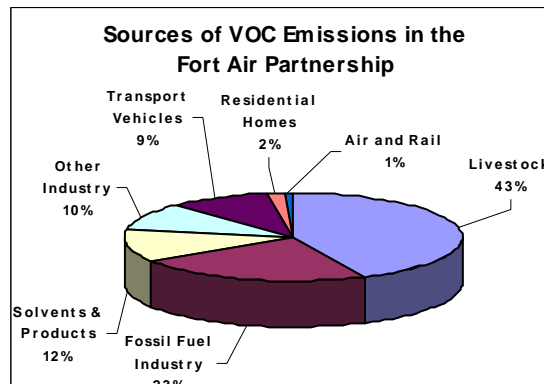
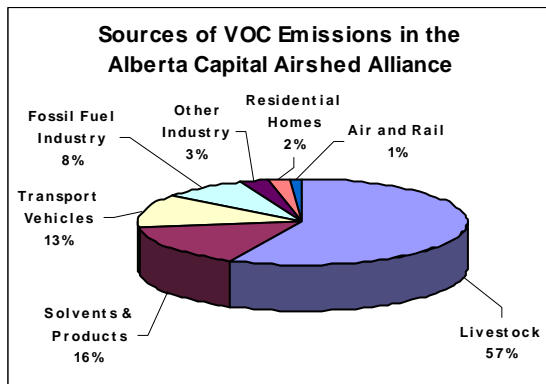
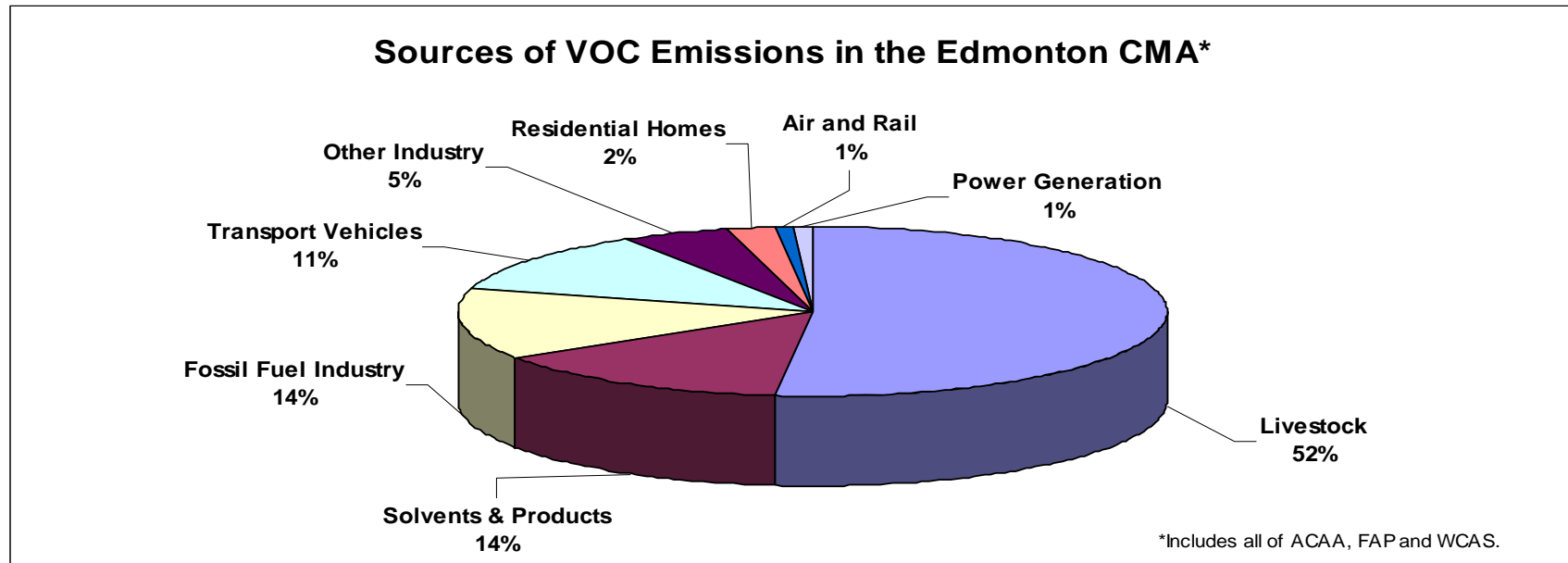


Figure 3: Sources of VOC emissions in the Edmonton CMA.

1.7 Ambient Air Quality in the Capital Region

Following the air quality assessments performed by AENV, the ACAA, FAP and WCAS were assigned to the Management Plan action level for O₃. Figure 4 illustrates the results of this assessment, both on an airshed-level basis, and on an individual monitoring location basis.

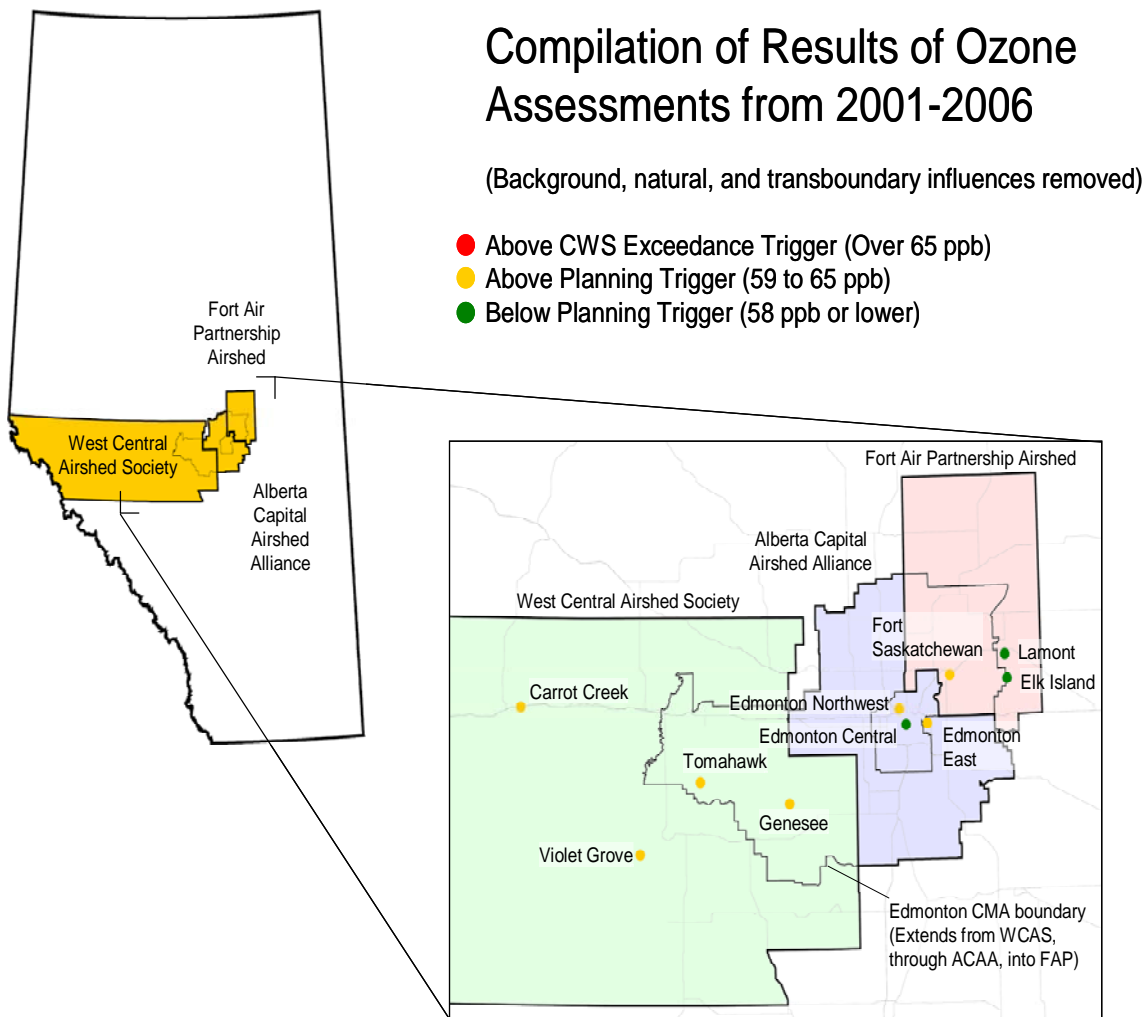


Figure 4: Compilation of Ozone Assessments from 2001-2006

Alberta Capital Airshed Alliance

The Edmonton CMA was assigned to the Management Plan action level following the 2001-2003 assessment. The Management Plan action level was triggered by the Tomahawk continuous monitoring station in 2003 and 2004 and by the Genesee continuous monitoring station in 2005 and 2006. Ozone events in the Capital Region are generally of anthropogenic origin, and peak in the summer months. These episodes tend to occur on hot, stagnant (i.e. low wind) days when precursors are able to build up and generate photochemical ozone. Edmonton is influenced by background O₃ as well, generally in the springtime, though such events are backed out of the analysis and did not contribute to the assignment to the Management Plan Action Level.

Fort Air Partnership Airshed

The Fort Saskatchewan monitoring station was assigned to the Management Plan action level following the 2001-2003 assessment. Ozone in the Fort Air Partnership can be background in origin, typically in the spring; or anthropogenic, typically in the summer. Anthropogenic ozone in the Fort Air Partnership is often generated upwind, in Edmonton, or the result of emissions from nearby industrial activity.

West Central Airshed Society

The Tomahawk, Genesee, Carrot Creek and Violet Grove continuous monitoring stations were all assigned to the Management Plan action level following the 2001-2003 assessment. Stations in the West Central airshed are often influenced by background O₃ in the spring. In the summer, O₃ can occasionally be generated from emissions of precursors in Edmonton during periods of hot weather. The Genesee station has more anthropogenic-based episodes in the summer than the other stations. This is likely due to its proximity to industrial sources and to Edmonton. The Carrot Creek and Tomahawk stations can also receive precursors from upwind Edmonton during the right conditions.

1.8 Trends in Ambient NOx Concentrations

Notwithstanding the exceedance of the Management Plan action level between 2003 and 2006, over the past decade, the trend in NOx emissions at all monitoring stations in the Edmonton CMA have been steadily declining. As Figure 5 indicates, the greatest declines have been in the areas with the greatest NOx emissions. Projected emissions trends compiled by AENV for the CASA Clean Air Strategy Project Team in June 2008⁷ also show that while NOx emissions are increasing in the upstream oil and gas and oil sands sectors due to increasing development, emissions are decreasing in the transportation sector due to improving vehicle pollution control technologies⁸.

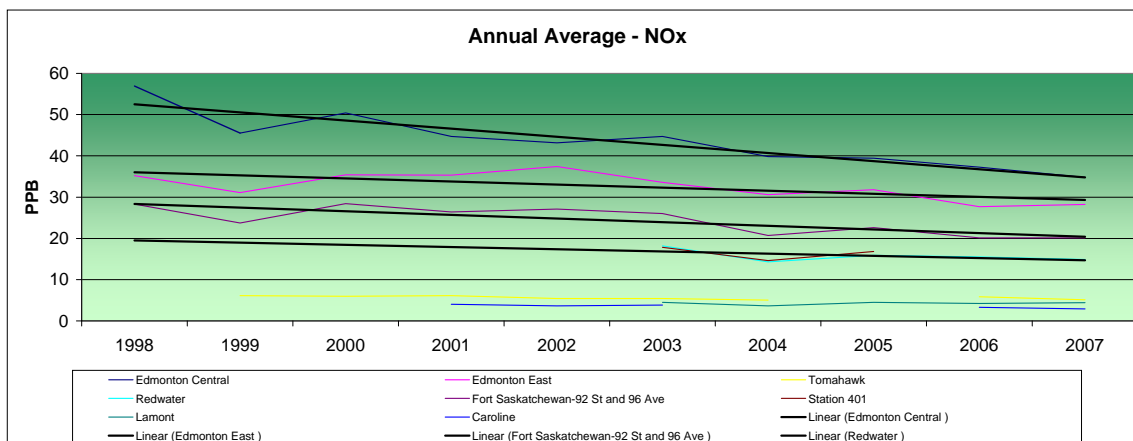


Figure 5: Annual Average Ambient NOx Concentrations, 1998-2007

7 www.casadata.org/Reports/SelectCategory.asp

8 Alberta Air Emissions Trends and Projections, Alberta Environment, June 2008.

1.9 A Management Plan Built on Stakeholder Input

In developing the Capital Region Ozone Management Plan, the Capital Airshed Partnership has continued to engage stakeholders throughout the process. The CAP Steering Committee hosted a multi-stakeholder workshop in Edmonton on September 25, 2008. The goals of this workshop were to:

- Build a shared understanding of air quality challenges in the Edmonton CMA;
- Understand objectives of the management plan and the process for its development;
- Identify elements of the management plan; and
- Identify alternative approaches to O₃ management.

Following the Stakeholder workshop, individual meetings were conducted with the Industrial (October 31, 2008), Electrical (November 4), and Municipal (November 7) sectors. The goals of these meetings were to:

- Understand O₃ management plans currently under development or in place by major sectors;
- Identify opportunities for, or gaps in, the regional ozone management plan;
- Identify preferred strategies for ozone management; and
- Identify barriers or constraints to effective management strategies.

Once a draft framework was developed, a second Stakeholder Workshop was held on November 26, 2008, to review and provide further input into the development of the Management Plan. The objectives of this meeting were to:

- Present a draft of the Ozone Management Plan; and
- Obtain feedback and recommendations from stakeholders.

This input has been reviewed and the Capital Region Ozone Management Plan has been revised to accommodate the interests of stakeholders while meeting the overall expectation of ensuring clean air for the residents of the Edmonton CMA.

2.0 OBJECTIVES AND STRATEGY

The *Objectives* of the Capital Region Ozone Management Plan are to:

1. **Prevent exceedance of the CWS for O₃;**
2. **Ensure that ambient levels remain below the management planning trigger for O₃; and**
3. **Encourage continuous improvement of air quality in the Edmonton CMA.**

Ozone levels in the Edmonton CMA have exceeded the CASA Management Planning trigger requiring the implementation of an Ozone Management Plan. While the primary ozone precursors are NO_x, and VOCs, NO_x is the limiting factor in the production of ground-level O₃, and the precursor that is most easily managed.

Therefore, the *Logic* that underpins the management plan is based upon a finding of the US Environmental Protection Agency that states:

Areas with the greatest decline in ozone concentrations are near, and downwind of, areas with the greatest reductions in NO_x emissions.⁶

The available data limits our ability to estimate the threshold of total emissions that would lead to an exceedance of the CWS. However, it is reasonable to assume that with the normal variation of meteorological conditions, naturally occurring sources, and emissions from primary sources, the probability of an exceedance occurring increases with greater emissions, remains the same at current levels, and decreases with less emissions.

The *Strategy* of the Capital Region Ozone Management Plan is then to:

Manage regional NO_x emissions to ensure ozone levels do not exceed the Canada Wide Standards or management planning trigger.

NO_x emissions largely result from the industrial, electrical generation, and transportation sectors plus a complex array of other sources that are not well characterized. Subsequently, the development of this Management Plan has taken into consideration the following:

1. **Current commitments to manage NO_x emissions within each of the primary emitting sectors;**
2. **The impact of these efforts on ambient ozone concentrations into the future; and**
3. **Additional efforts to encourage further decreases in emissions and improvements to air quality.**

Many initiatives are being implemented throughout the Edmonton CMA. Although there is confidence that these initiatives will be sufficient to manage O₃ levels to below the CASA Management Trigger, this plan has identified actions that will ensure continuous evaluation of ambient trends of O₃ and NO_x to confirm the objectives of this plan are being met.

Criteria used in selecting recommendations to be included in the plan were those of practicality, reasonableness, and implementability. Practicality considers the current knowledge limitations, the ability of the recommendation to address the O₃ issue specifically, and managing what we can

⁶ Evaluating Ozone Control Programs in the Eastern United States, United States Environmental Protection Agency, 2004

control. Reasonableness considers socio-economic balances (including cost effectiveness of the strategies chosen), management of ambient levels of O₃ to meet the CASA PM_{2.5} and O₃ Framework requirements, including continuous improvement objectives, the ability to address the concerns of the stakeholders and the ability to achieve stakeholder support for the plan. Implementable refers to the ability of regulatory bodies, government and industry to implement the recommendations outlined in the plan.

Our highest priority is filling the critical data gaps that must be addressed immediately, regardless of whether O₃ ambient concentrations have exceeded the Management Planning trigger. It is the intention of the CAP Steering Committee to become a implementation team to ensure stewardship of the recommendations identified in this plan. In the event that the management actions outlined in this plan are not sufficient to avoid future exceedances, the Capital Airshed Partnership will monitor the impact of the Management Plan and work with stakeholders to identify additional actions as required..

3.0 CURRENT OZONE MANAGEMENT INITIATIVES AND RECOMMENDATIONS

3.1 Industry Sector

A significant source of NO_x emissions in the Edmonton CMA is attributed to industrial facilities located within the Industrial Heartland. Alberta Environment proposes to manage NO_x emissions from these facilities through the Industrial Heartland Cumulative Effects Air Management Program that will limit total emissions apportioned to individual facilities while giving consideration to the needs of future additional facilities. Individual facility approvals would be based on commitments to meet those limits.

Two approaches to how NO_x emissions can be managed through this program have been developed through the work of the multi-stakeholder Industrial Air Management Area Air Working Group (IAMA AWG). These two options are currently before the Minister of the Environment with a decision expected by the end of 2008. Both approaches recognize that there is an upper limit to NO_x emissions from industry, that growth within the sector must be accommodated, and that time must be allowed for technological improvements to be implemented by existing industry. The decision of the Minister will be significant in guiding future approaches to emissions management. Regardless of the approach that is ultimately selected, it is critical that modeling be conducted to predict the impact of the selected approach on O₃ formation, with monitoring of actual results to confirm that the management plan is achieving its intended outcomes.

Improvements in technology and continuous improvement of operations will result in the most effective strategies for management of industrial precursor emissions. All industrial facilities are encouraged to keep clean areas clean, and to take voluntary action in support of emission reductions beyond regulatory requirements. Alberta Environment can also play a role by regularly reviewing and updating continuous improvement requirements and implementation of Best Available Technology Economically Achievable (BATEA) as well as regular reviews of BATEA standards.

Recommendations for managing NO_x emissions in the Edmonton CMA have been developed through feedback from stakeholders and are summarized in Table 1.

Table 1. Recommendations to manage NO_x Emissions from the Industrial Sector

Recommendation	Actions	Time frame ⁹	Responsibility	
			Lead	Support
1. Efforts already initiated to reduce NO _x in the industrial sector should continue as outlined in the Cumulative Effects Management Framework.	Review the impact of the implementation of the CEM and develop future actions as necessary to achieve the purposes of the O ₃ Management Plan	C	Industrial facilities	AENV
2. The results of the O ₃ modeling for the Industrial Air	IAMA AWG will communicate to CAP through a joint workshop	ST	IAMA AWG	AENV

⁹ C= Continuing

ST= Short-term

LT=Long-term

Management Area Air Working Group (IAMAAGWG) should be communicated to the Capital Airshed Partnership.	CAP to review results relative to the plan to determine future actions	ST	CAP	AENV
3. CAP should review the effect of emissions targets under the Cumulative Effects Management (CEM) Framework as it relates to management of O ₃	CAP to assess the effect of the established emissions targets under CEM in the context of modeling to develop future actions as necessary to achieve the purposes of the plan	C	CAP	AENV
4. Industrial facilities should be encouraged to consider NO _x reductions in their continuous improvement plans.	Annually report continuous improvement initiatives to reduce NO _x emissions to CAP for inclusion in CAP annual report	C	Industrial facilities	CAP
5. Alberta Environment should develop a process to build an inventory of continuous improvement projects as they are implemented.	CAP to document emission reduction projects completed in support of the ozone management plan.	C	AENV	CAP

3.2 Electrical Sector

Electrical energy in Alberta is primarily generated through coal-fired power plants, which produce relatively high levels of emissions including ozone precursors. While efforts have been made to retrofit emission reduction technology into these existing facilities, substantive reductions will result from replacing old generation units with new technology which have considerably greater generating capacity, higher fuel efficiency, and significantly lower emissions.

Some of the current generation facilities in Central Alberta are nearing the end of their design life. As new units come online they will be required to follow the BATEA standards and as such will produce fewer emissions.

In January 2002, the Minister of the Environment requested that CASA lead a project team to develop an approach for managing air emissions from the electricity sector to be implemented by January 2006. The Emissions Management Framework for the Alberta Electricity Sector provides several recommendations for the reduction of emissions within the electrical sector. The proposed framework identifies several key reduction strategies that, if adopted and implemented, would result in a significant decrease in the level of O₃ precursor emissions.

Recommendations pertaining to the electrical sector developed through feedback from stakeholders are summarized in Table 2.

Table 2. Recommendations to manage NO_x Emissions from the Electrical Sector

Recommendation	Actions	Time frame ¹⁰	Responsibility	
			Lead	Support
6. Efforts already initiated to reduce NO _x in the electrical sector should continue as outlined in the Electricity Emissions Management Framework	Review the impact of the implementation of the Framework and develop future actions as necessary to achieve the purposes of the O ₃ Management Plan	C	Electricity sector	AENV
7. Electricity generation facilities should be encouraged to consider NO _x reductions in their continuous improvement plans.	Annually report continuous improvement initiatives to reduce NO _x emissions to CAP for inclusion in CAP annual report	C	Electricity sector	CAP
8. Alberta Environment should develop a process to build an inventory of continuous improvement projects as they are implemented.	CAP to document emission reduction projects completed in support of the ozone management plan.	C	AENV	CAP

3.3 Transportation Sector

In 2006 total vehicle kilometers traveled per weekday in the Edmonton CMA had increased to over 27 million. In 2016 this number is expected to increase by 36% due to population and economic growth. However, due to improved vehicle technology and cleaner fuels, the transportation sector is projecting an overall decrease in emission levels. By 2016 both total NO_x and PM_{2.5} levels are projected to show a 35% decrease from 2006 levels.

Municipalities are also playing their part in the reduction of O₃ precursors though the promotion of public transit as a viable transportation option. Within the Edmonton CMA, the municipalities of the County of Strathcona, Edmonton and St. Albert, among others, have focused on supporting transit use across the Capital Region and have been working on several initiatives to improve transit systems.

A sustainable urban form is important to reducing O₃ precursor emissions by reducing private vehicle use and kilometers traveled. Many of the municipalities within the Capital Region have formal and informal policies focused on building cleaner, more sustainable cities. Many of the municipalities within the Capital Region put a focus on the development of a sustainable urban environment in their revised Municipal Development Plans. A more sustainable form would include design concepts such as:

¹⁰ C= Continuing ST= Short-term LT=Long-term

- Mixed use development with higher density buildings with easy access to amenities and employment centers;
- Reduced need for private vehicle transportation through transit-oriented development based on premium public transit systems;
- Extensive networks of walking, hiking and cycling trails;
- Promotion of bikeable and walkable urban areas;
- Accessible and well connected public spaces and buildings throughout municipalities; and
- Increased carpool lanes.

Within the municipal commuter fleet, actions have been proposed to reduce the number of Gross Emitting Vehicles (GEVs) on the roadways. Approximately 20% of the vehicles on the road today are responsible for 80% of the total emission levels within the civilian fleet.⁷ In general, vehicles manufactured prior to 1999 have been identified as contributing a large amount of ground level NOx emissions. Incentives are being developed to increase the likelihood that GEV owners will trade in these older models for newer, less polluting ones. Provincial action to remove these vehicles could include:

- Implementation of regulations and incentives to remove GEVs from roadways; and
- Incentives for purchasing lower emitting private use vehicles to increase fleet turnover.

More generally, Provincial action is encouraged to increase fuel efficiency and reduced emissions through:

- Incentives for decreasing emissions from public transport (i.e. buses) through purchase of hybrid and/or cleaner burning diesel engines;
- Incentives for purchasing higher efficiency small engines;
- Incentives for purchasing low emission lawnmowers; and
- Regulation of emissions from construction vehicles.

Anti-idling legislation has also become an important issue in the Edmonton CMA. Idling can contribute to O₃ precursor emissions and municipalities have initiated measures to reduce the number of parked cars left idling unnecessarily. Legislation may be required as a deterrent to unnecessary idling that would support the following:

- Education and awareness campaigns for anti-idling
- Develop best practices for municipal employees to ensure anti-idling for fleet vehicles
- Consistency in bylaws for anti-idling

Transportation related recommendations are listed in Table 3.

Table 3. Recommendations to manage NOx Emissions from the Transportation Sector

Recommendation	Actions	Time frame ¹¹	Responsibility	
			Lead	Support

⁷ The Alberta ROVER II On-road Vehicle Emissions Survey, Clean Air Strategic Alliance, June 2007

¹¹ C= Continuing ST= Short-term LT=Long-term

9. Regional planning should be encouraged to choose designs that promote a denser, more sustainable urban form	Review the impact of municipal planning through O ₃ modeling to determine its impact on the Management Plan	LT	CAP	AENV
10. The Government of Alberta should explore methods to reduce emissions from roadway traffic	Review available options to assist in developing policies and/or programs to achieve the overall objective of reducing emissions from GEVs	ST	GOA	
11. The GOA should explore methods to reduce emissions from small engines such as those used in lawn mowers, ATVs, boats, etc., as well as emissions from construction vehicles	Review the impact of off highway emissions through O ₃ modeling to determine its impact on the Management Plan	LT	GOA	
12. Municipalities throughout the Edmonton CMA should consider the implementation of consistent anti-idling legislation	Review the impact of anti-idling through O ₃ modeling to determine its impact on the Management Plan	ST	CAP	AENV
	Recommend to municipalities throughout the Edmonton CMA that they introduce anti-idling legislation	ST	CAP	

4.0 MEASUREMENT, MONITORING AND MODELING

Currently, there are gaps in the information necessary to ensure that the expected outcomes are actually achieved as these management strategies are implemented. The ongoing management plan must address the recommendations on measuring, monitoring and modeling summarized in Table 4.

Table 4. Recommendations for Monitoring, Modeling and Evaluation

Recommendation	Actions	Time frame ¹²	Responsibility	
			Lead	Support
13. Improvements to the ambient monitoring networks should be initiated by AENV, through the support of the respective airsheds where appropriate, to: <ul style="list-style-type: none"> i. ensure that management plan initiatives are achieving the expected air quality outcomes. ii. ensure ambient monitoring networks are providing the necessary information. iii. to better understand reasons for ozone exceedances. 	Ongoing monitoring of O ₃ and ozone precursors	C	Airsheds	CASA AENV
	Conduct on-going analysis of ambient monitoring data to track and respond to trends in O ₃ and precursor ambient concentrations	C	Airsheds	CASA AENV
	Conduct a review of the adequacy of ozone monitoring in and surrounding the Edmonton CMA and consider the addition of continuous and passive ambient O ₃ monitoring	ST	Airsheds	AENV CASA
	Review adequacy of current ozone precursor ambient monitoring programs (NO _x and VOCs)	ST	AENV	

¹² C= Continuing

ST= Short-term

LT=Long-term

14. Expanded modeling should be conducted to predict whether management plan initiatives will achieve the expected air quality outcomes	Conduct modeling downwind of the Edmonton CMA to predict the effects of emissions on surrounding airsheds.	ST, LT ¹³	AENV	
	Conduct CMAQ modeling to determine the effects of various sources of NO _x on ozone formation to target efforts more specifically	ST, LT ¹³	AENV	
15. A complete emissions inventory should be developed by Alberta Environment to improve estimates of O ₃ precursor emissions	Develop an emissions inventory of additional sources of emissions of NO _x that have not been considered in this management plan (e.g., oil and gas, off-road transportation and emissions, air and rail)	ST	AENV	
	Develop a VOC emissions inventory	ST	AENV	
16. Increased monitoring and analysis should be implemented to attempt to better understand reasons for O ₃ exceedances	Expand monitoring network and data collection based on modeling results and data gap analysis	LT	AENV	Airsheds
	Expand meteorological analysis as it relates to O ₃ events	ST	AENV	
	Complete an analysis of the ambient data for the purposes of understanding a scenario of various precursor emissions that will likely create an O ₃ exceedance	ST	AENV	
17. Alberta Environment should promote greater awareness of efforts made to reduce NO _x emissions	Establish education programs to inform the public of individual actions that may significantly reduce NO _x emissions.	ST	AENV	Airsheds
	Provide summary of annual reports provided by industry specifying NO _x emission reduction initiatives	ST	AENV	Airsheds

¹³ Air modeling will be conducted in the short-term and medium term. Modeling scenarios will be prioritized through a multi-stakeholder consultation process.

5.0 EVALUATION

Alberta's Capital Region is a dynamic and rapidly changing urban and industrial centre. A wide range of factors will determine the success of the Capital Region Ozone Management Plan including the economy, growth, industrial mix, technology and climate. A structured process for evaluation of the plan will ensure that it remains contemporary and modifications are implemented to ensure that our objectives are being realized.

The CAP should begin work on developing a contingency plan, based on the multi-stakeholder process, that can be implemented in the event that the ozone management trigger or exceedance level is exceeded in the future. The development of the contingency plan can be completed in 2 to 5 years, and should be based on new information associated with improvements in emissions inventories, modeling, ambient monitoring, and other work to address current data gaps.

Recommendations on evaluation are summarized in Table 5.

Table 5. System Evaluation

Recommendation	Actions	Time frame ¹⁴	Responsibility	
			Lead	Support
18. The Capital Region Ozone Management Plan should be reviewed in 5 years, unless events occur that warrant an earlier review	Formally establish CAP as an on-going implementation team	ST	CAP	AENV
	CAP will monitor and report on the implementation of the plan on a continuing basis	ST	CAP	AENV
	CAP will conduct an annual review of monitoring and modeling results to determine if there are any early review triggers such as increases in emissions, upward trends and exceedances of the CWS for O ₃	ST	CAP	AENV
	CAP will lead efforts to revise the ozone management plan based on new information that arises through a multi-stakeholder input process	LT	CAP	AENV
19. CAP will develop a contingency plan to address the potential that current and proposed management actions are insufficient to avoid an exceedance of the planning trigger or CWS limit.	CAP will lead efforts to develop a pre-emptive ozone management plan based on improved understandings gained from better monitoring, modeling, inventories and the resolution of other data gaps presently existing. The CAP will utilize multi-stakeholder input process to develop the plan to ensure a balanced approach is achieved.	LT	CAP	AENV

¹⁴ C= Continuing

ST= Short-term

LT=Long-term

6.0 THE PATH FORWARD

The Capital Region Ozone Management Plan provides a comprehensive framework for ensuring that O₃ concentrations do not exceed the Canada Wide Standard or the CASA Management planning trigger. This Plan is based upon the efforts of those within the major NO_x emitting sectors to reduce their emissions through continuous improvement in technology and processes in the industrial, electrical and transportation sectors. Through the stakeholder consultations that have been conducted in the development of this Plan, the Capital Airshed Partnership (CAP) Steering Committee has been satisfied that the planned initiatives within these sectors will be sufficient to ensure that these exceedances do not occur. The Management Plan does not stop there, however. There is an important continuing role for CAP in monitoring the effectiveness of these initiatives to ensure that the objectives of the Plan are achieved.

The recommendations contained within this Plan provide short-term, long-term and continuing roles for NO_x emitters, the Capital Airshed Partnership, Alberta Environment, and Airsheds and municipalities within the Edmonton CMA. To become established as an on-going implementation team, over the next two years the Capital Airshed Partnership will implement the following work plan which includes:

1. Developing a detailed time frame for the components of our work plan.
 2. Meeting twice per year, likely in May & October to review progress on the Management Plan.
 3. Arranging for a joint meeting with IMAAWG when the Cumulative Effects Management Framework is released to determine future actions.
 4. Establishing a process for collecting and reporting continuous improvement initiatives with industry and electrical generation facilities, and working with Alberta Environment to establish an inventory of emission reduction projects.
 5. Requesting and receiving updates from the Government of Alberta through Alberta Environment on emission reduction policies and programs that support emission reduction objectives.
 6. Communicating the Management Plan to municipalities with a request to take action on anti-idling legislation and other actions to reduce emissions.
 7. Ensuring that modeling includes the capacity to evaluate the impact of anti-idling on decreases in NO_x and O₃.
 8. Developing a process for the review of current ambient air monitoring including a standardized methodology that will ensure:
 - a. comparable data and analysis,
 - b. standardized quality assurance/quality control methods, and
 - c. continuity and consistency across airsheds.
 9. Supporting Alberta Environment and other stakeholders in the development of regional modeling, including a review of how other regional approaches could be adapted to the Edmonton CMA.
 10. Assisting Alberta Environment to identify data gaps, including, but not limited to additional sources of ozone precursor emissions, ambient monitoring and identifying processes to fill those data gaps.
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11. Developing a framework for a contingency plan for ozone management in the event of higher than expected O₃ concentrations based on improved monitoring, modeling, inventories and multi-stakeholder input.
12. Further refining the Management Plan to achieve its objectives more effectively by considering more focused, cost-efficient, source-based approaches targeting the actual cause of exceedances.
13. Further investigating the impact of VOCs on O₃ formation.

The Capital Region Ozone Management Plan has resulted from a successful collaboration of the three airsheds within the Edmonton CMA (i.e., Alberta Capital Airshed Alliance, West Central Airshed Society and Fort Air Partnership), Alberta Environment, and the various stakeholders interested in air quality in the Capital Region. Without their participation and support, neither this Plan nor its implementation would be possible. It is this foundation of common purpose and coordinated action that will enable the Capital Airshed Partnership to continue this success into the future. As the Capital Airshed Partnership moves ahead, it will strengthen and build upon these relationships to ensure that the capacity is in place to implement the substantial initiatives necessary to achieve our common objectives. This collaborative effort by public, private and non-governmental organizations will ensure that the interests of all stakeholders are accommodated while meeting the overall expectation of ensuring clean air for the residents of the Edmonton CMA.