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AIR MANAGEMENT IN ALBERTA

Alberta
Environment

Air

Management

In

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1.1 History

Alberta created the first environment department in Canada in 1971. Shortly thereafter the *Clean Air Act* was passed. Since then Alberta has adapted its approach to meet changing needs and to ensure our air remains clean. In 1992 the *Environmental Protection and Enhancement Act* (*EPEA*) replaced the *Clean Air Act.* Public involvement was an important part of *EPEA* and increased public participation was encouraged by:

- increasing access to information;
- allowing for broader public input to the assessment and Approval processes; and
- providing for an appeal of certain decisions.

1.2 Goals and Vision for Air Management in Alberta

Alberta Environment, together with industry and environmental groups has developed the following goals for management of air quality:

- Protect the environment by preventing short- and long-term adverse effects on people, animals and the ecosystem.
- Optimize economic efficiency.
- Promote pollution prevention and continuous improvement.

Alberta Environment has adopted the Clean Air Strategic Alliance (CASA) Vision:

"The air will have no adverse odour, taste, or visual impact and have no measurable short- or long-term adverse effects on people, animals or the environment".

Partnership and collaboration are an important part of Alberta's approach to air management; consequently, Alberta Environment works with a number of partners to successfully implement strategies to ensure our air remains clean. While the Alberta Government works with others, including the federal government, it believes that it is in the best interests of Albertans that Albertans regulate both industrial and urban development with a vision that focuses on:

- proper use of emission control technology,

- use of innovative tools,
- identification of appropriate environmental outcomes, and
- monitoring and reporting

to show that Albertans are working towards their vision of clean air.

Figure 1 depicts the components that make up Alberta's Air System.

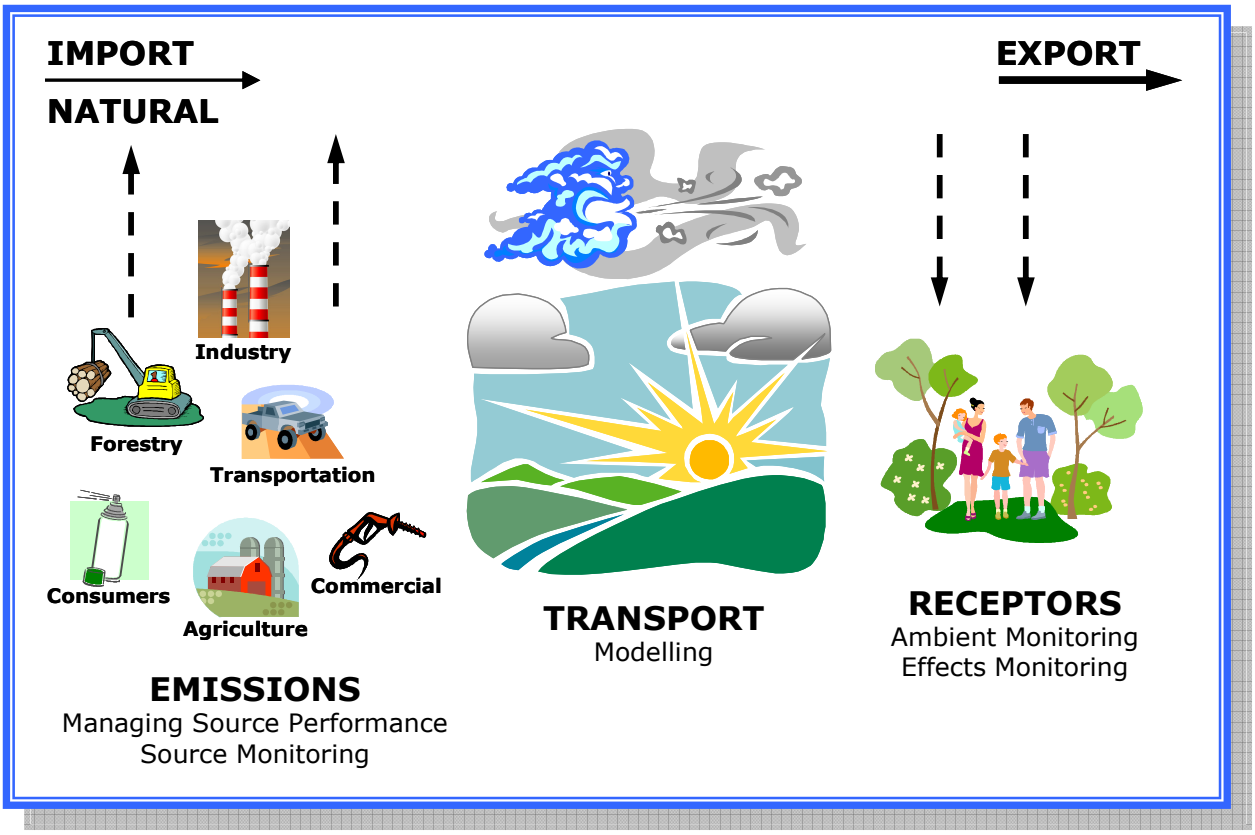

Figure 1 Air: The Physical System

2.0 INDUSTRIAL AIR QUALITY MANAGEMENT

Air quality for industrial facilities is primarily managed through environmental assessment, Approvals, and enforcement. The following key principles guide the management of industrial emissions to the atmosphere:

- industrial facilities must be designed and operated to prevent pollution;
- emissions from each industrial source must use technology that allows for a high level of control while considering economic factors;
- residual emissions must be dispersed through a stack designed to keep ambient concentrations below ambient objectives;
- cumulative impacts from multiple sources must not exceed the assimilative capacity of the airshed as defined by ambient air quality objectives;
- industrial operators are generally responsible for monitoring stack emissions and the resulting ambient concentrations around their facilities, to demonstrate compliance with emission limits and ambient objectives;
- industrial operators must report the monitoring results to the government;
- cumulative emissions must be within regional emission targets where applicable
- all emitters are responsible for controlling their emissions and bearing all costs associated with measuring emissions, monitoring potential effects and mitigating any impacts on air quality and the environment (Polluter Pay);
- pollution prevention (the use of processes, practices, materials, products or energy that avoid or minimize the creation of pollutants or wastes at the source) is preferred over end-of-pipe treatment;
- reductions in air pollution must not result in additional waste burdens on surface water, groundwater, or land; and
- all emitting sources must strive to improve their emissions performance with upgrades at appropriate time intervals (continuous improvement).

Other aspects of the management approach for industrial facilities includes: ambient air quality objectives; source performance standards; plume dispersion modelling; ambient air and source emissions monitoring; environmental reporting; emission inventories; Approvals; compliance assessments; and research. The management framework is illustrated in Figure 2.

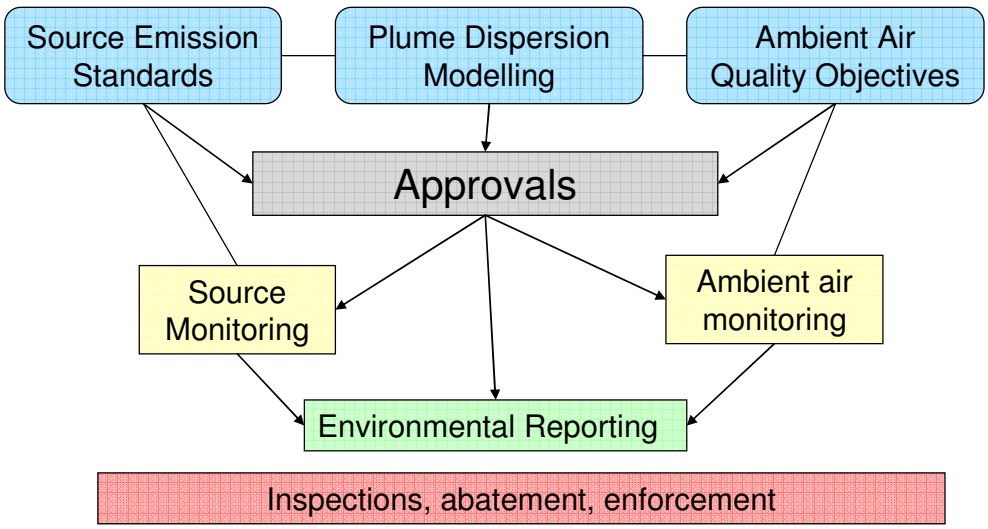

Figure 2 The Industrial Regulatory System

2.1 Environmental Assessment Process

The Environmental Assessment process provides a means of reviewing projects to assess their potential impact on the environment, including air quality. This process allows for full public participation and ensures economic development occurs in an environmentally responsible manner.

The purpose of the Environmental Assessment process is to:

- support the goals of environmental protection and sustainable development;
- integrate environmental protection and economic decision-making at the earliest stages of planning;
- predict the environmental, social, economic and cultural consequences of a proposed activity and to assess plans to mitigate any resulting adverse impacts; and
- involve the public proponents and Government departments and agencies in the review of proposed activities.

2.1.1 Source Performance Standards

Emissions of various substances must be restricted to ensure that the quality of the ambient air is maintained below ambient objectives. This is done through regulations, Approvals, or Codes of Practice. Source performance standards can be used to

calculate limits, which can be specified in Approvals issued to individual facilities. Source performance standards are typically set at levels which minimize emissions by specifying:

- numerical rate, such as mass per unit production;
- concentration of a substance in fuel or effluent;
- type of equipment or procedure; or
- prohibited practices.

Alberta may adopt or use agreed upon national or international source performance standards or may set emission standards based on its own review.

2.1.2 Plume Dispersion Modelling

Plume dispersion models are tools that link residual source emissions to ambient air concentrations in a specified area. Once an emission limit, based on technology capability, has been proposed for a particular source, computer models are used to determine the required stack height or source release conditions to disperse residual substances. Emission sources must be designed so that concentrations resulting from all emissions in the area remain below the Alberta Ambient Air Quality Objectives. Modelling takes into account the cumulative impact of all other sources emitting similar substances in the area. Modelling is also used in the siting of ambient air monitoring stations in the vicinity of industrial facilities. The *Alberta Air Quality Model Guideline* provides direction on the use of models in Alberta.

2.1.3 Ambient Air Quality Objectives

Ambient air quality objectives provide a basis for determining acceptable air quality and are used in a number of ways:

- Determine adequacy of facility design considering all sources in the area;
- Establishing stack heights and release conditions for each source;
- Assessing facility air quality performance.

Ambient air quality objectives are not levels to "pollute-up-to" but rather as ceilings that we do not want to reach. Over time, pollution prevention and continuous improvement should keep air quality well below the ambient air quality objectives.

2.1.4 Approvals

Regulatory Approvals issued under *EPEA* are the key regulatory implementation tools for the operation of the industrial air quality management system. They incorporate:

- source emission limits;
- required pollution control equipment/technologies and allowable emission sources;
- operational procedures and parameters required to minimize emissions;
- stack design criteria based on plume dispersion modelling to ensure that air quality remains below ambient air quality objectives; and
- environmental monitoring and reporting requirements, including emission inventory data.

Under *EPEA*, an integrated, single environmental Approval is issued to cover all phases of an industrial operation including: construction; operation; and reclamation. Integrated Approvals include air quality as only one of many components.

Approvals under *EPEA* can be issued for durations of up to ten years. The Approvals process also allows for public input and has an appeal mechanism that is administered by the Environmental Appeal Board.

For less complex activities, Codes of Practice are used as a regulatory tool. The Code of Practice is an enforceable document that specifies environmental requirements for the activity.

Some aspects of the upstream oil and gas industry are regulated directly by the Energy Resources Conservation Board and do not require an Approval or registration under a Code of Practice. These types of facilities are the smaller, more common types such as well sites, batteries, compressor stations, as well as activities such as drilling and completions. Any such activity must still conform to ambient air quality objectives.

2.1.5 Source Emissions Monitoring

Source emissions monitoring may be specified when an Approval is issued to a facility. Requirements vary depending on the substance monitored and the size and nature of the industrial facility. Source emissions monitoring serves a number of purposes including;

- ensuring pollution control technologies are operating effectively;
- characterizing complex emissions;

- providing information for provincial and national emission inventories; and
- providing data for tracking trends.

Monitoring can be either in-stack emission monitoring or fugitive emission monitoring.

In-stack Emission Monitoring: There are two types of in-stack emission monitoring requirements in Approval conditions. These are manual stack surveys and continuous emission monitoring. Manual stack surveys are short duration tests, usually consisting of three one-hour tests. Stack sampling equipment is used to collect effluent samples from the stack. These surveys are conducted by specially trained stack sampling personnel in accordance with the reference methods contained in the *Alberta Stack Sampling Code*. In addition, facilities that emit large quantities of substances must conduct monitoring with continuous emission monitoring systems (CEMS), which are instruments permanently installed on a stack. Measurements of the concentration and flow rate allow the mass emission rate to be determined on an ongoing, year round basis. Requirements for CEMS are set out in the *Alberta Continuous Emission Monitoring System (CEMS) Code*.

Fugitive Emission Monitoring: Fugitive emissions are typically volatile organic compounds (VOCs) but can be other compounds, may be emitted from leaking valves, flanges, sampling connections, pumps, pipes and compressors. These emissions can be a significant source of air contaminants. Industries, especially organic chemical plants, are required by their Approvals, to implement fugitive monitoring programs for fugitive emissions which will detect leaks in process equipment and piping. Prompt corrective action (e.g., repairs or replacement) is required. Annual status reports of leak detection and repair are sent to Alberta Environment as specified in regulations or Approvals.

2.1.6 Ambient Air Monitoring

Some industries are required to conduct ambient air quality monitoring for specific substances as part of the conditions in their Approvals. The number of monitoring stations, frequency and duration of monitoring or sampling, measuring or sampling techniques, and analytical methods, are dependent upon the substance to be monitored and its emission rate. Alberta Environment's expectations on how ambient monitoring is to be conducted are outlined in the *Air Monitoring Directive*. Ambient air monitoring serves a number of purposes including;

- ensuring pollution control technologies are operating effectively;
- providing an early warning system for potential contamination issues;

- assessing the impact of releases on the environment; and
- providing data for tracking trends in environmental performance and effects.

Ambient monitoring can take various forms:

- Continuous monitoring in a station located permanently, or for a specified time period, at or near the point of predicted maximum ground level concentration, maximum frequency of exposure direction, or for other considerations.
- Passive or active integrated sampling that collects or absorbs gaseous pollutants over a specified time period and sampling schedule.
- Innovative ambient monitoring programs such as remote sensing.

Airshed zones have been created in certain areas of the province to allow area stakeholders to identify and design solutions for regional air quality issues. The zones monitor, analyze, and report on the air quality in their region. Industries may be approved to reduce their own ambient monitoring in favour of the airshed zone monitoring.

2.1.7 Environmental Reporting

Industry is required to submit monitoring reports to Alberta Environment and the reporting requirements are specified in their Approval. The reports summarize required monitoring data and provide information on the quality assurance and quality control measures performed to ensure the data is accurate. The reports also outline problems which may have arisen, and what corrective actions were taken.

For certain types of environmental incidents, immediate reporting is required under *EPEA* and the associated *Release Reporting Regulation*. Alberta Environment has prepared a document entitled *Release Reporting Guideline*, which provides additional details on what types of situations require immediate reporting.

Air quality in Alberta is also reported periodically in the Department's State of the Environment report. In addition, if special monitoring has been conducted the report is made available on the Alberta Environment web site.

2.1.8 Compliance Assurance Program

Alberta Environment's Compliance Assurance Program begins with a foundation of regulatory requirements. Compliance is assured by activities that promote compliance

through **education** and **prevention**, and activities that compel compliance through **enforcement**.

Education promotes compliance by raising awareness of environmental protection and management, regulatory requirements, how to comply with those requirements, and the consequences of non-compliance. Education is also used by Alberta Environment to encourage continuous improvement and environmental stewardship.

The **Prevention** component is intended to support compliance by building capacity and the willingness within the regulated community to comply with the regulatory requirements, and to identify and address potential problems before they cause environmental damage.

Enforcement is to ensure that there are consequences for non-compliance. Parties that are in non-compliance are required to remedy problems, correct the non-compliance and to mitigate any damages.

This program and the components are described in the document *"Alberta Environment Compliance Assurance 2005"*.

3.0 COMPREHENSIVE REGIONAL AIR MANAGEMENT

It has been recognized that Alberta cannot always deal with air quality impacts on a project-by-project basis when considering cumulative effects. Comprehensive regional air management is used to address air quality issues in regions where development has necessitated an approach other than project-by-project Approvals. Our air management approach considers the impact of new development and all sources of air pollution on current and future air quality.

Concrete environmental targets will be set in areas where regional development necessitates such an approach. These targets ensure environmental protection on a regional basis.

3.1 Area or Non-point Source Emission Management Strategies

In addition to source emission standards for individual facilities, there is a need to develop strategies to control area sources. Area or non-point sources are those sources which are numerous, widespread, and are not easily regulated through the traditional Approval method (i.e. vehicles, home furnaces, consumer products).

Increasing levels of emissions in the Calgary-Edmonton corridor are chiefly from vehicle emissions and residential heating. Although emissions per vehicle have been reduced, the volume of vehicles on the road is increasing. Further, due to the increasing cost of natural gas, both individual homeowners and commercial businesses are looking to use alternate fuels in heaters and boilers. Alternate fuels, such as coal and wood, have higher levels of air contaminants associated with their use and typically do not have air pollution control equipment added as part of their combustion systems.

These sources are difficult to regulate due to jurisdictional issues (many are municipal or federal responsibilities) and the number of individual emitters. The management of the release from such sources must be done at the product manufacturing stage to be effective. The management tools can be the same as used for source emissions (pollution prevention and use of technology or the use of outright product bans such as has been done with chlorofluorocarbon compounds). Alberta Environment continues to develop the regulatory and non-regulatory tools that are available for managing these emissions.

4.0 AIR QUALITY PLANNING

Alberta Environment works with industrial organizations, environmental non-government organizations, outside stakeholders including the public, and other levels of government to develop and implement strategies and plans that will address air quality issues and concerns. Following is a brief description of some of the partnerships and collaborations that Alberta has participated in and some of their achievements.

4.1 Canadian Council of Ministers of the Environment

The Canadian Council of Ministers of the Environment (CCME) has been a critical forum for federal, provincial and territorial governments to identify common air issues and work to establish national standards for air quality. The CCME is comprised of the environment ministers from the federal, provincial and territorial governments. They normally meet at least once a year to discuss national environmental priorities and determine work to be carried out. Some of the Canada Wide Standards (CWS) that have been developed by the CCME include:

- mercury;
- benzene;
- dioxins and furans;
- refinery framework (NFPPER),
- Canada-wide acid rain program;
- ozone depleting substances; and
- particulate matter and ozone.

4.2 Clean Air Strategic Alliance

The Clean Air Strategic Alliance (CASA) was established in 1994 and is a key mechanism that Alberta uses to address air policy issues and help ensure sound management. The group is a multi-stakeholder partnership, which uses a consensus-building approach when developing recommendations and members work toward a shared vision and mission. Stakeholders include representatives selected by industry, government and non-government organizations. The implementation of CASA recommendations is generally the responsibility of the party with authority, including Alberta Environment.

CASA has a proven track record of developing innovative solutions that accommodate differing interests. Some of CASA successes include:

- Particulate Matter and Ozone Framework;
- Acid Deposition Management Framework;
- Flaring and Venting Management Framework;
- Pollution Prevention and Continuous Improvement; and
- Electricity Sector Emission Management Framework.

These programs are described briefly in the Appendix.

4.3 Information and Tools

Alberta Environment uses a variety of information and tools in the air quality management system. The following sections give a brief description of some of the information and tools that are needed and how they can be used.

4.3.1 Emission Inventories

Emission inventories are a key air quality management tool. They are useful in:

- assessing total emissions and emission trends;
- performing sector specific emission evaluations;
- providing benchmarks for reference to national/international protocols; and
- zonal/regional airshed management and land use planning.

Both industrial emission inventories for Alberta and comprehensive national emission inventories are used in the air quality management system.

4.3.2 Ambient Air Monitoring

Alberta Environment and Airsheds operate a comprehensive air and precipitation quality monitoring program throughout the province. Individual monitoring stations monitor some, but not all of the listed parameters. The program consists of:

- continuous (hourly);
- intermittent (daily);
- passive (monthly), and
- precipitation quality (weekly) networks.

Air quality parameters collected by continuous methods include:

- carbon monoxide;
- oxides of nitrogen;
- ozone;
- total hydrocarbons;
- particulate matter (PM_{10} and $PM_{2.5}$);
- ammonia;
- sulphur dioxide;
- hydrogen sulphide and
- carbon dioxide

Intermittent monitoring refers to air quality parameters that are collected as a 24-hour integrated sample according to the National Air Pollution Surveillance (NAPS) schedule. Parameters monitored on an intermittent basis include:

- particulate sulphate and nitrate;
- polycyclic aromatic hydrocarbons in particulate matter;
- particulate matter (PM_{10} and $PM_{2.5}$);
- particulate matter composition, and
- over 150 volatile organic compounds.

Passive methods are used to monitor sulphur dioxide, nitrogen dioxide, hydrogen sulphide and ozone as a 30-day total. Precipitation quality samples are collected on a weekly basis and analyzed for acidity as well as several major anions and cations.

In addition to routine air quality monitoring, monitoring of polycyclic aromatic hydrocarbons, volatile organic compounds, particulates, dioxins, furans, polychlorinated biphenyls (PCBs), and sulphur compounds may be conducted in response to public concerns or requests from municipalities.

4.3.3 Air Quality Models

Air quality models provide estimates of ambient air quality resulting from current or projected future emissions. An air quality model is a set of mathematical relationships or physical/chemical models that are based on scientific principles. Information required to do modelling includes;

- emission rates,
- meteorology,

- topography and
- ambient air information.

When modelling area sources, emission factors would typically be used to quantify emissions. Alberta Environment may use a variety of models for air quality assessments. For example, regional air quality models predict cumulative ground-level concentrations from point and area sources; as well as, chemical transformations, formation of acidifying substances and formation of ozone.

4.3.4 Ambient Air Quality Objectives

Ambient air quality objectives are used by Alberta Environment to:

- Report on the state of the atmospheric environment in Alberta;
- Report to Albertans on the quality of the air through an air quality index;
- Guide special ambient air quality surveys; and
- Create tiered response structures (e.g. Acid Deposition Management Framework).

4.3.5 Environmental Effects (health and vegetation)

It is known that air quality can affect human health and the health of ecosystems; however, many factors play a role in the severity of the response. For example, with respect to human health the following factors play a role in the response:

- Distribution of the air pollutant in space and time.
- Does the pollutant penetrate indoors?
- Where, when and how do people spend their time?

For ecosystems:

- Distribution of the air pollutant in space and time.
- The sensitivity of the ecosystem to the pollutant.
- Climate and hydrology of the site.

Having a greater understanding of the relationships between air quality and health issues should enable us to improve air quality management practices. Currently, Alberta Environment uses available health and ecosystem effects information when setting standards, objectives and guidelines.

4.3.6 Research

To support policy and system development, Alberta Environment is involved in planning, directing, and funding research. The results from research initiatives are used to inform decision-makers and stakeholders in their air quality management planning processes. In the past, air quality research has been directed at questions around natural emissions, effects on vegetation, emissions composition for various Alberta source types, ambient air quality characteristics, assessing emission reduction technologies, assessing ambient air quality, improving monitoring methodologies, and improving air quality management systems. Partnering with other departments, governments and industry on research is part of the overall research management strategy to avoid duplication and maximize the benefit received from provincial research dollars.

5.0 CONCLUSION

Air quality is important to the people within the Province of Alberta. The present management system has evolved over time and will continue to do so. The system uses an Industrial Regulatory System, Comprehensive Regional Management and Strategic Planning to assure air quality in the province.

6.0 REFERENCES

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APPENDIX

A.1 Acid Deposition Management Framework

Management of acidic deposition requires an integrated approach that includes measurement and estimation of emissions and deposition, and evaluation of the effects of deposition on recipient ecosystems. Alberta's, management framework is based on four levels of acid deposition:

- pre-industrial deposition (background);
- current level of deposition;
- target load; and
- critical load:

Each of the levels of deposition corresponds with specific management practices. Figure A.1 gives an overview of Alberta's Acid Deposition Management Framework.

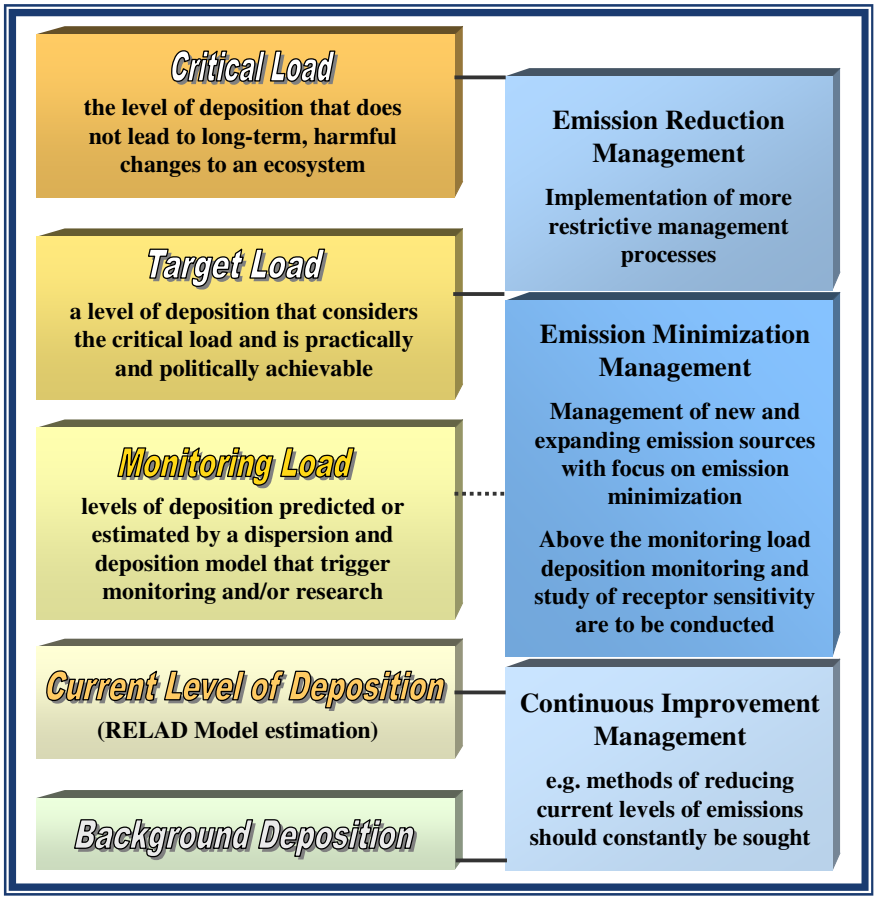

Figure A.1 Acid Deposition Management Framework

Alberta's Acid Deposition Management Framework is available from the Alberta Environment Information Centre at: http://environment.gov.ab.ca/info/home.asp

A.2 Airsheds

Many of Alberta's air quality issues are regional, both in their cause and the solutions that are required. In these cases, province-wide approaches may be inappropriate and inefficient. Instead, an airshed zone can enable stakeholders to design their own solutions to address regional air quality issues. Airshed zones are guided by local or regional multi-stakeholder non-profit societies who use the CASA consensus model to make decisions.

These airshed societies work within a designated area to monitor, analyze, and report on air quality. Stakeholders involved in airshed zone management may also develop a response plan to deal with air quality concerns in their region. A map of the airshed zones is provided in Figure A.2.

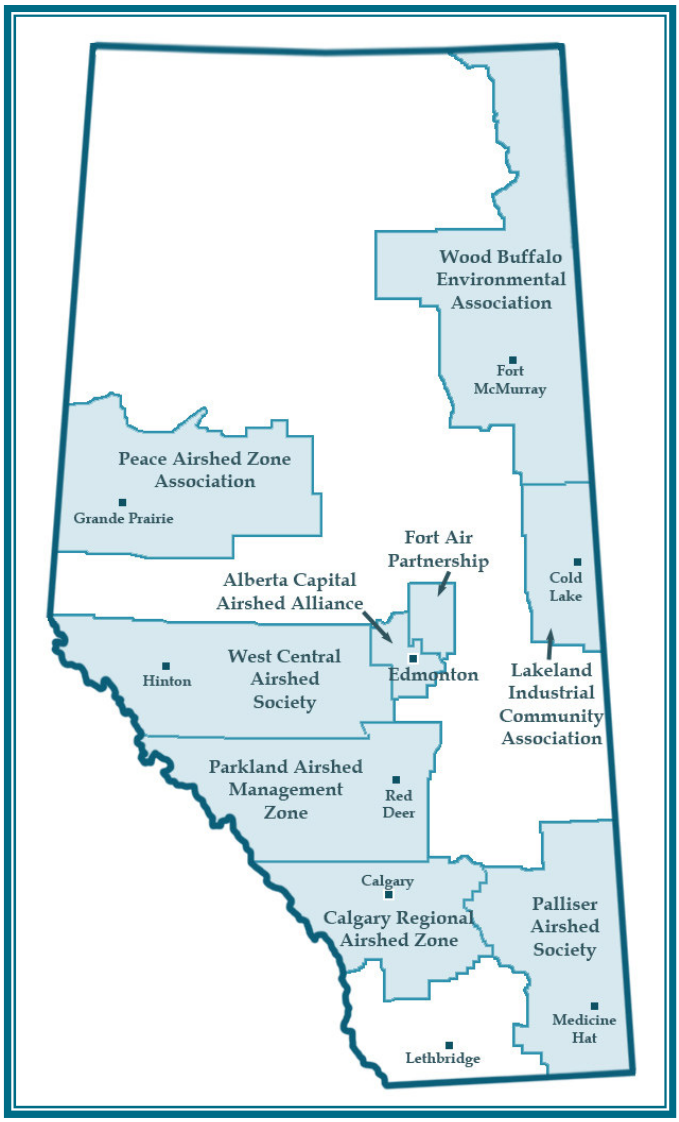

Figure A.2 Alberta Airsheds

A.3 Particulate Matter and Ozone Framework

The Particulate Matter (PM) and Ozone Management Framework for Alberta (Figure A.3) was developed in response to the endorsement of the CWS for Particulate Matter (PM) and Ozone by the CCME. Alberta's commitment under the CWS requires that the province meets specific ambient targets by 2010. The PM and Ozone Framework meets and sometimes exceeds the provisions of the CWS and it recognizes that implementation strategies may be different for different areas of the province. An annual analysis of ambient PM and ozone concentrations from Alberta's ambient air quality monitoring system determines the appropriate action level for each area of the province.

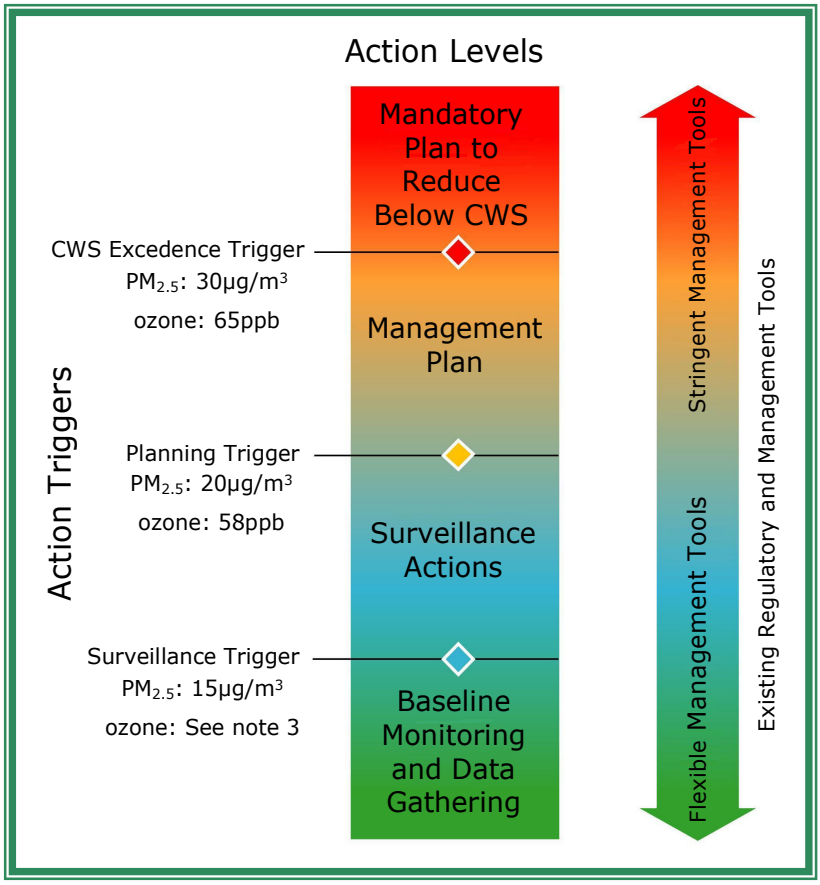

Figure A.3 PM and O_3 Management Framework

Particulate Matter – refers to microscopic solid and liquid particles that remain suspended in the air for some time. It is either emitted directly (primary PM) or formed in the atmosphere from precursor emissions (secondary PM). Important precursors of secondary PM are nitrogen oxides, sulphur dioxide and ammonia.

Ozone – unlike other pollutants, ozone is not emitted directly by human activities. Ozone in the lower atmosphere is produced by a complicated set of chemical reactions involving oxides of nitrogen (NO_x) and volatile organic compounds in the presence of sunlight. Ozone is also transported to the group from the "ozone rich" upper atmosphere by natural weather processes.

The Guidance Document for the Management of Fine Particulate Matter and Ozone in Alberta is available online at: http://www.casahome.org/

A.4 Flaring and Venting

In 1998 the Flaring and Venting project team recommended that Alberta strive toward an overall goal of the eventual elimination of routine solution gas flaring. It was acknowledged that this goal could not be reached in the short-term but that Alberta should work towards this goal. The bulk of this program is administered by the Energy Resources Conservation Board. Figure A.4 illustrates the Flaring Management Framework.

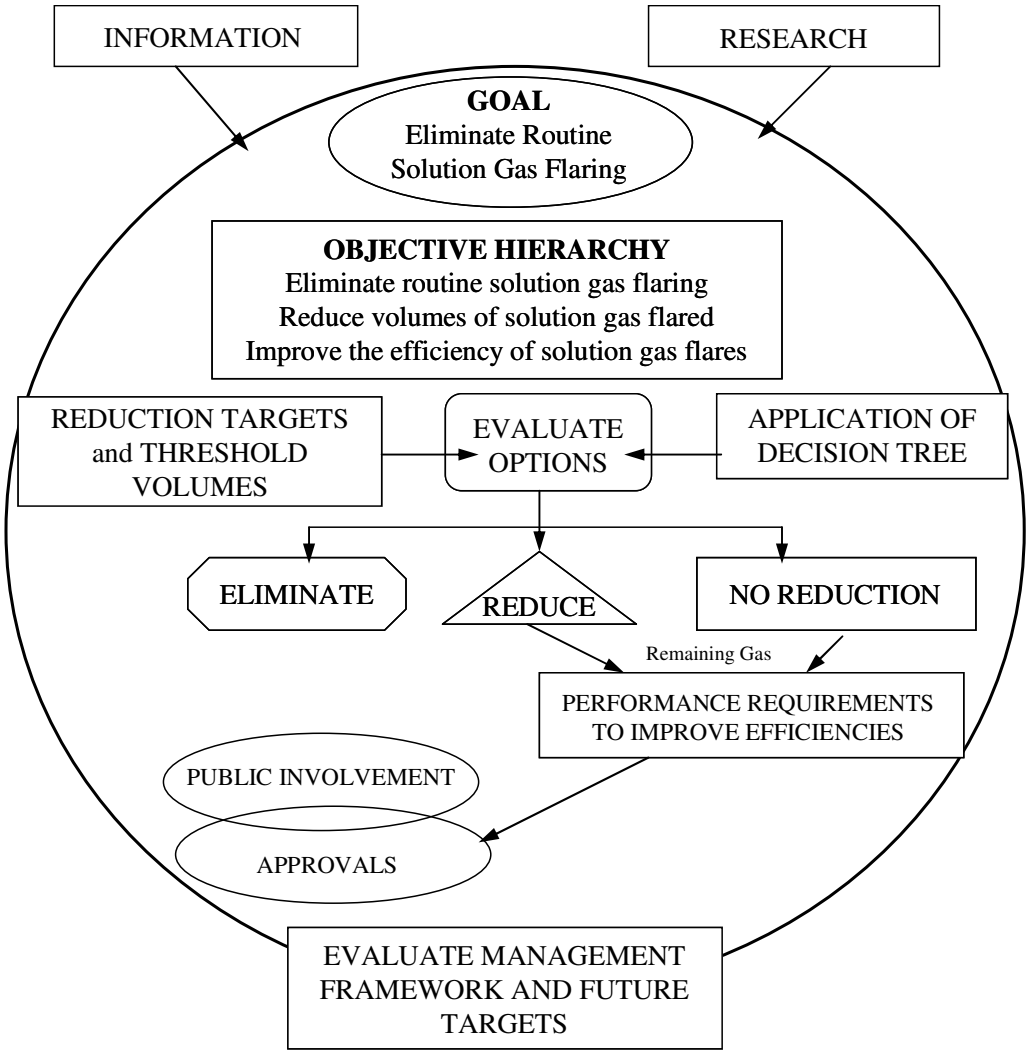

Figure A.4 Flaring Management Framework

A.5 Pollution Prevention and Continuous Improvement

Pollution Prevention means using processes, practices, materials, products or energy that avoid or minimize the creation of pollutants and waste at the source. The CASA framework (available online at http://www.casahome.org/) identified an opportunity to "continuously improve air quality by minimizing the use of polluting processes, practices, materials and products". Pollution prevention promotes continuous improvement through operational and behavioral changes.

The Pollution Prevention Environmental Management Hierarchy is illustrated in Figure A.5. Pollution prevention approaches generally focus on the upper half of the hierarchy with a shift to control down the pyramid.

Alberta Environment's approach to pollution prevention focuses on voluntary actions, partnerships and education.

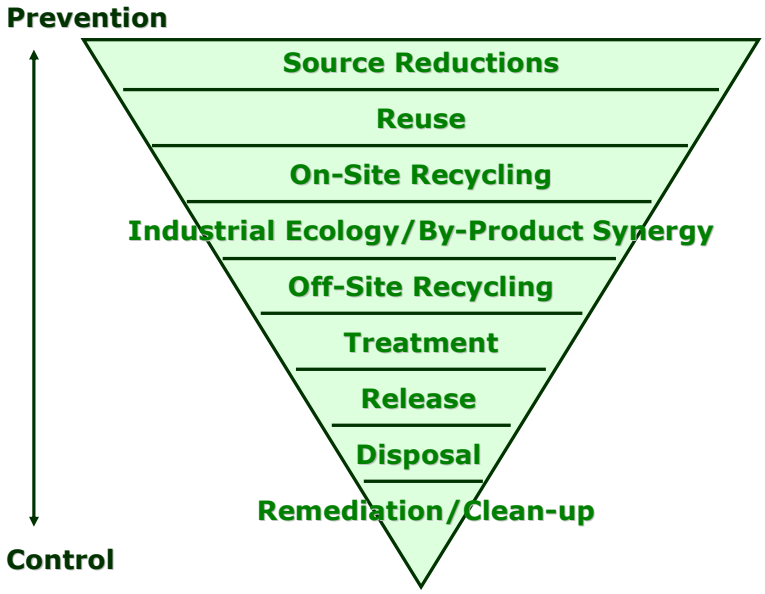

Figure A.5 The Pollution Prevention Environmental Management Hierarchy

Approaches include:

- Incorporate pollution prevention/continuous improvement messages into materials it updates and into new environmental education documents.
- Encourage and assist others to incorporate pollution prevention/continuous improvement messages into their materials.
- Initiate a pollution prevention/continuous improvement outreach program to industry, with particular emphasis on small and medium-sized enterprises.
- Encourage utilities to take advantage of opportunities for public education and outreach by including a pollution prevention/continuous improvement message with their bills.
- Seek opportunities to disseminate pollution prevention/continuous improvement messages through print and electronic communication vehicles.
- Work with partners to develop and implement pollution prevention activities.

A.6 Electricity Project Team

Alberta Environment accepted and adopted all of the recommendations outlined in the CASA report "An Emissions Management Framework for the Alberta Electricity Sector Report to Stakeholders" (available online at http://www.casahome.org/). The framework is aimed at continuously improving air emissions standards for electricity generation and will be implemented January 1, 2006. The following diagram (adapted from the report) illustrates the components of the framework.

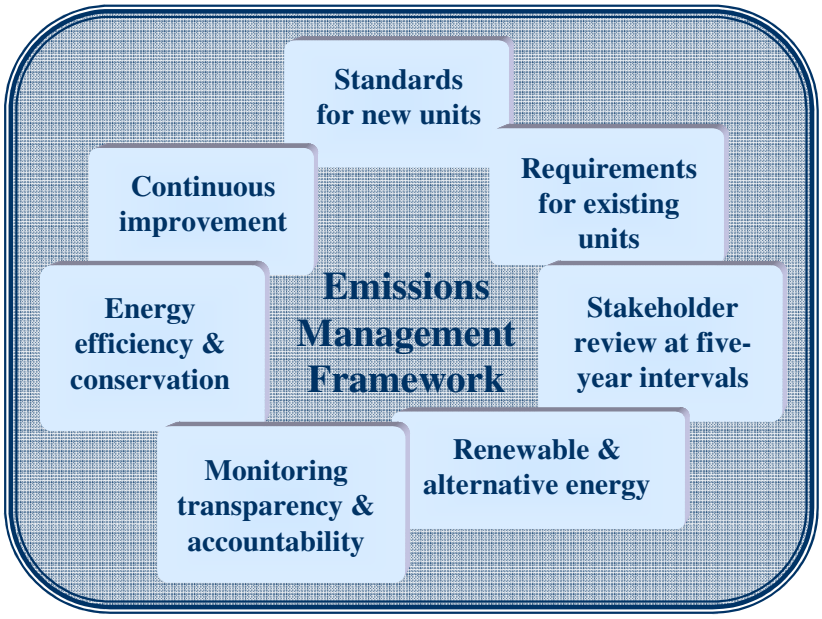

Figure A.6 Emissions Management Framework for the Alberta Electricity Sector

The proposed actions in the framework will result in:

- 50 per cent reduction in mercury by the end of 2009.
- 46 per cent reduction in sulphur dioxide by 2025.
- 32 per cent reduction in nitrogen dioxide by 2025.
- 51 per cent reduction in particulate matter by 2025.