Environment Canada Environnement Canada

LOW SULPHUR FUELS procurement guide

Les Ami(e)s de la Terre Friends of the Earth

Canada

LOW SULPHUR FUELS procurement guide

This guide was jointly developed by Environment Canada and Friends of the Earth to help municipal, provincial/territorial, and federal governments and other organizations take leadership for cleaner air by procuring low sulphur fuels (LSFs) where available and feasible.

Implementing LSF procurement is an immediate action that governments and other organizations can take to support the early introduction and development of cleaner fuels. The use of fuels with a low level of sulphur, in conjunction with the use of cleaner exhaust emission control systems, has many positive benefits for the environment and human health. The opportunity exists for governments and other organizations to meet their sustainable development and green procurement objectives by combining LSF procurement and exhaust emission control measures.

The opportunity exists for governments and other organizations to meet their sustainable development and green procurement objectives by combining LSF procurement and exhaust emission control measures.

The following pages provide:

- an overview of the environmental and health impacts of sulphur in fuels;
- a description of the benefits of using LSFs;
- information on regulations and standards for sulphur content in fuels;
- opportunities for LSF procurement in the regions and across the country;
- case studies of the successful implementation of LSF initiatives; and
- suggestions for developing an LSF procurement strategy in your organization.

The accompanying fact sheets provide materiel managers with additional information on the LSF procurement process.


WILHELMSEN LINES

This guide complements the 10-year Federal Agenda on Cleaner Vehicles, Engines and Fuels (2001), which is an integral part of the Government of Canada's strategy on clean air. The Agenda includes regulations, guidelines, and studies that will benefit the environment and the health of all Canadians by reducing emissions from a broad range of fuels, vehicles, and engines.

What are the environmental and health impacts of sulphur in fuels?

Sulphur is a naturally occurring compound in crude oil. The sulphur content of fuels varies depending on the type of crude oil produced and the refining process used. The combustion of sulphur-containing fuels — either in vehicles or at stationary sources (e.g., facilities) — results in the transformation of sulphur into sulphur dioxide and sulphate particles.

Exposure to sulphur dioxide at high concentrations can cause breathing problems and respiratory illness and can aggravate existing heart and lung conditions. In addition, sulphur dioxide can react with water vapour and other chemicals in the air to form very fine particles of sulphate. These airborne particles form a key element of urban smog. Smog is known to have adverse health effects such as premature deaths, increased hospital admissions, and other illnesses resulting in loss of productivity. Particularly vulnerable to smog are people with heart or lung disease, the elderly, and small children.

Sulphur dioxide and nitrogen oxides are two common air pollutants that contribute to acid rain. Acid rain is known to have damaged lakes, forests, and buildings, particularly in eastern Canada.

In vehicles, sulphur compounds in fuel reduce the efficiency of exhaust emission control systems, such as catalytic converters, by bonding to catalyst sites. This results in increased emissions of nitrogen oxides, volatile organic compounds, carbon monoxide, and particulate matter, which are the main contributors to smog.

What is an LSF?

A "low sulphur fuel" is a general term used in this guide to refer to a fuel product that contains sulphur at a concentration that is lower than the maximum allowable level. As regulations governing the level of sulphur in fuels become more stringent, the definition of an LSF will change.

What are the advantages of using LSFs?

The use of LSFs has both direct and indirect benefits. In using LSFs, your organization can assist in reducing air pollution by:

- providing a reduction in emissions of sulphur dioxide and sulphate particles that is directly related to the decrease in fuel sulphur content; and
- increasing the efficiency of exhaust emission control after-treatment devices of vehicles, if so equipped, and thereby reducing other emissions, such as nitrogen oxides, volatile organic compounds, carbon monoxide, and particulate matter.

The quantity of emission reductions achieved by using LSFs in existing vehicle, engine, or equipment technology can vary depending on the application, the level of sulphur reductions, and other fuel characteristics in the fuel previously used.

The reductions in emissions of air pollutants that result from the use of LSFs are associated with reductions in the formation of smog and acid rain and, consequently, reductions in their associated adverse environmental and health impacts. For example, based on a study of seven Canadian cities, it has been estimated that the use of gasoline containing sulphur at a concentration of 30 mg/kg will, over a 20-year period, result in:

- 1352 fewer cases of premature mortality;
- 1537 fewer hospital admissions and 4294 fewer emergency room visits;
- 4770 fewer cases of chronic bronchitis and 58 429 fewer cases of bronchitis in children;

- 993 134 fewer days of reduced activity and 2 086 511 fewer days of asthma symptoms; and
- 7 159 671 fewer cases of acute respiratory symptoms. [1]

New developments in the United States have put into question some of the research underlying on estimated health benefits. It is not yet clear whether, in resolving the uncertainty, the estimates of health benefits will become smaller or larger than the current estimates. Nevertheless, Environment Canada expects that reducing sulphur in fuels will result in improvements to air quality, which in turn will result in health benefits for Canadians.

What is the regulatory framework governing sulphur levels in fuels?

Governments in North America and abroad are developing or already have in place regulations and standards to limit the sulphur content in liquid fuels. In Canada, the composition of fuels, including sulphur content, can be regulated by the federal government using the authority under the *Canadian Environmental Protection Act, 1999* (CEPA 1999). LSF regulations that have been developed under CEPA 1999 include the *Sulphur in Gasoline Regulations* and the *Sulphur in Diesel Fuel Regulations*. These regulations specify phased-in limits for sulphur in gasoline and diesel fuel used in on-road vehicles.

In Canada, the composition of fuels, including sulphur content, can be regulated by the federal government using the authority under the *Canadian Environmental Protection Act, 1999* (CEPA 1999).

In addition, as set out in the Notice of Intent on Cleaner Vehicles, Engines and Fuels, published in the *Canada Gazette* on February 17, 2001, Environment Canada plans to recommend a regulatory limit for sulphur in off-road diesel, similar to a rule recently proposed by the United States. Also under the Notice of Intent, Environment Canada is developing measures to reduce the level of sulphur in fuel oils used in stationary facilities, with the view to matching the requirements set by the European Union.

The Federal Agenda on Cleaner Vehicles, Engines and Fuels set out action plans for Environment Canada to develop emission regulations for on-road and off-road

[1] Health and Environmental Impact Assessment Panel Report, Joint Industry/Government Study on Sulphur in Gasoline and Diesel Fuels (June 25, 1997), revised March 1998, Health and Environmental Effects Panel.

vehicles and engines aligned with U.S. federal standards. The *On-Road Vehicle and Engine Emission Regulations* were published in January 2003. The *Off-Road Small Spark-Ignition Engine Emission Regulations*, which will address small utility engines such as those found in lawn and garden machines, were proposed in March 2003. Other off-road engine emission regulations under development include those for compression-ignition engines, such as those used in construction and agricultural machines; recreational marine engines, covering outboards and personal watercraft; recreational vehicles, such as snowmobiles and all-terrain vehicles; and large spark-ignition engines, typically used in industrial applications such as forklifts.

Memoranda of Understanding (MOUs) between Environment Canada and manufacturers of off-road engines were put in place in 1999 and 2000 as interim measures pending the implementation of the new regulations. Under these agreements, manufacturers of various categories of off-road engines have agreed to voluntarily supply engines that meet the applicable standards of the U.S. Environmental Protection Agency (EPA). For more information on the MOUs, consult http://www.ec.gc.ca/transport/vehiclesfuels.htm.

Some provinces also regulate fuel quality and have sulphur content requirements for fuels under provincial petroleum and environmental protection acts.

The Canadian General Standards Board (CGSB), a standards development organization accredited by the Standards Council of Canada to write National Standard of Canada standards, has developed several voluntary standards for petroleum fuels, which specify sulphur content.

The current LSF regulatory development and sulphur content standards for fuels in Canada are outlined in Table 1.

TABLE 1 [1]

Fuel type	Federal CEPA 1999 regulations (current and future limits)	Provincial regulations/ bylaws	CGSB voluntary standards
Gasoline	*Sulphur in Gasoline Regulations (1999)* • 2003 – avg. 150 mg/kg • 2005 – avg. 30 mg/kg • 2005 – max. 80 mg/kg	• Quebec [2] – max. 1500 mg/kg • Southwest British Columbia [3] – avg. 150 mg/kg • Rest of British Columbia – avg. 200 mg/kg	• Leaded/unleaded – max. 1000 mg/kg [4]
Diesel fuel for use in on-road vehicles	*Sulphur in Diesel Fuel Regulations (2002)* • 2003 – max. 500 mg/kg • starting in 2006 – max. 15 mg/kg	• Quebec – max. 2000 mg/kg	• max. 500 mg/kg [5]
Diesel fuel for use in off-road equipment	CEPA regulation planned Expected to align with requirements being developed by the U.S. EPA for 2007–2010 phase-in: EPA Proposed Rule: 2007 – max. 500 mg/kg (including rail and marine diesel) 2010 – max. 15 mg/kg for off-road diesel fuel other than rail and marine	• Quebec – max. 5000 mg/kg	• Type A – max. 3000 mg/kg • Type B – max. 5000 mg/kg [6]
Fuel oil (light)	Federal initiative to examine options under way Target is to match European Union limit of max. 1000 mg/kg	• British Columbia [7] – Type 0 to 2 – max. 11 000 mg/kg • New Brunswick [8] Types 1 & 2 – max. 5000 mg/kg • Quebec Type 00 – max. 2000 mg/kg Types 0 to 2 – max. 5000 mg/kg • Montreal Urban Community [9] Types 1 & 2 – max. 4000 mg/kg • Ontario [10] (effective in Metro Toronto only) Types 1 & 2 – max. 5000 mg/kg • New Boilers Regulation (Ontario) [11] All types – max. 10 000 mg/kg	• Type 0 – max. 3000 mg/kg • Types 1 & 2 – max. 5000 mg/kg [12]

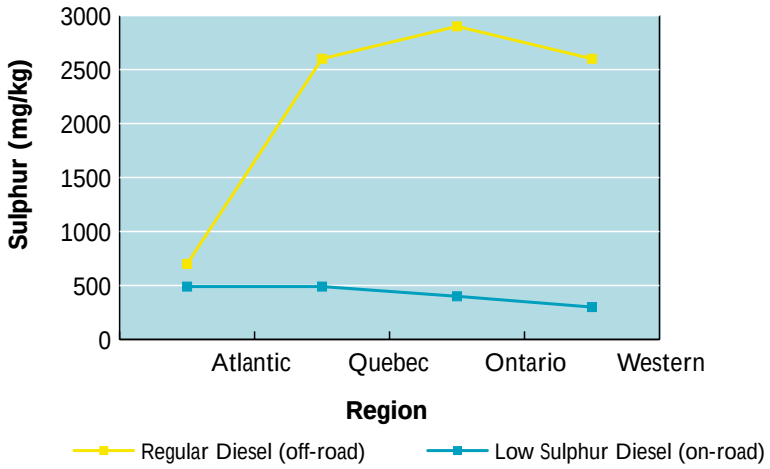
Fuel type	Federal CEPA 1999 regulations (current and future limits)	Provincial regulations/ bylaws	CGSB voluntary standards
Fuel oil (heavy)	Federal initiative to examine options under way Target is to match European Union limit of max. 10 000 mg/kg	• British Columbia – All types – max. 11 000 mg/kg • New Brunswick Type 4 – max. 15 000 mg/kg Type 5 – max. 20 000 mg/kg Type 6 – max. 30 000 mg/kg • Ontario (effective in Metro Toronto only) Types 4 to 6 – max. 15 000 mg/kg • Quebec Type 4 – max.10 000 mg/kg Types 5 to 6 – max. 20 000 mg/kg • Montreal Urban Community 10 000 mg/kg – max. 15 000 mg/kg (depending on area) • New Boilers Regulation (Ontario) All types – max. 10 000 mg/kg	No limit specified [13]

1 Limits are subject to change. Refer to most recent regulation, standard or by-law to confirm limits shown in table.
2 *Petroleum Products and Equipment Act,* Petroleum Products Regulation
3 *Waste Management Act,* Cleaner Gasoline Regulation
4 CAN/CGSB-3.5-99
5 CAN/CGSB-3.517-2000
6 CAN/CGSB-3.6-2000
7 *Waste Management Act,* Sulphur Content of Fuel Regulation
8 *Clean Air Act, Air Quality Regulation*
9 Montreal Urban Community, By-law 90
10 *Environmental Protection Act,* Sulphur Content of Fuels
11 *Environmental Protection Act,* New Boilers Regulation (Ontario)
12 CAN/CGSB-3.2-99
13 CAN/CGSB-3.2-99

Are LSFs available in your region?

The sulphur content of fuels in Canada varies depending on the type of crude oil produced and the refining process used. Figure 1 illustrates how the sulphur contents of low sulphur diesel and regular diesel (for off-road use) fluctuate by region.

FIGURE 1 FLUCTUATION IN SULPHUR CONTENT OF DIESEL FUELS BY REGION



Source: Environment Canada 2002, Sulphur in Liquid Fuels 2001

Your organization can be a leader and can assist the market penetration of LSFs by including sulphur content as a consideration in fuel procurement.

This fluctuation in the sulphur content of fuels across Canada is reiterated in Table 2, which illustrates the average volume-weighted maximum and minimum sulphur content of transportation fuels and fuel oils for refineries and importers by region in 2001.

The last line in Table 2, the national average range of sulphur levels in fuels that were available across Canada in 2001, is illustrated graphically in Figures 2 and 3.

As illustrated in Figures 2 and 3, the sulphur content of low sulphur diesel is far less than that of regular diesel used in off-road applications, and the sulphur content of light fuel oil is well below that of heavy fuel oil. As a result, these fuels, present an opportunity for organizations to reduce sulphur levels through the procurement of LSFs for their off-road fleets and facilities, where technologically feasible.

TABLE 2

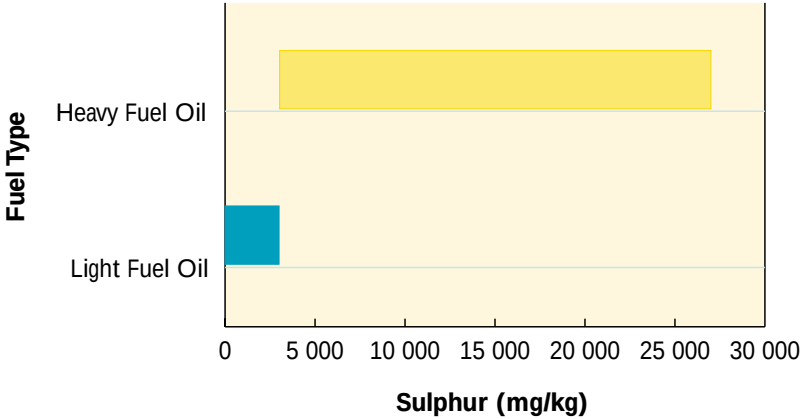
Region	Average volume-weighted sulphur content (mg/kg) for refiners and importers by region									
	Transportation fuels						Other fuels			
	Gasoline		Low sulphur diesel		Regular diesel		Light fuel oil		Heavy fuel oil	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Atlantic	48	356	148	500	485	989	1 020	3 000	4 214	28 102
Quebec	212	420	378	473	2 431	3 071	1 539	3 129	8 006	17 034
Ontario	22	596	20	437	1 297	3 676	1 269	3 440	11 751	25 736
Western	4	743	188	500	500	3 781	599	2 700	4 313	24 000
National	**4**	**743**	**20**	**500**	**485**	**3 781**	**599**	**3 440**	**4 214**	**28 102**

Source: Environment Canada 2002, Sulphur in Liquid Fuels 2001

Many refineries have already made and continue to make great gains in reducing the sulphur content of fuels. As a result, LSFs are currently available in some areas. The availability of LSFs is rapidly expanding as refineries upgrade their facilities to comply with impending regulatory requirements. Another factor that may influence the regional availability of LSFs is distribution agreements between refineries and distributors.

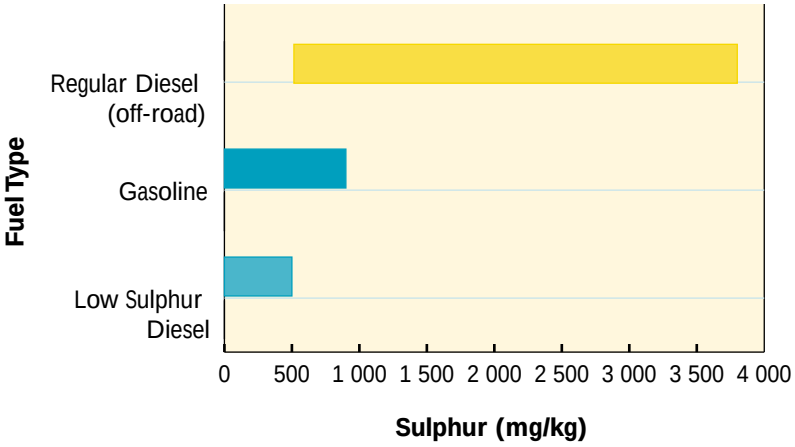
Your organization can be a leader and can assist the market penetration of LSFs by including sulphur content as a consideration in fuel procurement. To learn more about the availability of LSFs in your specific region, contact your local fuel suppliers.

FIGURE 2 NATIONAL RANGE OF AVERAGE SULPHUR LEVELS IN FUEL OILS



Source: Environment Canada 2002, Sulphur in Liquid Fuels 2001

FIGURE 3 NATIONAL RANGE OF AVERAGE SULPHUR CONTENT IN DIESEL FUELS AND GASOLINE



Source: Environment Canada 2002, Sulphur in Liquid Fuels 2001

Are there any examples of successful LSF procurement strategies?

Several municipal regions have successfully implemented LSF initiatives, as illustrated by the case studies given below.

CASE STUDY: CITY OF TORONTO

In 1998, Toronto Public Health and the City of Toronto Corporate Services Department produced a report at the request of the Board of Health exploring the possibility of purchasing LSFs for the City's corporate fleet. Toronto City Council approved the recommendations of that report, including:

- purchasing low sulphur diesel fuel for off-road vehicles; and
- considering sulphur content as well as price for bulk fuel purchases (gasoline and diesel).

This has resulted in a tendering process for fuels in which the request for proposal requires bidding companies to submit recent average sulphur levels by fuel type for the refinery that would supply the fuel. Bids are evaluated on both cost and potential emission reductions. This initiative cuts estimated sulphur dioxide emissions from the City's participating corporate fleets by approximately 50 percent each year, at a limited cost premium of 1 percent. Under the *Ontario Fuel Tax Act*, when on-road fuels are dyed red to indicate that they will be used for off-road purposes, the fuels are exempt from the on-road fuel tax, dramatically reducing costs.

CASE STUDY: REGION OF WATERLOO

Poor air quality in the Waterloo region was the impetus for conducting a regional emissions inventory, which indicated that vehicle sources were responsible for 60 percent of the City's emissions, and transit and police were responsible for the majority of vehicular emissions. As a result, a committee was formed that produced the following recommendations to reduce emissions from the city fleet:

- using low sulphur diesel for the off-road fleet;
- purchasing ultra low sulphur diesel for the region's transit buses;

- retrofitting older buses with a catalytic exhaust muffler; and
- replacing gasoline with a 10 percent ethanol blend (this will be implemented in the future).

Thanks to unprecedented interdepartmental cooperation and buy-in by all levels of employees that would be affected by the changes, council overwhelmingly approved the recommendations and was quick to implement them. The City found that using low sulphur diesel fuel for its off-road fleet reduced sulphur oxide emissions by approximately 9 tonnes per year, at an incremental cost of $76,300. The City tracks the success of this program through its financial system.

CASE STUDY: CITY OF LONDON, ONTARIO

Fuelled by air quality and health concerns, a task force comprising all sectors of the community, including the Health Unit, industry representatives, power generation, academia, and the City's engineering and environment departments, updated a previously completed air emissions study, and the Health Unit produced an Air Quality Action Plan {http://www.healthunit.com/yourenvironment.htm} to address its findings.

Subsequently, the Fleet Services Division of the Environmental Services Department recommended the use of a premium, ethanol-blended, ultra low sulphur gasoline (with a sulphur content less than 50 mg/kg; available from a local fuel retailer). City council approved the change based on community support and the low differential cost of implementing these measures.

The City fleet has been fuelled with this ultra low sulphur gasoline for approximately a year and a half, and the program has so far been considered a success. This initiative was taken as a leadership step, and it is hoped that community and industry will soon follow suit in reducing transportation-related emissions.

The procurement of ethanol-blended, low sulphur gasoline is specified within the request for proposal to allow flexibility with regulatory development. The annual budgetary impact of this leadership initiative was $25,000, due to a $0.04 per litre incremental cost for the new fuel.

How can you develop a successful LSF procurement program in your organization?

As illustrated by the case studies above, implementing an LSF procurement strategy is a proactive action that organizations can take to improve citizen health and meet sustainable development goals. Organizations that have taken action to procure LSFs have helped to foster the LSF market by creating early demand for cleaner fuel products.

Your organization can contribute to this environmental stewardship by:

- switching from fuels with traditionally higher sulphur levels to those with lower sulphur levels, where this is technically feasible and where the fuels are available — e.g., using low sulphur diesel fuel rather than regular diesel fuel in off-road applications, or replacing heavy fuel oil with light fuel oil in furnaces;
- installing emission control systems and/or vehicle/engine/equipment retrofits to existing vehicles in combination with using LSFs to enhance the emission reduction potential; and
- developing fuel contracting that includes sulphur content as a consideration and provides a preference for LSFs at an acceptable cost.

Feasibility study for replacing heavy fuel oil with light fuel oil

Environment Canada assessed the feasibility of converting a typical medium-sized to large heating plant (80 000 Mg of steam production) from heavy fuel oil to light fuel oil. It was found that little capital cost would be required for the conversion because of the similarity in firing systems. The primary operating cost would be the cost of the fuel (at the time of the study, the fuel purchase and operating costs for heavy fuel oil were 70 percent of the corresponding costs for light fuel oil). The heavy fuel oil fired plant would produce 8.3 times greater sulphur oxide emissions, 7.6 times greater nitrogen oxide emissions, and 15 times greater particulate emissions than the light fuel oil plant.

Source: Cost and Emission Comparison of No. 6 and No. 2 Fuel Oil, Environment Canada – Atlantic Region, April 26, 2002, Federal Industrial Boiler Program

Links and sources of information

For more information on how to implement an LSF procurement strategy in your organization, consult the fact sheets available at:

- Environment Canada {http://www.ec.gc.ca}
- Friends of the Earth {http://www.foecanada.org}

We are interested in your feedback on this initiative and in learning about any case studies on LSF procurement that can be featured on our website. Comments and case studies can be submitted to:

ogeb@ec.gc.ca
Oil, Gas and Energy Branch
Environment Canada
351 St. Joseph Blvd.
Gatineau, QC K1A 0H3

Produced by
Oil, Gas and Energy Branch, Environment Canada

Friends of the Earth

Acknowledgements

We wish to acknowledge the following groups for their input to and support for the development of this guide:

Natural Resources Canada

Public Works and Government Services Canada

Canadian General Standards Board

Ontario Public Health Association

City of London, Ontario

City of Toronto, Ontario

Region of Waterloo, Ontario

Definition of key terms

ACID RAIN:	A generic term used for precipitation that contains an abnormally high concentration of sulphuric and nitric acids. These acids form in the atmosphere when industrial gas emissions combine with water, and they have negative impacts on the environment and human health.
GROUND-LEVEL OZONE:	A colourless and highly irritating gas that forms just above the Earth's surface. It is called a "secondary" pollutant because it is produced when two primary pollutants react in sunlight and stagnant air. These two primary pollutants, nitrogen oxides and volatile organic compounds, come from natural sources as well as human activities.
HEAVY FUEL OIL:	Industrial fuels suitable for use in boiler plants (includes Types 4, 5, and 6). Heavy fuel oils are the last to be distilled during the refining process. Except for start-up and flame stabilization, virtually all petroleum used in steam plants is heavy oil.
LIGHT FUEL OIL:	Fuel suitable for use in liquid fuel burning equipment without preheating, primarily domestic-type burners (includes Types 0, 1, and 2). Virtually all petroleum used in internal combustion and gas turbine engines is light oil.
LOW SULPHUR FUEL (LSF):	A general term used in this guide to refer to a fuel product that contains sulphur at a concentration that is lower than the maximum allowable level. As regulations governing the level of sulphur in fuels become more stringent, the definition of an LSF will change.

OFF-ROAD VEHICLES, ENGINES, AND APPLICATIONS:

The off-road sector covers a broad range of applications, from small utility engines used to power lawn and garden equipment such as string trimmers and lawnmowers to multi-hundred horse power engines used in construction and mining machines. The sector also includes motorized recreational products, such as snowmobiles, all-terrain vehicles, and outboard engines. The terms "spark-ignition" and "compression-ignition" engines refer to the combustion cycle off the engine. Spark-ignition engines typically operate on gasoline, compression-ignition on diesel fuel.

ON-ROAD VEHICLES AND APPLICATIONS:

On-road vehicles generally refer to self-propelled vehicles designed for or capable of transporting persons, property, material, or apparatus on a highway and typically include light-duty vehicles (passenger cars), light-duty trucks (such as vans, pickup trucks, and sport utility vehicles), heavy-duty vehicles (such as heavy trucks and buses), and motorcycles.

PARTICULATE MATTER:

One of the major components of smog. Particulate matter includes microscopic particles in the air. These particles, capable of being inhaled by humans, are divided into two size ranges: $PM_{2.5}$ and PM_{10}. Of the two, "fine" particles less than 2.5 micrometres in size ($PM_{2.5}$) are responsible for causing the greatest harm to human health. Some $PM_{2.5}$ is released directly to the atmosphere from industrial smokestacks and automobile tailpipes, but a large percentage is actually formed in the atmosphere from other pollutants, such as sulphur dioxide, nitrogen oxides, and volatile organic compounds.

SMOG:

Smog is formed in the Earth's lower atmosphere, near ground level, when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight. The two main ingredients in smog that affect our health are ground-level ozone and fine airborne particles (particulate matter).

SULPHUR:	One of the elements present in varying quantities in crude oil, which contributes to environmental degradation when fuel is burned.
SULPHUR DIOXIDE:	A colourless gas that smells like burnt matches. It can be chemically transformed into acidic pollutants such as sulphuric acid and sulphates (sulphates are a major component of fine particles). Sulphur dioxide is the main cause of acid rain, which can damage crops, forests, and whole ecosystems.
SUSTAINABLE DEVELOPMENT:	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

The internet Web site addresses in this report were current at the time of printing and are subject to change.

Additional information can be obtained at Environment Canada's Web site at **www.ec.gc.ca** or at the Inquiry Centre at **1-800-668-6767**.