Managing Industrial Air Emissions in Canada

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BACKGROUND PAPER

Background Report:
Managing Industrial Air Emissions in Canada

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1. Introduction

In 2008, the Canadian Medical Association (CMA) released a groundbreaking report. According to the report, in 2008, as many as 21,000 Canadians would die prematurely from the effects of air pollution. That year, there would be over 9,000 hospital visits, 30,000 emergency department visits and 620,000 doctor's office visits due to air pollution. The economic costs of air pollution would top $8 billion in 2008, rising to over $250 billion by 2031.[1]

This stark assessment highlights the imperative for Canadian governments to act to address air quality issues across the country. Historically, in Canada the provincial governments have been the primary agents responsible for managing and regulating air emissions. When managing large industrial emissions, the environmental management tool of choice for most provincial environmental agencies has been command and control regulations in the form of emission standards. However, there is a growing interest in applying economic instruments, such as emissions trading and emissions charges[2], to incent improved environmental performance and achieve air quality objectives.

This paper examines the appropriateness of a shift towards the use of economic instruments for air quality management, by exploring the attributes of different environmental management tools. More specifically, this paper explores the attributes of command and control regulations, emissions trading and emission charge systems. It highlights some of the key strengths and weaknesses of each management tool with respect to their effectiveness, efficiency, associated administrative burden, and political acceptability. Several case studies are provided to further highlight the characteristics of each management tool.

This review can inform policy-makers' analysis regarding whether or not the apparent transition from command and control management tools towards economic instruments is appropriate to ensure air quality management objectives are met, and to protect Canadians' health.

[1]Press release: *New CMA Report Warns Poor Air Quality Killing Canadians,* Ottawa, August 13, 2008 http://www.cma.ca/index.php?ci_id=86912&la_id=1

[2] Emissions charges are also referred to as emissions taxes. However taxation tends to imply that governments use the tax to raise revenue, and this may or may not be the case in a system of emissions charges. To avoid confusion, in this paper, the term emissions charge is used to describe a system where a fee is levied on emissions. The use of revenue raised from these systems is considered separately from the design of the charge itself .

2. Environmental and Health Impacts of Air Pollution

Poor air quality and smog are important environmental and human health concerns. The main pollutants responsible for smog are particulate matter (PM) and ground level ozone. Particulate matter arises both from the direct emissions of PM and by the reaction of other pollutants, most notably sulphur dioxide (SO_2) and oxides of nitrogen (NO_x) in the atmosphere. Ground level ozone arises from the reaction between Volatile Organic Compounds (VOCs) and NO_x in sunlight.[3]

The human health and environmental impacts of smog have been well documented. Chronic exposure to PM can contribute to an increased chance of respiratory disease and lung cancer. In addition, PM is a "non-threshold" substance, that is, there is no level of exposure that is not associated with some health impacts. Ozone, above certain concentrations, can also present significant health impacts; it can cause breathing problems, trigger asthma and contribute to lung disease.[4] The effects of these emissions on Canadians can be significant. The Canadian Medical Association estimates that by 2031 almost 90,000 people will have died from the acute effects of air pollution, the number of deaths due to long-term exposure to air pollution will be 710,000.[5]

Smog creating emissions can also cause severe environmental damage. Particulate matter increases the acidity of lakes and streams, impacts nutrient levels in soils and damages forests and crops.[6] Ozone can impact the ability of sensitive plants to produce and store food, and can reduce forest growth and crop yields, both of which can, in turn, reduce ecosystem diversity. [7]

In Canada both emissions of PM and ozone remain a problem, for example, PM and ozone levels in many cities are consistently above the Canada-Wide Standard (CWS). In the period from 2003 - 2005, at least 30 per cent of Canadians lived in communities with $PM_{2.5}$ levels above the CWS, for ozone, this figure is 40 per cent.[8]

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[3] *Smog*, Environment Canada, last updated July 18, 2006,available at http://www.ec.gc.ca/cleanair-airpur/Smog-WS13D0EDAA-1_En.htm

[4] *World Health Organization fact sheet No. 313 - Air Quality and Health,* August 2008, World Health Organization, http://www.who.int/mediacentre/factsheets/fs313/en/index.html

[5] No Breathing Room: National Illness costs of Air Pollution, Canadian Medical Association, August 2008, available at http://www.cma.ca/multimedia/CMA/Content_Images/Inside_cma/Office_Public_Health/ICAP/CMA_ICAP_sum_e.pdf

[6] *Health and Environment – Particular Matter,* United States Environmental Protection Agency, last updated May 9, 2008, available at http://www.epa.gov/air/particlepollution/health.html

[7] *Health and Environment – Ozone,* United States Environmental Protection Agency, last updated May 9, 2008, available at http://www.epa.gov/air/ozonepollution/health.html

[8] Canadian Council of Ministers of the Environment. November 2006. "Canada-wide Standards for Particulate Matter and Ozone: Five Year Report: 2000-2005." Page 20. Available at: http://www.ccme.ca/assets/pdf/cams_proposed_framework_e.pdf.

3. Managing Ambient Air Quality in Canada

In order to manage the health and environmental impacts of air pollution, the federal, provincial and territorial governments have long shared responsibility to develop and set ambient air quality objectives and standards. In Canada, the federal government sets ambient air quality objectives in conjunction with the provinces, while the provincial governments apply these objectives using a wide variety of environmental management tools. Three key examples of federally set ambient air quality standards are the National Ambient Air Quality Objectives, the Canada Wide Standards for PM and Ozone and the recently introduced Comprehensive Air Management System.

3.1 National Ambient Air Quality Objectives

The Government of Canada, in partnership with the provinces, developed the National Ambient Air Quality Objectives (NAAQOs). The NAAQO prescribe goals for air quality based on the risk to key biological receptors (humans, plants, animals, and materials). However while the NAAQOs are intended to be primarily effects-based, they also reflect the incorporation of technological, economic and societal information.[9]

While the NAAQOs are federally set objectives, they can be adopted by provincial governments and can be implemented by provinces as they see fit. The primary distinction between the NAAQOs and the Canada-Wide Standards is that the NAAQOs apply to a broader range of substances and use different metrics for assessment, specifically NAAQOs exist for NO2, SO2, total suspended particulate, Ozone and Carbon Monoxide, and set hourly, 8-hour, daily and/or annual thresholds depending on the pollutant. [10]

3.2 Canada-Wide Standards

The Canadian Council of Ministers of the Environment - a council that includes the Ministers of the Environment from all provinces and territories, and the federal government - developed national standards for Particulate Matter and Ozone. The current national standards, called the Canada-Wide Standards (CWS), "represent a balance between the desire to achieve the best health and environmental protection possible in the relative near-term and the feasibility and costs of reducing the pollutant emissions that contribute to elevated levels of PM and ozone in ambient air".[11] These standards outline guidelines for governments to achieve a level of 65ppb for Ozone[12] and 30μg/m3 for PM[13]

[9] Health Canada, National Ambient Air Quality Objectives, http://www.hc-sc.gc.ca/ewh-semt/air/out-ext/reg-eng.php#a3
[10] Ibid.
[11] *Canada Wide Standards for Particulate Matter and Ozone*, Canadian Council of the Ministers of the Environment, Endorsed by the CCME council of Minister June 5-6, 2000 Quebec City, pg.2 available at http://www.ccme.ca/assets/pdf/pmozone_standard_e.pdf
[12] 8-hour averaging time, achievement to be based on the 4th highest measurement annually, averaged over 3 consecutive years.
[13] 24 hour averaging time, achievement to be based on the 98th percentile ambient measurement annually, averaged over 3 consecutive years.

by 2010.[14] As the federal ambient air quality standards are in fact guidelines, the onus is on each of the provinces to choose whether to implement them and which management tools are used to ensure the standards are met.

3.3 The Comprehensive Air Management System

The CCME has recently agreed to move forward with implementing a new air quality management system that includes air quality standards and consistent industrial emissions standards across the country.[15] The proposal is based on three main pillars – the development of Canadian Ambient Air Quality Standards (CAAQS), Air Management Zones and Base-Level Industrial Standards (BLIERS). The CAAQS will set ambient air quality standards starting with PM and ozone, then move on to address other key pollutants. The standards will be set through a time-limited federally-led process that involves all major stakeholders including provinces and territories. The standards are intended to be more stringent than the current CWS, and reporting against the standards will begin in 2015. Air Management Zones will establish place based emissions management that will be led by provinces and territories with the intention of ensuring ambient air quality standards are achieved. The BLIERs are industrial standards that will provide a base level of emissions performance for industries across the country. However they are not intended as a primary tool to ensure air quality standards are met, and management within air management zones may require further reductions from industry to ensure air quality standards can be achieved.[16]

4. Managing Emissions to Achieve Ambient Air Quality Goals

Provincial governments use a number of different mechanisms to control the emissions that lead to poor ambient air quality. With respect to PM and ozone, emissions management focuses on the precursors including NO_x, SO_2, PM and VOCs. The tools used to manage emissions vary between point and non-point sources. Point sources include large industrial facilities, which can be directly targeted for emissions reductions. Non-point sources include, for example, vehicle emissions and emissions from heating residential and commercial buildings.

For large point sources, common tools used to manage air emissions include emissions standards, often referred to as command and control regulatory instruments, and emissions pricing systems. In a command and control system, the government requires

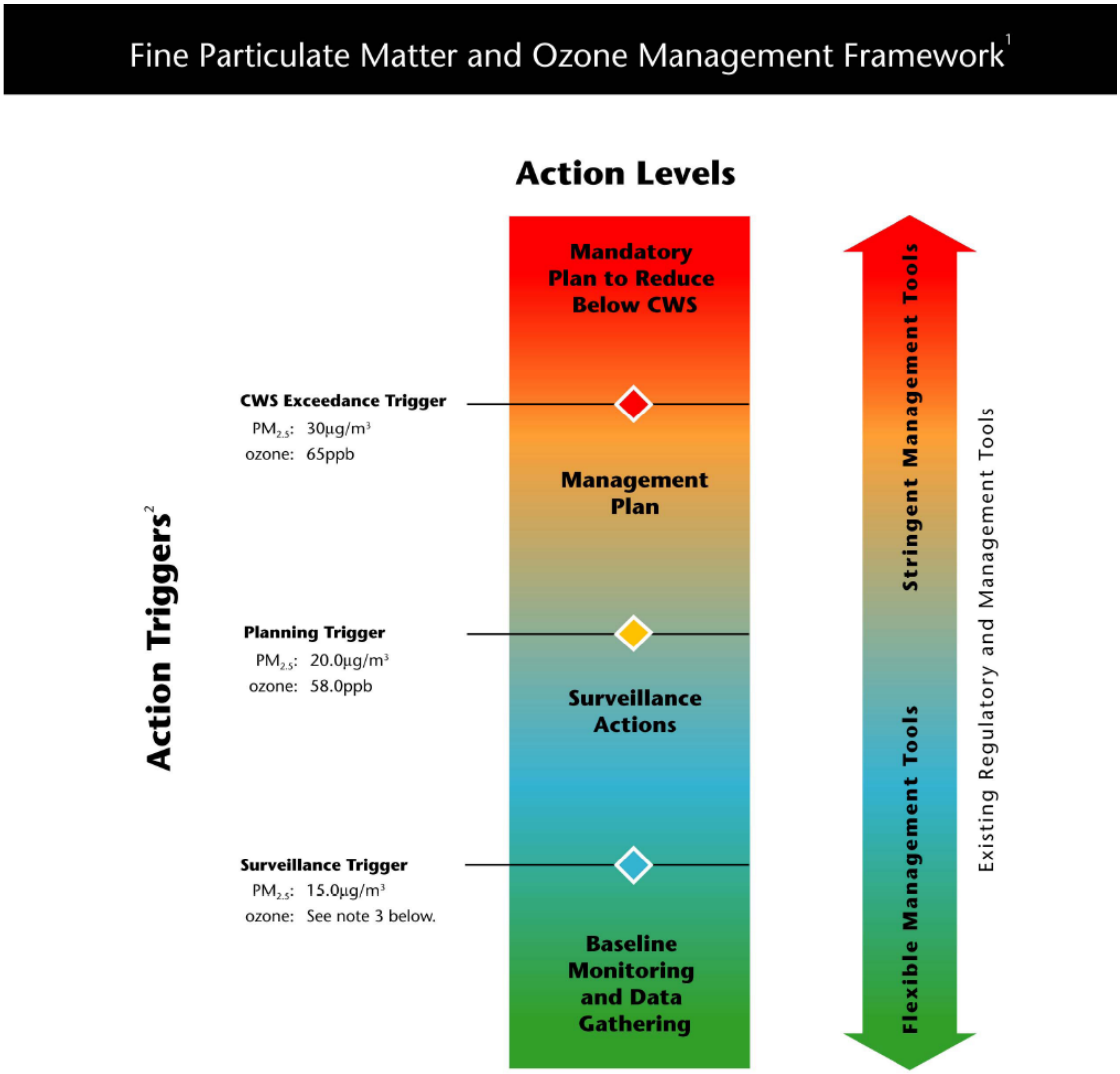
[14] Supra note 7.
[15] Comprehensive Air Management System (CAMS) Steering Committee. October 20, 2010. "Comprehensive Air Management System: A Proposed Framework to Improve Air Quality Management." Available at: http://www.ccme.ca/assets/pdf/cams_proposed_framework_e.pdf
[16] Comprehensive Air Management System (CAMS) Steering Committee. October 20, 2010. "Comprehensive Air Management System: A Proposed Framework to Improve Air Quality Management." Available at: http://www.ccme.ca/assets/pdf/cams_proposed_framework_e.pdf

individual facilities to install particular control technologies or achieve particular emissions levels. Emissions pricing systems can take the form of emissions trading systems, or emissions charges. In an emissions trading system, emissions targets are set by the government and emitters trade permits or credits to achieve the targets. In this case the price of emissions is set through the market. In the case of emissions charges, the government directly sets an emissions price by levying a charge on all or a portion of large industrial emissions.

For smaller sources, equipment standards, such as standards on wood stoves, energy efficiency standards or fuel economy standards, can be applied. Other policies can also be used to manage smaller sources, such as congestion charges and urban policies that improve densification in order to reduce emissions from vehicles. In addition, negotiations with other nations may be necessary to bring air quality under control in areas where transboundary emissions are responsible for pollution in an area. In Canada this tool is particularly necessary in certain regions, for example southern Ontario, where transboundary emissions play a significant role in contributing to air quality issues.

Because local concentrations of emissions in the air are the measure of appropriate ambient air quality, not all areas across the country need to reduce absolute emissions to the same degree. Some may need to make very deep reductions while other areas may need only mild emissions control. In general, actions will need to be more severe as ambient concentrations get higher. However, for some pollutants, such as PM, which is a non-threshold substance, some level of action is needed to limit impacts even where ambient levels are low. An example of a framework that applies this principle to some extent is the PM and ozone framework in place in Alberta, shown in figure 1.

Figure 1 Fine Particulate Matter and Ozone Management Framework[17]



1. *The framework must be applied in the context of its key elements, including guiding principles, existing initiatives and mechanisms that support management of PM & ozone, and the goals and objectives for each action level.*

2. *Action triggers for $PM_{2.5}$ are based on a 24 hour average, and achievement is based on the 98th percentile ambient measurement annually, averaged over 3 consecutive years. Action trigger levels for ozone are based on an 8 hour average, and achievement is based on the 4th highest measurement annually, averaged over 3 consecutive years.*

3. *For ozone, Alberta Environment will determine on an annual basis which areas of the province are in baseline and which are in surveillance.*

The following sections of this paper focus on tools that can be used to manage the contribution of industrial emissions to ambient air quality. However it is recognized that any effective air quality management system will require measures to not only manage

[17] Particulate Matter and Ozone Management Framework, Prepared by the Particulate Matter and Ozone Project Team for the Clean Air Strategic Alliance Board of Directors, 2003, pg. 32

industrial emissions but also to manage non-point source emissions and in certain regions transboundary emissions.

5. Managing Industrial Emissions

Over the last thirty years there has been a transition in the way national and sub-national (i.e. provincial and territorial) governments interact with their citizens and corporations, especially when it comes to the way they limit and control activities that have an impact on the natural environment.

Traditionally, governments seeking to prevent and manage air pollution relied almost entirely on coercive policy instruments; command and control type statutes and regulations.[18] The use of command and control regulations enables government to use the power of the state to enact specific laws and regulations that set explicit limits or standards to manage pollution releases. Command and control regulations typically rely on the use of penalties such as monetary fines, and potentially jail terms, for non-compliance.

Since the mid-1990's, there has been an ongoing trend away from coercive policy tools in favour of incentive-based tools (most commonly referred to as economic instruments) such as emission charges, emissions trading schemes, subsidies and voluntary initiatives to spur desirable environmental action.[19] In part, this shift can be explained by the weaknesses of command and control type mechanisms and the strengths of economic instruments.

To help contextualize the shift in the interest and use of management tools by Canada's provincial environmental agencies, the following provides a high-level overview of command and control regulatory approaches, emission charge systems and emissions trading schemes as management tools for industrial air emissions.

5.1 Emissions Standards

The most common approach to managing industrial air emissions in Canada is through the use of command and control mechanisms, which most often take the form of emission standards. Emission standards prescribe the specific limit of the amount of pollutant that can be released into the natural environment. Emission standards can also require regulated parties to install a particular control technology.

[18] (Stavins, 2003 p.5)
[19] (Howllet, 2001, p.304).

There are two main ways a government can impose emission standards:

- Performance based standards – which define a specific emission performance objective, but enable the regulated party to determine the technologies and approaches it will take to achieve compliance;
- Technology specifications –which prescribe that a specific emission control technology or equipment be used to control the emissions by a regulated party.

Command and control regulations offer both strengths and weaknesses for managing industrial air emissions. Key advantages to a command and control system include:

- Familiarity - Emission standards have long been used by provincial governments in Canada to manage air emissions.
- Assurance that local air quality outcomes are met - Emissions standards ensure that reductions are achieved at the facility level. This can be important to ensure that all facilities meet some minimum level of air pollution standard regardless of the air quality in the region. This can also be critical for pollutants that have significant effects on human health directly in the vicinity of industrial facilities, such as for PM and VOCs

There are also a number of disadvantages to a command and control style system. For example, these systems can be:

- Inefficient - Emission standards are often considered to be economically inefficient as they are not designed to seek out the lowest cost options to reduce emissions.
- Administratively onerous – These regulations require good information by the regulator on the emissions reduction capabilities of each individual facility, which can be a resource intensive process.

5.1.1 Case Study: The New Source Review

A good example of a command and control approach to managing air pollution is the "New Source Review" (NSR) program in the United States. Under this program, companies that are planning to build a new plant or make significant modifications to an existing plant are required to get an NSR permit. Sources may be required to meet different standards depending on the air quality in the area where the source is located.

There are three types of standards applied in the U.S.:

- *Best Available Control Technology (BACT)* is required on major new or modified sources in clean areas (i.e., attainment areas).
- *Reasonably Available Control Technology (RACT)* is required on existing sources in areas that are not meeting national ambient air quality standards.

- *Lowest Achievable Emission Rate (LAER)* is required on major new or modified sources in non-attainment areas.[20]

These standards are determined on a case-by-case basis, and are generally applied by State or local permitting agencies. The U.S. Environmental Protection Agency (EPA) maintains a database of appropriate emissions control technologies and provides guidance on how facility level assessments of BACT, RACT and LAER standards should be applied.

The Canadian Experience

Canada does not have an analogous federal system for applying emissions requirements to industrial facilities. However, some provincial governments apply source-based standards in a manner that is similar to the U.S. system. For example, Alberta regulates air emissions from industrial sources through setting standards based on:

- The baseline (existing) ambient air quality;
- Ambient air quality guidelines or prescribed ambient levels;
- Source emission standards based on the nature of the air contaminant, the process industry and best available demonstrated or best available air pollution technology; and,
- The results of air dispersion modelling which takes into account the local meteorology and terrain, and surrounding emission sources.[21]

The federal Comprehensive Air Management System includes source based performance requirements, known as BLIERs, that to some extent include elements of a command and control system. In this case the federal government will, in conjunction with stakeholders including provinces and territories, set quantifiable requirements at the facility or equipment level that regulated entities must meet, to be implemented by 2015. The BLIERS are expected to be enforced primarily by the provinces using whatever tools they feel are appropriate, with the federal government providing regulatory assurance to ensure the standards are met. The proposal allows for some flexibility in the achievement of the BLIERS, however the use of economic instruments, such as emissions trading, to meet the BLIERs is limited to use within air zones or within areas where air quality is affected by the facilities, and provided there is a clear timeline for when BLIERs will be physically implemented. Economic instruments may be more widely applied in the management of emissions in established air zones where reductions in emissions that go above and beyond the BLIERS may be required.[22]

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[20] *Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse - Basic Information,* U.S. Environmental Protection Agency, Last updated on July-25-07
http://www.epa.gov/ttncatc1/rblc/htm/welcome.html

[21] Air Toxics Management Program in Alberta, Prepared by Air Emissions Branch Air and Water Approvals Division Environmental Services Alberta Environmental Protection and Air Issues and Monitoring Branch Chemicals Assessment and Management Division Environmental Services Alberta Environmental Protection, April 1998

[22] Comprehensive Air Management System (CAMS) Steering Committee. October 20, 2010. "Comprehensive Air Management System: A Proposed Framework to Improve Air Quality Management." Available at: http://www.ccme.ca/assets/pdf/cams_proposed_framework_e.pdf

5.2 Emissions Trading

An emissions trading program is an economic instrument that governments can use to manage industrial air emissions by pricing air pollution. The application of an emissions trading program requires a regulatory agency to set a collective emission target or individual facility emissions intensity targets for regulated entities.

There are two primary types of emissions trading systems, a "cap-and-trade" system and a "baseline-and-credit" system.

Cap-and-Trade System

In a cap-and-trade system, the total volume of allowable emissions from all regulated parties is established by the government; this represents the "cap". The government then makes available a total number of permits equal to this cap. These permits are either allocated to facilities for free (called "grandfathering") and/or auctioned off to emitters. At the end of each compliance period, usually a year, each facility must remit to the government one permit for each unit of emissions emitted by that facility in that year.

In a cap-and-trade system where emissions permits are allocated for free, facilities with low abatement costs may reduce their emissions below their allocated permit levels, they can then sell any excess permits to those emitters that face high emissions abatement costs or, if the system allows it, bank these permits for use in future years. Where emissions are auctioned those emitters will pursue onsite reductions available at costs lower than the auction price and will purchase from the auction the remaining permits necessary to cover their emissions.

Baseline-and-credit System

In a baseline-and-credit system, each regulated party is assigned a baseline, which is representative of its allowable emissions intensity. If the facility's emissions intensity is below its baseline, it generates credits. These credits can then be sold to other emitter or, if allowable, banked for future use. If the regulated party's emissions are above its baseline, it must then purchase the required number of credits (the difference between the baseline intensity and actual emissions intensity multiplied by the facilities production in that year) to ensure compliance.

Both types of systems can allow emissions credits to be created by facilities outside of the covered emitters, called offsets. For example, emissions reduction credits can be created by renewable energy systems or improvements that increase energy efficiency at residential or commercial buildings. There are both strengths and weakness associated with using an emissions trading system to manage industrial air emissions.

Some advantages of using emissions trading systems include:

- Cost effectiveness - Emissions trading programs can offer significant compliance cost saving opportunities for regulated parties, relative to a command and control regulation.
- Flexibility – In an emissions trading system regulated entities can choose the most effective means to reduce emissions, thereby providing flexibility in compliance.
- Certainty of the emissions outcome – A cap-and-trade system can be designed to attain an emissions objective with certainty.

There are also several disadvantages of the use of emissions trading systems, including:

- The creation of "hotspots" - Emissions trading programs can result in the creation of "hot spots", where emitters in an area purchase credits rather than reducing their emissions, leading to deteriorating air quality in certain areas. For pollutants that affect regional air quality these issues can be alleviated by restricting trading within a particular air shed. However for pollutants that damage the local environment this issue makes emissions trading inappropriate.
- Volatile emissions prices – Emissions prices in the permit market can vary creating economic uncertainty for emitters. This volatility may result in a need for caps to be adjusted to ensure the desired price arises in the market-place.
- Difficulties in developing an appropriate market – An effective emissions trading system relies on a price arising from a market for emissions permits or credits, if there are too few participants in the system this market may not arise negating the benefits of the system.

5.2.1 Case Study: The US Acid Rain Program

In 1974, the U.S. Environmental Protection Agency (EPA) began implementing emissions trading programs to improve local air quality and control the levels of CO, SO_2, particulates and NO_x.[23] The first emissions trades occurred in the 1970s under a program commonly known as the "bubble policy". Under this policy firms were able to control the mix of emissions within the bubble (a number of sources or smokestacks) as long as the overall reduction requirements were satisfied.[24]

In 1990, the Clean Air Act Amendments offered an opportunity to innovate and evolve existing trading programs and regulations. The most popular innovation has been the SO_2 trading program or "Acid Rain Program" which was applied to United States' largest electrical power producers. The SO_2 trading program allocates a fixed number of permits to industry, and companies are required to surrender one permit for each ton of SO_2 emitted by their plants. A main element of the Acid Rain Program is the annual cap on average aggregate emissions. In this cap-and trade system, the emissions are fixed and the permit prices fluctuate. Companies are also able to transfer allowances among facilities or

[23] Hahn, Robert and Gordon Hester. 1989. "Where Did All the Markets Go - An Analysis of EPA's Emissions Trading Program." Yale Journal on Regulation.
[24] Burtraw, Dallas and Sarah Jo Szambelan. 2009. "U.S. Emissions Trading Markets for SO_2 and NO_x." Resources for the Future. Available at: http://www.rff.org/documents/RFF-DP-09-40.pdf.

to other firms and to bank their allowance permits for use in future years. Since emission banking is permitted under the Acid Rain Program, aggregate industry emissions must be equal to or less than the number of permits allocated for the year plus any surplus accrued from previous years.

The EPA set the cap for the SO_2 Trading Program at 8.95 million tons of SO_2 per year. Reductions to achieve the 8.95 million ton cap took place in two phases. Phase I began in 1995 and affected the 110 most emission-intensive coal-fired electricity generating facilities. Phase II, which started in 2000, covered coal-fired electricity generating facilities with a generating capacity greater than 25 MW.[25]

The Acid Rain Program is generally considered to be highly successful relative to traditional command and control regulations. By 2000, total SO_2 emissions were almost 40 per cent below 1980 levels.[26] Studies also found that the program may have resulted in cost savings of 43 to 55 per cent, versus a traditional command and control approach.[27]

The US also has a number of emissions trading systems to address regional air quality problems. For example, in 1994, the Regional Clean Air Incentives Market (RECLAIM) system was put in place to manage NO_x and SO_x emissions from a number of large industrial emission sources in the Los Angeles area. The system is divided into two zones and trading is restricted between zones to ensure trades don't contribute to increased downwind pollution.[28]

The Canadian Experience

There are two notable air pollution emissions trading systems that have been developed in Canada. In 2006, Alberta Environment implemented an emissions trading system to manage NO_x and SO_2 emissions from thermal generation power plants. The system complements the Province's regulatory improvement requirements outlined in each facilities approval by providing flexibility in the time period before physical requirements must be met. The system was not put in place to address any particular air quality problem but rather to enable regulated facilities to meet future regulatory requirements in the most cost-effective manner possible. The majority of the reductions from this trading program and regulated emission performance requirement are expected to after 2020. Therefore, it is difficult to assess the costs, benefits and effectiveness of the program at this time. [29]

In 2001, the Government of Ontario established a cap-and-trade emissions trading system for nitrogen oxides (NO_x) and sulphur dioxide (SO_2). The system currently requires electricity, iron and steel, cement, petroleum refining, pulp and paper, glass and carbon

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[25] Ibid

[26] Burtraw, Dallas and Sarah Jo Szambelan. 2009. "U.S. Emissions Trading Markets for SO_2 and NO_x. " Resources for the Future. Available at: http://www.rff.org/documents/RFF-DP-09-40.pdf.

[27] Ibid.

[28] U.S. Environmental Protection Agency . 2006. "An Overview of the Regional Clean Air Incentives Market (RECLAIM)." Available at: http://www.epa.gov/airmarkets/resource/docs/reclaimoverview.pdf.

[29] *An Emissions Management Framework for the Alberta Electricity Sector - Report to Stakeholders,* Prepared by the Clean Air Strategic Alliance Electricity Project Team, Clean air Strategic Alliance, 2003.

black industries to lower their emissions in stages. The system caps total emissions from these industries and allocates allowances to all major emitters which can be traded. In addition emissions reduction credits can be created by "non-capped" entities and sold to those entities in need of emissions reductions credits or permits to meet their obligations.[30] Ontario decreased its emissions of NO_x by 32 per cent between 1999 and 2008, and SO_2 by 54 per cent between 2000 and 2009.[31] Some, though not all, of these reductions are attributable to the existence of the trading program; other initiatives, such as the phase out of coal-fired power plants, and reductions from vehicular emissions resulting from the phase in of new vehicles with lower emissions, have also contributed.[32]

The case studies above highlight that emissions trading systems can be designed in many different ways. It is therefore important for policy-makers to consider the finer aspects (including intent, structure, coverage, the allocation of permits) of a system's design and its implementation.

5.3 Emissions Charges

An emissions charge is a payment or fee that is based on the quantity of pollutants that are released into the environment. Based on the value of the emissions charge, regulated parties self-determine if it is more cost effective to pay the emissions charge, install abatement control technologies, or decrease their output to reduce their emissions and thus avoid the charge.

Emissions charge programs do not on their own limit emissions. They simply impose a direct cost upon regulated parties to internalize the social costs of their air pollution in an effort to incent emission reductions. Therefore, emissions charge systems require government agencies to appropriately set the value of the emissions charge to ensure that the collective regulated parties optimize their emissions performance to a level that assures air quality outcomes are met. It is important to note that the price of the charge can be designed to escalate if an individual facility or collective number of facilities exceeds a pre-defined emissions threshold.

There are both strengths and weaknesses associated with the use of emission charges to manage industrial air emissions.

Key advantages of an emissions charge include:

- Internalising costs – In an emissions charge system polluters face a price on all emissions released, thereby internalizing the costs of their pollution.

[30] Emissions Trading Fact Sheet, Ontarion Ministry of the Environment, May 11th, 2005, available at http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/std01_079108.pdf
[31] Ontario Ministry of the Environment. 2009. "Air Quality in Ontario: 2009 Report." Available at: http://www.ene.gov.on.ca/stdprodconsume/groups/lr/@ene/@resources/documents/resource/stdprod_081228.pdf
[32] Ibid

- Flexibility – Under an emissions charge system regulated entities can choose the most effective means to reduce emissions, thereby providing flexibility in compliance.
- Cost-effectiveness – By providing flexibility emitters can seek out the most cost-effective means to achieve emissions reductions, thereby providing an economically efficient means of achieving an environmental outcome.
- Price certainty – In an emissions charge system an emissions price is set by the government, providing regulated entities with a degree of certainty over compliance costs.
- Simplicity – Emissions charges can be relatively simple to design and implement.

The disadvantages of emissions pricing systems include:

- Emissions uncertainty – In an emissions charge the reduction level results from the imposition of the price, as a result the emissions reductions achieved will be uncertain, which may require the price to be adjusted or for the system to be supplemented by regulatory elements, to ensure the appropriate outcome is met.
- Perceptions - Emissions charge systems are often perceived to be a government "tax grab" and as a result can face political opposition.

5.3.1 Case Study: The Swedish NO_x Charge

A number of European countries have imposed systems of emissions charges to manage air quality. In 1992 Sweden imposed a NO_x charge on energy producers, pulp and paper mills, food, manufacturing and incineration facilities that have an electrical generating capacity greater than 10 megawatts and produce over 50 gigawatt hours of power. When the program was implemented the charge was valued at approximately CAD $6000/t NO_x and was applied to approximately 120 facilities.[33] This price is very high when compared to for example NO_x permits prices in the US programs which are usually in the hundreds of dollars, although they can be higher.[34]

The Swedish NO_x charge was unique because it combined the charge with a refund system. Under this system all funds collected by the charge, with the exception of a small administrative charge, were refunded to those that paid the charge on the basis of energy input. In this way those emitters with above average emissions intensities would see a net cost, but those with below average emissions intensity could actually benefit from the charge. As a result, the high level of the charge could be imposed without creating a high cost burden for the industry as a whole and consequently limiting any potential negative trade and competitiveness related impacts. This feature of the system encourages targeted facilities to reduce their emissions per unit of energy significantly. The system has proven

[33] The charge has remained constant in nominal terms since its introduction.
[34] Sterner, Thomas and Lena Hoglund Isaksson. 2006. "Refunded emission payments theory, distribution of costs, and Swedish experience of NOx abatement." Ecological Economics 57, pages 100-102.

successful, resulting in mean emissions rates decreasing by 40 per cent over the period from 1992 to 2000.[35]

5.3.2 Case Study: French Emissions Charges

The French emissions charge provides a second example of innovative design of an emissions charge. France introduced an SO_2 emissions charge in 1985 and a NO_x charge in 1990. French law requires all large combustion facilities to remit the charge. Approximately 75 per cent of the funds collected are rebated to those that paid the charge based on abatement activities pursued by the firms, while the remaining 25 per cent is invested in surveillance activities. Subsidies were granted as a percentage of the capital cost of emission reductions according to the innovative character of the investment:

- 15 per cent for standard technologies;
- 25 per cent for innovative technologies; and,
- 35 per cent for very innovative technologies.[36]

6. Assessing Emissions Management Options for Canada

Based on the review of each management option presented, one may conclude that there is an opportunity to enhance the effectiveness, fairness and efficiency of the current model. Command and control systems can be effective but they are administratively onerous and may not be the most cost effective mechanism to achieve emissions reduction goals. Due to the scope of future reductions that will be necessary to bring national ambient concentrations below the CWS and to continue to improve air quality, in particular for non-threshold substances such as PM, it may be important to seek the most cost effective mechanisms to ensure these reductions occur.

Emissions trading can in theory provide a more cost-effective means to achieve a given emissions reduction goal. However given the variability in levels of air quality across the country, it is important that any emissions trading systems in place in Canada be designed to address the air quality issues in specific regions. In addition, in order for an emissions trading system to be effective there needs to be sufficient emitters in the system to create a market place for emissions. That is, emissions trading systems are designed such that an emissions price arises through a competitive market for emissions permits, this market will only arise if there are sufficient different players that no one buyer or seller can exert significant influence of the price of permits. Compared to the United States, Canada is not a large country and many areas where air quality is of concern may not have a sufficient number of large emitters to make a regional air emissions market feasible. As a result,

[35] Ibid.
[37] Supra note 28, pg. 100

while effective in theory, emissions trading systems may not provide the appropriate economic instrument to manage regional air quality in all parts of Canada.

An emissions charge system could be used to manage industrial air emissions in a cost-effective manner. Emissions charges have the advantage that they do not rely on having a large number of emitters in a region to ensure an emissions price arises, as a result an emissions charge can be used to manage regional emissions regardless of the number of emitters to be addressed in a particular region. Emissions charges are also administratively simple and straightforward to design.

Nevertheless, there are some disadvantages associated with emissions charges as a tool to manage industrial air emissions. The main disadvantage being they are frequently perceived as a new tax. However, if a system were to be designed with a revenue recycling mechanism, similar to the Swedish NO_x example, this issue can be overcome. Such a system can improve the palatability of the charge by reducing the total cost compliance for regulated facilities, going a long way to making emissions charges more politically acceptable in Canada.

Given these attributes and the potential applicability for such a system in the Canadian context the following section details an emissions charge proposal.

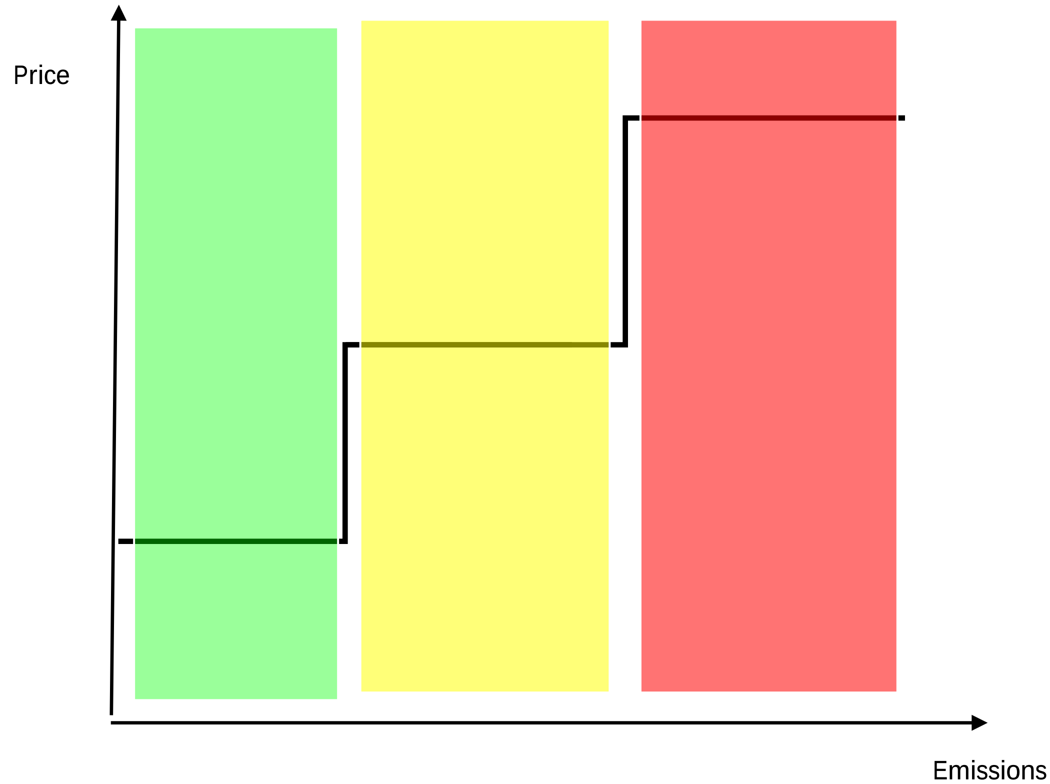
7. Policy Proposal: A System of Emissions Charges for Canada

Based on the review above, it is evident that there is merit in further exploring the appropriateness of an emissions charge systems for managing industrial air emissions in Canada. However, there are several important considerations when designing a system of emissions charges, specifically: how the charge will be set, whether the system of levying and recycling the charge should vary between NO_x and SO_2, and whether a regulatory role beyond imposing the charge may be necessary.

7.1 Setting the Charge

In general, emissions charges should be set at or slightly above the marginal cost of abatement to achieve the desired emissions reduction in order to encourage those with marginal costs of abatement below the rate to reduce emissions and those with higher costs to pay the charge. However, different levels of control are required to manage emissions such that desired air quality end-points are achieved. A graduated charge would be needed to ensure the charge drives the level of control required in areas with different air quality issues. For example a schedule of charges could be introduced where the charge escalates based on the total emissions or a region's air quality, as illustrated in Figure 2 below.

Figure 2. Taxation Levels in Areas with Different Air Quality Issues



7.2 NOx Charges

Determining the appropriate means of calculating the charge is another critical system design feature. Some environmental charges, such as carbon charges, can be levied on the carbon content of fuels because there is a direct relationship between the carbon content of fuels and the CO_2 emissions that result when the fuel is burned. NO_x charges, however, must be imposed on emissions rather than on fuel, as NO_x formation is virtually independent of the nitrogen content of fuels. These emissions are mainly due to a chemical reaction in the combustion chamber between nitrogen and oxygen in the air, and there is a highly non-linear relationship between temperature, other combustion parameters and the formation of NO_x.[37]. As a result fuel based charges are not appropriate for NO_x, and a NO_x charge would need to be levied on emissions of industrial facilities.

Revenue recycling, as in the Swedish example, is an effective way to minimize adverse cost impacts of emissions charges while ensuring the price signal is still applied to the emitters. By recycling revenue, emitters respond to the price signal in order to reduce payments or receive a benefit from the recycling system. However, the system as a whole sees no net cost with the exception of the cost of abatement since the revenue from the charge is

[37] Supra note 28, pg. 100

recycled to the industry. This can improve the political palatability of the system while ensuring its effectiveness is not diminished.

In the Swedish system, revenue is rebated based on the energy output of firms, that is, the facilities performance in relation to the average emissions per gigajoule. This can be effective as the majority of NO_x emissions arise from stationary combustion, and a charge can be consistently collected and rebated covering most of the emissions of concern.

7.3 SO2 Charges

SO_2 emissions provide a different challenge. Unlike NO_x emissions, some SO_2 emissions are directly related to the sulphur content of fuels. As a result, for SO_2 emissions that result from combustion, charges can in theory be levied either on the sulphur content of fuels or emissions. However, where there are industrial processes that emit SO_2 that is unrelated to fuel combustion, an emissions based charge may be necessary. In addition, high sulphur content fuels like coal can be cleaned, resulting in emissions that are unrelated to the sulphur content of the fuels, again warranting an emissions rather than a fuel based charge.

For SO_2, refunding on the basis of output may not be as simple as for NO_x. Where SO_2 emissions result from the combustion of fuels, revenue can be recycled on an output basis, and in this case the recycling will drive both a shift to lower sulphur fuels and investment in emissions control technology. However, where emissions result from industrial processes, for example in the gas processing industry, an analogous metric to energy output would need to be determined for that particular sector.

An alternative system to output-based recycling could be a system similar to the French revenue recycling system, where revenue is rebated based on abatement technology. Rebates are based on the degree of action being taken, and as such it encourages abatement. In addition, like the French system, greater rebates could be provided for more innovative technologies to help to encourage technology development.

7.4 Regulatory Roles in an Emissions Charge System

Emissions charges have the capacity to manage air pollution at the regional level effectively. However the implementation of an emissions charge system would not completely negate the need for a regulatory role for governments in managing air quality.

One important concern with an emissions charge system to manage air pollution at a regional level is how a charge can deal with the situation where an airshed is “full”. That is, an emissions charge can be designed to escalate to drive greater emissions reductions as emissions rise in a region, however a point may arrive when new emitters cannot be accommodated in an airshed. At this point the regulator may still have a role to play in ensuring new facilities are only licensed in areas where the airshed can support the additional emissions.

In addition, Canadians, regardless of the air quality in their regions have some basic expectations of facilities. Specifically, when a new facility is constructed it is expected to employ modern technology, and as such meet some minimum level of performance. In addition old facilities will be expected to shut down or upgrade technology, even if they can afford to pay the carbon price in a given area. This points to a remaining basic role for regulators even under an emissions charge system, to ensure facilities meet some minimum level of emissions performance. This type of mechanism is incorporated in Canada's proposed CAMS system through the BLIERs and provides a useful compliment to an emissions charge system.

8. Conclusion

There are a number of mechanisms that governments can choose from to manage air pollution in Canada and there is plenty of experience globally with these mechanisms to provide guidance for Canada. Command and control mechanisms may be necessary for some pollutants, such as VOCs and PM, due to human health considerations; however they may be an overly expensive and administratively burdensome means of addressing the regional impacts of NO_x and SO_2 emissions. Emissions pricing systems, such as cap-and-trade systems or emissions charges, potentially offer a more economically efficient mechanism for achieving emissions reduction levels. While cap-and-trade systems accomplish the desired economic efficiency they may not be able to be effectively employed in all parts of Canada. Emissions charges may provide a means to apply an economically efficient outcome in an administratively simple manner that is applicable across the country. In addition, European experience with revenue recycling can significantly reduce the costs on emitters of imposing emissions charges, thus increasing its political palatability.

If emissions charges are pursued in Canada further work would need to be done to explore design elements. Clear assessments of abatement costs would be needed to determine the levels of the charges including an understanding of how abatement costs vary across industry and regions of the country. In addition, an understanding of the sources of SO_2 would need to be gathered to determine if charges should be applied on emissions rather than on the sulphur content of fuel. Precise metrics for recycling, including determining whether output, an analogous metric to output, or abatement technology would be the most effective means to recycle revenue would need to be developed. Finally the role of regulators in the imposition of an emissions charge system may need to be explored to ensure the effectiveness of such a system.

While there is much further work to be done, this work may be less burdensome than what would be needed to enact cap-and-trade or command and control systems, and as a result designing emissions charge systems in Canada warrants a closer look.