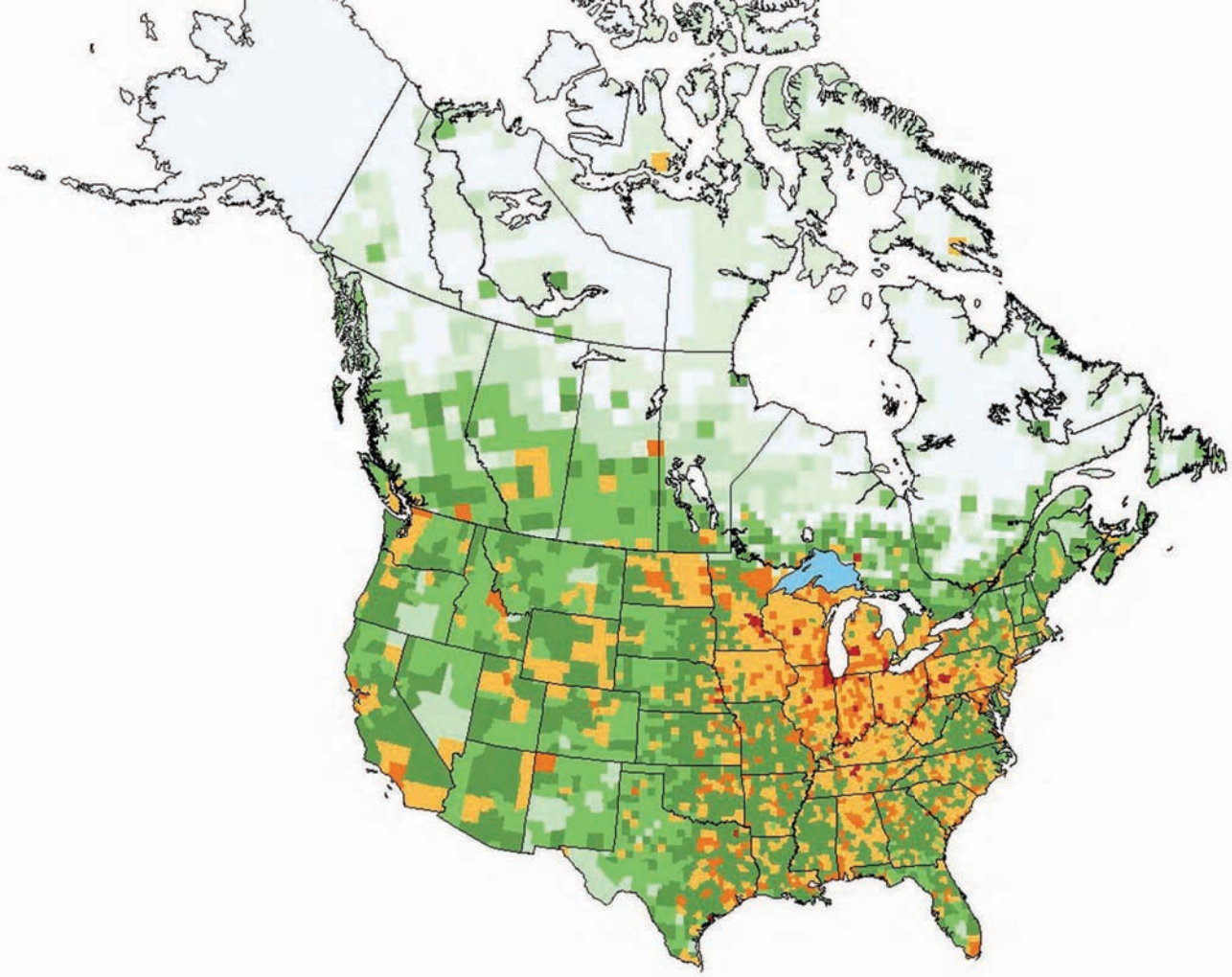

Second Summary of Critical Air Quality Issues in the Transboundary Region

2007

Report from the International Air Quality Advisory Board to the International Joint Commission

INTERNATIONAL JOINT COMMISSION
Canada and United States

COMMISSION MIXTE INTERNATIONALE
Canada et États-Unis

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Table of Contents

Context

In January 2004, the International Air Quality Advisory Board (IAQAB) submitted its first Summary of Critical Air Quality Issues in the Transboundary Region to the International Joint Commission (IJC). This is the second report to the IJC on critical air quality issues. It recognizes the considerable progress made by the two countries on the first set of issues and sets out a second set for the Commissioners' consideration.

Introduction

Statistics confirm that Canada and the United States have a serious energy addiction.

The availability of inexpensive energy has driven the technological advances that have made North American living standards among the highest in the world in spite of the vast geographical area and, particularly in the case of Canada, sparse population. The net result is that citizens of our two countries have the distinction of using more energy per person than anywhere else in the world. That fact, coupled with the evidence that production and use of energy are primary sources of air pollution, underlies the challenge we face in managing transboundary air quality today.

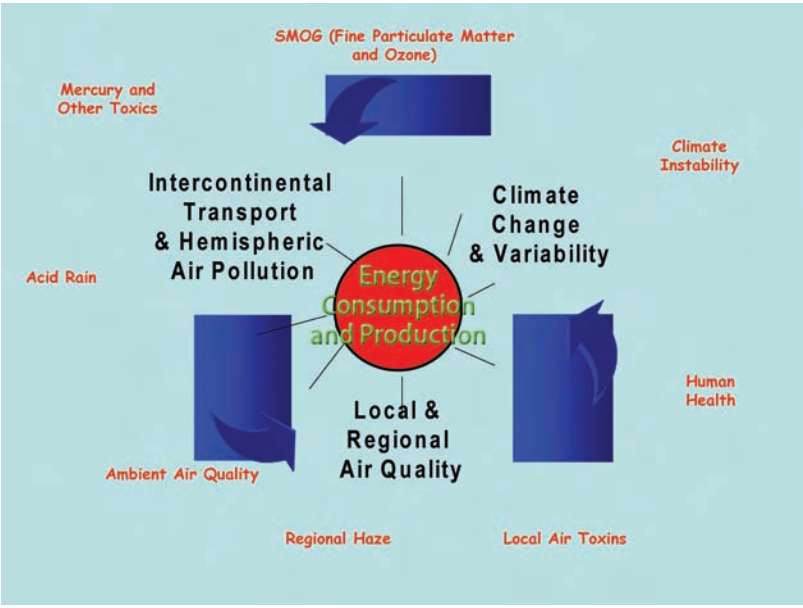

Figure 1. Relationship between energy consumption and production, air quality, human health and environmental quality

The diagram above illustrates the relationship between energy consumption and production, air quality, human health and environmental quality. Burning fossil fuels creates air pollution and greenhouse gases. And Canadians and Americans burn so much fossil fuel to operate industries, heat homes and drive vehicles, that we are releasing more greenhouse gases per capita than are being released in any other country in the OECD with the exception of tiny Luxembourg.[1]

As we address air quality issues in our U.S.-Canada region and do so in the face of our energy addiction, a complicating factor is the fact that our air pollution is not only being

carried through the atmosphere within our own region but also across the ocean to affect air quality in Europe. And while we work to deal with air pollution from our energy sector, pollution from Asian countries like China and India is fast becoming a source of air quality and health concern in the United States and Canada as we understand more about atmospheric transport bringing their pollution into our airspace.

Figure 2 below is a sketch of the global pathways of intercontinental pollution transport from the various continents.[2] The transparent arrows show transport in the lower troposphere (below 3 km), whereas coloured arrows indicate transport in the middle and upper troposphere (above 3 km). The upper panel shows transport pathways in summer while the lower panel shows transport pathways in winter.

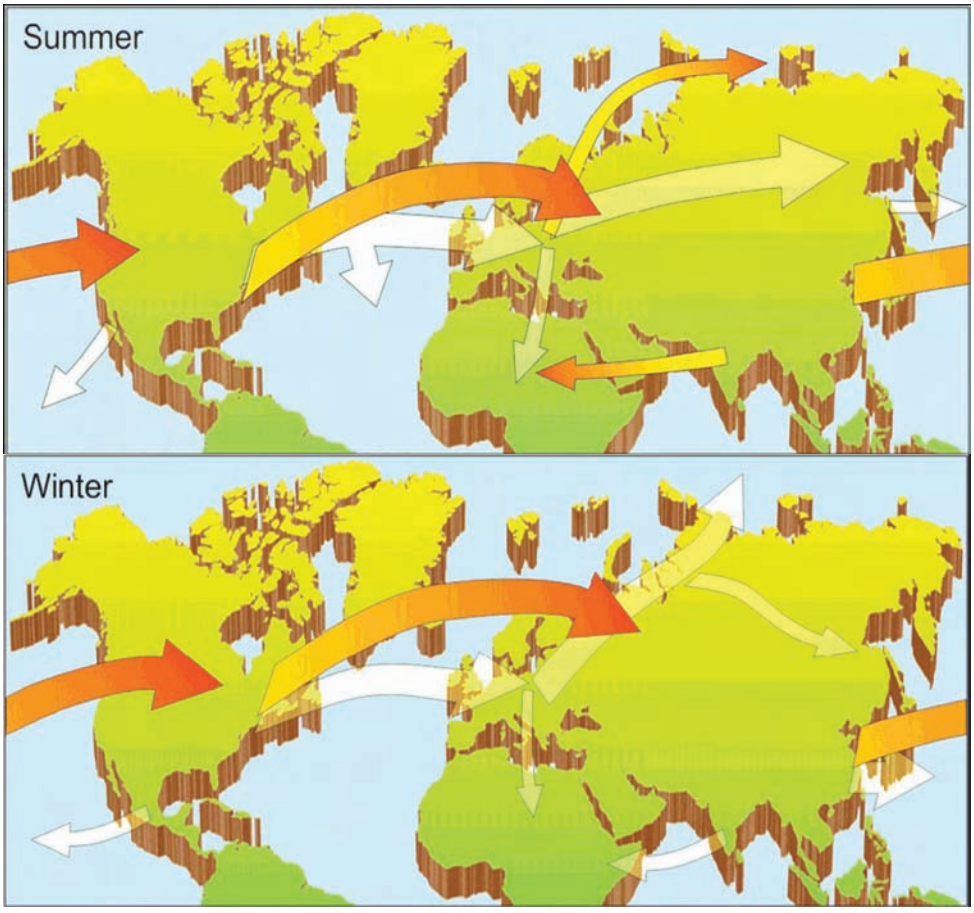

Figure 2. Pathways of intercontinental pollution in summer and winter relating to the transboundary region

This Second Summary of Critical Air Quality Issues in the Transboundary Region focuses on six key air quality issues. The International Air Quality Advisory Board has chosen these six issues because each represents an area of critical concern about which the International Joint Commission should be aware. For each of the six critical issues, the IAQAB has prepared advice and proposed recommendations for practical steps forward for the Commission to consider.

1.0 Accelerated energy development in Canada and the United States and cleaner air - can we have both?

1.1 The Story

While sources of oil in Middle Eastern OPEC countries are predicted to continue to meet global oil supply needs for some time to come, non-OPEC countries are expected to play an increasing role in the total global oil supply.

In the meetings surrounding the 2006 G8 Summit, Canada's Prime Minister announced that Canada is emerging as an energy superpower. The facts are that Canada produces more energy per capita than any other G7 country. It is the world's third largest producer of gas, seventh in oil production, the biggest hydroelectric generator, the largest supplier of uranium and has substantial coal exports. Alberta's oil sands are second only to the Saudi Arabian oil reservoirs as the world's largest oil reserve.

The relationship between the Canadian energy industry and the U.S. economy could not be closer. Energy security is a cornerstone of the U.S.-Canada-Mexico North American Free Trade Agreement. The United States imports more total petroleum from Canada than any other country followed by Saudi Arabia and Mexico[3].

Despite the magnitude of energy production in Canada, however, energy production in the United States is more than four times larger. According to the OECD, total energy production in 2003 in the U.S. was the highest among OECD countries at 1643 million tonnes oil equivalent (Mtoe) while Canada's was second highest at 385.3 Mtoe. In 2003, the United States produced three times Canada's production of natural gas, fourteen times more coal, more than twice Canada's oil and ten times the amount of nuclear energy.[4]

1.2 What Does It Mean?

Canada and the United States retain tremendous economic advantages due to the vast energy resources at their disposal. Private sector investment to exploit the energy resources fuels strong economies in both countries. According to Canada's National Energy Board (NEB), C$94billion in capital expenditures is expected to be spent on Canada's oil sands recovery projects during the decade between 2006 and 2015. During one week in July 2007 alone, announcements of new private sector investments in Alberta's oil sands amounted to $38 billion dollars. Shell Canada set out its plan to spend up to $27-billion on Canada's biggest oil sands upgrader. U.S. refiner Marathon Oil Corp. announced a $6.6-billion friendly

BIO-FUELS:
A love/hate relationship

The implications of biofuel policies require careful and complete scrutiny. The need to reduce greenhouse gas emissions and the advent of relatively high gasoline prices has resulted in the active promotion of alternative renewable fossil fuels, such as biodiesel and ethanol as attractive options or supplements for transportation fuels, without a full consideration or disclosure of the consequences of such actions.

The Canadian and U.S. governments are investing in biofuel production, as are state/provinces and local units of governments. Close to three billion litres of biofuel renewable fuels will be needed annually to meet the requirements of the new Canadian regulations alone. Notwithstanding that the use of biofuels can increase conventional health threatening air pollution, policies regarding the development of these fuels have significant implications for land, soil, food, and groundwater resources and policies. The focus to date has largely been on whether biofuels development consumes more energy than it would provide, without full consideration of the consequential affects. Policies to advance biofuels can apparently be in direct conflict with important public land, soil, water and food policies.

takeover bid for Western Oil Sands Incorporated. Suncor Energy filed a $4.4-billion regulatory strategy for the mining plan of its Voyageur South site. And there is downstream refinery capacity being built as well. In 2006, Shell Canada and BP announced new multi-billion dollar refineries near Sarnia, Ontario and Whiting, Indiana that will upgrade synthetic oil from the oil sands projects in Alberta.

While the economic benefits to the U.S. and Canada of the energy sector are tremendous, there are costs to the environment. Exploitation of the Alberta oil sands, for example, is said to be creating irreversible environmental damage in the province. The list of environmental concerns is long and includes unsustainable water allocation in a province that has been plagued by drought, acid rain downwind in Saskatchewan, regional haze and hazardous air pollution. Nuclear power as a possible replacement for natural gas to fuel oil sands production is a contentious issue. The oil sands are expected to become the single largest contributor to greenhouse gas emissions growth in Canada. More and more public calls are being heard for a review of the current rapid pace of development in the Alberta oil sands possibly through increased royalties.[5]

With the current level of investment in Canada and the U.S. to develop the vast energy resources, it goes without saying that all new operations and facilities should be built using, at a minimum, the most up-to-date "Best Available Technology" or BAT to ensure the smallest environmental footprint by energy development both now and into the future. And more could be achieved if governments and the private sector took the view that completely new ways should be found to address pollution when we develop our energy resources – ways that would go beyond "end-of-the-pipe" technological solutions and move toward innovation in pollution elimination.

There is little evidence, however, that governments are seriously committed to either – requiring BAT as a minimum so that new industry must be "built clean" using the technology that already exists or calling for the development of innovative ways to develop our energy resources – without the pollution that we have come to expect. The lack of serious commitment to action in a timetable that will bring real benefits now is surprising in light of the missed opportunities in pollution prevention and abatement technology research and development that it represents.

1.3 Recommendation

Accelerated energy development in Canada and the United States and cleaner air - can we have both?

Both accelerated energy development and cleaner air are possible. The Canadian and U.S. governments should encourage leadership in air quality research and development using practical measures such as tax incentives tied to emission reductions or by requiring a portion of every dollar spent by the private sector on energy exploitation and production be dedicated to innovation in air quality protection research and development.

For example, C$100 million in private sector funds set aside in Canada alone for innovative air quality protection research and development would represent less than 1/100th of one per cent of the capital that the National Energy Board predicts business will invest in the Canadian oil sands between 2006 and 2015.

Energy Conservation – is it worth it?

While states like Vermont have created Efficiency Vermont, the first statewide provider of energy efficiency services, and provinces like Ontario have created programs to encourage energy conservation like the Home Retrofit Program, the results of California's almost forty years of experience in energy conservation are revealing.[6]

Since 1974, California's per capita energy consumption has remained essentially constant, while overall U.S. consumption figures have jumped 50 per cent. Carbon dioxide emissions per capita in California have fallen by 30 per cent since 1975, while country wide levels have remained essentially level. Annually, the average Californian family spends an estimated $800 less on energy now than it would have spent without the efficiency improvements of the past 20 years.

California has achieved its energy conservation success mainly by charging consumers higher prices for its energy – energy that it derives from expensive renewables and natural gas. But another important factor in the success was a decision, in 1982, to adopt an innovative approach to energy utility regulation called decoupling. Decoupling set separate targets for utility revenue and electricity usage and allowed energy utility profits to grow while sales declined. The state power companies altered their focus away from sales of electricity. Now the state and the utilities spend $700 million a year to promote energy efficiency.

Finally, California's energy conservation has been achieved by state wide regulations and standards which required industry to innovate – and created whole new technologies that have been leading the country in energy-efficient building and appliance design. Through California's success in energy conservation has come energy efficient refrigerators, electronic ballasts that led to compact fluorescent lamps and a coating for glass that allows light in but blocks heat from either entering (during summer) or escaping (during winter).

2.0 As the locus of energy development moves westward, can we tackle western transboundary air quality concerns?

2.1 The Story

The vast reserves of energy resources that exist in the western regions of Canada and the United States are being developed. British Columbia has substantial coal deposits and sees the exploitation of coalbed methane deposits in its future. Saskatchewan is the largest natural gas producing province in Canada, the second largest oil producing province (after Alberta) and the world's largest producer and exporter of uranium. Alberta accounts for 80 per cent of the Western Canada Sedimentary Basin's ultimate recoverable resources of light oil, and for 40 per cent of the heavy oil. Alberta oil sands production is expected to triple from current levels to 2.9 million barrels of oil per day (MMBOPD) in 2020. Total crude production in Alberta will be about 3.2 MMBOPD by 2020, of which about 2.5 MMBOPD will likely be exported mainly to U.S. markets.[7]

In the U.S. West, coal is the most abundant fossil fuel. The Wyoming Powder River Basin provides about 38 per cent of all of the coal produced in the U.S. and coal production is expected to continue its upward trend to feed a growing nationwide demand for electricity. The West also contains the largest onshore oil-producing region in the contiguous United States. It has 41 per cent of the estimated proven and potential gas reserves in the United States and produces nearly 20 per cent of the nation's natural gas with a projected growth in production that is the largest increase in the United States.[8] Finally, Colorado, Wyoming, New Mexico, and Utah hold an estimated one-third to one-half of the total estimated recoverable coalbed methane reserves in the United States.

Increasing energy resource development coupled with population growth in the western provinces and states has resulted in concerns about air quality at the local and regional scale. Transboundary air pollution is also emerging as an issue as the evidence of air pollution transport among western states and provinces grows.

A bilateral mechanism already exists through which to address western transboundary air pollution. In 1991, Canada and the United States signed an agreement to address transboundary air quality issues – the U.S.-Canada Air Quality Agreement.[9] Originally negotiated to address the acid rain problems in the east, the Agreement was amended in 2000 with an Ozone Annex[10] when scientific evidence demonstrated that ground-level ozone or summertime smog was a transboundary air quality issue of concern for the central and eastern states and provinces.

Under the auspices of the Agreement, transboundary issues in the west were put on the agenda in 2003 when a pilot project was announced in the Georgia Basin-Puget Sound of southern British Columbia and northern Washington State. A small transboundary airshed in which transboundary airflows are significant, air quality in the airshed is currently relatively "clean" but facing the prospect of deterioration as the area's population and economies grow. The pilot project completed the Georgia Basin-Puget Sound International Airshed Strategy[11] in 2005. The goal of the Strategy is prevention of air quality deterioration through a number of emission reduction initiatives in the areas of clean vehicles and fuels, agricultural emissions, marine vessel and port emissions, residential wood heating and the review of major new industrial sources of pollution.

The completion in 2005 of the Canada-U.S. Particulate Matter Science Assessment[12] was another important factor setting the groundwork for the future addition of western air quality issues to the Air Quality Agreement. Particulate matter or PM – a component of smog - is an important air quality concern in Canada and the United States. The emissions that combine to create PM are also involved in the creation of acid rain, ground-level ozone as well as regional haze or visibility problems such as those depicted in the photos of Killarney, Ontario below. According to the Canada-U.S. PM Science Assessment, transboundary PM is an issue of concern from one side of the country to the other.

Figure 3. Killarney Provincial Park, Killarney Ontario. The photo on the left was taken on September 13, 2005 during a regional air pollution event. At the time of this photograph, PM2.5 levels were measured as 38ug/m3 at a nearby monitor. The photo on the right was taken from the same location on September 20, 2006. When this photo was taken PM2.5 levels were very low, less than 2 ug/m3.'

Specific air quality issues in the west are already on the agenda. The Georgia Basin-Puget Sound transboundary region was highlighted in the Science Assessment as an area where action on both sides of the border is required to prevent air quality levels from deteriorating as population and economic growth increases. In the prairie or Rocky Mountain region, while PM levels continue to be low relative to levels in the east, the science assessment advised governments to monitor the region especially in relation to transboundary visibility or regional haze. The caution advised by the Science Assessment was interestingly bolstered by air quality modeling undertaken by another Canada-United States study carried out under the auspices of the Air Quality Agreement – the Canada-United States Emissions Cap and Trading Feasibility Study[13]. The air quality modeling performed for this study showed that visibility levels in the U.S. prairie states would likely improve if the western Canadian power plant emissions contributing to PM were reduced and capped.

2.2 What Does It Mean?

Transboundary air pollution issues in the western half of the Canada-U.S. transboundary region are emerging as concerns to be addressed. The U.S.–Canada Air Quality Agreement is a mechanism that has proven to be effective in remediation of transboundary air quality issues in the east. The 2006 Canada-United States Progress Report[14] outlines the emission reductions that have been achieved already in Canada and the U.S. to address transboundary acid rain and ozone and reviews the improvements in the environment that have resulted from the emission reductions.

On April 13, 2007, the U.S. and Canadian governments announced their intention to negotiate amendments to the Air Quality Agreement to address transboundary particulate matter. The negotiations to develop a PM Annex will provide an opportunity for the two governments to incorporate commitments in the Agreement that will reduce PM levels in the east where they are now a transboundary problem. The negotiations could also allow governments to incorporate unique western issues in the Agreement in a way that recognizes and deals with industrial pollution from the growing energy industry in the western provinces and states. For instance, the PM Annex could incorporate actions by governments to address emissions that are creating acid rain and regional haze in the western prairie region. Further, to build on the existing cooperation in the Georgia Basin-Puget Sound area, the Agreement could designate this particular region as a transboundary region under the Agreement along with commitments to control existing pollution from key sources such as ports and marine shipping and to prevent future air quality deterioration.

Air Quality Agreement – Leadership in Bilateral Cooperation

The United States-Canada Air Quality Agreement was negotiated and signed by President Reagan and Prime Minister Mulroney in 1991, signifying a bilateral desire to cooperate on transboundary air quality. Since then, the Agreement has provided the foundation and framework for practical and effective cooperation between the two countries.

The Agreement has resulted in improvements in air quality in both countries. Under the Agreement, ecosystem damage from acid rain has decreased substantially and with the amendment in 2000 of the Ozone Annex to the Agreement, summertime smog levels in eastern U.S. and Canada are declining as the targets and timelines for emissions reductions committed in the Agreement are met. A PM Annex, to be negotiated in the coming months, should add new emission reduction commitments that will improve PM levels in Canada and the U.S. and have the added benefit of further lessening damage from acid rain and summertime smog.

2.3 Recommendation

As the locus of energy development moves westward, can we tackle transboundary air quality concerns?

The United States-Canada Air Quality Agreement can address the emerging transboundary air quality issues in the west. Upcoming negotiations of a PM Annex should include the following: designate the Georgia Basin-Puget Sound as a transboundary area and commit to reducing emissions in key polluting sources such as marine ships and ports to prevent air quality deterioration; and address new emissions from western energy development by committing to actions that will reduce the emissions that create smog, acid rain, regional haze and other emerging western air quality issues.

3.0 Are governments doing enough to deal with increasing aviation and marine pollution along our coasts and in our cities?

3.1 The Story

In the first Critical Issues report, the IAQAB identified that further reductions in emissions from boats, ships and planes were needed. Then, as now, it was clear that as governments in North America and the European Union have moved to tighten emissions standards for new cars, trucks and small engines, other transportation sources not yet regulated to the same extent would become increasingly significant sources of pollution.

Marine Emissions

Fuel used in ocean going vessels has much higher sulphur content than the more strictly regulated gasoline and diesel fuels used in land-based vehicles. The International Maritime Organization (IMO) MARPOL Convention[15] sets the fuel standards for ocean going vessels and these standards are not stringent. The fact that ship emissions growth rates are faster than GDP[16] coupled with MARPOL's weak fuel standards means that pollution from commercial ships is expected to account for one-fifth of all diesel soot generated in 2020 in the U.S., making ships the second-largest source nationwide[17]. In the region around Vancouver, British Columbia, marine vessels are a large and growing source of smog forming emissions. Without action to reduce marine vessel emissions, marine vessels are forecast to exceed cars as the largest source of smog-forming contaminants in the Lower Fraser Valley after 2010.[18] In the Great Lakes, the aggregate air-quality effect from ship emissions needs further study. In certain instances the effect may be as significant as some large industrial sources, but different types of engines and fuels do have less environmental impacts.

Aviation Emissions

While estimates of the growth in emissions from air passenger and airfreight traffic vary, all sources agree that it has grown significantly. Most scientists believe that pollutants released by airplanes at high attitudes cause substantial damage to the atmosphere but aviation emissions are also an air quality concern at ground level. For example, it is estimated that 15 per cent of the traffic in the area of the Montréal–Pierre Elliott Trudeau International Airport, located in a busy suburb of Montréal, is airport related. In the United States, the number of aircraft take-offs and landings have grown from around 15 million in 1976 to almost 30 million in 2000 or about 105 per cent. While emissions from most source sectors are declining due to control programs, the growth in air travel and the continued lack of control programs for aircraft engines is resulting in increased pollution from airports.[19]

3.2 What Does It Mean?

While the U.S. and Canadian governments have the authority and do regulate engines and fuels for cars, trucks and other land-based vehicles, the reduction of emissions from aircraft and ships poses special challenges. Fuel standards are set internationally for aviation by the International Civil Aviation Organization (ICAO) and for ocean going vessels by the International Maritime Organization's MARPOL Convention. Engine standards are set through both international and domestic requirements. Independent action on fuel or engine standards applied within the territory of one national government would be difficult.

Despite the challenge of acting independently, voluntary measures between governments and the private sector are possible and may achieve some emission reductions. An example is the 2004 voluntary agreement between the Government of Canada and the Air Transport Association of Canada to reduce the growth of greenhouse gas emissions in Canada's aviation sector through energy efficiency improvements.

The problem of how to address the challenges of reducing ship emissions has been on U.S. and Canadian agendas for a number of years. To achieve reductions from ocean going vessels that are registered offshore requires working through the International Maritime Organization's MARPOL Convention. Annex VI of MARPOL includes provisions that allow special regions to be designated as Sulphur Oxide Emission Control Areas (SECAs) where all ships must use fuel that meets certain fuel standards. In 2002, the European Commission took advantage of the Annex VI SECA provisions and designated SECAs in a number of areas in the European region where air quality and acid rain are problems and where all ships are required to use lower sulphur fuels.

A two pronged approach is underway in the U.S. and Canada to address marine emissions. Using their own regulatory authorities, both Canada and the United States are regulating the levels of sulphur in non-road diesel fuel, which will lower emissions from marine vessels within the Great Lakes and in other near-coastal areas along the coasts of North America. The United States Environmental Protection Agency (EPA) has also announced proposed new federal emission standards for marine diesel engines in both ocean going vessels including container ships, tankers, bulk carriers and cruise ships as well as smaller engines used in recreational and small fishing boats, yachts, tugs and great lake freighters. The proposal aims to cut emissions that contribute to smog formation by as much as 90 per cent. However, ship emissions must also be addressed through the International Maritime Organization. A July 2007 proposal from the United States to the IMO would set new limits for pollutants from ships operating in certain areas, set new stringent standards for all engines in ocean going vessels and even tighter standards for engines operating in areas designated as SECAs where air quality is an issue of concern. In parallel, Canada and the U.S. are promulgating the domestic regulations necessary to allow them to officially sign onto or "ratify" Annex VI of MARPOL so that they will be able, as "Parties" to Annex VI, to submit proposals through MARPOL to establish SECAs for North America. To that end, the U.S. has given its consent to ratify Annex VI and is awaiting the passage of implementing legislation. In Canada, the Canada Shipping Act Regulations for the Prevention of

Pollution from Ships and for Dangerous Chemicals (SOR/2007-86) were amended in June 2007 to include the provisions for a future SECA.

Controlling emissions from aviation and marine fuels and engines is only part of the problem of emissions from these transportation sources. The operations at airports and ports themselves create substantial air pollution whose hazardous effects could be controlled. In airports, for instance, airplane operations while on the ground, emissions from ground support vehicles and pollution from traffic moving people and goods to and from the airport could be addressed using cost-effective, technically feasible means – if governments were so inclined. Where ports are concerned, similar action is possible. The operations at container terminals and of ships docked in port and the pollution created by trucks and other port related vehicles can all be addressed and emissions reduced.

Certain ports have already taken action. In May 2006, the Washington State ports of Seattle, Tacoma and British Columbia's Vancouver announced the Pacific Northwest Ports Clean Air Strategy. The Strategy aims to reduce, by 2010, particulate matter from ships at berth by 70 percent and from cargo handling equipment by 30 percent. The strategy, which includes long-term emission reduction goals for ships and cargo handling, will also address port-related emissions from train, truck and harbor craft activities. The focus of the emission reductions will be diesel emissions and greenhouse gases from the port activities and PM emissions from ships at berth and from cargo handling equipment. The Port of Los Angeles has created an air quality program that focuses on reducing emissions from container vessels docked at the Port of Los Angeles. Instead of running on diesel power while at berth, the ships are equipped to "plug in" to shore side electrical power which the Port provides.

3.3 Recommendations

Are governments doing enough to deal with increasing aviation and marine pollution along our coasts and in our cities?

The U.S. and Canadian governments should lead by example to reduce aviation and marine emissions by: ratifying Annex VI of the International Maritime Organization's MARPOL Convention as soon as possible and creating North American SECAs where ships would be required to meet stringent fuel and engine standards, committing to actions in the Canada-U.S. Air Quality Agreement that will reduce marine and aviation emissions at airports and ports and in the Great Lakes Region, and supporting actions by other levels of government to reduce air pollution at ports and airports including, for instance, shore-based power for ships in ports and other policies to incent sustainable practices in the Border Region.

Port of Los Angeles Shore-Based Power

Alternative Maritime Power (AMP)™, is a one-of-a-kind air quality program that focuses on reducing emissions from container vessels docked at the Port of Los Angeles. Instead of running on onboard diesel power while at berth, AMP-equipped ships "plug in" to shore side electrical power; literally an alternative power source for oceangoing vessels, for the entire time it takes to load and unload containers. Ships that use AMP™ eliminate an estimated 1 ton of smog pollutants per day in port as compared to ships that use conventional marine fuel.

4.0 If data are the currency of effective action, why are the nations' air quality information systems always the "poor cousins"?

4.1 The Story

Although rarely in the headlines, data on air quality are so important to achieving any kind of progress on air pollution that, as support for data collection diminishes in Canada and the United States, so does our ability to know what to do about air quality concerns or whether actions already taken have been successful.

Data on air quality are the underpinning of efficacious action. Examples abound in recent history of routine data gathering warning scientists of unexpected - and unintended - consequences of industrial products and processes. For example, finding the ozone hole was a surprise for the weather scientists who were carrying out routine monitoring of the upper atmosphere.

In Europe comprehensive monitoring systems are supported and used routinely as the basis for policy development. Asia is rapidly developing monitoring capacity. Governments are slowly developing the Global Earth Observation System of Systems (GEOSS) as recognition that an early warning system of monitoring is needed for the health of the planet.

The Canadian and U.S. monitoring systems developed to support research and assessment for acid rain, smog and visibility are the following.

1. Interagency Monitoring of Protected Visual Environments (IMPROVE). Located in 156 national parks and wilderness areas in the U.S., IMPROVE is the network that collects information about visibility, regional haze and aerosol conditions in parks and pristine areas. IMPROVE has been a key participant in visibility-related research and its extensive data set has allowed for analysis of trends in aerosol concentrations.

2. Clean Air Status and Trends Network (CASTNET).
   CASTNET, with over 80 sites in the U.S., is the primary source for data in the U.S. on dry acidic deposition of sulphur and nitrogen-containing chemicals and rural ground level ozone or summer-time smog. CASTNET is used in conjunction with other national monitoring networks to provide information for evaluating the effectiveness of national emission control strategies such as the Acid Rain Program and the Clean Air Interstate Rule.

3. National Atmospheric Deposition Program (NADP).
   NADP is the network devoted to precipitation monitoring sites with over 250 sites spanning the continental United States, Alaska, and Puerto Rico, and the Virgin Islands. The purpose of the network is to collect data on the chemistry of major ions containing sulphur, nitrogen,

and other chemicals in precipitation for monitoring of geographical and temporal long-term trends. NADP Mercury Deposition network also measures mercury in precipitation; efforts are underway to add measurements of various forms of mercury in air.

4. Canadian Air and Precipitation Monitoring Network (CAPMoN).
CAPMoN is a rural air quality monitoring network that focuses on the major ions primarily of sulphur and nitrogen in remote and pristine sties. There are currently 28 measurement sites in Canada and 1 in the U.S.A. The purpose of the CAPMoN network is to determine the spatial patterns and establish the temporal trends of atmospheric pollutants related to acid rain and smog, provide data for long-range transport model evaluations and effects research, and to study atmospheric processes.

These four networks are coupled with others whose main purpose is to provide governments and the public with information about air quality levels in relation to governmental air quality goals such as the Canada wide Standards for Ozone and Particulate Matter in Canada and the National Ambient Air Quality Standards (NAAQS) in the U.S.. The U.S. The Air Quality System[20] (AQS) database contains measurements of air pollutant concentrations in the 50 United States, plus the District of Columbia, Puerto Rico, and the Virgin Islands. The measurements include both criteria air pollutants and hazardous air pollutants. The Canadian National Air Pollution Surveillance (NAPS) Network[21] monitors both criteria air pollutants at 152 stations in 55 cities in ten provinces and two territories in addition to toxic air contaminants in 40 urban and rural locations in Canada.

Data monitoring networks in North America have traditionally focused on natural and anthropogenic "regional and local" issues such as forest fires, acid rain and smog – events and pollutants that were not recognized as being transported outside of the Canada-U.S. borders. With economic development in China, India and Southeast Asia and recognition that intercontinental and hemispheric transport is carrying natural material such as dust as well as hazardous substances, smog and acid rain from Asia to North America and from North America to Europe, the ability to understand, assess and monitor North American levels and trends in the air and the environment is crucial to air quality intervention.

4.2 What Does It Mean?

Over the past 25 years, support for the type of monitoring networks described above has dwindled. Generally, support has followed a pattern. An issue is asserted to be a major environmental problem and the lack of information needed to understand its nature, extent, and impact is decried. A program of monitoring and research is instituted to gather the knowledge needed to develop an appropriate policy response. A response is fashioned and implemented, and frequently a pledge is given to continue environmental monitoring to evaluate the effectiveness of the policy actions. However, the monitoring program associated with the issue enters an almost immediate decline as new issues are identified, and limited resources are demanded by other problems. In this phase, budget-driven changes such as temporary shutdowns, site moves or closures, changes in sampling intervals, and reductions in quality assurance and quality control diminish the value of the long-term data set due to overall loss of continuity in the historical record.

In terms of IMPROVE and CAPMoN, support has shifted with the political attention given to a particular environmental issue. Support for CASTNet and NADP in the U.S. was adequate during the years when acid rain was the main issue on the national environmental agenda. Once the focus of the federal agenda changed, however, support has slowly eroded with the consequences that field hardware and communications equipment at the monitoring stations are worn out and scientists are moving on to other fields.

The inefficiency of an approach that does not sustain support for monitoring imposes additional direct and hidden costs. The start-up and shutdown costs of designing and implementing networks are significant. A lack of coordination between existing and new monitoring efforts adds to the delays in addressing emerging issues and to the cost of generating the information required to develop sound policy. The value of an extensive time series record goes beyond the identification of a specific problem. Long-term time series permits verification that decisions are effective, solutions are indeed working and the ongoing costs and benefits of the given control program are assessed accurately. Finally, when there is insufficient monitoring information about what is actually in the atmosphere, policy advice must rely on models to predict what should be in the atmosphere – and models that are not grounded in good monitored data may not provide good advice.

When governmental support for a monitoring network falters, accountability reporting to the public is often the first to suffer. Without data, accountability reports cannot be provided. When Canada did not support the collection of information through its CAPMoN network on acid rain between 2000 and 2004, the maps included in the Canada-U.S. Air Quality Agreement Progress Report 2006 that were meant to report on the level of ecosystem damage in eastern North America were almost blank for the Canadian side of the border. According to the Progress Report, "… the data available for 2000–2004 in Canada were insufficient to permit interpolation and contouring."[22] The following Figures taken from the Progress Report show Canada's territory on the map filled in for 1990-1994 and almost blank for 2000-2004.

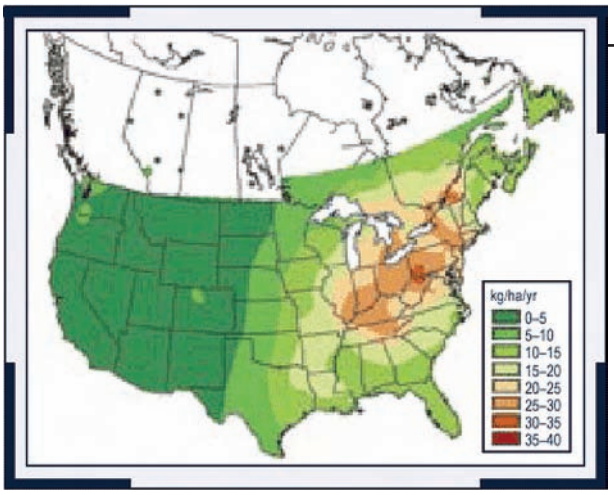

Figure 4. Mean sulphate wet deposition for 1990-1994, for comparison with Figure 5

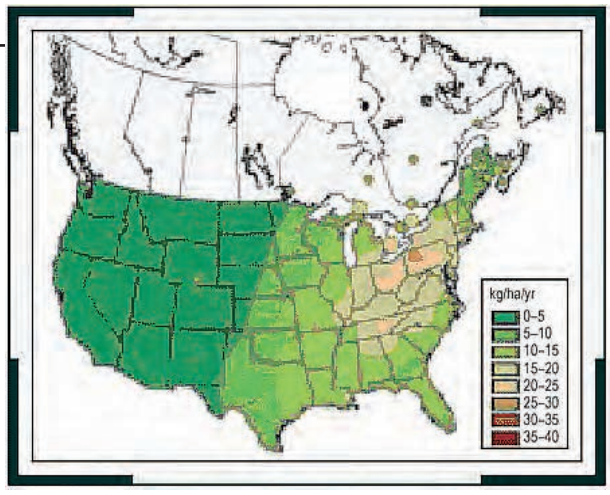

Figure 5. Mean sulphate wet deposition for 2000-2004

4.3 Recommendation

If data are the currency of effective action, why are the nations' air quality information systems always the "poor cousins"?

The Canadian and U.S. governments should support the collection of air quality data by maintaining stable funding and by providing opportunities to enhance networks in response to emerging issues.

The U.S. and Canadian governments are requested to brief the Commission on their programs and plans to ensure sustained adequate information for public accountability reporting on air quality and the environment.

The Canadian and U.S. governments should coordinate air quality monitoring, by implementing a user-driven GEOSS-linked model much like the Great Lakes Observing System.

Ammonia - an emerging issue

In some sensitive western North American mountain locations chemically reduced nitrogen (primarily ammonia and particulate ammonium) contributes as much as 50 per cent of the "total load" deposition of nitrogen. In the Midwest and prairies of the United States and Canada, reduced forms of nitrogen are the dominant forms deposited to forests and fields. The primary effects of the deposition are acidification of poorly buffered soils and "eutrophication" – over-fertilization – of coastal waters. Reduced nitrogen is also a key ingredient in particle matter pollution. In agricultural regions, oxidized forms of nitrogen from mobile emissions and power plants can combine with reduced nitrogen emitted from animal waste and fertilizer, resulting in the formation of smog and visibility degradation.

Emissions inventories for reduced nitrogen are inadequate because the Canadian National Pollutant Release Inventory (NPRI) and the U.S. Toxics Release Inventory (TRI) do not require the reporting of its emissions from farms, feedlots or industry (ex. fertilizer plants). Furthermore, there are few monitors across North America to determine the spatial variability of ammonia once it enters the atmosphere.

Reacting to over-fertilization of soil and water that occurred in large European regions, national governments evoked aggressive ammonia policy in the late 1990s, recognizing that to address this problem, ammonia emissions must be reduced. As a result, the science on agricultural sources of nitrogen is advanced and in the Netherlands, where the issue has been examined for several decades, the information database adequately supports the development of policies to effectively control agricultural sources of nitrogen.

In Canada and the United States, passive monitoring methods such as the Southern Ontario Ammonia Passive Sampler Survey could be adapted to measure forms of reduced nitrogen emitted from farms and feedlots at an adequate number of locations to elucidate emissions hot spots. Further measurements of "total deposition loads" of nitrogen to land and water, including nitrogen species in rain, snow, fog and cloudwater, as well as particulate and gaseous deposition, should also be supported at a limited number of locations to better benchmark the simpler passive monitor data.

While the spatial wet deposition of both oxidized and reduced forms of nitrogen is reasonably well understood, nitrogen deposition via dry deposition processes is less clear because North American filter-pack concentration measurements are insufficient in number, are not especially precise for measuring oxidized nitrogen chemical species, and do not capture ammonia. In addition, fiscal reality has diminished the number of dry deposition measurement locations in Canada and threatens to reduce U.S. measurement locations as well. Sufficient understanding of total deposited atmospheric nitrogen will require a program to measure all of the important chemical species of nitrogen at an adequate number of locations with appropriate temporal resolution for decades to come.

GLOS, IOOS and GEOSS Model for International Data Collection, Management and Use

More than 100 countries and organizations, including Canada and the U.S., are working together to create the Global Earth Observation System of Systems (GEOSS). The goal of GEOSS is to alert policy makers and managers throughout the planet of environmental and economic challenges using information that can be understood and is so well integrated that it is "borderless".

In the U.S., the ocean and coastal component of GEOSS is the Integrated Oceans Observing System (IOOS) of which the Great Lakes Observing System (GLOS) is a regional node. On the other side of the border, the Canadian Group on Earth Observations (CGEO) has been formed, led by Environmental Canada, the Canadian Space Agency and a host of other cooperating agencies. The IOOS societal goals are to wide-ranging and comprehensive including economic goals like safe and efficient maritime transportation and environmental results like preserving and restoring health ecosystems.

A novel approach has been used to achieve the goals of IOOS in the Great Lakes. Funded by grants from the U.S. National Oceanic & Atmospheric Administration and coordinated by the GLOS Regional Association, a nonprofit corporation led by a wide variety of stakeholders, including all levels of government, Native Americans, academic interests, industry and other information users, , the regional association has developed and adopted a diverse governance structure, assessed user needs and developed annual work plans and a five-year vision for observing system enhancements. Via its website, the system already provides current data and forecasts regarding Great Lakes water levels, surface temperature and weather – information that is critical to boating and shipping interests. Top user needs to be addressed in the future include water protection in southeast Michigan and remote sensing to support monitoring of nutrient and sediment loading.

Most recently, GLOS has focused on creating a regional data and communications system that includes a binational monitoring inventory, the geospatial maps developed by the IJC's Lake Ontario and St. Lawrence River Study, and air emissions datasets from the eight Great Lakes states and the province of Ontario.

Recommendation: The U.S. and Canadian governments should coordinate air quality monitoring in the boundary region, by implementing a user-driven GEOSS-linked model much like the Great Lakes Observing System.

5.0 Individual actions are critical where small-scale, scattered air pollution sources are concerned – can our governments adapt to be effective?

5.1 The Story

The Acid Rain programs in Canada and the U.S. focused on the largest industrial contributors to the problem – power plants and smelters – and did so successfully. This was the most efficient way to address the issue at the time. It was cost-effective and emissions from smelters and power plants have declined in the last three decades while improvements in the environment are measurable.

Evidence now shows that small –scale sources - often consumer goods – are now substantially contributing to health and environmental damage as emissions from the big smokestack polluters decrease. The location of the emissions from these sources is important. They are often found where the greatest numbers of people live – in and around cities. Finally, as discretionary income increases in United States and Canada and consumers spend their money, the number of the products whose pollution is a concern is increasing.

Recreation vehicles and lawn and garden equipment
As noted in the first Critical Issues report, recreational vehicles, including snowmobiles and outboard motors and lawn and garden appliances (lawn mowers, edge trimmers, etc.) have been shown to be important contributors to the formation of ozone or summertime smog. In some parts of the United States, walk-behind and riding mowers and other garden appliances account for up to 10 per cent of summertime smog-forming emissions from mobile sources.

Open burning
Open burning is the uncontrolled burning of materials where smoke is released directly into the air without passing through a chimney and where the material that is burned is only partially combusted. Open burning in cities and towns generally occurs on decks and in backyards using fire pits or "chimineas" whereas open burning in rural areas often means burning household trash and other garbage in a pit or using a steel drum known as a burn barrel.

The U.S. EPA Dioxin Re-Assessment estimated that the uncontrolled burning of household trash was generating 19% of the total quantifiable annual releases of dioxin/furans in the United States. This figure is supported by EPA emission tests on the burning of household/commercial waste in barrels.[23] Open burning of unsorted trash also contributes to the emissions of hazardous pollutants[24] and smog-forming pollutants that can cause health problems ranging from respiratory distress, damage to the liver, kidney, and central nervous system and cancer[25].

Woodstoves
Smoke from burning wood contains large amounts of smog-forming and hazardous pollutants. In many homes in Canada and the United States, wood is the primary source of heat. In certain areas, wood smoke can become one of the most important concerns in air quality.[26] For instance, in Québec, wintertime smog episodes have become a problem as more and more people have started to burn wood for heat to save money. The number of homes in the province with wood burning appliances shot up from 87,000 in 1987 to about 150,000 in 2000 according to Statistics Canada. An estimated 100,000 of these homes are in Montréal.

5.2 What Does It Mean?

The traditional regulatory "big stick" approaches to pollution management have their place in air quality management. However, where small-scale, dispersed pollution sources and the actions of individuals are concerned, governments must adapt to be effective.

Equipment Bans and Use Limitations at the Local Level
Canadian and U.S. federal governments and the State of California are regulating manufacturers to build cleaner engines to power nearly all walk-behind and riding lawnmowers as well as small generators and other devices.

However, even when cleaner engines are available to consumers, the cost to replace old working engines with new cleaner ones creates a barrier to change. To address this, a number of approaches are being taken. Communities on both sides of the U.S. – Canada border are restricting the use of lawn mowers and other handheld engines by municipal personnel on "smog" days. Residents are also being asked to participate on a voluntary basis. In 2007, Ontario announced its intention to ban the use of all lawn equipment engines using the old "2-stroke" technology during summer months and cities like Toronto are considering a more extensive ban.

Education, Municipal By-laws and Enforcement
In many jurisdictions in both Canada and the United States, a permit is required for any open burning. Others have banned this practice while in other jurisdictions, there are restrictions on the timing, location and type of fuel allowed. However the public's lack of awareness, and, in rural settings, limited and less convenient alternatives for garbage disposal as well as the lack of enforcement of current regulations and restrictions reduce the effectiveness of current government policies.

Citizen surveys conducted in Northwest Wisconsin and Northeast Minnesota (2000) and Ontario (2001) revealed that convenience was the number one reason cited for burning garbage. A large percentage of the people who were surveyed said that they would continue open burning even if alternatives were available. These citizen surveys also demonstrated how little people knew about the health and environmental risks associated with open burning. Many smaller municipalities, being unaware of the health and environmental risks, had no local bylaws or regulations to prevent open burning[27]. In circumstances where bylaws existed, there was little enforcement.

The U.S.-Canada Great Lakes Binational Toxics Strategy[28] has set out a target to address pollution from open burning through educating government officials and the public, improving garbage and recycling services/facilities and supporting municipal governments in developing bylaws and enforcing them.

Subsidizing "Change-out' Programs

Many North American woodstove manufacturers have developed new, advanced combustion systems that use an estimated 30 per cent less wood and reduce dangerous emissions by up to 90 per cent. These new high-efficiency Canadian Standards Association or EPA-certified stoves are widely available across Canada and United States. The United States banned the sale of non-certified woodstoves in 1991.

However, the vast majority of people in the United States and Canada are still using old stoves or fireplaces and education and information has had little overall impact on woodstove replacement decisions. Costs for the high-efficiency stoves are relatively high compared to older models and the old stoves do not wear out. Clearly a government command and control approach is not an effective way to reduce woodstove emissions.

In an effort to get new high-efficiency stoves into people's homes, an innovative subsidy program is underway in Libby, Montana. The Libby woodstove "changeout" program is a government/industry effort to provide financial subsidies in order to remove the largest contributor to the city's poor air quality – old woodstoves. Libby is located in the remote northwest corner of Montana in a bowl-shaped valley surrounded by steep mountains - ideal topography for temperature inversions that can trap pollution and create potential adverse health effects. A significant portion of Libby's residents rely on woodstoves for heating, and during the cold winter months, the entire valley can become enshrouded in smoke.

When the program was started in 2005, the goal was to replace 1100 stoves with new efficient, certified stoves by 2007. Within one year, half of the stoves had been replaced and, so far, 1000 new certified stoves have been installed. The cost of the program has been made up of $1 million donated by industry, $100,000 from EPA and $50,000 from the state of Montana.

Governments taking a leadership role

Governments have the opportunity to both establish standards for other sectors of the economy and to set an example in the management of their own operations. For example, the Canadian federal government (excluding Crown corporations) manages more than 47,000 buildings with a total area of over 31 million square meters, owns and operates more than 27,000 vehicles and is the single largest public sector purchaser in Canada with annual spending of over $13 billion on products and service. It goes without saying that the influence that federal "green" requirements could have on the national economy and the goods and services in the marketplace would be substantial.

In both Canada and the U.S., federal, state and provincial governments have historically put in place a number of programs to "green" their operations, including the establishment of an Office of Greening Government Operations in the Canadian Department of Public Works and Government Services.

In January 2007, the U.S. President, building on past government efforts, signed an executive order "Strengthening Federal Environmental, Energy, and Transportation Management." The order sets goals for sustainable practices in the U.S. federal government in the areas of energy efficiency, acquisition, renewable energy, toxics reductions, recycling, sustainable buildings, electronics stewardship, fleets, and water conservation. The purpose of the initiative is to put the federal government into a leadership role where it will not only be more efficient and effective in its daily operations but also lead by example in the areas of environmental and energy stewardship. This initiative represents a significant step forward in both setting clear direction from the Presidential level on the importance of this issue and in providing for a common basis for future reporting on the success of government efforts.

In Canada, the Office of Greening Government Operations has worked interdepartmentally on providing guidance on government priorities for greening its operations, specifically in the areas of energy, vehicles and procurement and led the development of policies on greening the executive fleet and green procurement, among other things. To date, however, Canada has not put in place a Canadian equivalent to the U.S. executive order and it is not clear if a common basis for reporting on the results of government efforts exists.

Backyard boilers provide heat and burn waste - but at what cost?

With the rising costs of heating fuel, consumers are installing boilers in their backyards to heat their homes. These boilers are often inefficient devices with no pollution controls. But the fact that fuel can be anything from wood to household wastes including left over building materials or old tires drives their increasing popularity.

In June 2006, the New Brunswick Lung Association issued a strong caution against the use of outdoor wood boilers for residential or business heating purposes. They noted that the design and operation of most outdoor wood boilers create air quality impacts far greater than the currently acceptable standards from indoor wood burning devices. As such, they called backyard boilers a potentially important lung health hazard.

Even if a backyard boiler uses wood for fuel, there are virtually no regulations to limit the amount of pollution from the boilers. Vermont is the only state in the U.S. that has adopted regulatory emission standards to control these units. Backyard boilers can emit over ten to as much as twenty times the air pollution emitted by an indoor Canadian or U.S. certified woodstove, and they are used year round. Exposure to wood smoke has been shown to exacerbate asthma attacks, reduce the ability of children to fight respiratory infections and make breathing difficult for people suffering from Chronic Obstructive Pulmonary Disease.

5.3 Recommendation

Individual actions are critical where small-scale, scattered air pollution sources are concerned – can our governments adapt to be effective?

The Canadian and U.S. governments should play a leadership role in working with provinces, states, cities and regional governments to both "green" their own operations and to support programs financially that reduce and control pollution from open burning, woodstoves, and consumer products such as lawn and garden equipment.

6.0 New frontiers in air quality: can governments change from reactive to proactive – from cumbersome to nimble?

6.1 The Story

In the last 40 years, the management of air pollution has moved from a focus on regulating key widely used chemicals to attempting to regulate thousands of more specialized chemicals.

Industry continues to create chemicals, scientists are developing nanomaterials whose potential to pollute is unknown and atmospheric research is finding out that pollutants like "ultrafine particles" exist and are important health and environmental pollutants.

Nanotechnology is a new field of research and industrial application, and its risks and benefits are being examined and evaluated. In the nanoworld, there are three major industry sectors. Nanoelectronics continues the development in microelectronics, especially for computers, but at significantly smaller size-scales. Nanobiotechnology combines nanoscale engineering with biology to manipulate either living systems or to build biologically inspired materials at the molecular level – materials with "intelligence". Nanomaterials precisely control substances or particles to produce nanostructured materials such as engineered surface coatings. The rapid development of nanotechnology presents new challenges for air pollution science and policy and for the regulatory regimes that are established to protect air quality and health.

Particles in the smallest "ultrafine", submicrometre ranges are the byproduct of fuel combustion. Difficult to measure, ultrafine particle research in cities is focusing on health and air quality effects associated with urban roads. Studies are showing that people living and working in close proximity to an urban arterial road are likely to be exposed to levels of ultrafine particles well above 'normal' levels while only experiencing somewhat elevated levels of the particulate matter that is routinely measured and regulated for air quality purposes.

The link between ultrafine particle creation in the nanoparticles range and sulphur content of fuel, lubricating oils and other fuel properties such as aromatic content and volatility is also raising questions. The reduction of sulphur content in fuel and new engine designs and after-treatment technologies will present new ultrafine particle production challenges and solutions that will need to be investigated.

6.2 What Does It Mean?

It is clear that governments in the U.S. and Canada are working diligently to implement the tools they have to prevent chemicals and other "traditional" pollutants from damaging health and the environment. At the July 2007 Montebello, Quebec Trilateral meeting of Prime Minister Harper, President Bush and Mexico's President Calderon, the three countries' top environmental officials agreed that their Agencies will coordinate efforts to accelerate and strengthen national and regional chemical assessment and management in North America. This trilateral partnership calls on each country to coordinate efforts to assess and take action on industrial chemicals by 2012.

The U.S. commitment within the trilateral effort is to complete assessments and take action as needed, on more than 9,000 chemicals produced above 25,000 pounds per year. In Canada, the "Chemicals Management Plan for Canada" is founded on a list of 23,000 domestic substances in the Canadian Environmental Protection Act Domestic Substances list that have been screened for toxicity. In addition, there are 4300 substances that have been identified for further work, including 200 chemical substances about which the government of Canada has challenged industry to provide them information. These 200 chemicals include three substances that are largely used as commercial mixtures in making polyurethane foam found extensively in household furniture and automotive upholstery.

Recently, a number of countries have instituted new or updated programs to address existing substances. One of the most extensive new programs is the European Union (EU) chemicals legislation, REACH (Registration, Evaluation and Authorization of Chemicals), which came into force in June 2007. The subject of much controversy, the legislation requires companies to submit safety information on substances that are used or imported into the EU in quantities greater than 1 tonne per year. Below that amount, only a limited amount of information must be provided. The legislation is also intended to promote the substitution of alternatives for persistent bioaccumulative substances, where alternatives exist, as well as enhanced public access to information. While perspectives on the legislation continue to be mixed, REACH may be the first law that could, if properly enforced, help reduce daily exposure to persistent and bioaccumulative chemicals.

Questions remain in relation to toxic chemical management. Are the regulatory tools now available to handle existing and new toxic chemicals adequate to the task? And with respect to ultrafines, the products of nanotechnologies and other, still unrecognized substances, other questions are important. How can governments keep up with and prevent air quality and health damages from newly recognized substances and products of nanotechnologies being developed? What more can governments in the U.S. and Canada do to be able to deal effectively through their regulatory regimes to prevent air quality and health effects as new materials are developed or recognized?

6.3 Recommendations

New frontiers in air quality: can governments change from reactive to proactive – from cumbersome to nimble?

The U.S. and Canadian governments should examine their existing regulatory regimes, designed to deal with existing substances, to assess how they can be sufficiently rigorous and nimble to deal with issues posed by newly developed and newly recognized substances.

The Canadian and U.S. governments are requested to brief the Commission on their strategies to deal with new and emerging substances such as nanomaterials and their possible effects on air quality and human health.

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