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A New Annex to the Canada-US Air Quality Agreement

Border Policy Research Institute

BORDER POLICY RESEARCH INSTITUTE
WESTERN WASHINGTON UNIVERSITY

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Introduction. Canada and the U.S. will soon begin negotiating the terms of an annex to the Canada – U.S. Air Quality Agreement. The annex will pertain to a type of air pollution known as *particulate matter*, colloquially referred to as PM. This article discusses the form of the Canada – U.S. Air Quality Agreement, the general nature of PM pollution, the transboundary aspects of PM pollution, and the regulatory context pertaining to PM within each nation. The article concludes with a discussion of the outcomes likely to be embodied within the upcoming annex to the Agreement. We judge that the annex is likely to be descriptive of the individual domestic initiatives already pursued by the two nations, rather than a document that establishes groundbreaking binational policy actions.

Form of the Agreement. The Agreement was adopted in 1991 in order to establish "a practical and effective instrument to address shared concerns regarding transboundary air pollution."[1] Adoption of the Agreement occurred after a decade of bilateral discussions concerning the issue of acid rain; and the first annex of the Agreement, adopted simultaneously with the main body, identifies standards pertaining to sulfur dioxide (SO_2) and nitrogen oxides (NO_x), the precursor pollutants largely responsible for the acidification of rainfall. The Agreement establishes the following basic framework:

- The main body contains generic provisions concerning the nature and method of cooperation between the two nations. Standards related to specific pollutants are established within the Agreement's annexes.
- The Agreement is intended to address pollutants emitted in one nation that might "endanger human health, harm living resources and ecosystems and material property and impair or interfere with amenities and other legitimate uses of the environment" in the neighboring nation. Pollutants that have effects of a "global nature" are excluded from the Agreement.
- A bilateral Air Quality Committee coordinates implementation of the Agreement. The Committee must prepare biennial reports upon progress achieved pursuant to the Agreement.[2] The formation of topic-specific subcommittees is authorized. The Agreement itself is subject to review by Canada and the U.S. at five-year intervals.
- The International Joint Commission (IJC), a longstanding binational body that focuses upon boundary waters, is used as the agency for dissemination of reports and for solicitation of public feedback upon those reports. The IJC is also one forum available for resolution of disputes pertaining to the Agreement.
- Specific standards and programs enacted in annexes do not supersede the powers of sovereign entities. Implementation does not occur unless nations, states, and provinces enact appropriate laws and provide necessary funding.
- Each party is obligated to provide notice of new proposals/activities within its jurisdiction that might have the effect of polluting the neighboring nation. Each party has the opportunity to provide comments in response to such a notice. The parties seek to avoid or mitigate new sources of transboundary pollution. Additionally, a party can request consultation with respect to a *pre-existing* source of pollution located in the neighboring nation.
- The parties agree to exchange monitoring data and to coordinate their technical activities and research.

Birth of the PM Annex. As noted above, the Agreement's first annex dealt with SO_2 and NO_x, the pollutants largely responsible for acid rain. By the mid-1990s, substantial progress in the reduction of SO_2 and NO_x had been achieved, and other pollutants were targeted for cooperative action. In 1997 a letter of intent was signed that identified a course of action related to both PM and ozone, with ozone slated for earlier action. Following three years of assessment and negotiation, an ozone annex to the Agreement was adopted in 2000, and attention turned to PM. By late 2004, Environment Canada and the EPA completed a joint analysis of PM pollution and published the *Transboundary PM Science Assessment*,[3] which is specifically intended to support the negotiation of a PM annex. In April 2007 the two nations issued a joint statement that negotiation of a PM annex would begin, with the aim of completing negotiations by late 2008.[4]

It is important to understand how *international* commitments relate to a nation's *domestic* initiatives. An international commitment is typically made only after a nation's domestic program is underway, so that the international commitment does not reach beyond what can be durably supported by that nation (i.e., the program must garner political support and withstand legal challenge). The timeline of PM-related actions that Canada and the U.S. have each pursued serves to illustrate this point. As seen in Figure 1, each nation has policies and programs in place, with

some having been in place for many years. The decision to now establish an international commitment is made possible by the well-developed internal policies enacted within each nation, together with the well-understood nature of the issue.

PM Pollution. Some background information related to particulate matter (PM) is warranted. PM refers to particles capable of being suspended and transported within the atmosphere. The particles may be either solid or liquid and may be of a variety of sizes. Regulatory attention is focused upon particles with a diameter of less than 10 micrometers (10 um), because such particles can be inhaled into the lungs, evading the filtering mechanisms present in the upper respiratory tract. The abbreviation "PM_{10}" is used to refer to particles less than 10 um in diameter. Over time, awareness has grown about the severity of the health effects associated with differing sizes of PM_{10}, and agencies therefore now separately regulate $PM_{2.5}$ (PM with a diameter of less than 2.5 um), which can lodge deeply within the lungs and, in some instances, move from the lungs into the bloodstream. $PM_{2.5}$ is also referred to as *fine* particles, with *coarse* thus referring to the portion of PM_{10} that is larger than $PM_{2.5}$. As a visualization aid, a human hair has a diameter of about 70 um, so seven jumbo particles of PM_{10} (or 28 of $PM_{2.5}$) set side-by-side would span the width of a hair.

PM comes into existence in two ways. *Secondary* PM forms as a result of chemical reactions between precursor gases that have been emitted to the atmosphere, typically as byproducts of combustion. Secondary PM constitutes the bulk of *fine* particle pollution (i.e., $PM_{2.5}$). In contrast, *primary* PM is material that is directly emitted to the atmosphere, corresponding to our common perception of solid particles. While some primary PM is $PM_{2.5}$ (e.g., the smallest soot particles), much primary PM is coarse particles generated by physical processes such as grinding and crushing. Windblown dust, road dust, and larger soot particles are other common kinds of primary PM, mostly falling within the coarse size range.

Coarse PM settles out of still air in a matter of hours, while $PM_{2.5}$ often remains suspended for days. Within that timespan, winds might move the pollution over a distance of hundreds of miles. Precipitation is the typical means by which $PM_{2.5}$ is removed from the atmosphere.

The issues of PM pollution and acid rain are interrelated. An engine or power plant that burns a "dirty" fuel (e.g., coal, diesel) and that lacks good emission controls will emit SO_2 and NOx in gaseous form. (Recall that SO_2 and NOx are the pollutants that were the subject of the initial annex of the Agreement.) Within the atmosphere, SO_2 and NOx undergo chemical reactions to create secondary $PM_{2.5}$ in the form of sulfate (SO_4) and nitrate (NO_3) droplets. Eventually, the SO_4 and NO_3 are removed from the atmosphere by precipitation, falling as rainwater that contains sulfuric and nitric acid. The actions taken to tackle acid rain, a pressing *environmental* issue in the 1970s and 1980s, therefore also served to reduce secondary $PM_{2.5}$ pollution. And as is later discussed, SO_2 and NOx remain the target of contemporary *health*-based efforts to reduce PM pollution—efforts from which environmental benefits will also ensue.

Figure 1. Timeline of Regulation of PM by Canada and the U.S.

1970 - U.S. amends the Clean Air Act to regulate TSP (total suspended particulate, which is particles smaller than 45 um). A maximum annual average of 75 ug/m³ is established, as well as a 24-hour maximum of 260 ug/m³.

1987 - U.S. adopts standards for PM_{10}. A maximum annual average of 50 ug/m³ is established, together with a 24-hour maximum of 150 ug/m³.

1997 - U.S. adopts standards for $PM_{2.5}$. A maximum annual average of 15 ug/m³ is established, together with a 24-hour maximum of 65 ug/m³.

1997 - Canada and the U.S. agree to address transboundary PM pollution at a future point.

2000 - Canada adopts a Canada Wide Standard for $PM_{2.5}$: a 24-hour maximum of 30 ug/m³.

2004 - Canada and the U.S. complete the *Transboundary PM Science Assessment.*

2006 - U.S. stiffens the standard for $PM_{2.5}$. The 24-hour maximum is reduced to 35 ug/m³.

2007 - Canada and the U.S. announce that negotiation of a PM annex will begin.

PM Standards. Figure 1 provides a timeline of federal regulatory actions taken by Canada and the U.S. with respect to PM, and Table 1 shows the current federal PM emission standards of each country. Air quality standards are in the form of a maximum allowable atmospheric *concentration* of a pollutant over a certain *averaging period.* The concentration is typically expressed in units of micrograms of pollutant per cubic meter of air (ug/m³), and averaging periods are designed to reflect what pollutant concentration is tolerable on a long-term basis (i.e., the *annual average* shown in Table 1) and what is tolerable dur-

Table 1. Current U.S. and Canadian Federal Standards Related to PM

	PM_{10} (24-hour avg)	$PM_{2.5}$ (Annual avg)	$PM_{2.5}$ (24-hour avg)
U.S.	**150 ug/m³** < 1 exceedance per yr, 3-yr avg	**15 ug/m³** avg value over 3 yrs	**35 ug/m³** avg of 98th% values over 3 yrs
Canada	-	-	**30 ug/m³** avg of 98th% values over 3 yrs

ing an episode of acute exposure (i.e., the *24-hour averages*). A higher concentration is usually tolerable over a short period. A network of monitoring devices is deployed throughout the populated regions of Canada and the U.S., such that continuous pollutant concentration data is available in order to gauge regulatory compliance.

Figure 1 reveals regulators' evolving concern about the health hazards of PM. The *size* of particle targeted by the standards has shrunk (i.e., from 45 um in 1970 to 2.5 in 1997), and the allowable *concentration* has declined (i.e., 24-hour max. of 260 ug/m^3 in 1970 and of 30 in 2000). A large body of research confirms that fine PM is responsible for adverse cardio-pulmonary health effects for tens of thousands of North American residents.

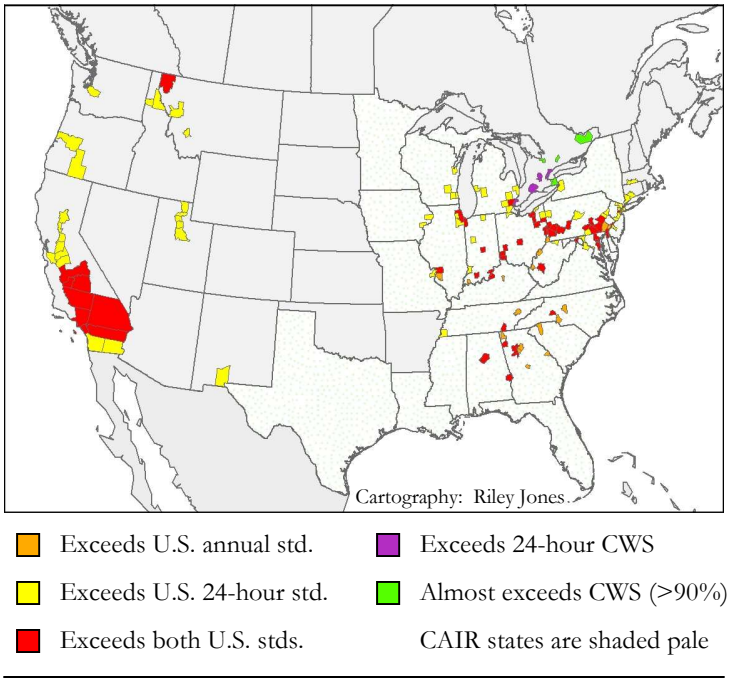
Figure 1 shows federal action in the U.S. decades prior to comparable action in Canada. This fact is not an indication of Canadian disinterest, but rather a reflection of the differing powers of national and sub-national governments within each country. In the U.S., authority for environmental regulation rests with the federal government, whereas similar authority in Canada rests with each province. Some provinces burdened by significant pollution launched PM programs long before the adoption of a Canada Wide Standard (CWS) in 2000. And a CWS itself differs from a "standard" as promulgated in the U.S. A CWS is a value jointly agreed to by the Canadian Council of Ministers of the Environment (i.e., the assembly of provincial environmental ministers) and is more akin to a shared objective than a binding standard. There is no legal consequence associated with failure to achieve the objective. In contrast, a U.S. standard is binding nationwide and is enforceable in federal courts.

State of the Air. Figure 2 shows the current situation with respect to exceedances of federal $PM_{2.5}$ standards in the U.S. and Canada. Exceedances south of the border are relative to the U.S. standards, and those north of the border are relative to the CWS, a slightly more stringent value. In each country, compliance is determined by use of monitoring data averaged over a three-year span, and the 2003 – 2005 timespan is depicted in the figure.

One must look closely to discern the problematic regions in Canada, all of which are located in the southern Ontario peninsula. Problem areas are obviously much more numerous in the U.S. In the East, exceedances tend to be related to coal-burning power plants and to industrial facilities. In California, urbanization in general (i.e., vehicles, industry) is the source of the problem. Forest fires and agricultural practices also can contribute significantly to PM pollution on an intermittent basis, with major fires in a single year capable of skewing the 3-year average and thereby causing an exceedance.

Recall that winds can transport $PM_{2.5}$ large distances, with no regard for jurisdictional boundaries. Pollution generated in the U.S. industrial heartland is a major factor contributing to the exceedances depicted in southern Ontario. In some instances, as much as 75 percent of the PM present in a city is due to distant pollution sources, and PM emitted in China has at times produced concentrations in North America as high as 20 ug/m^3 (i.e., 66 percent of the amount allowed in the CWS).

Figure 2. $PM_{2.5}$ Exceedances (2003—2005)[5]



Work in Progress. In both nations, the adoption of standards necessitates the instigation of programs designed to reduce pollution in geographic regions of concern. In the U.S., reductions in PM pollution are ongoing because of programs initiated over time in response to the 1990 amendments of the Clean Air Act:

- The acid rain program had the effect of reducing PM pollution, as noted earlier. This program established a "cap and trade" market for SO_2 and NOx emitted by existing power plants in certain eastern states, with tiered implementation deadlines in 1995 and 2000.
- The Clean Air Interstate Rule (CAIR) promulgated in 2005 further reduces the allowable cap on SO_2 and NOx emissions within 25 eastern states (identified by pale shading in Figure 2). Phased implementation will lead to full benefits by 2015.
- Automobile tailpipe emission standards became more stringent in 2004, and the allowable sulfur content of gasoline was greatly reduced in 2006.
- Allowable sulfur content in diesel fuel was greatly reduced in 2007, and diesel engine emission standards also became much more stringent.
- Emission standards applicable to non-road engines (both gas and diesel) are becoming more stringent over time, with deadlines for various kinds of engines scheduled throughout the period from 2000 to 2008.
- Standards applicable to newly constructed industrial facilities have been in effect since 1970, but older fa-

cilities historically enjoyed an exemption. A new program phases out the exemption, with old facilities made to install Best Available Retrofit Technology.

In most of Canada, as we have seen, air quality meets the CWS, so the emphasis has been upon "Keeping Clean Areas Clean" and upon "Continuous Improvement" of air quality. Typical provincial initiatives include working with individual industrial facilities to encourage voluntary installation of control technologies, and conducting public education regarding installation of clean woodstoves. Given the exceedances present within its jurisdiction, Ontario has opted for a regulatory framework that is less dependent upon voluntary action. In 2005, Ontario enacted a provincial regulation that will use a "cap and trade" scheme to reduce industrial SO_2 and NO_x emissions by 2015.

At the federal level, the Harper government initiated a Clean Air Regulatory Agenda (CARA) in late 2006.[6] The CARA proposes a shift toward regulation in lieu of voluntary action. A larger suite of Canada Wide Standards would be established (in cooperation with the provinces), and a national "cap and trade" program would be operated for SO_2, NO_x, PM, and a category of pollutants known as Volatile Organic Compounds (VOC). The government hopes to enact necessary federal legislation by 2010 and impose national caps by 2012. Over a span of two to four decades, the caps would be successively lowered. With respect to emissions generated by engines (on-road, off-road, marine, rail), the federal government has the ability to act unilaterally, and the CARA aims to impose emission standards equivalent to those in the U.S.

Negotiating the PM Annex. To date, the U.S. and Canada have engaged in internal consultations preparatory to the formal negotiation process. Although the U.S. Department of State and the Canadian Department of Foreign Affairs and International Trade will lead the actual negotiations, the nations' environmental agencies—the EPA and Environment Canada—will be heavily involved. The internal consultation process is intended to ensure that the lead agencies understand the positions of other federal agencies and of the states and provinces.

We can surmise what the annex will likely contain. The U.S. will commit to continued implementation of the programs listed above as "Work in Progress." Canada will itemize relevant programs already established by individual provinces (e.g., Ontario's 2005 regulation) and may also choose to identify programs contemplated in the CARA, with language carefully crafted to allow for the possibility that the CARA might not come to be.

With each nation moving toward "cap and trade" markets for SO_2 and NO_x, the notion of a continental marketplace seems most economically efficient. While such an initiative is beyond what the two nations can launch at this time, it is important that the annex not preclude the eventual implementation of such a marketplace.

The joint scientific studies make clear that cross-border PM transport is largely an eastern phenomenon, and that most flow is from the U.S. north into Canada. Given this reality, there is little motivation for individual provinces, particularly western ones, to establish commitments within the annex. (Similarly, some provinces might find little reason to support the CARA).

For a state or province pursuing a solution to a *local* transboundary PM problem, the forum associated with negotiation of this annex may be of little relevance. Because federal government is preeminent in the U.S. (with respect to environmental regulation), and because the EPA focuses upon "big picture" programs such as CAIR, an action sought by an individual state is not likely to find a voice at the negotiating table. As an aside, if a state and province wish to address such a problem via coordinated regional regulations, federal preeminence in the U.S. can *still* impede matters, because an individual state is typically reluctant to develop a regulation that goes beyond the federal umbrella, given the cost of developing and defending such a regulation. Regional transboundary initiatives of a *non*-regulatory nature are much simpler to deploy.

As noted at the outset, the upcoming PM annex to the Canada – U.S. Air Quality Agreement is likely to be an instrument descriptive of the individual domestic initiatives pursued by the two nations, rather than a groundbreaking policy document. This descriptive function is nevertheless important, in that it serves to underscore decades of cooperative effort to more closely align air policy. The vast improvement in air quality that has been achieved throughout the shared airshed is a testament to that cooperation, and without continued cooperation, desired future improvements will be difficult to achieve.

Endnotes.

1. See Articles I and II of the Canada–U.S. Air Quality Agreement, which is accessible at: www.epa.gov/airmarkets/progsregs/usca/agreement.html
2. The biennial progress reports are accessible at: www.epa.gov/airmarkets/progsregs/usca/index.htm
3. The *Canada–United States Transboundary Particulate Matter Science Assessment* was published December 2004 by the Canada–U.S. Air Quality Committee and is accessible at: www.epa.gov/airmarkets/progsregs/usca/docs/transboundary.pdf
4. The text of the joint statement is accessible at: www.epa.gov/airmarkets/progsregs/usca/jointstatement.html
5. Canadian data is based upon Figures 1 and 2 in the *Canada-wide Standards for Particulate Matter and Ozone: Five Year Report: 2000–2005*, published in November 2006 by the Canadian Council of Ministers of the Environment. The report is accessible at: www.ccme.ca/assets/pdf/pm_oz_2000_2005_rpt_e.pdf American data is based upon a map titled "Counties Exceeding Revised PM2.5 Standards" within a portfolio of maps/graphs published online by the EPA. The map is accessible at: www.epa.gov/air/particlepollution/pdfs/20061025_graphsmaps.pdf
6. Information regarding the Clean Air Regulatory Agenda can be accessed at: http://www.ec.gc.ca/cleanair-airpur/Clean_Air_Act-WS89430DC2-1_En.htm?