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AIR QUALITY – WHERE ARE WE NOW? WHERE ARE WE GOING?

HIGHLIGHTS

- Canada and British Columbia air quality has improved remarkably since the 1970s and has continued to improve from 2000 to today. There has been a steep decline in the quantities of pollutants including particulate matter, ground level ozone, nitrogen oxides, and sulphur dioxides. As a result, we compare favourably with the United States and most other OECD countries.
- In BC, air emissions continue to decline. At the same time there has been increase in activity (i.e., number of facilities.) This demonstrates that BC businesses have done a good job protecting human health and the environment, while creating jobs and investment.
- Since 2012 Ministers of Environment from across Canada have been developing a Canada-wide Air Quality Management System (AQMS). The AQMS includes air quality objectives for air zones known as CAAQS (Canadian Ambient Air Quality Standards), and equipment standards known as BLIERS (Base-level industrial Emissions Requirements), as well as efforts to address mobile sources (not discussed in this paper).
- CAAQS are non-binding objectives. Each province or territory can choose to achieve or not the objectives in the context of its unique geography, economic structure and social context. BLIERS will be national minimum equipment standards. Importantly, CAAQS are not intended to be translated as go-no-go permit conditions.
- It may be more challenging to find the next tranche of economically feasible air pollutant reductions. Collaboration among government, industry and other stakeholders will be essential.
- Careful consideration of several outstanding and substantive policy questions is necessary if the AQMS is to become a robust framework with sustainable outcomes.

Shortly after the publication of the Business Council's last review of the air quality and air quality regulation in BC and Canada, the Canadian Ministers of Environment (CCME) implemented a process to examine and update the Canadian Ambient Air Quality Standards (CAAQS) for particulate matter (PM), ground level ozone (O_3), sulphur dioxide (SO_2) and nitrogen oxides (NO_x). CAAQS for PM2.5 and O_3 were established in May 2013, and a review will begin shortly with revisions expected for approval by 2018. The 2020 and 2025 objectives for SO_2 are complete and are awaiting approval by the CCME. The objectives for NO_2 are under development.

The CAAQS outcomes, as described in the terms of reference, will be numerical values (i.e., thresholds) determined[1] to represent acceptable

[1] Health Canada conducts research and produces human health risk assessments (HRAs) for each pollutant. To date HRAs have been completed for SO2, diesel exhaust and PM10. The structure and results of all HRAs more or less follow the same format. Much of Health Canada's research is also published in the following journals: *Environmental Pollution, Air Quality, Atmosphere and Health, BMC Public Health, PLoS One, Environmental Health Perspectives, Journal of Exposure Science and Environmental Epidemiology, Environmental Health, Environment International, Atmospheric Environment, Environmental Research, Environmental and Molecular Mutagenesis.*

concentrations of outdoor air pollutants for protecting human health and the environment. The values are described as objectives for air zones rather than go-no-go permit requirements for specific facilities. This distinction is not well understood. It has been a source of confusion and has created uncertainty for governments, industry and the public. In particular, there have been observed instances in which existing CAAQS have been used for regulatory application discussion purposes; this is not an appropriate interpretation.

As objectives (i.e., something aimed at or sought), CAAQS are non–binding and the federal, provincial and territorial governments with roles and responsibilities for managing air quality "*will work to ensure that air pollutant concentrations do not exceed the CAAQS within their borders, and…strive for continuous improvements in air quality.*" The stated intention is to *"prevent the CAAQS from becoming "pollute up to levels" by formalizing an expectation that governments would do more than just focus on achieving the CAAQS."* Further, the Air Quality Management Framework (AQMS) anticipates that there may be instances where achieving a CAAQS objective is not possible. Provinces and territories have the authority to consider the unique regional attributes of geography, economic structure and social context. With this in mind, they can make decisions not to achieve an objective – non-attainment. However, the optics of and communications around non-attainment will be challenging, given the "social acceptance criteria"[2] currently embedded in permitting and project review processes. Clarity and communication about scope and use is both missing and necessary.

In addition, while not intended, air quality objectives may become de facto emission caps in certain air zones, particularly where there are attainment issues. This may result in limited opportunities for industrial growth. Why? First, industry-generated data on emissions is robust and accessible. Second, information to measure emissions from non-industry sources is less available, and more difficult and expensive for governments to generate. Third, regulatory tools to target industry emissions (e.g. permitting) are already in place and are the most immediate tools available to policymakers to drive emission reductions. On the other hand, the tools to manage non-industry emissions (e.g., vehicle emissions and emissions from heating residential and commercial buildings) are less sophisticated and more difficult to implement. Therefore, industrial sources are often (usually) the first to be

DEFINITIONS

Air Zones: An air zone is a finite geographic area exhibiting similar air quality issues and trends throughout. Provinces and territories have the responsibility to delineate and manage air zones based on local circumstances. BC has seven air zones.

Air Zone Management Framework: A four level colour-coded system of air pollution concentration ranges prompts a corresponding range of management actions to be implemented at an air zone level. These actions are progressively more stringent.

Ambient Air Quality

The concentrations of different pollutants in the air that are deemed acceptable for reasons including protection of human health and the environment.

Typically measured near ground level and away from direct sources of pollution.

Numerical measures include micrograms per cubic meter (ug/m^3) and parts per billion or million by volume or mass (ppb or ppm). Most criteria use ppb or ppm; PM uses ug/m^3.

[2] http://www.bcbc.com/publications/2015/rethinking-social-licence-to-operate-a-concept-in-search-of-definition-and-boundaries.

constrained when mandatory action plans for regional non-attainment are triggered.

Complicating this further is the development of Base-level Industrial Emissions Requirements (qualitative and quantitative equipment standards) (BLIERs), another key element of the national AQMS. BLIERs are intended to be minimum national performance standards and will apply to all industrial equipment across Canada. The development and implementation of BLIERs will drive ambient air quality improvements in areas of industrial activity. BLIERS are attractive because they enable the market to choose the best available solutions for specific facilities, as opposed to government choosing technology. However, CAAQS are being developed in isolation of these considerations. There are instances where BLIERS may conflict with current provincial objectives (i.e., be lower) and, where for good reasons, a provincial or territorial government may not want to make changes to existing regulations.[3] This conundrum remains unresolved in the AQMS process.

PUTTING EMISSIONS IN PERSPECTIVE

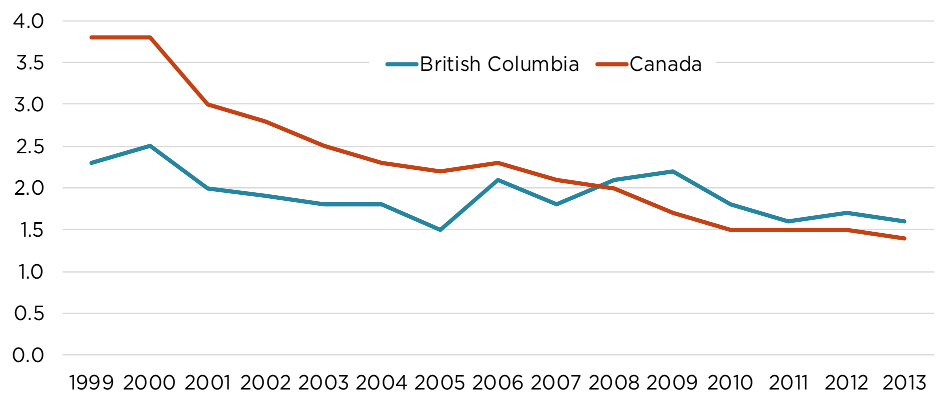
SO2 and NOx

Canada's relative position compared to the United States and the OECD in terms of total SO_2 and NO_x emissions is good. The quantum of emissions and rate of decreases are representative of our geographic size and industrial composition.

Domestically within Canada, emissions of NO_x and SO_2 have declined dramatically since 1970. Data from the National Air Pollution Surveillance Program (NAPS) shows SO_2 levels were reduced by 96% between 1970 and 2008.[4] Between 2009 and 2014 this downward trend for SO_2 and NO_x has continued, with further decreases of 30% and 11%, respectively. The overall pattern of decline for SO_2 and NO_x is similar for British Columbia, with respective decreases of 24% and 11% from 2009 to 2014.[5]

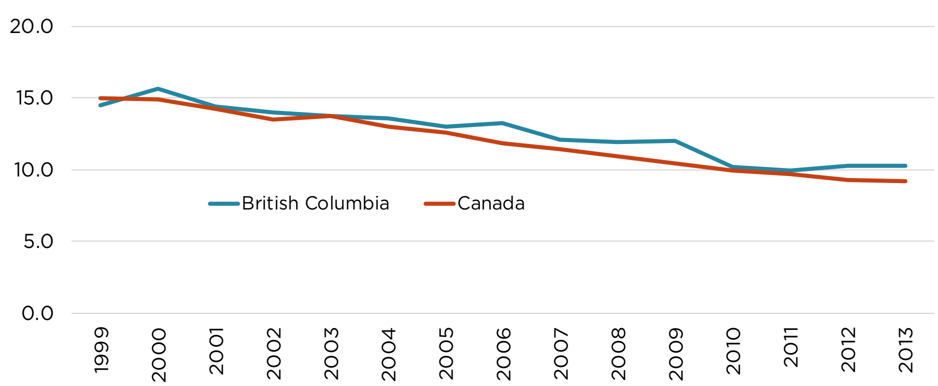
The following charts represent British Columbia as whole. It is true that some communities experience and will continue to see exceedances relative to objectives. Critically, elevated ambient air quality levels are not indicative of either adverse environmental or health impacts, nor do they suggest performance issues at a particular facility.

FIGURE 1: **SO_2 1999 TO 2013 (AVERAGE ANNUAL PARTS PER BILLION)**



Source: National Air Pollution Surveillance Program (NAPS).

FIGURE 2: **NO_x 1999 TO 2013 (AVERAGE ANNUAL PARTS PER BILLION)**



Source: National Air Pollution Surveillance Program (NAPS).

[3] Quebec has opted out, citing duplication with its Clean Air Regulation.
[4] National Air Pollution Surveillance Program (NAPS): http://www.ec.gc.ca/rnspa-naps/default.asp?lang=En&n=5C0D33CF-1.
[5] National Air Pollution Surveillance Program (NAPS): http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=307CCE5B-1 and http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=C8BFC3F2-1.

PARTICULATE MATTER AND OZONE

The most important particulates are those with a diameter of less than 10 microns.[6] Because of their size, they can travel deeply into the lungs and cause a variety of respiratory-related health concerns. As a general rule, outdoor air levels of fine particles, including ground level ozone,[7] increase during periods of stagnant air (very little wind or air mixing) and may look like humidity or fog. Exceedances also depend on the site and season.

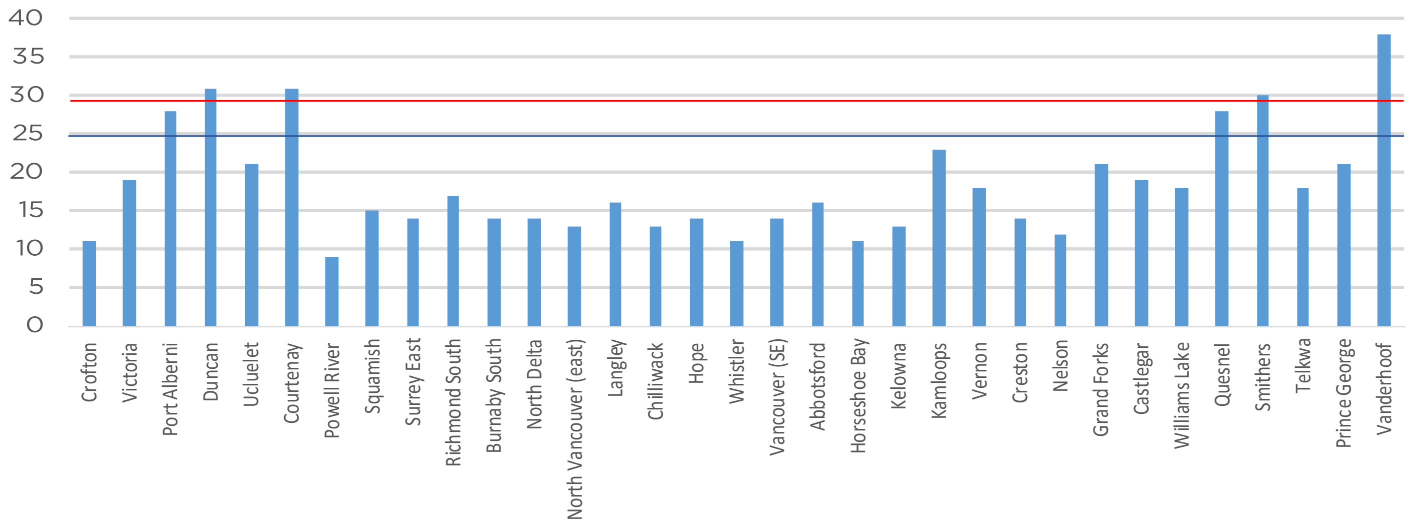
Substantial progress has also been made on PM[8] within Canada since 1970, with a 53% reduction in total suspended particulates. For the period 1984-2008, a further 54% decrease in specific measurements of PM_{10} and $PM_{2.5}$ occurred.[9] All of Canada's major cities have PM measures below the World Health Organization's upper limit — an average annual 10 ug/m3.[10] Since 2000, British Columbia's levels have fluctuated between 5.2 and 7.1 ug/m^3. These measurements are not only below the CAAQS target (10 ug/m^3) but also well below the stated BC objective of 8 ug/m^3.[11]

The highest $PM_{2.5}$ concentrations in BC are typically in the fall/winter and during wildfires. For many communities in BC, including those with significant industrial facilities, measures of both $PM_{2.5}$ and ground level ozone are also below the current BC and CAAQS objective, even when measured on a 24 hour basis. Some communities may have exceedances for the reasons noted (blue line is BC 24 hour objective, red line is the CAAQS 24 hour objective).

THE NEXT TRANCHE OF REDUCTIONS

Overall, British Columbia (and Canada) has made huge progress over the past 46 years in reducing air emissions. This is positive for both human health and the environment. However, given the steep declines in emissions to date, many of the low-cost abatement options and opportunities to deploy technology to reduce emissions are already in place. There may be challenges in finding economically feasible opportunities for the next increment of reductions going forward. This will make it necessary for collaboration between industry, communities and governments to identify solutions that balance the inevitable trades offs involved.

FIGURE 3: **BRITISH COLUMBIA 2014 - PM2.5 UG/M3 (ROLLING DAILY 3 YEAR AVERAGE 98TH PERCENTILE)**



[6] 1x10-6 of a metre.

[7] The CAAQS standard for ground level ozone is 63 ppb, measured as the annual 4th highest daily 8-hour maximum, averaged over three consecutive years. In 2013, Vancouver has the lowest emissions at 24.8 ppb compared to other Canadian cities including Edmonton (32), Calgary (34), Toronto (33.3), Ottawa (43), and Montreal (32.2). Vancouver maintains its low emission status when compared to Hong Kong (27.2), Amsterdam (29.9), Paris (31.5), Stockholm (33.3), Berlin (33.9), Boston (37.8), Washington DC (38.6), Denver (46.4), and Phoenix (48.2).

[8] Particulate matter is made up of natural sources (soil; bacteria and viruses; fungi, molds and yeast; pollen; and, salt particles from evaporating sea water) and human sources as by-products of vehicle use, residential wood burning for space heating, and industrial processes.

[9] There was also a 97% reduction in lead that was largely a result of phasing lead out of gasoline.

[10] http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=en&n=FDBB2779-1.

[11] http://www.bcairquality.ca/reports/pdfs/aqotable.pdf.

Data from the National Pollutant Release Inventory[12] suggests this conclusion to be at least partly true.[13] Total air emissions by all types of industry across Canada between 2010 and 2014 decreased by 8%, with a corresponding decline in the total number of facilities. While it is likely that some reduction in emissions has come from improvements at existing plants, a portion of those reductions has occurred because of reduced industrial activity. Is this reduced activity a function of a stagnant global economy or the result of ever increasing regulatory requirements?

The good news for British Columbia, in comparison to the rest of Canada, is that on average there was a 13% decrease in air emissions accompanied by an increase in the number of facilities. What this suggests is that positive results have been achieved mainly through focussed efforts of industry, rather than through the development and implementation of regulations such as the CCME's AQMS.

SOME CAUTIONARY POINTS ABOUT DATA AND MONITORING

Data are central to understanding the impacts from air pollutants. This data is collected from a combination of point sources, usually on-site/within the fence line of a facility, and non-point source monitors. British Columbia has a robust set of monitoring stations, a relatively good understanding of sources of emissions, and a reasonable grasp of the quality of ambient air in air zones. This is not the case for most other jurisdictions in Canada.

Having good data is a double edged sword. On the one hand, it enables more precise decision making (i.e., investment in new equipment) based on the pattern of emissions and the actual performance of various industrial facilities. On the other hand, this rigour may disadvantage BC industry because public expectations will be higher. This may lead to additional costs being imposed on BC facilities, and raises competitiveness issues not only in terms of trade within Canada but also internationally.

Policy considerations for monitoring are conceptually straightforward but challenging to implement. These include ensuring point source information be used with caution when considering ambient standards, in particular, whether or not objectives have been achieved. In addition, it is critical that a consistent set of criteria be used to inform the placement of monitoring stations, such as their distance from and placement within a community so that data gathered accurately present ambient air quality in an air zone.

TABLE 1: **CHANGES IN TOTAL EMISSIONS BY TYPE AND NUMBER OF FACILITIES, BRITISH COLUMBIA**

Emissions Type	Change in Emissions 2010 to 2014	Percent Change	Facility Count	Percent Change
PM	-29,158	-23.21%	3	1.9%
SO2	-8,191	-16.89%	8	9.8%
NOx	222	0.35%	6	1.5%
		-13.25%	Do not sum facilities as this may double count the number of facilities (i.e. improvements may reduce more than one pollutant type simultaneously)	

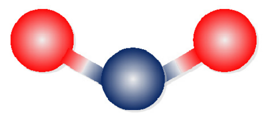
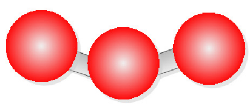
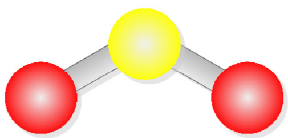
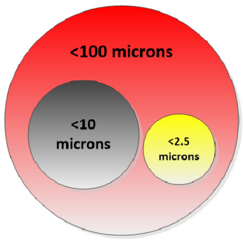
CONCLUSION

Let's be clear. Industry supports the development of sound, science-based ambient air quality standards and is anxious to find ways for continuous improvement at existing facilities, where feasible and practical. Achieving this requires further consideration of the following policy questions.

- How will CAAQS ensure enough room for new entrants in already constrained air zones?
- How will the implementation of CAAQS manage the risk of leakage, and the potential for stranded investment / shutting in of current activity?

[12] http://www.ec.gc.ca/inrp-npri/donnees-data/index.cfm?lang=En.
[13] The NPRI is designed to track the largest sources of pollution from facilities, but not all sources of pollution in Canada. The NPRI requires that facilities meeting certain reporting criteria report their releases of more than 300 substances, as applicable. The list is updated regularly. This means that certain small facilities and facilities undertaking certain activities or in certain sectors are exempt from reporting.

TABLE 2: **FOUR MOST COMMONLY REGULATED AIR EMISSIONS SOURCES**

	**Nitrogen Oxides (NOx)**: vapour and small particles produced from the reaction among nitrogen, oxygen and hydrocarbons (during combustion), especially at high temperatures. Reacts with and destroys methane.
	**Ground Level Ozone (O3) (smog)**: produced as a by-product from car engines and industrial operations in reaction to sunlight in air containing hydrocarbons and NOx.
	**Sulphur Dioxide (SO2)**: pungent toxic gas released from industrial activities primarily from burning coal but also naturally from volcanic eruptions.
	**Particulate Matter (PM 2.5 and 10)**: the sum of all microscopic solid and liquid particles suspended in air including pollen, dust, and smoke – produced from roads, agriculture, some industrial activities, residential wood burning, forest fires and burning fossil fuels.

- How should emission reductions be incentivized, the primary objective of CAAQS, without making them into permit conditions?
- Will there be different standards for new and old facilities in an air zone?
- How will exceedances be handled?
- How should companies plan for future ratcheting up of standards?
- How does CAAQS, which are pollutant-specific, reconcile the interaction among and overall loading of pollutants in an air zone?
- How should CAAQS be prioritized in the context of other environmental objectives that also have merit?
- Should greenhouse gases (GHGs) be added to the list of pollutants and if so how will trade-offs be made among pollutants such as GHGs?
- How will issues with monitoring be reconciled (i.e., the use of the use of point-source associated monitoring stations for the assessment of air zone attainment)?
- How will/should the socio-economic implications of change be captured?
- How will the aspirational nature of the CAAQS objectives be communicated to the public, versus the practical implications for industry?

Unfortunately as the process towards CAAQS implementation proceeds, these important questions remain unanswered for the most part. It will be necessary to take the time to do the analysis and incorporate outcomes as they will be key to a robust AQMS regime going forward.

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