Developing Ambient Air Quality Objectives For Canada

Advice to the Minister of the Environment

Canada

National Round Table on the Environment and the Economy | Table ronde nationale sur l'environnement et l'économie

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National Round Table on the Environment and the Economy

About Us

The National Round Table on the Environment and the Economy (NRTEE) is dedicated to exploring new opportunities to integrate environmental conservation and economic development, in order to sustain Canada's prosperity and secure its future.

Drawing on the wealth of insight and experience represented by our diverse membership, our mission is to generate and promote innovative ways to advance Canada's environmental and economic interests in combination, rather than in isolation. In this capacity, it examines the environmental and economic implications of priority issues and offers advice on how best to reconcile the sometimes competing interests of economic prosperity and environmental conservation.

The NRTEE was created by the government in October 1988. Its independent role and mandate were enshrined in the *National Round Table on the Environment and the Economy Act,* which was passed by the House of Commons in May 1993. Appointed by Governor in Council, our members are distinguished leaders in business and labour, universities, environmental organizations, Aboriginal communities and municipalities.

How We Work

The NRTEE is structured as a round table in order to facilitate the unfettered exchange of ideas. By offering our members a safe haven for discussion, the NRTEE helps reconcile positions that have traditionally been at odds.

The NRTEE is also a coalition builder, reaching out to organizations that share our vision for sustainable development. We believe that affiliation with like-minded partners will spark creativity and generate the momentum needed for success.

And finally, the NRTEE acts as an advocate for positive change, raising awareness among Canadians and their governments about the challenges of sustainable development and promoting viable solutions.

We also maintain a secretariat, which commissions and analyses the research required by our members in their work. The secretariat furnishes administrative, promotional and communications support to the NRTEE.

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Executive Summary

This Advisory Note sets out advice from the National Round Table on the Environment and the Economy (NRTEE) in response to a request from the federal government regarding the development of long-term clean air strategies for Canada. In the fall of 2006, the federal government asked the NRTEE to provide advice on national ambient air objectives for particulate matter (PM) and ozone for both the medium (2020 – 2025) and long-term (2050).

From the outset of its research, the NRTEE concluded that providing advice on specific numerical air quality objectives would require a level of expertise and time commitment beyond the scope and timeline of the government's request. The NRTEE concluded that its best value-added advice would be to focus on the purpose of the ambient air quality objectives and the process of setting them. Our research and this Advisory Note therefore focus on the process of setting national objectives, rather than specific quantitative standards or objectives. This advice is meant to inform the more significant, substantial deliberations of professionals and experts who need to be involved in determining the actual standards and objectives for Canada. More specifically, the advice is intended to assist the federal government in how best to develop national ambient air quality objectives for Canada, a goal set out in the government's *Regulatory Framework for Air Emissions* (April 2007).[1]

Based on our key findings, the NRTEE offers the following conclusions for consideration by the federal government:

1. National long-term ambient air quality objectives should be supported by medium-term standards. National ambient air quality objectives should consist of two distinct, albeit related, elements: science-based long-term objectives that establish a national and primarily qualitative goal; and medium-term standards that serve as control measures to reduce pollutants and that can be most effectively applied at the regional level to reflect regional differences in actual air quality.

2. The Government of Canada should play the lead role in developing national ambient air quality objectives for all Canadians. A coordinated national approach is needed to establish consistency across the country, thereby ensuring equity among all citizens, as well as a level playing field for all industry, regardless of location. The federal government is best positioned to play this role. Governments at all levels, led by the federal government, should begin by setting an agreed timeframe by which these objectives would be established and the standards set in place.

3. An independent science-based process should be established to develop Canada's long-term, national ambient air quality objectives. The federal government should develop the long-term, national science-based objectives through an independent process led by a panel of Canadian experts with the involvement of international expertise. The panel would be responsible for reviewing the latest available international scientific data and would involve provinces, territories, and municipalities through a consultative process. The panel would then recommend the long-term national objectives to governments.

1 *Regulatory Framework for Air Emissions. Government of Canada.* April 2007.

1 Introduction

1.1 Purpose of Advisory Note

This *Advisory Note* represents the second portion of a broader set of advice presented to the government by the National Round Table on the Environment and the Economy (NRTEE) pertaining to the development of long-term climate change and clean air strategies for Canada.[2] In the fall of 2006, the federal government asked the NRTEE to provide advice on national ambient air objectives for particulate matter (PM) and ozone for the medium (2020 – 2025) and long term (2050). While this note does not comment in a quantitative sense on the ambient air quality objectives, it does provide observations and insights on the process involved in developing longer term ambient air quality objectives for Canada.

After the NRTEE was asked to provide advice on setting ambient air quality objectives, the Government of Canada released its Regulatory Framework for Air Emissions (April 2007). The Regulatory Framework commits Canada to specific short-term actions to achieve reductions of both air pollutant and greenhouse gas (GHG) emissions. It does not, however, specify medium- or long-term objectives for air pollutants; rather, it indicates the government's intention to set national air quality objectives in the future: "In addition to setting industrial emission targets, the government will set national air quality objectives for particulate matter and ground-level ozone based on an assessment of the health and environmental effects associated with exposure to these air pollutants in the air we breathe in Canada [p. v]."

1.2 NRTEE's approach to providing this advice

From the outset of its research, the NRTEE concluded that providing advice on specific numerical air quality objectives would require a level of expertise and time commitment beyond the scope and timeline of the government's formal request. The NRTEE therefore concluded that its best value-added advice would be to focus on the purpose of ambient air quality objectives and the process of setting them. The NRTEE research and this *Advisory Note* have accordingly focused not on recommending specific quantitative standards or objectives, but instead on providing useful information with respect to the process of setting national objectives. This advice is meant to inform the more significant and substantial deliberations of the professionals and experts who will be involved in determining the actual standards and objectives for Canada.

This *Advisory Note* briefly describes the history and current status of Canada's air quality management frameworks, identifies areas for improvement with regard to setting long-term objectives and medium-term standards, and ends with a discussion of the potential roles for governments. It concludes with some observations for consideration by the federal government when developing its approach for future management and regulation of air quality in Canada.

2 *Getting to 2050: Canada's Transition to a Low-emission Future.* NRTEE, Ottawa. 2007.

In evaluating the government's request, the NRTEE focused on three integrated policy challenges:

- long-term ambient air quality objectives;
- medium-term air quality standards; and
- the role of governments at all levels.

In conducting this research it became clear that the terms "objectives" and "standards" have been used interchangeably to mean different things. For the purposes of clarity in this document, we use:

- *objective* to represent a long-term notion or number that will protect human health. This number is based solely on the known scientific effects of a particular pollutant; and
- *standard* to represent a pollution concentration that will be enforced by some jurisdiction and is influenced by the practical and economic realities of compliance.

There is also a temporal dimension to these definitions. Whereas *objectives* refer to the longer term such as 2050, *standards* are more relevant to the medium-term (such as 2020). Thus one can envision a series of standards that are staged in time to ultimately achieve a longer term, science-based objective.

The NRTEE undertook the following process in developing this *Advisory Note*:

- A research agenda was developed and verified with the NRTEE members.
- An expert advisory group reviewed the main elements of the research agenda and provided guidance.
- Research was commissioned from experts.
- The NRTEE engaged the expert advisory group in debating and discussing its research and findings.
- The final report was reviewed and approved by the NRTEE members.

In terms of research, the NRTEE examined past practices and processes related to the development and implementation of air quality objectives both within Canada and internationally.[3] This literature review was then supplemented by a series of lengthy interviews with Canadian and international experts and stakeholders.

3 The findings in this Advisory Note are based on two commissioned research reports: (1) What National Ambient Air Objectives Could Look Like, SENES Consultants Ltd. and Stratos Inc.; and (2) Lessons Learned from the Canada-wide Standards Process, Cheminfo Services Inc.

2 The history and current status of National Ambient Air Quality Objectives

Both PM and ozone have a long history of regulation in North America. They are two of the air contaminants originally regulated in Canada as "criteria pollutants," some 30 years ago. Although these two air pollutants have been historically regulated, and air quality improvements are evident, they continue to be important indicators of air quality. This importance reflects an evolving understanding of their impact on health outcomes, particularly as new scientific techniques and epidemiological methods identify more precise cause-and-effect relationships between exposure and wide-ranging health outcomes. Ongoing scientific research has confirmed that even at comparatively low concentrations, these air contaminants are associated with morbidity and mortality responses[4] in the general population. In addition, the pollution concentration estimates associated with these effects are at levels that most Canadians frequently encounter. Thus there is a compelling public health commitment to manage and reduce exposures to these pollutants.

2.1 The issue of particulate matter and ozone

Health risks from air pollution are associated with direct exposure to ambient levels of PM and ozone, the main components of smog. Health science indicates that even at very low levels in the air these pollutants may have negative effects on human health, as well as a negative impact on the health of the ecosystem.

Particulate matter

PM consists of airborne particles in solid or liquid form, and may be classified as primary or secondary depending on the compounds and processes involved during its formation. Primary PM is emitted at the emissions source in particle form; for example, in the smokestack of an electrical power plant or a recently tilled field subject to wind erosion. The formation of secondary PM results from a series of chemical and physical reactions involving different precursor gases, such as sulphur and nitrogen oxides. Numerous studies have linked PM to aggravated cardiac and respiratory diseases, such as asthma, bronchitis, and emphysema and to various forms of heart disease. PM can also have adverse effects on vegetation and structures, and contributes to the deterioration of visibility and regional haze.

Just as knowledge of PM and its health effects have increased over time, the development of PM air quality objectives has also evolved. During the 1970s and 1980s, regulatory efforts focused on controlling exposure to total suspended PM. In the late 1980s, this changed to

4 Examples of recent large studies linking PM exposure with mortality include: (1) the National Mortality and Morbidity Air Pollution Study (NMMAPS), which evaluated data from 90 large US cities (Dominici, F., A. McDermott, S.L. Zeger, J.M. Samet 2003. *Airborne Particulate Matter and Mortality: Timescale Effects in Four US Cities.* Am J Epidemiol. 2003 Jun 15); and (2) a recent study by the American Cancer Society (Pope, C.A., R.T. Burnett, M.J. Thun et al. 2002. *Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution.* JAMA. 2002).

establishing limits on inhalable PM or PM_{10} (for particles < 10 µm diameter), and, more recently, to limits on $PM_{2.5}$, the respirable fraction of PM (for particles < 2.5 µm diameter). For example, in 2006 the US EPA[5] organized a panel of experts to participate in expert deliberations as to the concentration-response relationship between average annual $PM_{2.5}$ exposures and annual mortality. Although considerable uncertainty remains as to the details of the dose-response relationship, this EPA study established a reasonable consensus regarding the relationship between mortality and $PM_{2.5}$.

The review of regulatory decisions across Canada, the United States, and Europe indicates the absence of a current consensus as to the level at which a medium- to long-term goal for PM should be set. Appendix 1, which summarizes some of the existing domestic and international PM objectives, standards, guidelines and/or reference levels, illustrates the lack of consistent international objectives, as well as the diversity of ways being used to approach the management and control of this contaminant.

The review of the documentation for setting $PM_{2.5}$ regulatory standards in various jurisdictions shows that most committees appointed to investigate the relationship between health effects and PM recommend health-based standards for $PM_{2.5}$ within a range of 15 to 25 micrograms per cubic metre (µg/m³)(24-hour averages). In support of their recommendations, these committees cite the precautionary principle, as well as the lack of a known threshold below which adverse health effects do not occur. These values are based on professional judgments by health professionals rather than on statistical calculations. The update of the World Health Organization (WHO) air quality guidelines in 2005 also recommended a $PM_{2.5}$ value of 25 µg/m³ for short-term exposures. Moreover, the WHO emphasized that, for non-threshold pollutants such as $PM_{2.5}$, exposure should be reduced even where current concentrations are close to or below the proposed guidelines; it also encouraged countries to consider increasingly stringent standards and to track progress via emission reductions and declining concentrations.

In most jurisdictions, the numerical values chosen for particular standards or guidelines reflect political considerations; they try to balance the need to address public health concerns against PM levels that can be reasonably achieved within a 10-to-15-year period.

Ozone

Ozone is 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 — nitrogen oxides (NOx) and volatile organic compounds (VOCs) — react in sunlight and stagnant air. Ozone is known to have significant effects on human health. Exposure to it has been linked to premature mortality and a range of morbidity health end-points, such as hospital admissions and asthma-symptom days. In addition to its effects on human health, ozone can significantly affect vegetation and decrease the productivity of some crops; it may also contribute to forest decline in some parts of Canada.

5 US EPA, 2006. U.S. EPA Expert Elicitation Study on the Concentration-Response Relationship Between Annual Average Ambient $PM_{2.5}$ Exposures and Annual Mortality. Pre-Elicitation Workshop Summary. 20 January.

Ozone and PM are the two primary pollutants in smog, which has been linked to many adverse effects on health and the environment. High levels of smog are typically associated with the summer, because of the presence of sunlight and warmer temperatures. However, the smog problem occurs throughout the year, with winter smog (due to PM contributions rather than ozone) being a serious concern when stagnant air causes a build-up of pollutants in the air. This is usually caused by increased wood heating and vehicle usage during the winter months.

Judging from the review of available documents pertaining to issues surrounding the implementation of ozone targets, the European Union (EU) appears to be the most active jurisdiction dealing with ozone levels. The EU issued a directive on ozone in 2002, the main purpose of which was to establish long-term objectives, target values, an alert threshold, and an information threshold for concentrations of ozone in ambient air at the community level. These values were designed to avoid, prevent, or reduce harmful effects on human health and the environment as a whole, and to ensure that common methods and criteria are used to assess ozone concentrations and, as appropriate, ozone precursors (NOx and VOCs) in ambient air.

Appendix 2 summarizes a few of the existing Canadian and international objectives, standards, guidelines, goals, and reference levels for ozone. The purpose of this table is to show the diversity of ways currently used to approach community air quality improvement. It also shows the lack of consistent international standards upon which Canada can draw.

In most jurisdictions, the existing standards, objectives, and guidelines for PM and ozone employ standards already in force or those to be achieved in the relatively near term. It is important to note that no jurisdictions have been found that establish PM or ozone standards for the medium-term (2020-2025) or objectives for the longer term (2050), as Canada is seeking to do.

2.2 Canada's national air quality management framework

The actual setting of ambient air quality *objectives* in Canada is considered the dual responsibility of both the federal government and the provincial and territorial governments. However, air quality *management* in Canada is shared between federal, provincial, and regional or local authorities. This means that while provinces have the responsibility and authority to set and enforce air quality objectives, local and regional governments have the authority to pass by-laws that may restrict activities contributing to air pollution emissions in areas under their control. Moreover, the provincial governments have the authority to delegate primary responsibility for air quality management to regional or municipal jurisdictions. For example, in British Columbia, the provincial government delegated authority for air quality management to the Greater Vancouver Regional District (GVRD). In another example, the government of Quebec has delegated air quality management responsibilities to the Montreal Urban Community. But because air quality is of obvious local concern to residents, and even though many of the legislative and regulatory instruments are under both federal and provincial jurisdictions, Canada has typically pursued a shared and coordinated approach to setting ambient air quality standards.

2.2.1 National ambient air quality objectives

Historically, national ambient air quality objectives (NAAQOs) were first established by the federal government in 1969 under the *Clean Air Act*. In 1976, standards for ozone and PM were established under this act. In 1988, the *Canadian Environmental Protection Act* (CEPA) was passed into law, replacing the *Clean Air Act*. A federal/provincial advisory committee was established — the Working Group on Air Quality Objectives and Guidelines (WGAQOG) — which developed revised NAAQOs under CEPA. The committee's objectives were intended to represent national goals for outdoor air quality, to protect public health and the environment, and to ensure some degree of uniformity across the country.

In 1999, the WGAQOG revised the PM objective and set a range of PM levels, rather than a specific value. Designed to ensure a substantial reduction in the risks to human health and the environment, the ranges are the following:

- 35 – 40 µg/m^3 for PM_{10} (for particles < 10 µm diameter)
- 20 – 25 µg/m^3 for $PM_{2.5}$ (for particles < 2.5 µm diameter)

In 1999, when attempting to define a reference (baseline) level for ozone, the WGAQOG concluded that "most studies indicated a continuum of effects through all [the] ambient levels, with adverse effects below the Reference Level." In 1999, it stated that "substantial health benefits associated with reducing ozone concentrations may exist" at levels of 20 ppb and 25 ppb daily one-hour maxima.

In 2000, CEPA was revised, introducing a new framework for setting ambient air quality objectives. This framework reflected the current state of knowledge regarding air quality parameters. It provided a uniform scale for assessing air quality that could guide governments in the risk management process, using such items as local standards and control strategies. It also advocated a continuous improvement approach for protection of the environment. In 2001, CEPA declared PM_{10} (less than or equal to 10 microns in diameter) a "toxic"[6] substance. Ozone and its precursors (sulphur oxides, nitrogen oxides, volatile organic compounds, and gaseous ammonia) were subsequently added to the List of Toxic Substances, giving the federal government the authority to take action to reduce these substances in the environment.[7] Once a substance is added to this list, the federal government works with the provinces, territories, industry, non-government organizations, and other interested parties to develop a management plan to reduce or eliminate the harmful effects of the substance on the environment and on the health of Canadians.

6 Under CEPA a substance is toxic if it is entering or may enter the environment in a quantity or concentration or under conditions that (a) have or may have an immediate or long-term harmful effect on the environment or its biological diversity; (b) constitute or may constitute a danger to the environment on which life depends; or (c) constitute or may constitute a danger in Canada to human life or health.

7 For substances that are found to be toxic under CEPA 1999 and are added to the List of Toxic Substances in Schedule 1 of CEPA, Environment Canada and Health Canada must propose an instrument to establish preventive or control actions for managing the substance and, thereby, reduce or eliminate risks to human health and the environment posed by its use and/or release.

2.2.2 Canada-wide Standards

In January 1998, recognizing the need for a more collaborative national approach on standards setting, Canada's environment ministers, under the auspices of the Canadian Council of Ministers of the Environment (CCME), agreed to accept the Canada-wide Standards (CWS) process. This approach put in place a new national process for setting standards, guidelines, objectives, and criteria for the protection of the environment and human health. Standards for PM and ozone were among the first to be developed by the CCME for consideration (1999). The following standards were approved in 2000:

- The CWS for $PM_{2.5}$ is 30 µg/m^3 — a 24-hour average;
- The CWS for ozone is 65 ppb — an 8-hour average, with achievement based on the fourth-highest level measured annually over three years.

The target date for achievement of the standard was set for 2010. A system for monitoring and reporting on progress was put in place, as were special measures to take into account the transboundary flow of pollution from the United States and other countries.

While these standards were initially intended to minimize exposure risks to human health and the environment, other considerations came into play in their development. Thus the final numbers had less to do with science and more to do with a negotiated settlement between the various jurisdictions. As a result, there is now perhaps too much flexibility, where provincial governments are able to adopt the CWS or not, or to use them as benchmarks for differing provincial standards that take into account their own priorities and circumstances.

2.2.3 Current situation

Following the establishment of the CWS and the desire to avoid duplication with NAAQOs, changes were made in how air quality is collectively managed by the federal government, provinces, and territories under the CCME. In 2005, the Air Management Committee (AMC) was established, which, along with the Committee on Health and Environment (CHE), reports to the CCME through the Environmental Planning and Protection Committee (EPPC). The EPPC directed the AMC to recommend a path forward regarding ambient air quality objectives. Subsequently, an ad hoc working group recommended that the former WGAQOG not be reconstituted and that any new work be conducted through existing CCME committees/working groups.

Today, a subcommittee (Particulate Matter/Ozone Review Coordinating Committee) is charged with making a recommendation to the AMC concerning future revision to the PM and ozone CWSs. A decision on the need to revise the PM or ozone CWSs will be made early next year (2009); if deemed necessary, it will trigger a revised standard-setting process for PM or ozone, or both, to be completed by 2010.

2.3 Assessment of the current and future jurisdictional roles

With the review of the current situation completed, the NRTEE research conducted targeted interviews to provide more focused information on a path forward for standards and objective setting. Stakeholders and experts were asked to provide their views on the roles and responsibilities of the various levels of government in Canada. Below is a summary of what was heard:

- The federal government is best placed to set broad-based objectives through a consultative mechanism promoted by the CCME, although legitimate questions do exist as to whether its consensus-based approach leads to "lowest common denominator" outcomes and standards. A concerted federal approach would establish consistency across the country, particularly from a business competitiveness standpoint. As well, the federal government should exercise its authority in the control of transboundary air pollution, whether it comes from the United States, or via inter-provincial or international movement. A stronger federal involvement in objective setting is important, too, to ensuring actual progress. Because the federal government regulates transportation fuels it has a distinct role in this area as well.
- The provinces and territories, through their regulatory powers, have actual control over local air emissions, except for substances with an immediate health impact (as defined under CEPA). Provincial/territorial input to the establishment of all standards is needed in order to ensure that levels will be both measurable and enforceable. Provincial/territorial involvement in a federal objective-setting process will provide the province or territory with the incentive to go on to develop effective standards and other enforcement tools.
- At the municipal and regional level, respondents noted the tremendous opportunity for local action to address the already existing air quality. Municipalities are the level of government most engaged with their communities; they can influence and incite community-led projects and provide credible, responsive feedback on the impacts of action taken. In addition, municipalities have authority over some of the infrastructure through which improvements in transportation, and hence reduced fuel use and emissions, can be realized. Respondents described the approach taken in British Columbia, within the Greater Vancouver Regional District, as a successful model for managing local air quality and one that could be applied elsewhere.

3 Observations

Based on its research, the NRTEE observes that the current system for setting national ambient air quality objectives in Canada for PM and ozone, which now incorporates the CWS process, has the potential to provide a solid and thorough basis for setting effective and appropriate objectives in the future. However, the NRTEE research identified that more can be done in the following key areas:

- long-term ambient air quality objectives;
- medium-term air quality standards; and
- the role of governments at all levels.

3.1 Long-term ambient air quality objectives

Long-term objectives should set a national directional goal that the entire country can strive to achieve.

Long-term ambient air quality objectives should be the starting point in Canada's efforts to address PM and ozone. Long-term objectives directly shape important decisions around medium-term air quality standards; they put national goals into operation and instigate short-term actions, provincial and territorial implementation plans, and private sector decisions. The sooner these long-term objectives can be set, the sooner more immediate decisions on abatement efforts, including technology deployment, can be positively influenced.

Given the uncertainty about the state of the atmosphere by mid-century, the possible innovations in abatement technology, and, above all, the improvements in the understanding of genetics and human health effects of air pollutants, it is unrealistic to attach legally binding numerical targets to long-term objectives. Instead, long-term ambient air quality objectives should be "directional" — that is, national goals expressed in qualitative terms that the entire country can then work toward. In this way, the objectives can provide a fair and equitable basis for improvements in air quality across the country; they can also serve as the basis for sustained policy commitments that will direct significant improvements in air quality in Canada over the next 30 or 40 years. Long-term objectives can serve, too, as a benchmark, against which to measure future performance and — when paired with reporting obligations — to hold governments accountable.

Long-term objectives can take a number of forms, such as "a level equivalent to the natural background" or one tiered to a certain tolerable, acceptable, or desirable level of health risk.[8] An objective could involve percentage reductions from current conditions, or aim to match or exceed the best international objectives.

8 This is the basis of the current Canada-wide Standard for particulate matter and ozone, in which the long-term air quality management goal is to minimize the risks of these pollutants to human health and the environment.

Long-term objectives should be based on the best available science, be focused principally on human health effects, and be updated accordingly.

The evidence is overwhelming that chronic, poor air quality adversely affects the health of the entire population. Health effects range from respiratory conditions such as asthma and chronic bronchitis to premature death and increased mortality. From an environmental perspective, ozone has also been linked to reduced plant productivity, resulting in reduced agriculture crop yields and forest growth.

This means that long-term objectives are the end point, and need to be science-based, driven primarily by an improved understanding of the effects of air pollutants on human health and, to a lesser extent, on ecosystem health (see Appendix 3). Questions of regional differences, technology, costs, affordability, and pollution sources are factors better addressed in terms of medium-term standards, rather than in terms of the objectives themselves.

The process of setting long-term objectives should begin with the definition of a set of principles.

Based on Canadian and international experience to date in setting air quality standards, the process of setting long-term national objectives should begin with the definition of a set of clear and common principles to which all jurisdictions must commit to achieving. These principles could include, for example, that:

- all Canadians have the right to be able to breathe clean air wherever they live; and
- jurisdictional accountability should be transparent and unambiguous, with reporting on progress made available to Canadians.

The fact that Canada's air quality is affected by transboundary flows needs to be accounted for when setting objectives.

Canada's long-term air quality objectives have an important international dimension. First, meeting a long-term objective in some parts of Canada — notably in southern Ontario and the lower mainland of British Columbia — will depend to a great extent on cooperation with the United States. Second, long-range transport of air pollutants — particularly from the growing economies in Asia — is a continuing concern. These trends increasingly make air pollution a global, as well as a national and regional, problem, while underscoring the importance of national objectives that can protect air quality for Canadians in all regions. Long-term objectives for Canada should therefore account for transboundary effects from these respective regions.

3.2 Medium-term air quality standards

Medium-term standards are needed to put the national long-term objectives into effect.

To be credible and effective, long-term objectives need to be supported by explicit medium-term standards. Medium-term standards are tangible targets that industry can understand and achieve through investment decisions and other actions. Standards, implemented through regulations, can establish expectations regarding the current regulatory period and send a signal

to industry to expect a further set of reductions in the following regulatory cycle. For many Canadian industries, the medium-term of 2020 aligns with the current economic cycle. Many existing facilities (and sources of pollutants) will be reaching the end of their lifecycle by 2020. By undertaking action now through this current "window of opportunity," industries and governments will be able to plan their capital investments to specifically meet air quality standards.

Medium-term air quality standards should be achieved through pollution control programs, which could include a mix of binding regulations and market mechanisms. These should be developed through a regionally-based, participatory consultative process.

Whereas long-term objectives are directional and qualitative, medium-term standards should serve as quantitative, enforceable mechanisms for moving toward a specific target over a certain timeframe. As with the long-term objectives, developers of the standards should take into account scientific findings with respect to human health and the ecosystem effects of air pollutants. Other considerations, such as "keeping clean areas clean,"[9] will ensure the avoidance of future problems. As well, the developers of standards need to consider regional differences (in geography and meteorology, for example), as well as regional economic factors. Given the need to take these considerations into account, medium-term standards should be developed through a regionally based consultative process. But again, it is critical to work toward a common objective by making the standards more stringent over time — both to balance the transition and to ultimately achieve the end objective.

Medium-term standards can be achieved through enforceable pollution control programs, and could include a mix of regulatory measures (including performance-based emission standards) and market-based mechanisms such as emission charges and cap-and-trade systems. Limited exemptions would be needed to account for those areas unable to achieve the standards without severe economic dislocation, or because of transboundary pollution sources. But even in those exempted cases, regions would still have to work toward the standards and report on their progress. In addition, non-legislatively based instruments such as guidelines and codes of practice would have a role to play.

3.3 The role of the federal government

Public awareness of air quality issues and expectations for government action at all levels have likely never been greater. Indeed, clean air has emerged as a "top shelf" concern of Canadians, and expectations are high for government action. This presents the federal government and, indeed, all governments with an opportunity for undertaking significant action in support of improved air quality in all regions. Past national efforts at improving air quality were apparently hampered by a lack of accountability within the current federal-provincial-territorial framework. In fact, there is a question as to whether the current CCME process, as

9 An important commitment of the CWS for PM and ozone is the implementation of a "keeping-clean-areas-clean" program in areas with ambient concentrations below the CWS levels.

now constituted, is sufficiently effective to give clean air objectives and standards the profile, or assurance of progress, that Canadians need. As we move forward, accountability has to be clearly established if the national objectives and standards are not only to be set but, more importantly, achieved.

Federal leadership is needed to build a coordinated national approach to improving air quality that is both fair and equitable to all citizens and industry.

The federal government should lead the coordination and development of the long-term, national air quality objectives. The federal government is best placed to lead the work on setting long-term objectives via a science-based effort, one that could be undertaken through an independent national panel as set out below. A coordinated national approach, led by the federal government, is necessary to establish appropriate consistency across the country — an important factor in ensuring equity among all citizens and a level playing field for industry.

The federal government also can play an important leadership and coordinating role through its jurisdiction over transboundary issues, transportation fuels, and the toxic substances provisions of CEPA. It can bring to the table its scientific expertise, as well as its ability to promote equity among the provinces by assisting with capacity building.

Federal leadership on its own is not enough, however. Provincial and territorial governments will have a lead role in setting and enforcing air quality standards in their respective jurisdictions. Furthermore, the provinces and territories will play a key role in engaging the industrial sectors' efforts to achieve air quality standards. Municipal and regional governments, too, will have significant opportunities to influence community-led projects in order to improve air quality and direct infrastructure improvements in transportation, which in turn can lead to reduced fuel use and emissions. An effective national approach should involve all levels of government, resulting in shared responsibility and clear accountability.

Communication and consultation will be important tasks for the federal government.

The federal government has still another key role: communicating the long-term air quality objectives and medium-term standards to Canadian industry. Industry must be certain that the objectives and standards have the full commitment of the federal government. Policy certainty will signal that emission reductions are required, which in turn will trigger the investment decisions and innovations that lead to lower emission reduction costs and the resulting human health and ecosystem benefits.

The federal government must engage the Canadian public regarding the air quality objectives and standards. Citizen involvement and regular reporting to Parliament and Canadians on the progress to date will be key elements in ensuring accountability and in gaining public acceptance of, and support for, air quality initiatives. The same holds true for provincial and territorial governments. One element of this effort will be to build awareness of the importance of, and need for, individual action on reducing air pollution.

3.4 Challenges

The NRTEE research identified a number of challenges to the process of setting long-term objectives and medium-term standards. The key challenges are the following:

- the need for a more comprehensive approach and a more consistent focus than has been seen to date regarding the implementation, abatement, monitoring and refinement of standards;
- the reality that various jurisdictions have different capacities for meeting standards or objectives. More stringent standards could have higher cost implications, which might pose significant challenges for some regions. Furthermore, certain regions might not be able to attain a "national" objective, or standard, based on their current air quality situation (i.e., perhaps their baseline of emissions already exceeds a particular standard or objective). For such situations, the challenge will be how best to deal with these "non-attainment" areas and any potential exemptions needed to address them.
- the need to determine how to apply the highest standard to local areas, given the differing air shed circumstances across the country that must be taken into account; and
- the need to precede the positioning of a PM or ozone standard valuation with a clearer understanding of regional effects and a complex set of epidemiological considerations. As noted earlier, no single agreed policy document identifies an obvious, overarching single standard; that there are several hundred suggests that health impacts may occur in a set of environmental conditions with the common elements of PM and/or ozone exposure.

4 Conclusions

Based on the above observations, the NRTEE offers the following conclusions for the consideration of the federal government:

1. **National long-term ambient air quality objectives should be supported by medium-term standards.**

   National ambient air quality objectives should consist of two distinct, albeit related, elements: science-based long-term objectives that establish a national, primarily qualitative goal; and medium-term standards that serve as control measures to reduce pollutants and that can be most effectively applied at the regional level to reflect regional differences in actual air quality.

   The sooner these objectives and standards are in place, the sooner they can begin to influence the capital investment decisions of industry over the next few years and to trigger opportunities for technological innovation, environmental improvements, and economic growth. In particular, the medium-term standards for 2020 need to be put in place as soon as possible to provide industry with policy and regulatory certainty.

2. **The Government of Canada should play the lead role in developing national ambient air quality objectives for all Canadians.**

   The federal government should take advantage of the current high levels of public interest and expectations regarding national air quality and move to develop national ambient air quality objectives for PM and ozone. A coordinated national approach is needed to establish consistency across the country, thereby ensuring equity among all citizens, as well as a level playing field for all industry, regardless of location. Led by the federal government, governments at all levels should begin by setting an agreed timeframe by which these objectives would be established and the standards set in place.

   If the government were to take the lead role in developing new national objectives and decide to use the existing CWS process as a starting point for setting new objectives, the NRTEE has a number of suggested amendments for its consideration (Appendix 4). Of these suggestions, the NRTEE highlights the following "lessons learned" as critical issues to be addressed in any future objectives- or standards-setting process:

   - A consensus-based approach among participating governments results in agreement only at the "lowest-common-denominator" for the ambient air quality standards, therefore resulting in levels that may not be the most appropriate for the protection of human and ecosystem health.
   - The accountability and credibility of emission inventories, emission forecasts economic analysis, and monitoring systems needs to be strengthened.
   - Mechanisms to ensure clear accountability for the implementation and enforcement of standards are needed.

- A suitable mix of voluntary and mandatory standards that would take local and regional impacts into account is needed.
- Strong leadership and accountability, as well as transparent reporting mechanisms, are needed to ensure progress toward the achievement of standards and objectives.
- A regular five-year progress review by ministers, senior public service officials, and scientific experts is needed.

3. An independent science-based process should be established to develop Canada's long-term national objectives.

The federal government should consider developing long-term, national science-based objectives via an independent process led by a panel of Canadian experts and with the involvement of international expertise. The panel would be responsible for reviewing the latest available international scientific data and for undertaking consultations with provinces, territories, and municipalities. The panel would also be charged with recommending the long-term national objectives to the government. The objectives must be updated as science improves and as new information and understanding become available. Such a process is important as it provides the issue with the profile needed to advance it.

By contrast, medium-term standards must reflect regional differences, taking into account a wide range of environmental, economic, and political considerations. They also will be implemented through regional (provincial or territorial) management plans. This puts a premium on inter-jurisdictional cooperation; it implies that the process of establishing these targets needs to differ from the one used for developing national long-term objectives and also to involve more regionally based consultations and a larger set of interests.

In each process, however, both citizen involvement and regular government reporting to constituents regarding progress are needed — not only to ensure accountability but also to gain public acceptance and support.

Appendix 1: Summary of Existing Control Levels for Particulate Matter (PM)

Country	Jurisdiction	$PM_{2.5}$ – 1 hr avg	$PM_{2.5}$ – 24 hr avg	$PM_{2.5}$ – annual avg	PM_{10} – 24 hour avg	Total Suspended Particulate
Canada	Canada-wide Standard (2000)		30 µg/m³ (2)			
	British Columbia				50 µg/m³ (24 hour)	120/400 µg/m³ (1)
	British Columbia/ GVRD		25 µg/m³	12 µg/m³		
	Alberta	80 µg/m³	30 µg/m³			
	Manitoba		30 µg/m³			
	Ontario					
	Quebec		30 µg/m³ (11)			150/70 µg/m³ (10)
	City of Montreal	35 µg/m³ (9)	25 µg/m³ (9)			150/70 µg/m³ (10)
	Nova Scotia					
	Saskatchewan		30 µg/m³			
	New Brunswick		30 µg/m³			
	Newfoundland and Labrador		25 µg/m³			
	Northwest Territories					
United States	Federal		35 µg/m³ (2)	15 µg/m³ (3)		
Europe	EU			25 µg/m³ (4)	50 µg/m³	
Global	World Health Organization		25 µg/m³ (5)	10 µg/m³ (6)	50 µg/m³ (24 hr) (7) 20 µg/m³ (annual) (8)	

Notes:

1 – Acceptable Level / Tolerable Level

2 – 3-year average of the 98th percentile of the 24-hour average achieved by 2010

3 – Averaged over 3 consecutive years

4 – Target of 20% reduction in ambient $PM_{2.5}$ levels over the period 2010-2020

5 – Interim targets of 75, 50, and 37.5 µg/m^3 for areas of poorer air quality

6 – Interim targets of 35, 25, and 15 µg/m^3 for areas of poorer air quality

7 – Interim targets of 150, 100, and 75µg/m^3 for areas of poorer air quality

8 – Interim targets of 70, 50, and 30µg/m^3 for areas of poorer air quality

9 – Valuer IQA

10 – 24-hour average / annual average

11 – By 2010

Appendix 2: Summary of Existing Control Levels for Ozone (O_3)

Country	Jurisdiction	Ozone – 1 hr	Ozone – 8 hr	Ozone – 24 hr	Ozone – annual
Canada	Canada-wide Standard		65 ppb (by 2010)		
	Health Canada	20 ppb non-accident mortality, 25 ppb respiratory hospitalization (6)			
	British Columbia	100/160/300 µg/m³ (1)	65 µg/m³	30/50 µg/m³ (2)	30 µg/m³
	British Columbia — Fraser Valley	51/82 ppb (2)			65 ppb
	Alberta	160 µg/m³ or 82 ppb			
	Manitoba	100/160/400 µg/m³ (1)	65 ppb		
	Ontario	165 µg/m³			
	Quebec	82 ppb			
	City of Montreal	82 ppb	38 ppb	25 ppb	15 ppb
	Nova Scotia	160 µg/m³ or 82 ppb			
	Newfoundland and Labrador	160 µg/m³	87 µg/m³		
	Saskatchewan		65 ppb		
	New Brunswick		65 ppb		
	Northwest Territories		65 ppb		
United States	Federal	0.12 ppm(5)	0.08 ppm		
Europe	EU — ozone directive	180 µg/m³ (3) 240 µg/m³ (4)	120 µg/m³		
Global	World Health Organization		100 µg/m³		

Notes:

1 – Desirable / Acceptable / Tolerable

2 – Desirable / Acceptable

3 – Information threshold

4 – Alert threshold

5 – Applies only in limited areas

6 – Reference levels

Appendix 3: Possible Health Effects Occurring at Ambient Air Quality Levels in Canada (Bates et al., 2003[10])

Pollutant	Definite Effect	Probable Effect	Possible Effect
Fine particles (PM_{10}, $PM_{2.5}$)	Time-series and cohort association with daily respiratory and cardiac mortality Aggravation of asthma Increased hospital admissions for respiratory and cardiac conditions Depressed lung function in schoolchildren (acute & chronic) Increased prevalence of bronchitis Increased risk of lung cancer Increased school absences Increase in banded neutrophils	Aggravation of acute respiratory infections Increased risk of wheezy bronchitis in infants 4-12 months Decreased rate of lung growth in children Increased exhaled NO Tachycardia in the elderly Reduced heart rate variability Increased c-reactive protein Increased blood vessel constriction	Decreased birth weight Increased blood fibrinogen Increased asthma prevalence
Ozone	Increased hospital admissions for acute respiratory diseases Aggravation of asthma Increased bronchial responsiveness Increased response to sulphur dioxide (SO_2)	Effect on mortality Increased sensitivity to allergens	Aggravation of acute respiratory infections Chronic bronchiolitis with repetitive exposure

10 Bates, D.V., J. Koenig, M. Brauer, R. Caton and D. Crawley 2003. Health and Air Quality 2002 — Phase 1: Methods for Estimating and Applying Relationships between Air Pollution and Health Effects for the British Columbia Lung Association.

Appendix 3: Possible Health Effects Occurring at Ambient Air Quality Levels in Canada (continued…)

Pollutant	Definite Effect	Probable Effect	Possible Effect
Ozone	Increased reduced activity days Increased school absences for respiratory illness Reduced lung function		Increased prevalence of asthma

Appendix 4: Summary of Lessons Learned from Canada-wide Standard (CWS) Process and Suggestions for Future Processes

Process Element	Lessons Learned, Conclusions from the CWS Process	Suggestions for Future Processes
Management and Accountability	• CWS process was, in part, established to harmonize and reduce "patchwork" of environmental management across Canada. • Its consensus-based approach respects and protects jurisdictional powers and interests so as to manage complex air quality issues. • Its consensus-based, voluntary approach is time-consuming and considered expensive, by some. • Its consensus approach does not result in the highest of environmental standards for air quality targets, but rather a "lowest-common-denominator." • Provincial/territorial jurisdictions with small environmental departments lack resources to analyze and fully participate. But they do benefit from the analytical process and its results. • It provides weak accountability mechanisms for ensuring progress toward achievement of objectives/targets. • Its stakeholders are valuable for accountability.	• Strategically apply consensus approach to decide on optimal combination of voluntary or mandatory instruments in order to manage different emission sources. • Federal jurisdictional representatives and stakeholders believe that stronger leadership from federal government is required to effectively manage air quality. • Consider institutionalizing stakeholder participation to enhance accountability, maintain public and political awareness. • Realize that federal governments should continue to provide analytical and/or management support to provinces/territories, especially those with smaller environmental departments that lack resources.
Situational Analysis	• CWS process operationalized and tested the capabilities and credibility of the health science, the environmental information systems, modeling, and the analytical capacity. • The weaknesses identified in monitoring systems, emission inventories, forecasts, and air quality modeling have led to improvements.	• Continue to support scientific research to resolve uncertainties with respect to source-receptor linkages, exposures, health effects, etc. Consider establishing an independent group to prioritize research efforts. • Continue to enhance monitoring systems, emission inventories, forecasts, and air quality modeling capabilities.

Appendix 4: Summary of Lessons Learned from Canada-wide Standard (CWS) Process and Suggestions for Future Processes (continued…)

Process Element	Lessons Learned, Conclusions from the CWS Process	Suggestions for Future Processes
Policy Decision	• A ministerial decision is required to set directions and provide the authority to implement. • CWS process is subject to powers and procedures that were suitable before PM and ozone were declared toxic in 2003 (under CEPA 1999).	• Ensure that there is a clear direction and mandate from minister(s) before proceeding on to major initiatives. • Maintain communication linkages with minister(s) so as to ensure alignment of policies with direction of management process.
Objectives and Targets	• CWS process focuses on voluntary air quality targets for PM and ozone, in order to respect jurisdictional requirements and manage interests. • No direct tie-in occurs between objectives/targets and what technology/practices has already achieved and could achieve. • CWS air quality targets do not provide a clear direction for emission reductions (by sector or jurisdiction).	• Establish comprehensive set of objectives and targets that fully support the environmental management process. • Define the suitable mix of voluntary and mandatory objectives/targets, based on how sources can be practically managed, measured, and monitored. • Calculate the potential air quality health-benefits results, based on best available technology (BAT), best practices, and/or best processes for similar sources. • Evaluate establishment of objectives/targets, based on maximizing net social benefits.

Appendix 4: Summary of Lessons Learned from Canada-wide Standard (CWS) Process and Suggestions for Future Processes (continued…)

Process Element	Major Conclusions	Suggestions for Future Processes
Economics	• Credibility of economic analysis is considered low. • Input data, improvements in linkages between air quality and emission reductions, and economic models need improvements.	• Continue to increase economic modeling capability, including the reduction of cycle time for generating results. • Develop general equilibrium economic modeling capability. • Develop facility, process-specific input and modeling to address unique provincial and sectoral technical and economic issues. • Increase transparency of economic and linked health benefits in air quality models.
Decision-making on Instruments	• Federal and jurisdictional governments proceed with their own instruments. • CWS's unique jurisdictional instruments work contrary to harmonization for emitting sectors, sources. • Federal and jurisdictional instruments are not always linked to CWS targets for air quality.	• Synthesize federal and jurisdictional activities into a comprehensive assessment of emissions projections and air quality. • Develop abilities to translate required air quality improvements into emission reductions for Canadian jurisdictions (and US states).
Implementation and Enforcement	• Mechanisms to ensure accountability for federal or jurisdictional implementation are weak or nonexistent. • No sanction mechanisms are applied to ensure jurisdictional implementation. • No guidance is given to assist with instruments and implementation activities.	• Develop firm timelines and expectations for implementation activities. • Establish an appropriately funded organization to conduct continuous oversight and accountability regarding progress. • Develop guidance documentation to assist jurisdictions with implementation. • Identify penalty mechanisms that can be applied to encourage jurisdictional action.

Appendix 4: Summary of Lessons Learned from Canada-wide Standard (CWS) Process and Suggestions for Future Processes (continued…)

Process Element	Major Conclusions	Suggestions for Future Processes
Measurement, Monitoring, and Reporting on Progress	• A clear reference method for monitoring $PM_{2.5}$ is unavailable. • Reporting requirements for ambient air levels in CMAs below 100,000 population are nonexistent. • Publicly available progress reports are nonexistent. • Linkages between CWS targets and effect of emission-reduction instruments are absent.	• Require frequent mandatory progress reporting to ensure public accountability and transparency. • Establish measurement and monitoring protocols early in the management process. • Require a more extensive monitoring and reporting system that encompasses all Canadians, even those in small communities. • Establish objectives/targets that can be measured and linked to instruments.
Continuous Improvement (CI)	• 5- and 10-year reviews are considered appropriate for CWS targets. • Transparency during CWS review process is lacking.	• Formalize stakeholder involvement for review of environmental management elements. • Set new objectives/targets in CI process.

Appendix 5: List of Acronyms

AMC	Air Management Committee (of CCME)
CCME	Council of Ministers of the Environment
CHE	Committee on Health and Environment (of CCME)
CEPA	Canadian Environmental Protection Act
CWS	Canada-wide Standard
EPPC	Environmental Planning and Protection Committee
EU	European Union
GHG	greenhouse gas
GVRD	Greater Vancouver Regional District
NAAQOs	National Ambient Air Quality Objectives
NOx	nitrogen oxide
NRTEE	National Round Table on the Environment and the Economy
PM	Particulate matter
$PM_{2.5}$	Particulate matter with particles < 2.5 µm diameter
PM_{10}	Particulate matter with particles < 10 µm diameter
ppb	parts per billion
ppm	parts per million
SO_2	sulphur dioxide
SOx	sulphur oxide
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
WGAQOG	Working Group on Air Quality Objectives and Guidelines
WHO	World Health Organization
µm	micron or micrometre
$\mu g/m^3$	micrograms per cubic metre

Appendix 6: Experts Meetings on Providing Advice on National Ambient Air Quality Objectives

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