A breath of fresh Air

The state of environmental policy in Canada

edited by Nicholas Schneider

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A Breath of Fresh Air in Environmental Policy

Nicholas Schneider

The natural environment and the interaction of humans with it are subject to constant change, as are the policies that influence this interaction. In the 1970s, environmental policies tended towards "command-and-control" approaches which, while sometimes successful, were not cost-effective. Over the following years, however, the range of policy tools available to decision makers has expanded to include a greater number of market- and free market-based approaches.

Unlike command-and-control policies, market mechanisms have the potential to achieve environmental goals at lower costs, due in part to the ability of individuals to make the most cost-effective decisions in light of economic incentives. While market methods are rarely used in Canada, the authors of this book demonstrate how and why we need to adopt market-based methods to achieve our environmental goals.

Given Canadians' well-known concern for the environment, it may be difficult to find anyone in Canada who is against improving the quality of the environment. However, a reliance on unnecessarily costly and intrusive policies over the past several decades has likely turned some people against environmentalism. But there are a growing number of market-based policy options that would improve environmental quality at a lower cost and with less government intervention than in the past. These policies are a breath of fresh air because they are cost-effective, market-oriented, less intrusive, and more appealing to broader sections of the Canadian public.

The purpose of this book is to outline several market-based environmental policy options, and to explain why the enactment of such policies would improve environmental quality and natural resource policy in Canada.

In this book, the authors provide examples of the direct application of market-based policies. These policies include the strong protection of property rights, the use of environmental pricing, the application of cost-benefit analyses, and the devolution of the power of decision making to local agents who are most closely connected to the issues and more easily held accountable. The book concludes by describing how Canada can learn from the policy experiences of other countries.

This chapter summarizes the shift towards market-oriented environmental policies that has occurred over the past 30 years, and presents a simple framework for understanding such policies and how they can be expanded in Canada. This chapter concludes by presenting recommendations for improving environmental policy in Canada.

> Has there been a change in environmental and natural resource policy?

In the late 1980s, opinion polls showed that almost 80 percent of Americans considered themselves to be "environmentalists" (Polling Report Inc., 1999).[1] Environmentally friendly products began to fill store shelves, and the three new "Rs"—reduce, reuse, and recycle—were adopted by schools. Organizations such as Greenpeace and the World Wildlife Fund became household names, and the United Nations' *Our Common Future* report established the working definition of "sustainable development." At the first Earth Summit in Rio de Janiero in 1992, environmental issues began to shape international politics, as delegates from nearly 180 nations adopted agreements on development, biodiversity, forestry, and climate change.

In the 1990s, environmental topics slipped in relation to other issues. Worries about health care, the deficit, the economy and, since 2001, terrorism, national security, and the events in Iraq and Afghanistan, became more prevalent. In 2004, two environmental strategists went so far as to publish an essay on the state of the environmental movement titled, "The Death of Environmentalism" (Shellenberger and Nordhaus, 2004). In hindsight, it seems as though the warning was unwarranted. Opinions have once again shifted, and environmental issues are now among the top priorities of Canadians.[2]

Companies are trying to "green" their image, books on eco-lifestyles and low-impact living are crowding bookshelves, Kyoto is a household name, and the video, *An Inconvenient Truth*, is being shown in classrooms.

Though today's environmental issues are nothing new, a few changes that have taken place over the last 15 years are worth highlighting. First, in addition to existing concerns such as air and water quality, the issue of climate change has brought a new level of complexity and scope to environmental issues. Second, though the public generally perceives only worsening trends (Angus Reid, 2007), much progress has been made towards improving environmental quality. For example, the Fraser Institute's most recent *Index of Environmental Indicators* charted positive progress across a wide range of environmental measures (Brown et al., 2004). Third, while it may not be obvious to all casual observers, the policies used to address environmental and natural resource challenges have changed over the past 15 years. The use of market mechanisms within environmental policy has increased substantially to the point where it now seems to be the default policy choice for some issues.

As Wallace E. Oates notes, this is a departure from the earlier days of environmental policy, when landmark legislation such as the *Clean Air Act* and the *Clean Water Act* from the early 1970s essentially ignored economics and market approaches. According to Oates,

> Environmentalists were decidedly hostile. The market system was the reason we had pollution in the first place, they said. The idea of putting a price on the environment was morally repugnant … Environmentalists thus flatly rejected an economic approach. (2006: 302)

1 The Americans who were surveyed were asked, "Do you consider yourself to be an environmentalist, or not?"

2 Cheadle (2007, Jan. 4) reports that environmental policy is the top priority. Rook (2007, May 15) reports that it is the second highest priority, behind health.

Robert Hahn, among others, has made a similar observation:

> In the seventies, emissions fees were more likely to be viewed as "licenses to pollute." Today, most policy discussions … identify the need for using incentive-based instruments to achieve goals in a cost-effective manner. The sea change in attitude toward the use of incentive-based instruments represents one of the major accomplishments of environmental economics over the last three decades. (1999: 16)

In retrospect, it is somewhat remarkable that economics and market ideas had so little influence on major environmental policies in the 1970s, especially since these basic ideas had been established for decades and, in some cases, centuries. A.C. Pigou (1920) was one of the first to suggest that market mechanisms could be used to correct for environmental externalities. The use of cost-benefit analysis to evaluate regulations dates back to Otto Eckstein (1958). Moreover, methods of solving environmental disputes under the common law, without resorting to government regulation, were standard practice well before the modern environmental era (Brubaker, 1995).

Nevertheless, market and free-market approaches were not widely used in the 1970s and 1980s. Even recently, the Organisation for Economic Co-operation and Development (OECD) has strongly criticized Canada for not making sufficient use of what it calls "market-based instruments." However, this delay has not stopped researchers from demonstrating the principles and ideas of environmental economics. In 1990, the Fraser Institute published *Economics and the Environment: A Reconciliation*, which described how a market-based approach could help environmentalists achieve their goals:

> The essence of the reconciliation is that it is possible to use economic means in order to obtain environmental ends … [B]y using such economic building blocks as free market prices, private property rights, and, most important, a legal system that carefully defines, delineates, and protects such rights, the goals of the environmentalists can be achieved. [A]lso, that using these building blocks is a better and more effective way of attaining an ecologically sound environment than is directly and explicitly attempting to promote this end. A strict adherence to private property rights, in other words, will do more to secure air and water purity and sound resource management than will centralized control over the economy, even if done with this purpose in mind. (Block, 1990: vii)

> Conceptualizing market-based environmental policy

There are three broad policy categories which separate market-based approaches from non-market-based approaches.[3]

3 While these categories are useful for illustrating the differences, few policy tools fit cleanly into one category or another without any overlap. Some analysts may categorize policies differently. In addition, the categories do not include voluntary and non-compulsory programs that Canada has sometimes been criticized for relying too heavily upon (for example, see OECD, 2004). However, non-compulsory

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Command and control: The government, through regulation, sets the policy outcome (for example, a pollution standard to be met, or a resource harvest level to be attained) and dictates how compliance is to be achieved. A regulation that imposes a new emissions standard and prescribes what technologies must be used to meet the standard is an example of this regulatory approach. Because regulators cannot know the most cost-effective means of reducing emissions for each of the many different firms, command-and-control approaches often incur higher costs and prove less efficient than market-based policies (Harrington and Morgenstern, 2004).

Market: The government creates an economic incentive and lets the market determine which means will be used to achieve a particular policy goal. The creation of a tradable quota system for fisheries is an example of a market-based policy (see, for example, Jones with Bixby, 2003). An emissions tax is another example of a regulation that creates an economic incentive to reduce emissions, but allows individual emitters to decide how much they will reduce and by what means. Policies that fall within this category are sometimes referred to as "market-like," "quasi-market," "incentive-based," or "economic incentive" methods. The basis for many of these policies can be traced back to Pigou (1920). The OECD (1999) studied the use of these methods and found a growing number of examples in Canada and other countries.

Free market: Disputes over environmental resources are settled privately through voluntary trade (market exchanges), or by the courts. Having clearly defined and well-protected property rights (e.g., the right to clean air in your backyard, or the integrity of a private forest), individuals have a vested interest and an incentive to protect and conserve; there is no need for the government to interfere. The government's role is to ensure that property rights are protected and, when conflicts arise, to adjudicate disputes over those rights (see Coase, 1960; Rothbard, 1982). T.L. Anderson and D.R. Leal (2001) and E. Brubaker (1995) have documented the uses of free-market environmental protection. Examples of these uses include the private purchase and protection of environmentally significant lands, as is often done by land trusts; the private ownership and breeding of wildlife and endangered species; and the ability of landowners to invoke their riparian rights to stop others from discharging pollution into waterways adjacent to their land.

In a recent address, Wiktor Adamowicz, President of the Canadian Agricultural Economics Society, reflected on the state of environmental policy in Canada, concluding,

> In general, Canada has relied on command-and-control policies while other industrialized countries, notably the United States with examples like the market for SO_2 emissions, have moved toward market-based approaches. (2007)

Adamowicz noted some recent policy developments that may help establish greater support for

means such as advertising, information campaigns, and eco-labeling may be useful in educating people about government approaches that fall into any of the three categories outlined in this chapter.

market methods to address environmental challenges in Canada. The water licence transfer system under Alberta's *Water Act* has resulted in some trading, and trading programs have also been developed for certain air emissions in Alberta's electricity sector (Clean Air Strategic Alliance, 2003).

> Putting ideas into practice

We wrote this book to highlight the importance of implementing market-based environmental policy in Canada. Several chapters focus on policy options, such as the use of property rights, market pricing of environmental goods and services, and permit trading for natural resources. Other chapters explore whether policy makers should rely on a *laissez fair* approach, or intervene more aggressively by implementing economic incentives. Policy evaluation tools also are addressed. And finally, an international perspective shows that there is much to be learned about environmental policy from other countries.

In chapter two, Ross McKitrick describes the substantial improvements in Canada's air quality since the 1970s, as well as the overstated claims of ill health associated with poor air quality. He also notes that despite much effort, ozone concentrations have been largely unresponsive to policy, which demonstrates that we should not expect easy solutions. Dr. McKitrick suggests the use of pricing mechanisms as a policy option.

In the following chapter, Elizabeth Brubaker examines how government financing, regulation, and operation of water and wastewater facilities create problems for Canada's aging infrastructure. Brubaker explains how allowing private operation and financing of public water utilities would allow the government to better concentrate on its role as a regulator rather than as a water utility operator.

In chapter four, Indur Goklany compares two approaches to addressing climate change: mitigation and adaptation. While the two are not mutually exclusive, his analysis provides good reasons for pursuing adaptation programs in any set of climate policies.

In chapter five, Elizabeth Brubaker makes a strong case for returning environmental and natural resource policy to its common law roots. Not long ago, landowners could effectively rely on the courts to defend their right to use their land and adjacent waterways, free from invasion and the pollution of others. This tradition, Brubaker writes, is several centuries old, and was used effectively in Canada well into the twentieth century.

In chapter six, Quentin Grafton argues that the best managed fisheries in Canada are characterized by incentive-based approaches which may include the adoption of individual transferable quotas, by which the government sets a level of harvest and then distributes quotas (or permits) to fishers.

Following Grafton, Glenn Fox examines the growing market for ecological goods and services in chapter seven. Fox notes that despite evidence of growing supply and demand, market trading of such goods is not occurring often.

Turning to city-related environmental issues, in chapter eight, Randal O'Toole investigates whether policies that forcibly increase urban density actually reduce the commuting associated with urban sprawl. O'Toole recommends that city planners stop trying to change

people's transportation choices directly, and instead concentrate on making sure people pay the full costs of their choices.

In chapter nine, Lisa Skumatz examines a market-based solution to managing garbage. She argues that because homeowners generally pay for garbage services as part of their property taxes, the charge they face for each additional bag of garbage is essentially zero. This creates little incentive for homeowners to reduce the amount of waste they create. Skumatz argues that more communities should consider adopting a "pay as you throw" program that charges a fee for each bag collected.

In chapter 10, Alison Berry and Holly Lippke Fretwell outline how more than 90 percent of Canadian forest land is publicly owned, in contrast to countries such as Sweden where less than 20 percent is publicly owned. This extent of government control magnifies the need for effective forestry policy. Berry and Fretwell explore ways for the government to incorporate market mechanisms to improve forest stewardship such as relying on tenure agreements that provide longer-term secure rights for private forest managers.

In the following chapter, Robin Neill describes the unfortunate state of the aquaculture industry, which is hindered by an outdated, tangled regulatory system and a lack of clearly defined property rights. Because of this situation, the aquaculture industry's ability to meet growing demand for its product and to maintain higher environmental standards has been diminished.

> The relevant comparison: market failure vs. government failure

How much should the government intervene in environmental issues? Should it take a *laissez fair* approach and rely on the courts to enforce and protect private property rights when parties are unable to resolve their conflicts? Or should it be willing to intervene in order to create economic incentives?

One policy cannot meet all challenges. E.C. Pasour (1982) argues that policy makers should consider the reality of markets and politics before acting, which would require them to confront the risks and trade-offs between market failure and regulatory failure.

Public policy is often presented as a solution to market failure, but there are several ways in which the government can also fail. C. Wolf (1979) outlines several ways in which governments can fail. For example, the goal of government agencies is often to increase budgets and power unrelated to or unnecessary for their purpose. Failure may also result from a lack of competition, which can lead to redundant and rising costs, as well as an inequitable distribution of power and influence, and a focus on short-term political gains, which can lead to long-term unintended consequences.

How relevant are these types of government failure? In chapter 12, Dean Lueck reflects on the evolution of the *Endangered Species Act* (ESA) in the United States, and provides a troublesome example of the unintended consequences of policy. His research shows that landowners often engage in preemptive habitat destruction to prevent endangered or threatened species from settling on their property. By punishing landowners, the ESA may actually increase habitat destruction in some cases.

An international perspective: learning from others

Canada is not alone in its effort to address environmental concerns, and there is much to be learned from other countries. In chapter 13, John Baden and his colleauges document the evolution of American environmental policy since the first Earth Day in 1970. The authors describe how the development of effective environmental policy lagged behind the spread of environmental awareness, as evidenced by the country's reliance on command-and-control approaches during the 1970s.

In the final contribution to this volume (chapter 14), David Pannell offers insights based on Australia's land, water, and biodiversity conservation policies, which have included a greater reliance on economics than programs in Canada. His chapter is useful reading for anyone who is considering environmental policy design and implementation.

Conclusion

According to Geoffrey Heal (2007), "far too many environmental policies have relied on telling people exactly what to do and what not to do. They have been classic command-and-control policies." As this book documents, the use of command and control regulation has resulted in unnecessarily high costs, and has limited individual decision making in favour of government interference. These costs limit what can be achieved, and the degree of government control creates animosity among property owners.

Free-market and market-based environmental policies would yield considerable benefits for Canadians. The cost-effectiveness of market-based policies means that more environmental improvement can be achieved at a lower cost. The authors of this book, who are experts in Canada, the United States, and Australia, demonstrate that proven market tools can be applied to just about any environmental and natural resource issue in Canada.

After weighing the risks of market failure as opposed to government failure, it should be clear that Canada should rely more on market approaches as its primary response to environmental challenges. Doing so would go a long way toward lessening the conflict that often exists between protecting environment quality and protecting economic liberty, both of which are highly desirable and beneficial to Canadians.

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Nicholas Schneider

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Air Pollution Policy in Canada: Improving on Success

Ross McKitrick[1]

False perceptions of air pollution

In the 1970s, people worried about inflation, which was often over 10% per year. We don't worry about it today, at least not very much, because inflation has fallen to low levels. Most types of air pollution are also much lower than they were in the 1970s (see figures 1–5 for some examples). But unlike inflation, people worry more about it now than they did back then.

Why the difference? Perhaps, it is because people are well informed about inflation. They notice when prices are going up, especially when their wages don't keep up. And the government regularly releases summary data about inflation, especially the Consumer Price Index, which is prominently published in an easily accessible form, so people's local experience of rising prices is mirrored in national-level statistics. As inflation fell in the early 1990s, people saw the official numbers dropping and it concurred with their own experience of stabilizing prices. Concern about inflation fell accordingly.

In the case of air pollution, people do not perceive it directly. People certainly notice extreme smog episodes but, on an annual basis, they are relatively rare occurrences—we expect to have a few each summer, lasting about a week each time. Otherwise, ordinary air pollution is not noticed. Do you know the level of suspended particulate matter, in micrograms per cubic metre, in the outdoor air in your city today? Do you know the concentration of sulphur dioxide (SO_2) or carbon monoxide (CO) in parts per million? Could you guess it to within plus or minus 100%? Not likely. Measuring such things requires highly specialized equipment. People would not directly perceive a change up or down, even a doubling or halving of typical daily concentrations.

For example, which city had higher monthly average SO_2 levels in 2002, Calgary or Ottawa? Answer: Ottawa, as it turns out. But, if you happened to make the trip from Ottawa to Calgary that year, did you stop and think how nice it was that the monthly average concentration of SO_2 was about one part per billion lower? Of course not. And if you were living in Calgary, did you experience more SO_2 in 1990 or 2002? Answer: 1990, by a small margin. But again, it is unlikely anybody noticed the change.

We could ask the same questions about other conventional air contaminants, like volatile organic compounds (VOC), ozone (O_3), total suspended particulates (TSP), or nitrogen oxides (NO_x). By and large, people have little or no idea what the current levels of air pollution are, how they compare across cities, whether they

1 I would like to thank four anonymous reviewers whose input greatly improved the final version of this chapter.

are higher this year than last year, and what the long-term trends are.

Without this kind of information, people are susceptible to unsubstantiated claims that air pollution is getting worse and worse, or that we face a "crisis" over air quality. In light of the proposed federal *Clean Air Act*, Canadians are confronting major new proposals for air-pollution policy in an information vacuum, making decisions on the basis of little more than slogans and propaganda. Yet Canada has an excellent system for monitoring air contaminant levels and the data are available via the Internet. Unfortunately, the data are published in an unprocessed form that makes it effectively inaccessible to most people. So this chapter starts by reviewing some broad trends in Canadian air pollution. If we are going to have a meaningful discussion about what kinds of policies ought to be pursued regarding air pollution, it has to start with an understanding of the facts of air pollution. This certainly includes the types, levels, and trends in air pollution, but it is also necessary to dispense with some unfounded alarmist rhetoric about the health consequences of contemporary ambient levels of pollution. I will also explain some of the current policy mechanisms in place and the problem of using Air Quality Indexes to assess today's pollution levels. I conclude with some suggestions to guide those making policies to improve air quality in Canada.

> Common air contaminants in Canada since 1974

Canada has measured air pollution levels in a widespread, systematic way since 1974. A large compilation of data is available at the Environment Canada "NAPS" web site of the National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>. Some provincial governments have more extensive data collections because they monitor in more locations than are included in the NAPS system. Ontario, for instance, has data for some monitoring sites going back to the early 1960s. Ontario publishes an annual report on air quality that makes use of NAPS and other monitoring data. The most recent edition, *Air Quality in Ontario: 2006 Report* (Ontario, Ministry of the Environment, Environmental Monitoring and Reporting Branch, 2007) is an informative document of very high quality.

NAPS data are posted in large files in ASCII format showing the hourly readings of common air contaminants by station ID. If you have the time and programming skills, you might be able to find information about long-term air-quality trends in your city, but few people are likely to do so. The Fraser Institute published a compilation that makes the information more easily accessible (Brown et al., 2005). In this chapter, we reproduce some trend graphs produced for the Fraser Institute in late 2004, using data up to the end of 2002 (where available), which was, at the time, the most up to date.

The following are the common types of air pollutants (also referred to as "criterion air contaminants") that have been systematically monitored since the 1970s: sulphur dioxide (SO_2); carbon monoxide (CO); particulate matter (PM); ground-level ozone (O_3); nitrogen oxides (NO_x); and volatile organic compounds (VOC). Particulate matter smaller than 35 micrometers in diameter are called total suspended particulates (TSP). The TSP category is further broken down by particle size: PM_{10} refers to fine particles, smaller than 10 microns

diameter; $PM_{2.5}$ refers to ultra-fine particles, smaller than 2.5 microns in size.

SO_2 was a focus of concern in the 1970s and 1980s, chiefly because of acid rain. When SO_2 mixes with oxidants and moisture in the atmosphere, it can make the rain acidic and this was flagged as a cause of stress on ecosystems through acidification of lakes and soils. Carbon monoxide is toxic to humans at high levels, and possibly has milder toxicity at low levels. O_3 is a lung irritant and, at high levels, makes breathing uncomfortable. It is not directly emitted into the atmosphere; instead it is formed as a result of a chemical reaction between NO_x and VOC under intense sunlight. NO_x, consisting of nitric oxide (NO) and nitrogen dioxide (NO_2), can be a lung irritant on its own at high-enough levels and is visible as the brown haze sometimes seen on summer days. VOC is a term that describes a long list of reactive gases, some of which are natural in origin and some of which result from personal and industrial emissions.

Canada has established National Ambient Air Quality Objectives (NAAQO) that prescribe standards for daily and annual exposure. The current standards are listed in table 1.

Figures 1a–d and 2a–d (pp. 31 ff.) show trends in average monthly levels of SO_2 and TSP in Vancouver, Calgary, Toronto, and Montreal from 1974 to 2002 (except where data are unavailable after the late 1990s). Figures 3a–d, 4a–d, and 5a–d (pp. 35 ff.) show the comparable time series for CO, NO_2, and O_3. Comparable patterns are found in other large and mid-sized cities in Canada.[2]

2 Canada-wide averages up to 1996 are shown on Environment Canada's web site at <http://www.ec.gc.ca/soer-ree/English/Indicators/Issues/Urb_Air/Tech_Sup/uasup5_e.cfm>.

Table 1: Canadian National Ambient Air Quality Objectives (NAAQOs)

Averaging time	Maximum desirable concentration	Maximum acceptable concentration	Maximum tolerable concentration
Sulphur dioxide (SO_2)			
annual	11 ppb	23 ppb	—
24-hour	57 ppb	115 ppb	306 ppb
1-hour	172 ppb	344 ppb	—
Total suspended particulates (TSP)			
annual	60 µg/m³	70 µg/m³	—
24-hour	—	120 µg/m³	400 µg/m³
Ozone (O_3)			
1-hour	50 ppb	82 ppb	153 ppb
Carbon monoxide (CO)			
8-hour	5 ppm	13 ppm	17 ppm
1-hour	13 ppm	31 ppm	—
Nitrogen dioxide (NO_2)			
annual	32 ppb	53 ppb	—
24-hour	—	106 ppb	160 ppb
1-hour	—	213 ppb	532 ppb

Source: Environment Canada (2005: table 9.)

From these graphs, and the larger data sets from which they are drawn, we can draw several conclusions.

Sulphur dioxide (SO_2)

Monthly average levels of sulphur dioxide (SO_2) have fallen quite a bit since the 1970s. They were never a problem in cities on the Prairies. In eastern cities, including

Toronto, Montreal, Ottawa, Hamilton, Windsor, Halifax, and London, monthly average levels frequently exceeded 20 or 30 parts per billion (ppb) up to the late 1970s, but today's levels are typically below 10 ppb, and the ordinary average is now about 5 ppb. The annual average desirable standard is 11 ppb and the maximum acceptable standard is 23 ppb.

Total suspended particulates (TSP)

Monthly average levels of total suspended particulates (TSP) in Canadian cities were, on average, well over 120 micrograms per cubic metre ($\mu g/m^3$) in the 1970s. The annual average desirable standard is 60 $\mu g/m^3$ and the maximum acceptable standard is 70 $\mu g/m^3$. Since then, monthly average TSP levels have fallen in many places to near or below 60 $\mu g/m^3$. Vancouver has successfully achieved monthly average levels of 10 to 30 $\mu g/m^3$; Toronto and Montreal are slightly higher, usually having levels around 30 to 60 $\mu g/m^3$. (Note that there is a gap in records for Toronto from 1995 to 1998.) Saskatoon, Regina, Winnipeg, and Ottawa are similar to Toronto and Montreal. Calgary, Edmonton, Hamilton, and Windsor continue to have TSP levels between 50 and 100 $\mu g/m^3$. Halifax has always (since 1974) had TSP readings below 50 $\mu g/m^3$, and they are currently below 30 $\mu g/m^3$.

Carbon monoxide (CO)

In all Canadian cities, monthly average levels of carbon monoxide (CO) have been steady in recent decades at about 1 part per million (ppm). In some cities, the CO levels briefly rose in the 1970s to nearly 2 ppm but have been at or below 1 ppm for two decades or more. Environment Canada's 8-hour desirable standard is 5 ppm and the maximum acceptable standard is 13 ppm (there is no monthly or annual average standard).

Nitrogen dioxide (NO_2)

Environment Canada's annual average desirable standard for nitrogen dioxide (NO_2) is 32 ppb and the maximum acceptable level is 53 ppb. Most Canadian cities exceeded this standard for some months of the year up to the late 1980s, but since the mid-1990s they have had monthly average levels between 20 and 30 ppb. Edmonton has a slight tendency to exceed the 32 ppb level in some months, but during most of the year it too has levels at or below 30 ppb. Other than that, Canadian cities keep their monthly average NO_2 levels below 30 ppb.

Ozone (O_2)

All Canadian cities exhibit seasonal ozone patterns with monthly averages varying between 10 and 40 parts per billion (ppb). There has been little or no trend in ozone levels since the 1970s, with some evidence of an upward trend after 1990 in some cities. The Canada-wide desirable annual standard is 65 ppb. Compliance is determined by taking the 8-hour daily average for every day of the year, selecting the fourth-worst day of the year and averaging it with the same measure taken for the two previous years. If this average is less than 65 ppb, the city is said to have met the Canada-wide standard. All provinces except Quebec have agreed to meet this standard (Canadian Council of Ministers of the Environment, 2000: last, supernumerary, page). Since ozone episodes

can involve spikes that last for four to eight days, the standard as currently written effectively requires a city not to have any summertime ozone episodes. It can be safely predicted that this standard will be very difficult to meet. In Ontario, the standard was violated at almost all monitoring locations over the 2002-2004 averaging interval, even though monthly averages are below 40 ppb (Ontario, Ministry of the Environment, 2006).

Successes

We can say the following, in general, about Canadian urban air pollution.

- Carbon monoxide levels are not a problem.
- Sulphur dioxide levels were a problem in many areas in the 1970s and 1980s, but have been successfully controlled to the point that they are now well within the acceptable levels.
- Suspended particulates have been reduced to just below the acceptable level in most cities, though progress seems to have stalled since the 1980s.
- NO_2 levels are mostly at acceptable levels and have not changed much since the 1970s. The slight improvement has taken the form of eliminating the episodes of unacceptably high NO_2 levels but there has been no strong downward trend in average levels.
- Ozone levels have not gone down. Episodes of high ozone levels still occur, mainly in the summer, though the average annual levels in Canadian cities are low compared to the national standards.
- Atmospheric lead levels (not shown in the figures) fell dramatically in the late 1980s in response to the federal decision to ban lead in gasoline and paint. Since 1990, levels of lead in urban areas have been effectively zero in Canadian cities.

It is noteworthy that the type of air pollution that has been most resistant to change is ozone, which is not directly emitted by human activity. The process by which ozone is formed involves air pollution emissions, but it also depends on complex local atmospheric conditions. Ozone formation requires intense sunlight, a stable atmospheric boundary layer, and the right mix of precursor gases. Consequently, it is mainly associated with summertime conditions, and high levels do not last more than a few days. For most of the year in Canada, ozone is not a problem. Reducing the summertime ozone spikes is very challenging since reductions in emissions of precursor gases do not guarantee reductions in current ground-level ozone concentrations.

Challenges

The overall picture we can take away from figures 1–5 is one of success at addressing some key challenges. Most cities, most months, have air quality that meets or exceeds Environment Canada's quality guidelines. The challenges that now confront us have the following features.

Different cities face different challenges

Calgary and Edmonton, for example, do not have problems with SO_2, but particulate levels are still a concern. Halifax has problems with neither. Hence, attempts to impose one-size-fits-all policies across Canada will invariably misdirect resources for further air quality improvements.

Air-quality guidelines

Having met existing air-quality guidelines, we need to ask whether the guidelines themselves remain satisfactory or need to be revised further. As will be discussed below, while there is weak evidence of a statistical correlation between ambient air pollution and some health indicators, recent re-analyses and controlled laboratory experiments have provided persuasive evidence that today's air-quality standards do not need to be tightened.

Ground-level ozone

It is unlikely that major improvements in ground-level ozone can be achieved in the near future. This is not to say that improvements are impossible but, since ozone concentrations have been largely unresponsive to policies up to now, the difficulty in finding a "silver bullet" should not be underestimated. At present, the Canada-wide standards developed in June 2000 specifically required provinces to determine natural background levels of PM and ozone, so that they would not find themselves being held to standards that were cleaner than unpolluted air.

> Air pollution and health

Toronto Public Health (Basrur, 2000) has claimed that thousands of people die of air pollution each year, a sound bite that was repeated by the federal Conservative government when launching their *Clean Air Act*. If it is true, let's see the list of names, so the courts can certify a class action lawsuit on behalf of their survivors. But there is no list. These are not actual bodies; they are numbers generated by a computer. The computer model consists of a linear formula that takes current average levels of air pollution, multiplies them by some coefficients drawn from an unbalanced and uncritical survey of some epidemiological research, and yields a number that is supposed to tell us the fraction of actual deaths each year attributable to air pollution. It almost sounds plausible until you try entering the Toronto pollution levels from the mid-1960s. The model would attribute about half the observed deaths from that period to air pollution and predicts more deaths in February 1965 due to air pollution than there were deaths from all causes (McKitrick, 2004). This is, to say the least, implausible.

The claim that ozone is killing Canadians was seriously challenged several years ago when British researchers Koop and Tole (2004) published a detailed statistical evaluation of air pollution and mortality in Toronto. Using the state-of-the-art Bayesian Model Averaging technique, they evaluated over 567 trillion model specifications and concluded that the data do not provide robust support for a correlation between ground-level ozone and mortality. They noted that some statistical specifications could appear to yield a positive relationship between air quality and premature death rates, but the models that fit the data best only attribute mortality effects to the weather variables. When they looked for possible interaction effects (that is, maybe pollution only matters in hot weather), they found nothing but a table

"composed of zeroes (to three decimal places)" (Koop and Tole, 2004: 42).

This is not the first time that detailed re-analysis has overturned an apparent statistical correlation between pollution and mortality. In a widely-cited pair of studies, Schwartz (1993, 1994) examined data from Birmingham, Alabama, and concluded that a link exists between particulate matter and both hospital admissions and excess mortality. Smith et al. (2000) replicated these results on a new version of the Birmingham data, but then showed that they are not robust to minor changes in the statistical (regression) model. In other words, slight variations in the assumptions behind the analysis cause the result to disappear, which is an indicator that the underlying effect is not truly present in the data. Clyde (2000) also re-analyzed the data from Birmingham using Bayesian Model Averaging and found that Schwartz's method overstated the relative risk estimates and under-estimated the uncertainty. Upon re-analysis the results disappeared.

Dominici et al. (2002) estimated correlations between exposure to PM_{10} and risk of mortality in 88 American cities. While the nationally pooled results seemed to show a small positive effect, in all but seven cities the city-specific relative risk coefficients were insignificant and in 20 of the 88 cities the effect was negative: increased particulate pollution was associated with *reduced* mortality risk. The difficulty of identifying risks at low levels of air pollution also make it difficult to identify if there is a "safe lower limit" for air pollution, below which health concerns can be definitely ruled out. Epidemiological studies have not identified such a level but nonetheless there is evidence that contemporary urban air is not hazardous.

In 2000, the British government's Committee on the Medical Effects of Air Pollution (COMEAP) was asked to review claims that air pollution is a health hazard. After examining both epidemiological and clinical evidence they concluded that "[f]or the most part, people will not notice or suffer from any serious or lasting ill effects from levels of pollution that are commonly experienced in the UK, even when levels are described as 'high' or 'very high' according to the current criteria" (COMEAP, 2000: §3.1). Earlier, COMEAP issued a report on whether air pollution is a causal factor behind rising asthma incidence. They concluded:

> As regards the initiation of asthma, most of the available evidence does not support a causative role for outdoor air pollution. (This excludes possible effects of biological pollutants such as pollen and fungal spores.) … As regards worsening of symptoms or provocation of asthmatic attacks, most asthmatic patients should be unaffected by exposure to such levels of non-biological air pollutants as commonly occur in the UK. A small proportion of patients may experience clinically significant effects which may require an increase in medication or attention by a doctor. … Factors other than air pollution are influential with regard to the initiation and provocation of asthma and are much more important than air pollution in both respects … Asthma has increased in the UK over the past thirty years but this is unlikely to be the result of changes in air pollution. (COMEAP, 1995: §§1.16–1.19)

No clinical support for epidemiological findings

One reason that scientists have been reluctant to attribute health effects to air pollution is that experimental

clinical studies do not provide a causal explanation for the correlation observed in some epidemiological findings. As Green et al. report (2002: 328), the implied risk-factor coefficients commonly used in epidemiological models to tie mortality to air pollution imply that ambient concentrations of sulphate aerosols are 1.7 times more carcinogenic than emissions from coke ovens, to which they add, rhetorically, "How plausible is that?" The 1999 Health Canada Science Assessment of the then-proposed National Ambient Air Quality Objectives for particulate matter concluded:

> Despite the fact that the ranges of particle concentrations [in laboratory experiments] usually exceed those experienced by the general population, little evidence for a dose–response relationship has been documented in the clinical toxicological literature … Overall, the clinical data does not lend much support to the observations seen in the epidemiology studies, particularly to the observations that high ambient particulate concentrations are associated with mortality within hours or a few days at most. (CEPA/FPAC Working Group on Air Quality Objectives and Guidelines, 1998: 14)

An updated assessment in 2004 (CCME, 2004) offered only cautious support for the small effects in epidemiological studies and also reported on a significant error discovered in a widely used statistical algorithm that added an upward bias to many of those published risk estimates. It restated the conflict between epidemiological and experimental results without resolution. Likewise, an updated review by COMEAP was underway in 2006, and a preliminary statement indicates that they are prepared, on prudential grounds, to view the epidemiological findings as indicative of causality. However, their updated review is focused on new epidemiological findings and does not refute the earlier clinical findings. They express caution about the ongoing uncertainty (COMEAP, 2006).

> Current Canadian policy on air pollution

In discussing a policy on air pollution that fits the Canadian situation, it would be a mistake to think that we are starting in a vacuum. Canada already has a detailed regulatory system for managing air quality. While factors other than regulation (such as technological innovation, and energy-efficiency gains; see McKitrick, 2006) may explain some of the post-1970 improvement in Canadian and American air quality, it is important to note that our assessment of current Canadian environmental policy starts from the observation that it is not obviously "broken" or in need of major overhaul.

Industrial air pollution

Provincial governments across Canada regulate industrial air pollution primarily through the issuing of approvals to firms that will be emitting to the atmosphere. The process of obtaining a Certificate of Approval (CoA) involves inspecting individual facilities and reviewing the specific equipment.[3] The standards applied under

3 See, for examples, the following web sites: Alberta Environment (2004); British Columbia, Ministry of Environment (2005); Ontario,

a CoA may include a combination of some technical requirements on the equipment, some prohibitions on emissions, and—principally—guidelines about allowable effects on the ground-level air at the "point of impingement" (POI), that is, the maximum estimated concentration at ground level where the contaminant leaves the site on which it is generated, or at another suitably defined external location. In Ontario's POI guidelines, there are 344 compounds listed, each with one or more standards associated with them (Ontario, Ministry of the Environment, Standards Development Branch, 2005). The standards take the form of acceptable concentrations at the point of impingement over different averaging times.

Some direct emission controls have been enacted for large point-source emitters. In Ontario, for example, the *Environmental Protection Act*, Regulation 194/05, lists a few large sources of SO_x and NO_x and their specific emission limits (Ontario, 2005). The Imperial Oil refinery at Sarnia is allowed to release 23,938 tonnes of SO_2 per year in 2006 and 2007, but must reduce those emissions to 9,200 by 2009 and thereafter. The same facility is allowed 3,164 tonnes of NO_x emissions, which must be reduced to 2,660 by 2009.

Tradable permits for SO_x and NO_x emissions

Regulation 194/05 also implements a system of tradable permits for SO_x and NO_x emissions in Ontario.[4] The system initially covered all generating plants with more than 25 Megawatts (MW) of installed capacity, or which generate more than 200,000 MW hours for sale in Ontario, and who emit NO_x and SO_x. It has since been expanded to cover all firms that sell electricity to the Ontario power grid. Firms that have been assigned emission limits are allowed to trade those limits among themselves and can bank their credits for use in future years. Credits are assigned based on a firm's share of electricity generation in the previous year. Allowing firms to trade their emission allowances rewards firms that exceed their emissions abatement targets, since they can sell their unused allowances and make money. It also helps firms that are finding it more costly than expected to meet their targets, since they can purchase allowances from other firms. Firms outside Ontario (limited to certain northeastern US states) can generate Emission Reduction Credits for sale to Ontario firms if they can show that they undertook emission reductions that would have a demonstrable benefit for Ontario's air quality. Overall, the targeted amount of pollution reduction is achieved at lower cost than under the old "command-and-control" system. Allowance trading does not set aside the POI requirements under each firm's Certificate of Approval.

Compulsory emission controls

The current structure of provincial air pollution law can give the impression that Canada does not have compulsory emission controls. In October 2006, when the federal Conservative government published a Notice of Intent to Regulate along with their proposed Canada *Clean Air Act* they stated, "Canada has historically relied on a variety of non-compulsory measures to reduce air

Ministry of Environment (2006); Québec, Développement durable, Environnement et Parcs (2002);

4 For more details, see Ontario, Ministry of Environment (no date), <http://www.ene.gov.on.ca/envision/env_reg/er/documents/2001/RA01E0020-C.pdf>.

emissions. However, these have not proved sufficient to reduce the health and environmental risks across the country" (CEPA Environmental Registry, 2006).

This is obviously untrue. The environmental risks associated with air pollution have, as noted above, been substantially reduced over the past 30 years. Emission caps and ambient air-quality standards do exist, as do emission controls on hundreds of compounds of concern. The certification process introduces considerable flexibility into the system for controlling air pollution, as it should, but the effectiveness of the outcome is obvious in the data.

Perhaps the reason so many people are confused on this point is that there is no one large, omnibus legislation that imposes a blanket emissions cap on all businesses. Instead, firms face regulations that are tailored to their specific operations. The basic principle, uniformly applied, is that, when the contaminant leaves the site it has to be diluted to the point where it is not a source of nuisance or injury to neighbours. Exceptions to this rule are associated with the high-profile, large-scale, firms like Inco in Sudbury, petrochemical operations in Sarnia, and power-generating stations at Lambton and Nanticoke, which are subject to further, specific regulations.

Motor vehicles

Canada has effectively followed the US federal motor-vehicle emission standards since they were first enacted in the 1960s. This is sensible since the Canadian motor-vehicle market is closely integrated with that in the United States and there is no need to redo all the research that lies behind the US federal regulatory system. The US regulations set limits for new vehicles in grams or pollution emitted per mile traveled.[5] There are three classes of regulation, covering Volatile Organic Compounds (VOC), carbon monoxide, and NO_x (as of 1982, PM_{10} was also covered). Within each category, there are standards for both cars and light trucks (SUVs and pickup trucks). Table 2 shows that the standards have become progressively more stringent since 1966. Each standard is scaled so it equals 100.0 in 1966. The actual 1966 values were 8 to 10 grams/mile for VOCs, 4 grams/mile for NO_x, and 80 to 102 grams/mile for CO, where the range covers the car/light truck categories.

It is clear that new cars today are much cleaner than they were in the 1960s. New automobiles produce less than 5% of the CO emissions per mile than those on the road in 1966, and less than 2% of the NO_x. As for VOCs, a smog pre-cursor, a new car in 2006 would have to be driven for over 150 miles to produce the same quantity of VOC emissions as a new car did in one mile in 1966. PM_{10} levels have also fallen since 1982. For both new cars and new light trucks, the allowable emissions in grams per mile were cut by 87% between 1982 and 2007. The improvements also extend beyond new cars: market-driven quality improvements mean that new vehicle-emission characteristics last longer through the car's life cycle than was the case in the 1970s.

Early versions of these standards were applied in Canada in 1971 through the *Motor Vehicle Safety Act*. As standards in the United States tightened, the federal government brought Canadian motor-vehicle

5 These are listed at United States, Department of Transportation, Federal Highway Administration (2006), <http://www.fhwa.dot.gov/environment/aqfactbk/page14.htm>.

Table 2: Tightening motor vehicle emission standards in the United States since 1966

	VOC		NO_x		CO	
	Autos	Light Trucks	Autos	Light Trucks	Autos	Light Trucks
1966	100.00	100.00	100.00	100.00	100.00	
1971	38.68	100.00	100.00	100.00	42.50	100.00
1981	3.87	21.25	24.39	63.89	4.25	17.65
2001	2.36	4.00	9.76	11.11	4.25	3.33
2006	0.66	0.88	1.71	1.94	4.25	3.33
2007	0.66	0.88	1.71	1.94	4.25	3.33

Note: Standards are scaled to start at 100; for actual quantities, see text.

Source: Ontario, Ministry of Environment (no date), <http://www.ene.gov.on.ca/envision/env_reg/er/documents/2001/RA01E0020-C.pdf>.

manufacturers into compliance using voluntary agreements, or Memorandums of Understanding. Since the United States is such a large motor-vehicle market and automobile manufacturing is integrated across the border, Canada has harmonized engine and emission standards to those in the United States. This regulation was transferred in 1999 to the (federal) *Canadian Environmental Protection Act* (CEPA). CEPA prescribes a fleet average NO_x standard that is slightly tighter than the 2004 US standard but not as tight as the Tier II standards being phased in (*Canada Gazette*, 2003). CEPA also allows firms that go beyond the required standards in one model year to count that as a credit towards its fleet average in a subsequent year.

British Columbia and Ontario have enacted motor-vehicle Inspection and Maintenance (I/M) programs. These require an inspection of a car at the time of license renewal to determine if the vehicle achieves basic air-quality standards. The standards are less stringent for older vehicles and the vast majority of cars (over 90%) pass the test. Cars that fail the test have to undergo a tune-up or other maintenance, up to a specified dollar limit, then they are re-tested. If they do not pass the test the second time, but have reached the dollar limit for maintenance, they are given a temporary license renewal. Economists who have studied these programs have pointed out that they waste a lot of resources testing cars that have an extremely low probability of failing the standards; consequently, any pollution reductions achieved come at a very high average cost (Harrington and McConnell, 1999; Harrington, McConnell, and Ando, 2000).

The federal role

In the United States, the federal government has a prominent role in regulating air pollution through its administration of the *Clean Air Act* (1970) and Amendments (1977, 1990). Among other things, the *CAA* sets out national ambient air-quality objectives that are binding

on states and counties. If a county is deemed to be out of compliance with one or more federal air-quality standards, the state must file a remediation plan with the Environmental Protection Agency (EPA). Part of the remediation plan usually includes emission standards for specific sources or classes of sources. These standards have to be federally enforceable. The EPA, therefore, has the power to enforce these emission standards directly to ensure compliance.

By contrast, the Canadian federal government has tended to exercise less direct regulatory control. Up until passage of the CEPA in 1999, Ottawa mainly played a coordinating role through the Canadian Council of Ministers of the Environment (CCME). The CCME, for example, negotiated Canada-wide standards for ozone and particulate matter in June 2000 (though Quebec did not agree to sign the resulting accord). To the extent that there are regulatory actions involved, they are undertaken by provincial governments, not the federal government. Because the federal government plays a coordinating role, there may be an impression that Canada has no clean air legislation. This is of course not true. Air pollution control is a provincial responsibility and is handled through the Certificate of Approval process, among other mechanisms.

The passage of CEPA introduced a new mechanism for federal regulation via the designation of substances as "toxic," which then allows the federal Minister of the Environment to enact emission controls. One controversial, and indeed nonsensical, application of this rule occurred in 2004 when the federal government designated carbon dioxide (CO_2) as a "toxic substance." CO_2 is not toxic in any reasonable meaning of the term, as it is an integral part of human and plant respiration. It is not covered by provincial air-pollution regulations. The federal government sought authority to regulate it in order to address greenhouse gas commitments made under the Kyoto Protocol. By using the CEPA "toxic" designation, it circumvented having to pass new and potentially unpopular legislation in Parliament.

The climate-change issue is discussed elsewhere in this book, in a chapter by Indur Goklany. The fundamental problem with proposals for controlling carbon-dioxide emissions, as he explains, is that, even if conventional projections of global warming and their projected economic impacts are taken at face value, the best (implied) overall outcomes for long-term human prosperity and welfare are those in which CO_2 emissions are allowed to continue growing. Attempts to cap or reduce CO_2 emissions are much more difficult and expensive than attempts to reduce criterion air contaminants, mainly because CO_2 emissions are tightly coupled with average income levels and there is no economically viable way to filter or scrub large volumes of CO_2 from smoke. Consequently, even if emission-reduction targets have a small, long-term cooling effect on the climate, it is not sufficient to offset the economic hardship associated with the emission reductions.

> Ultra-fine particles and air-quality indexes

In recent years, Canadian and American regulators have become increasingly concerned with a species of particulates called $PM_{2.5}$, or ultra-fine particles smaller than 2.5 microns; they are also called aerosols. Larger particles are less of a threat to health since our lungs can expel them. A concern about fine particles is that

they embed themselves deep in the lungs and enter the bloodstream. Sulphate aerosols are formed by chemical reactions in the atmosphere involving sulphur dioxide and oxidizing precursors. SO_2 can be oxidized by the hydroxyl radical OH or hydrogen peroxide (H_2O_2) and form into sulphuric acid (H_2SO_4), or acid rain and other sulphates (SO_4). This dissociates into several molecules, including SO_4. NO_x can also help convert sulphur dioxide into sulphate (Stein and Lamb, 2000). Because of the complex nature of sulphate formation, the fact that SO_2 levels have fallen so much in recent years does not necessarily imply that sulphate levels have also dropped. What matters is whether the conditions that support the formation of sulphate aerosol have changed substantially.

Much attention has been focused on SO_4, or sulphate aerosol. Its ability to go deep into lung cavities makes it a useful compound for medicinal purposes. A common medicine in asthma inhalers is albuterol sulphate (Drugs.com: Drug Information Online, 2006). In this case, the active ingredient is attached to a sulphate aerosol to facilitate absorption, which raises the question of why doctors would prescribe it if it were a hazard to human health. For the purpose of comparison, the European Union has issued ambient air standards of 40 μg/m^3 for aerosols ($PM_{2.5}$). A standard asthma inhaler delivers a medicinal sulphate dose of about 10,000 μg/m^3 (Green et al., 2002). Experimental evidence indicates that acid aerosols like sulphate or nitrate do not cause measurable cardiopulmonary responses at current ambient air levels, or even at concentrations much higher than are observed in North American cities, and there is ample experimental evidence that concentrations of aerosols experienced in contemporary outdoor urban air have no effect on the function of human lungs (Green et al., 2002, 2003).

Nonetheless, Ontario now counts SO_4 when calculating its Air Quality Index (AQI). This has led to a perception that Ontario is experiencing "more smog days" than ever before. The reality is different because the AQI has been revised. The Government of Ontario developed the AQI in the early 1990s. It is formed by measuring six air contaminants and translating each one onto an index scale, where numbers up to 15 mean Very Good air quality, 16 to 31 means Good, 50 to 99 means Poor, and so on. The highest reading of the six becomes the AQI value. Smog Advisories were first published in 1993. Regulators issue an advisory if they project, based on current air pollution readings and weather forecasts, that there is a high probability that at least one of the components will indicate Poor air quality over a wide area within the next 24 hours.

On hot, muggy days with a temperature inversion, all six categories may go up into the Poor or Very Poor (100+) categories, indicating a serious smog episode, though in reality it is extremely rare for most contaminant types to go that high. But in the mid-autumn, it may be that five of the six categories are in the Good or Very Good category, while one goes up into the Poor category. Both would trigger a "smog alert."

In August 2002, the province added $PM_{2.5}$ to the list of AQI compounds, so sulphate aerosols can now trigger a smog alert. The next fall, two alerts were issued in October based on $PM_{2.5}$ levels, and, in February 2005, an alert was issued, again based on the new $PM_{2.5}$ criterion. Media coverage at the time noted how remarkable it was that these were the "first ever" smog alerts in the mid-fall or mid-winter. But that is because the AQI system

had been re-defined. Had the AQI system been in place (including the $PM_{2.5}$ component) as far back as the late 1960s, fall and winter smog advisories would likely have been routine: today's smog advisories would seem few and far between by comparison.

Provinces use Air Quality Indexes for public information, to notify people about specific, short-term, smog episodes. However, the AQI is not a good way to measure trends in overall air quality, since the system is new and subject to revisions. Basic contaminant concentration data should be consulted for estimating trends in air quality.

> Looking ahead: Some "dos" and "don'ts" for the Canadian air-quality agenda

Do we need a new set of air-quality regulations in Canada? Is the current system "broken" and in need of fixing? The difficulty in answering this question is that people have different things in mind when they think about air pollution. Some people might instinctively think of the air in mid-Toronto, near Highway 401, on a sweltering July day at rush hour. If we think that the aim of air-pollution policy is to ensure that, under those conditions, the air outside ought to be as clean as it is on an April morning in Muskoka, then clearly current regulations will seem inadequate. But this is obviously unrealistic. There are some times and places where we will always encounter deteriorations to air quality. The question is whether further improvements can be achieved at a low-enough cost to make the change worth pursuing.

As I write this (September 26, 2006), air quality across Ontario is either Good or Very Good, according to the Ontario AQI system, at every monitoring site around Ontario. There is nothing special about this day. Here in southern Ontario it is sunny and mild, people have gone to work, businesses are running, the lights are on, and traffic is moving steadily on all the major routes. Does this imply bad air quality? No, the air quality is Good or Very Good as of 11 AM across all our urban areas, with no indication of problems developing. This is the typical situation for Canadian cities. The fact that air quality is good is, at least in part, attributable to the current suite of air pollution regulations, which allow people to pursue economic growth and development while still enjoying good air quality. The determinants of the AQI today are either ozone or fine particulates, the elements over which we have the least direct control. The contaminants we do control directly are at levels too low to affect the AQI reading, at least on this day, in southern Ontario. In this sense, the system we have is not broken and we should be reluctant to tinker with it.

On the other hand, there remain perceptions that air quality is not good, or is getting worse, and that we need to intervene with stronger measures. To that end I will suggest a number of "dos" and "don'ts" to guide policy formation.

1 Do educate the public about the state of Canada's environment

People need direct, objective information about the environment. Provincial and federal governments collect large amounts of basic data about the current state of the environment and past trends, yet little or none of it is made available to the public in a usable form. Instead, people pick up bits and pieces of information

from agenda-driven sources. Environmental groups cite the increased number of AQI-based smog warnings in Ontario and tell people that air quality is getting worse and worse, without explaining the changes to the system that account for the increased frequency of smog advisories.

In recent years, the National Round Table on the Environment and the Economy proposed a set of "Sustainability Indicators," and produced a report on the subject (NRTEE, 2003). Unfortunately they were aiming in the wrong direction, trying to aggregate all environmental measures into one grand index. What is needed is an initiative in the opposite direction to provide disaggregated information on as many individual topics as possible.

Picture a web site where people can look at a map of the country and, by clicking a mouse, zoom in to provinces and regions and cities and neighborhoods. At each level, they would have access to long-term data as well as current conditions. This chapter has been concerned with air quality, and has emphasized taking a long-term view of the matter. Suppose that by going to this web site you could find your city, and even your neighbourhood, within the city and instantly call up graphs of criterion air contaminants back to the early 1970s, or the 1960s, as well as recent averages and current up-to-the-hour readings. Suppose you could click on a contaminant's name and get a sidebar explaining what the chemical is, how it is formed, and what the major sources are. In some cases, the sidebar would be able to show time series of emissions. Then suppose that, with another click, you go to a page that describes the current regulatory system in your province and city for controlling that type of air contaminant. The data also exist to make long-term water pollution levels available in the same way, as well as forest cover, ground contamination, and many other topics of interest to the public.

Policy must be formed on the basis of accurate understanding about the situations being addressed. At this point, there is a lot of misinformation being published about the state of the environment, leading to vague anxiety and, in some cases, unrealistic expectations about what needs to be done. For a relatively small investment in data dissemination, the discussion of environmental policy in Canada could move onto a much stronger, more objective foundation. This would help focus policy attention on real problems, not imaginary or obsolete ones.

2 Don't impose a policy suitable for "downtown" problems on the whole country

I don't mean to suggest that downtown Toronto, Montreal, or Vancouver have the "worst" air—depending on the contaminant, they can be quite clean. Ozone, for example, forms just as readily over rural areas as in urban areas (in Ontario, Tiverton, and Grand Bend have some of the highest ozone levels). But a lot of people live and work in downtown areas and concerns about air quality tend to focus on those places where there is both elevated pollution and high population density.

It is tempting, when contemplating how to improve downtown air quality, to think about transportation policy initiatives, such as regulations on gasoline formulas, new standards for car emissions, and subsidies for public transit. These types of regulation apply to all consumers, including those who live outside the city core, so a lot of costs will be borne by people who do

not contribute to the problem. And even if the policies are effective, they primarily influence air contaminants that, these days, cannot be viewed as serious problems. Transportation tends to be associated with carbon monoxide and NO_x. At today's low levels, neither one is a problem in our cities, so imposing higher fuel costs or vehicle costs on broad strata of society will likely not generate sufficient payoff to make the new initiatives worthwhile.

3 Do maintain a decentralized approach to air emissions policy and give people a say in their own local policy framework

One-size-fits-all regulations on a national level do not do justice to the variation in preferences and priorities across the country; nor are they compatible with local democratic governance, particularly since a lot of air pollution depends on local meteorology or the local mix of pollutants. In addition, some communities place very high value on air quality, whereas others might view it as of lesser importance than promotion of local industry. To whatever extent possible, it is a good principle to tailor pollution policy to take account of these differing valuations.

In *How to Repair the Air in Our Cities* (McKitrick, 2003), I described a practical way of tailoring air-quality regulations on a city-by-city basis. The proposal involves replacing the current system of licensing motor vehicles by year with a system of licensing them by distance driven, where the cost per kilometer is adjusted by the emissions characteristic of the car and a local "clean air premium" parameter chosen by the people in a referendum or by their city council. This way, people who do not drive or who want to raise the cost associated with automobile air pollution will have a direct way of doing so, through a public vote. Presumably, some towns would vote to place a relatively low cost per kilometer on car licenses, while others would raise the price; and either way it would reflect local preferences rather than centralized commands.

The CoA system that governs industrial air emissions across Canada also allows for discretion and local flexibility both in the allowance of emissions and in the enforcement of regulation. Though it makes it hard to quantify and catalogue the full range of pollution-control mechanisms currently in place, it has proven to be an effective and flexible way to achieve tangible results in controlling air pollution. That flexibility should be preserved if the federal government moves to centralize air-emissions policy under a new *Clean Air Act*.

One simple way of doing this would be to grandfather existing provincial regulations in all regions that currently comply with National Ambient Air Quality Objectives for SO2, CO, TSP, ozone, and NO2, so that regions already complying with clean air rules are exempt from any new rule-making at the federal level. This reflects the simple principle of building on success, rather than punishing it.

Having said that, there are circumstances in which variations in rules across the country increase costs. The United States currently has a patchwork of different requirements for gasoline formulation. This has created "boutique" markets that force refineries to produce small batches for individual regions, although differences in the formulations are minor compared to the cost burden created for consumers. In cases where there are economies of scale in compliance, it can be

preferable to maintain consistent regulatory requirements everywhere.

4 Don't try to motivate policy by appealing to perceptions that are exaggerated or known to be false

We all agree that clean air is more desirable than dirty air and that worthwhile improvements to air quality can sometimes be achieved at a manageable cost if priorities are set wisely and policy instruments are carefully devised and implemented. That is the basis for continuing to make progress on air quality. But all too often politicians try to justify new measures to combat air pollution on the basis of inaccurate claims that air quality is getting worse and worse; or that air pollution is causing children to get asthma; or that thousands of people die and tens of thousands get sick due to air pollution; or that billions of dollars in economic losses are incurred; and so on. Those sorts of claims do not stand up to close scrutiny.

Claims of a health crisis due to air pollution have been repeatedly shown to be overstated.[6] But if the alarmist claim gets debunked, does that mean we shouldn't try to improve air quality? No, it just means that we should make policy based on facts, not fears, and especially not on fears based on exaggerations and hyperbole. If there is a good rationale for a policy decision, it should not require falsehoods or fear mongering to get public support.

6 See McKitrick, Green, and Schwartz (2005) for a more detailed critical review of the claimed health hazards of modern ambient urban air.

5 Do set realistic goals for ozone and aerosols, after critically assessing the evidence

Ozone and aerosols are difficult to deal with because of the complex processes that govern their formation. We can continue to try reducing the precursor compounds, namely sulphur, NO_x, and VOCs. But the reductions in particulate and NO_x emissions that have happened already have not translated into corresponding reductions in average ozone levels. They may have helped diminish the peak values during summertime ozone spikes. A sound strategy should begin with a recognition of what is feasible. There are atmospheric models that can be used to simulate the effectiveness of different policy strategies (see, e.g., DSS Consulting/RWDI, 2005), and continued research into acid aerosol formation is needed to help identify the most effective strategies for reducing general ozone and aerosol levels, as well as attenuating the summertime peaks. There is some evidence that VOC emissions matter more than NO_x emissions for limiting ozone levels. But, until the matter is better understood, it would be unwise to promise major reductions in ground-level ozone levels. The Canada-wide standard for ozone, discussed above, is a noble goal but we should not be too surprised if it is not readily achievable, especially since ozone is sensitive to the intensity of solar flux and we are near the start of a new solar cycle (NASA, Marshall Space Flight Center, Solar Physics Group, 2006).

6 Don't keep trying to solve yesterday's challenges

Sulphur dioxide reached high levels in urban air in the 1970s but has fallen to low levels today. Carbon

monoxide is also at very low levels and motor-vehicle emission controls appear to be adequate for ensuring that increased driving does not translate into increased atmospheric CO loads.

Recognizing the progress that has been made up to the present does not mean that no further improvements need to be made, but it does remind us that the lowest-cost reductions have already been exploited and further improvements will be more costly and elusive than previous ones. For the purpose of setting priorities, governments should recognize where progress has been made and consider whether it would be better to devote attention and resources to other concerns that have not received adequate attention, and where greater reductions in risks can be obtained at lower costs.

7 Do steer towards using pricing mechanisms where possible

The United States and countries in Europe have shown, by example, that market mechanisms (emission taxes and tradable permits) can be effective methods for pollution control. For example, in the United States the permits market for sulphur dioxide has been a successful method for reducing SO_2 emissions while minimizing the cost of compliance for industry. Ontario has taken the lead in Canada by introducing NO_x and SO_x emission trading programs.

Tradable permits systems can reduce, but not eliminate, the social cost of emission-control policies. The question of whether emissions need to be reduced below current levels must be decided on its own merits. Many studies done by government agencies and activists claiming to "prove" that large potential economic benefits would arise from further air pollution reductions rely on the kind of exaggerated health-effects rhetoric criticized above. In general, cost-benefit analysis of environmental policy should be done by people who are not in a conflict of interest. Bureaucrats who work in the environmental regulation area are potential beneficiaries of a push to tighten pollution laws and extend the environmental regulatory bailiwick. At the very least, their cost-benefit analyses should not be taken at face value unless they have been independently reviewed by staff in other government branches, and unless they openly present the evidence contradicting the claims that air pollution is a threat to life and health.

Here are two suggestions for situations where pricing mechanisms might be pursued.

7.1 NO_x and SO_x emissions trading in the eastern Canadian airshed

The federal government, through the CCME, should consider coordinating a large-scale pricing system to control SO_x and NO_x emissions in the eastern Canadian airshed. The American experience has shown that emissions trading is feasible, and the introduction of limited trading in Ontario shows that Canadian firms and regulators are ready to take the next step. Implementing an emissions-trading system across provinces would require careful planning to deal with several thorny issues. First, it is clear from the environmental economics literature (e.g., Parry et al., 1999) that giving away permits rather than auctioning them increases the social costs of the tradable permits system. A tradable permits system with permits freely distributed based on existing output shares effectively creates an industrial cartel. Consumer prices go up and competition is diminished.

By auctioning the permits instead, then using the revenue to pay for reductions in income or payroll taxes, the government minimizes the cartel power and the general social cost of the emission-control policy. In some cases, the emission goals can be reached at no overall macroeconomic costs.

Second, since eastern Canadian provinces all have emission policies in place already, it would be necessary to determine if a new emissions trading system made some earlier regulations redundant or counterproductive. This was not recognized in the United States when the acid rain allowance program was introduced. An older program called New Source Review was made redundant and its continuation actually undermined the intent of the emissions-control policy by delaying the changeover to new, less emissions-intensive industrial equipment (Gruenspecht and Stavins, 2002).

7.2 Ozone precursor management during urban smog episodes

Regarding NO_x, VOCs, and other ozone precursors, the challenge right now is to manage episodes of very high pollution levels. One possibility is to implement temporary surcharges on motor fuels and stationary-source NO_x and VOC emissions in a city on days when the 8-hour average ground-level ozone reading goes above 50 ppb. The emissions tax should be targeted towards large emitters, such as plants with installed combustion capacity exceeding 25 GWh useful energy per year. The surcharge would not be large enough to seriously affect real income, but a level of 5¢ to 10¢ per litre would encourage drivers to economize on road use. The tax would have to have a specified phase-out time, such as 24 hours after the 8-hour O_3 average has dropped below 40 ppb.

The Government of Canada should not keep the proceeds of the taxes. Instead, they should be aggregated by the cities and paid out at the end of the year to suitable recipients, such as hospitals. This kind of revenue-recycling does not assume compensation is needed for increased health-care costs due to the smog episode, since, on the grounds discussed above, we do not expect increased health-care costs due to ordinary variations in smog. But by maintaining local revenue neutrality the "smog surcharge" would be more feasible politically, and by agreeing ahead of time to the specific conditions for its removal, it is less likely that governments would distort it into a net revenue source in the guise of a virtuous "green" tax.

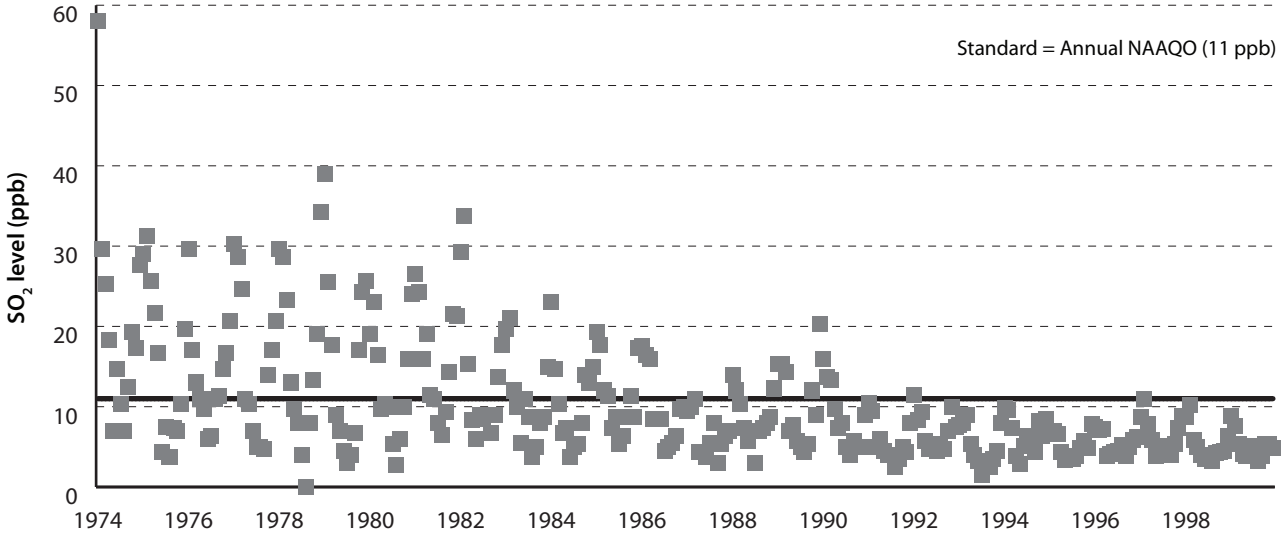
> Conclusion

Misunderstandings about Canadian environmental conditions and pollution policy abound. Many people seem to think air emissions in Canada are unregulated and that air quality is getting worse and worse. Neither claim is true. This chapter reviews recent evidence and shows that broad measures of air quality show real improvements since the 1970s. Most Canadians experience air quality, for most or all of the year, that is well within established air quality guidelines and is very unlikely to be deleterious to health. This chapter has also explained that Canada's decentralized regulatory system might have led to the impression that firms are not subject to emission controls when, in fact, they are carefully regulated. Consequently, there is no evidence that the system is "broken" or in need of major overhaul. Canada and the United States effectively decoupled air pollution from

economic growth during the 1970s and 1980s. This is one of the greatest technological and social achievements of the twentieth century, yet it seems to have gone unnoticed and uncelebrated.

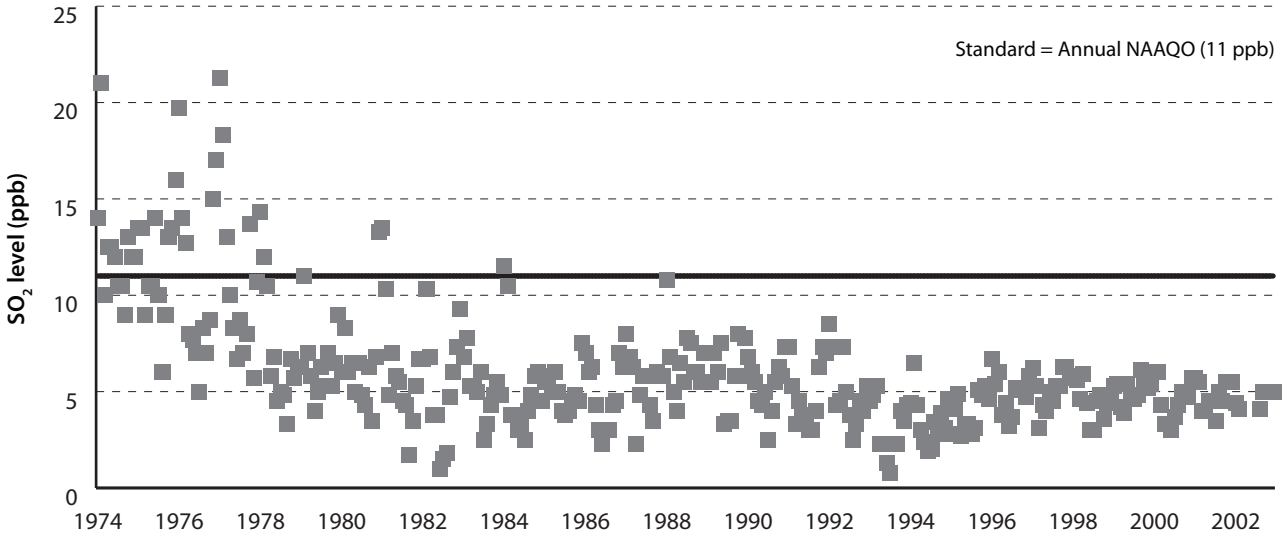
What is needed now, more than any new regulatory initiatives, is a comprehensive effort to put complete, objective, and detailed information about all aspects of environmental quality, including both current conditions and long-term trends, into the public sphere so that further discussion about the environment can take place in a context of facts and understanding, not rumours and rhetoric. Future environmental regulatory initiatives should be tailored to local needs, not aimed at ornate but misplaced national gestures. Future initiatives should be flexible and efficient, they should be responsive to local preferences and needs, and they should work with, not against, our market economy. As we continue to improve the current Canadian environmental policy mix, it is important to be both realistic and optimistic, and to remember that we are building on success.

Figure 1a: Trend in ambient levels of SO_2 in Montreal, 1974–1999



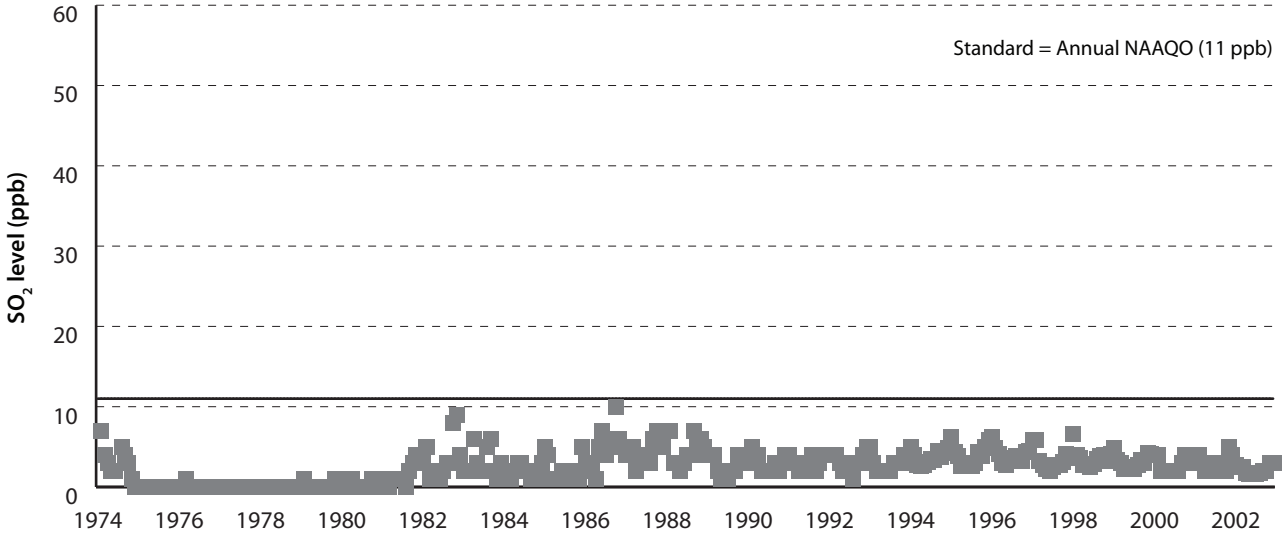
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 1b: Trend in ambient levels of SO_2 in Toronto, 1974–2002



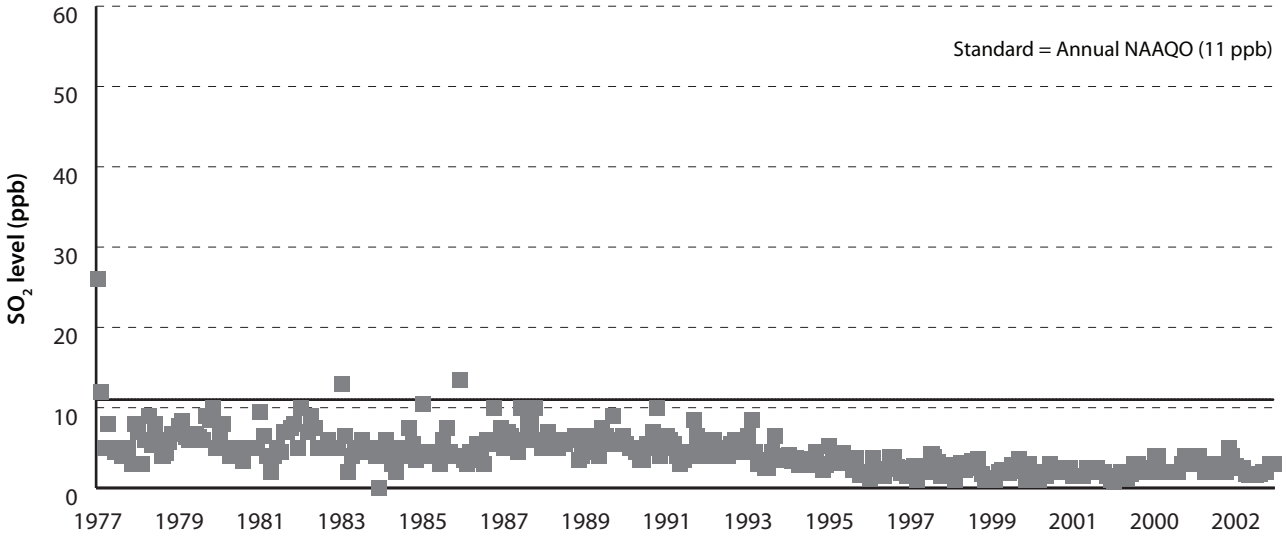
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 1c: Trend in ambient levels of SO_2 in Calgary, 1974–2002



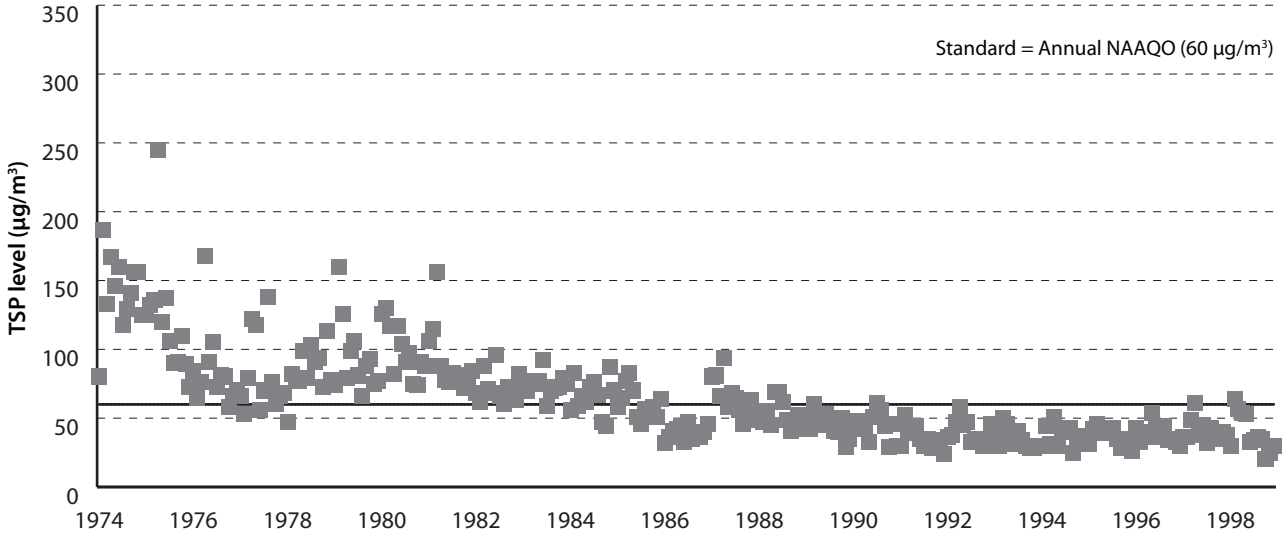
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 1d: Trend in ambient levels of SO_2 in Vancouver, 1977–2002



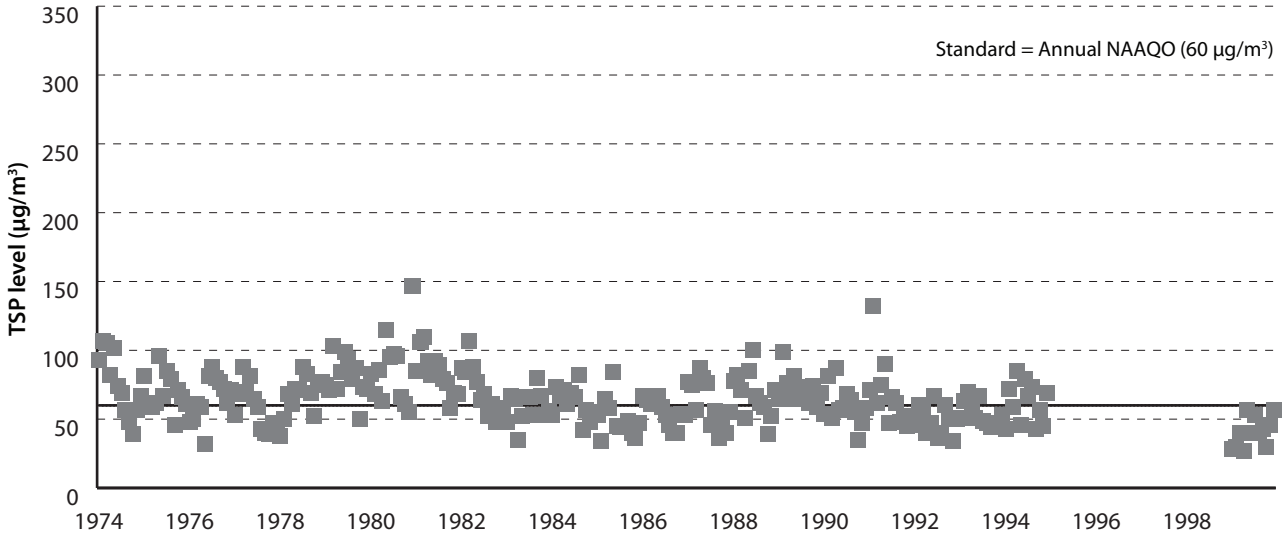
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 2a: Trend in ambient levels of TSP in Montreal, 1974–1998



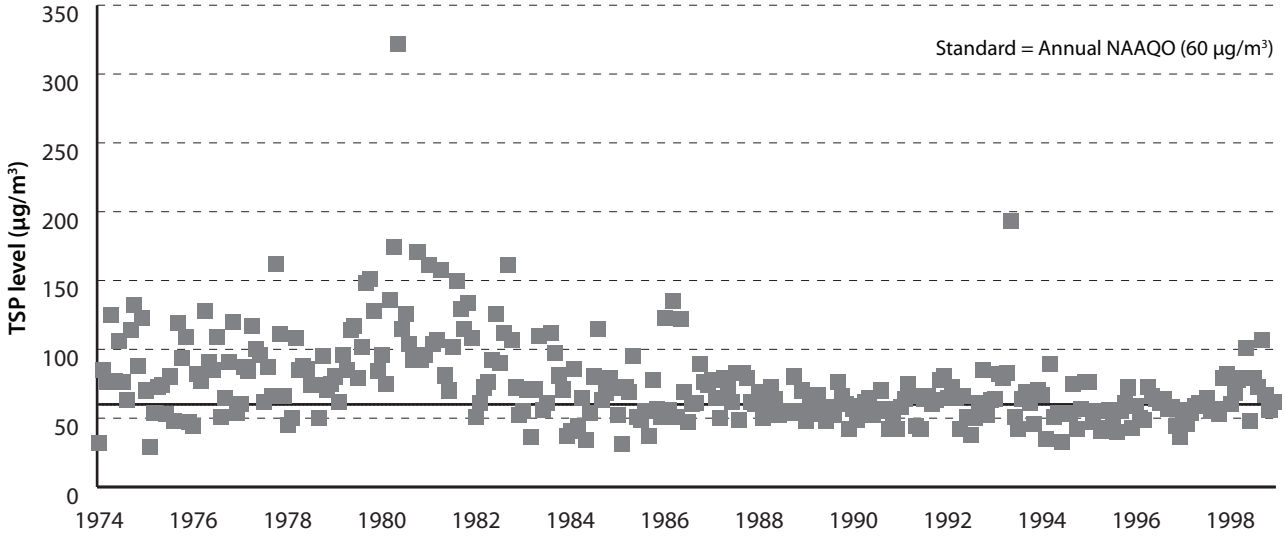
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 2b: Trend in ambient levels of TSP in Toronto, 1974–1999



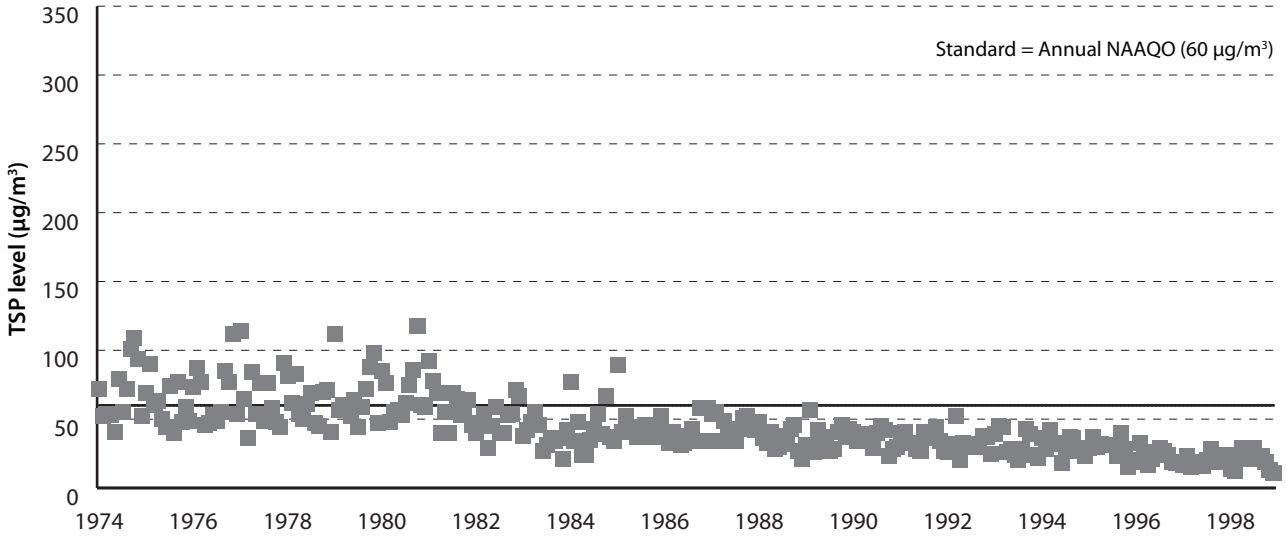
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 2c: Trend in ambient levels of TSP in Calgary, 1974–1998



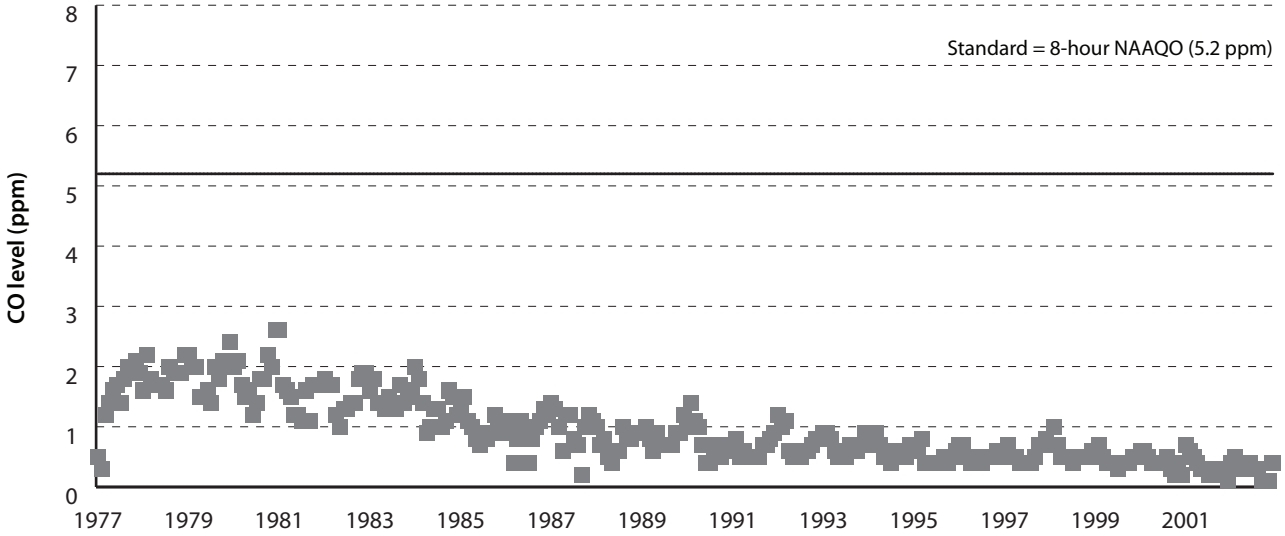
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 2d: Trend in ambient levels of TSP in Vancouver, 1974–1998



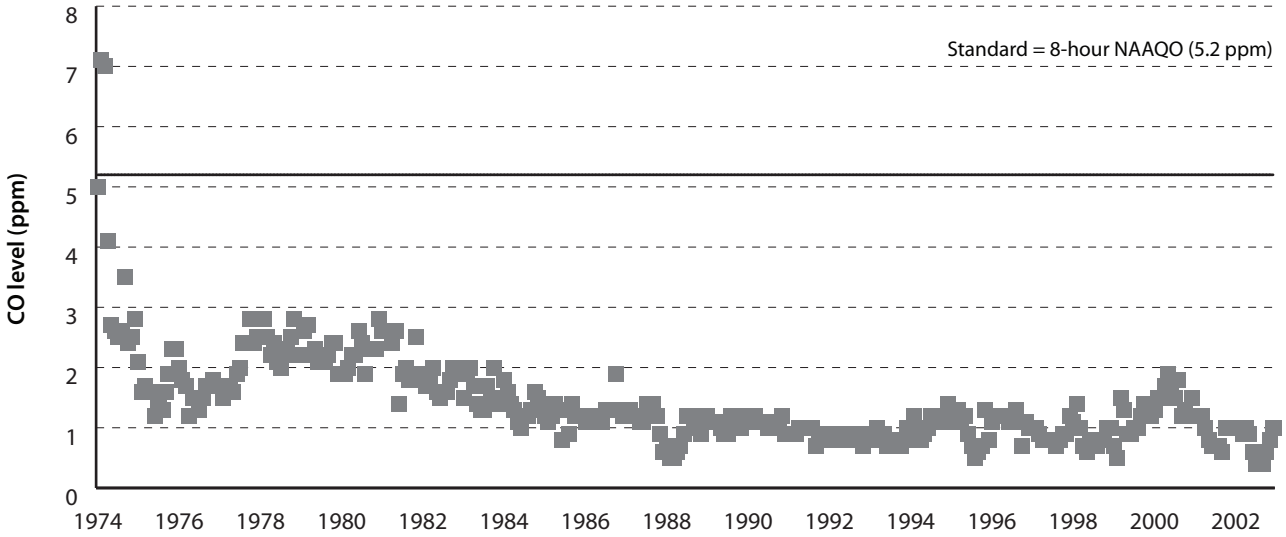
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 3a: Trend in ambient levels of CO in Montreal, 1977–2002



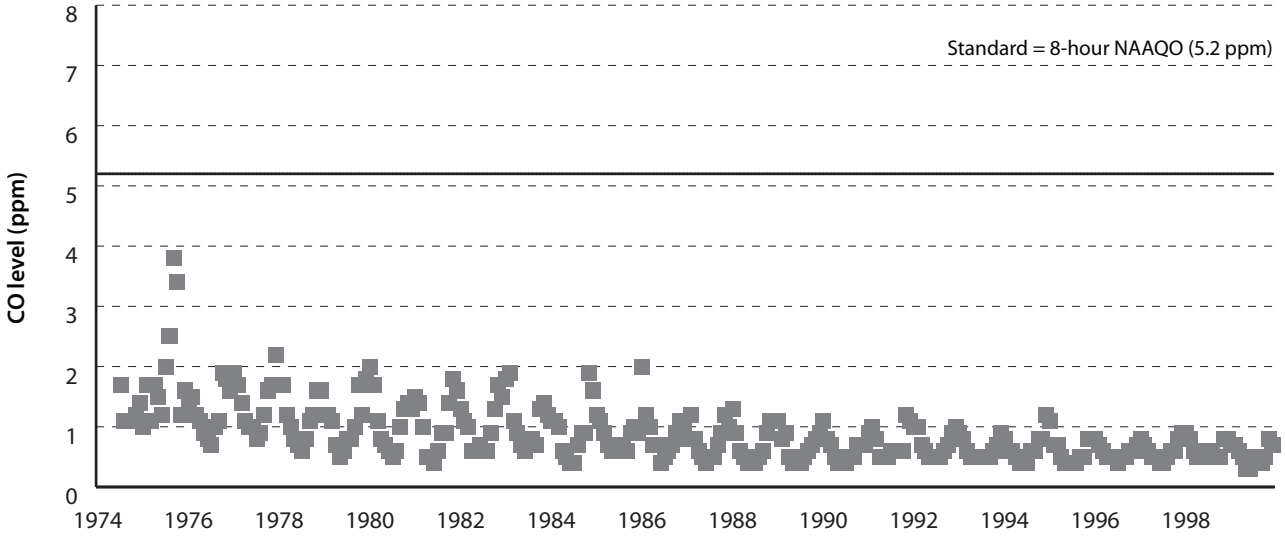
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 3b: Trend in ambient levels of CO in Toronto, 1974–2002



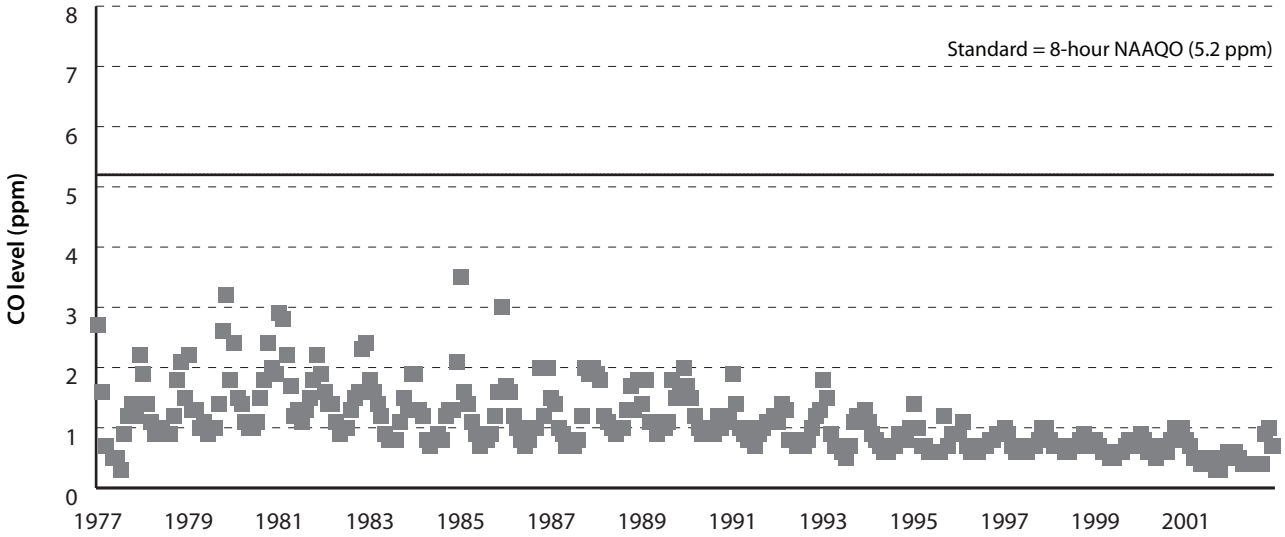
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 3c: Trend in ambient levels of CO in Calgary, 1974–1999



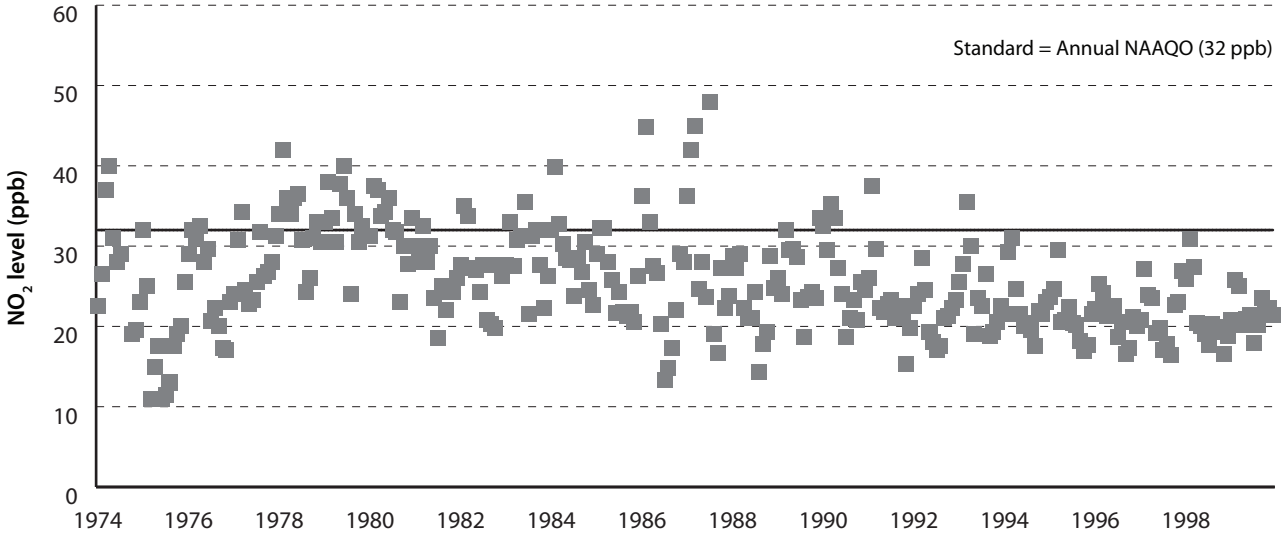
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 3d: Trend in ambient levels of CO in Vancouver, 1977–2002



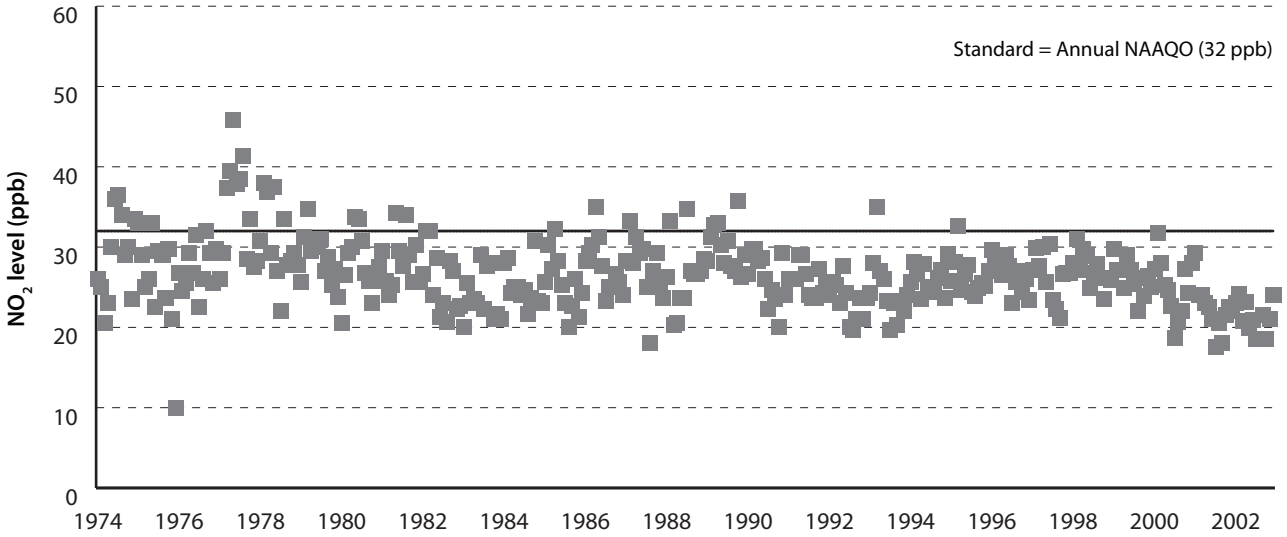
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 4a: Trend in ambient levels of NO_2 in Montreal, 1974–1999



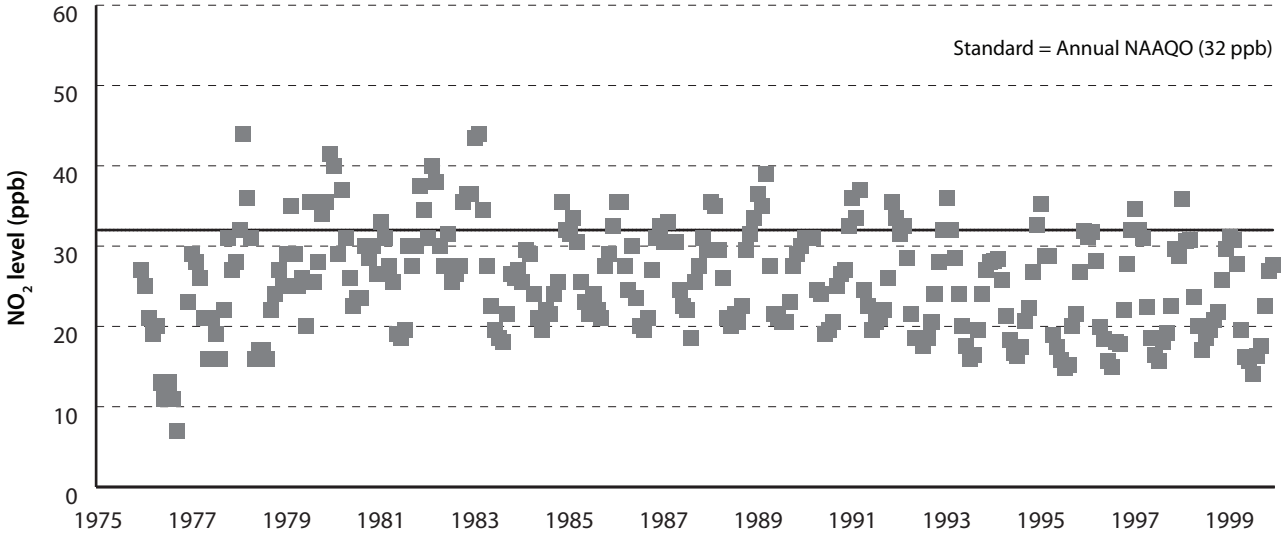
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 4b: Trend in ambient levels of NO_2 in Toronto, 1974–2002



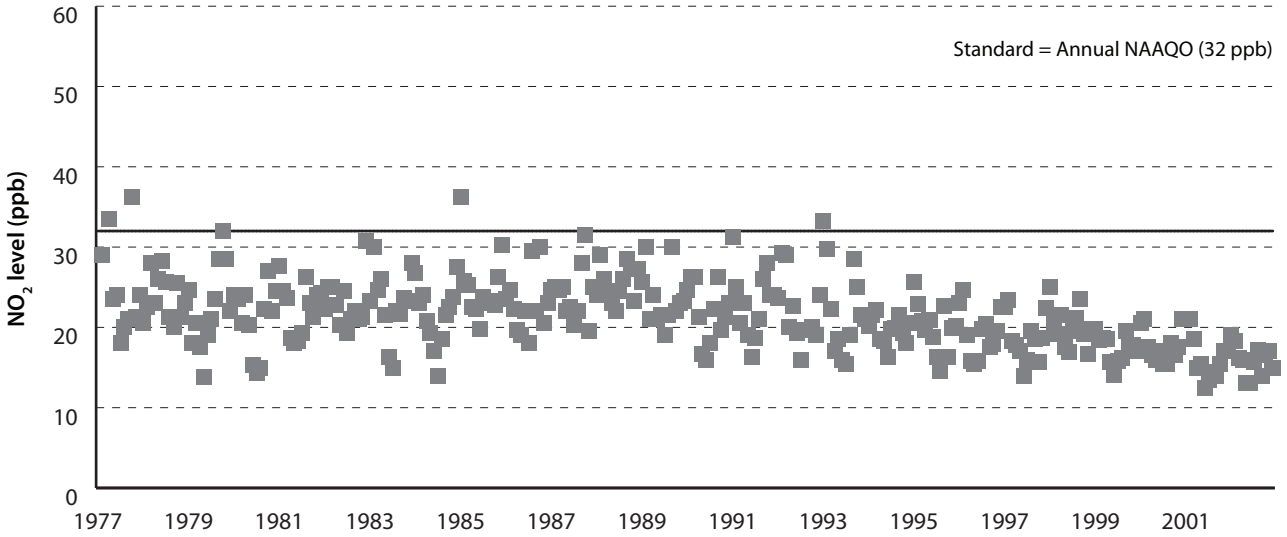
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 4c: Trend in ambient levels of NO_2 in Calgary, 1975–1999



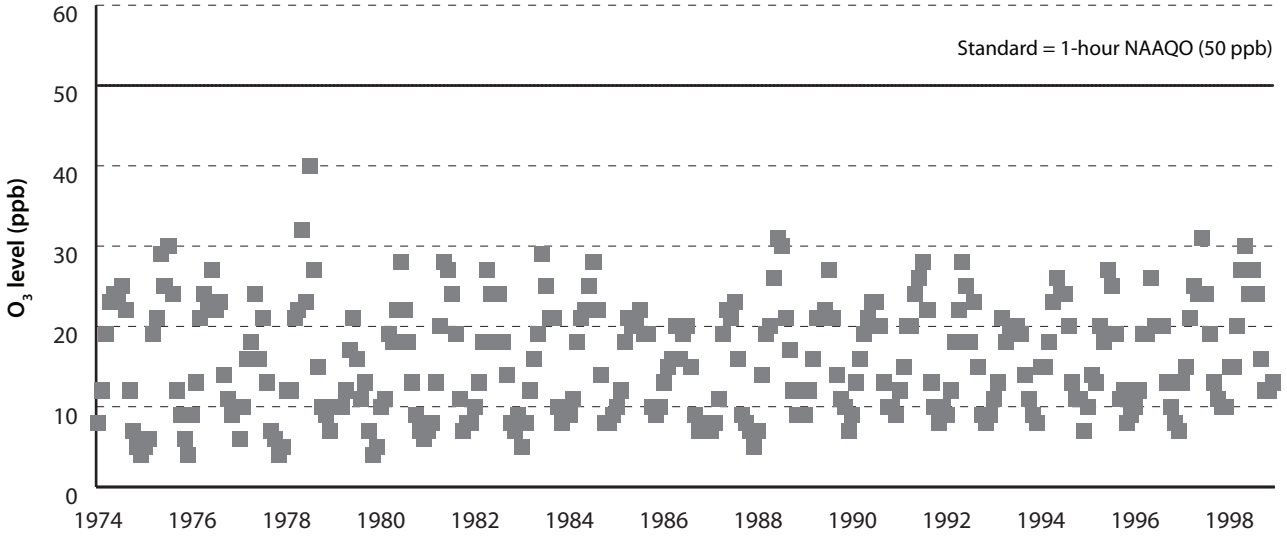
Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 4d: Trend in ambient levels of NO_2 in Vancouver, 1977–2002



Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

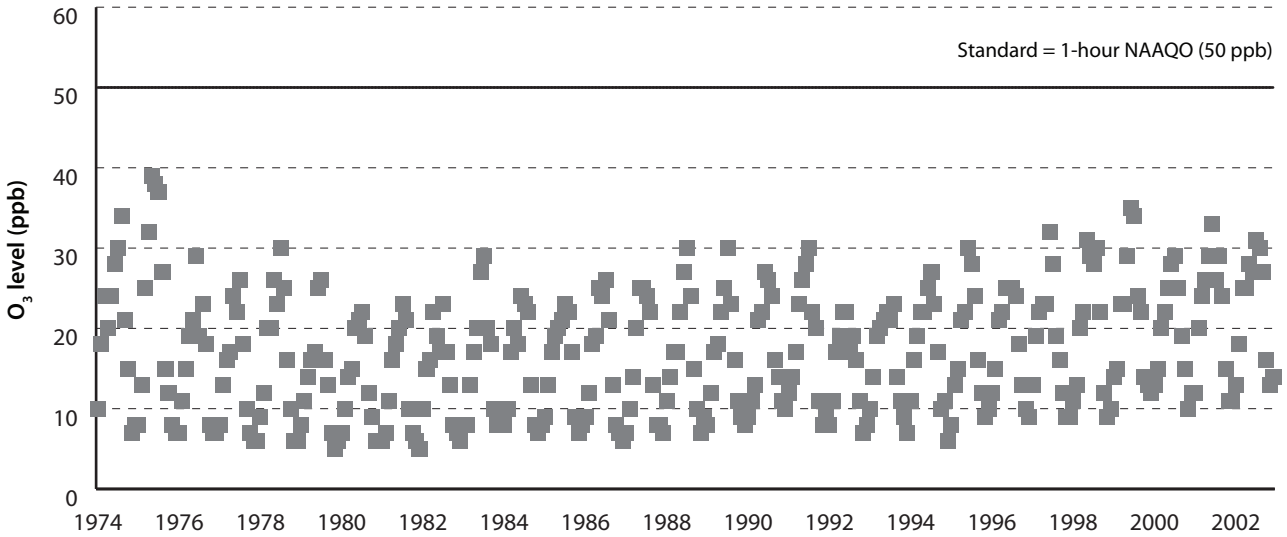
Figure 5a: Trend in ambient levels of O_3 in Montreal, 1974–1998



Note: The Canada-wide Standard for O_3 caps average peak episodes at 65 ppb. See text for details.

Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

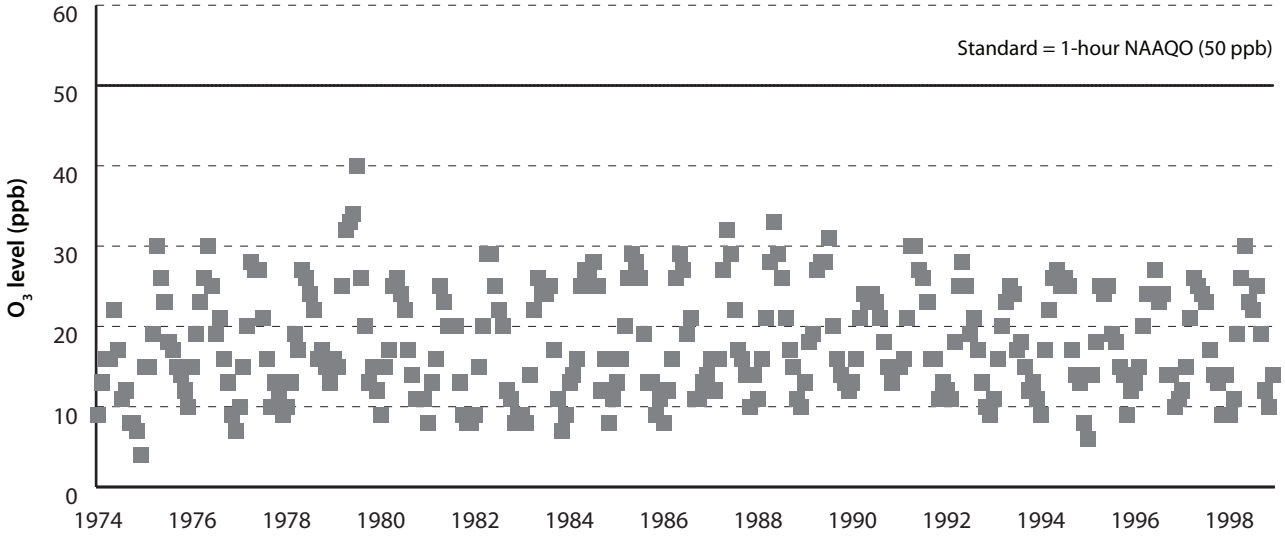
Figure 5b: Trend in ambient levels of O_3 in Toronto, 1974–2002



Note: The Canada-wide Standard for O_3 caps average peak episodes at 65 ppb. See text for details.

Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

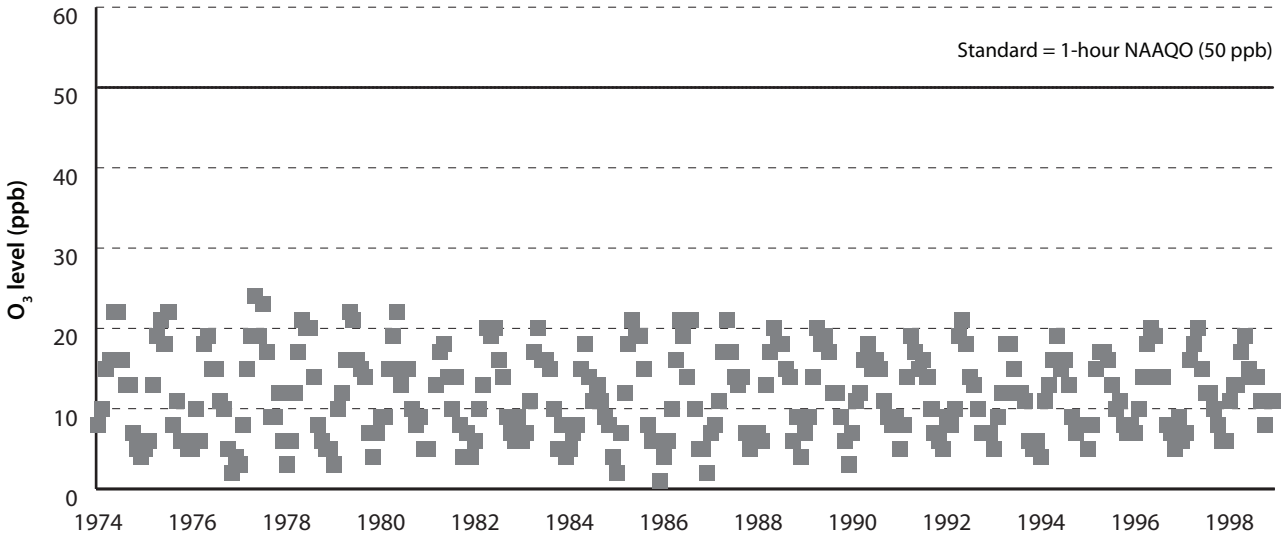
Figure 5c: Trend in ambient levels of O_3 in Calgary, 1974–1998



Note: The Canada-wide Standard for O_3 caps average peak episodes at 65 ppb. See text for details.

Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

Figure 5d: Trend in ambient levels of O_3 in Vancouver, 1974–1998



Note: The Canada-wide Standard for O_3 caps average peak episodes at 65 ppb. See text for details.

Source: Environment Canada, National Air Pollution Surveillance network, <http://www.etc-cte.ec.gc.ca/NAPSData/Default.aspx>.

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A breath of fresh Air

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Water and Wastewater Treatment in Canada

Tapping into Private-Sector Capital, Expertise, and Efficiencies

Elizabeth Brubaker

Walkerton. North Battleford. Kashechewan. Such communities have come to symbolize the breakdown of Canadian water and wastewater utilities. Across Canada, hundreds of communities provide unsafe drinking water or inadequate wastewater treatment, threatening human health and the environment. The vast majority of the troubled systems are publicly owned, publicly operated, publicly financed, and publicly regulated. Canada's limited experience with public-private partnerships, along with the more extensive experience of other jurisdictions, suggests that private investment, private expertise, and private efficiencies can and should play an important role in solving the problems besetting the country's public systems.

The precise number of substandard water systems in Canada is unknown. There is no single source of comprehensive data on utility performance. Although Environment Canada periodically surveys municipalities, many fail to provide the requested information. Only 312 municipalities, representing 9.7 million Canadians, responded to questions about the quality and quantity of drinking water in Environment Canada's 2001 survey of municipal water use. The results, while not necessarily representative of Canada at large, were troubling: municipalities representing 25% of the population of the responding municipalities had experienced water-quality problems that year, and municipalities accounting for more than 22% had issued boil-water advisories. Furthermore, those accounting for almost 25% had suffered water shortages (Environment Canada, 2004). Boil-water advisories are common in small and remote communities across Canada (Health Canada, 2006). In 2006, one estimate put the number of advisories at more than 1,000 (New Democratic Party of Canada, 2006). Even large cities are not exempt, as illustrated by the boil-water advisory issued in Vancouver in November 2006.

Problems with drinking water are particularly severe in aboriginal communities, 85 of which were under drinking-water advisories in October 2006 (Health Canada, 2006). Indian and Northern Affairs Canada (INAC) reported in 2003 that 30% of the 740 community water systems it assessed failed to meet federal *Guidelines for Canadian Drinking Water Quality*, and that 39% exceeded aesthetic objectives, such as those for iron, sodium, or turbidity. It determined that 29% of the systems posed high risks and that another 46% posed medium risks. INAC also assessed 462 wastewater systems, finding that 22% failed to meet *Canadian Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments*. It classified 16% of the systems as high risk and 44% as medium risk (Indian and Northern Affairs Canada, 2003: 17–20).

Inadequate wastewater treatment is also common in non-native communities. The Treasury Board has called municipal wastewater effluents "one of the largest threats to the quality of Canadian waters" (Treasury Board of Canada Secretariat, 2004). This warning echoed one issued by Environment Canada. Based on a 1999 survey of 1,285 municipalities with a total population of 25.4 million people, Environment Canada determined that almost 47% of municipal wastewater in Atlantic Canada was discharged into receiving waters without any treatment. On the Pacific coast, almost 85% of municipal wastewater was discharged after receiving only primary treatment or, in some cases, after merely being screened (Environment Canada, 2003). The untreated or inadequately treated sewage threatens not only the environment, but also human health, shellfish harvesting, recreation, and tourism, with attendant economic costs (Environment Canada, 2001).

The failures of water and wastewater utilities result from several factors. Many systems are old, nearing the end of their useful lives. Many are too small, unable to meet the needs of growing populations. Many are underfunded, starved for both capital and operating funds by politicians unwilling to raise water prices to sustainable levels. Many are badly managed or are operated by ill-trained staff. Many are laxly regulated. For all of these reasons, Canada is facing, in the words of a study prepared for Infrastructure Canada, "an infrastructure crisis of frightening proportions" (Mirza and Haider, 2003: 3). The crisis may well intensify as populations grow, infrastructure ages, and municipalities face more stringent standards.

The status quo cannot be counted on to meet these challenges. Canada's utilities could benefit in several ways from greater private-sector involvement. Given political realities, few local or central governments are likely to experiment with private ownership. Within the context of public ownership, however, the private sector has much to offer: it can provide capital; it can bring to water utilities a great deal of expertise; and it has myriad incentives to construct and operate systems effectively and efficiently. Furthermore, it can be held accountable more easily than the public sector. Each of these benefits is discussed in greater detail below.

> Capital investment

Canada's water and wastewater systems are in desperate need of investment. Estimates vary, in part because many municipalities lack accurate assessments of their infrastructure's condition. It is widely accepted that many tens of billions of dollars are required. The National Round Table on the Environment and the Economy suggested in 1996 that, over the following 20 years, Canada would need to invest between $38 billion and $49 billion to maintain and refurbish existing water and sewage infrastructure. In addition, it estimated, it would need to invest $41 billion in new stock (1996: 10, 35). The Canadian Water and Wastewater Association roughly echoed the Round Table's projections, estimating that, between 1997 and 2012, $27.6 billion would be required to renew water treatment and distribution and $61.4 billion would be needed to upgrade sewers and wastewater treatment (1998: iv).

The public sector has been unable or unwilling to provide the necessary investment. Federal and provincial subsidies have declined in recent decades, further

stressing municipal capacity. Governments and industry consultants have recognized for more than 15 years that the private sector can and should help meet investment needs (Price Waterhouse, 1991; MISA Advisory Committee, 1991; Interministry Committee on Local Government, 1994; Thompson Gow, 1995; Delta Partners, 1997). The Bank of Canada points out that, although the market for financing of infrastructure through public-private partnerships is in its infancy in Canada, many of the conditions required to support its development are in place (Woodman, 2006). Financing partnerships are gaining momentum. Several provinces have established agencies dedicated to partnerships. Institutions are increasingly interested in investing in infrastructure. Indeed, in October 2006, the Canada Pension Plan Investment Board, attracted by the prospect of stable cash flows, made a $1.05-billion offer for a portion of a British water utility.

Although Canada has limited experience with privately funded water infrastructure—one important exception being Moncton, which in 1998 contracted USF Canada to finance, design, build, and operate a state-of-the-art water filtration plant—private investment is commonplace elsewhere. Most often, private investment has occurred in privately owned utilities. In England and Wales, where water and wastewater systems were privatized in 1989, the private companies' investment in infrastructure has averaged more than £3 billion a year and shows no signs of letting up (Ofwat, 2006). Private water companies in the United States have likewise invested considerable sums in infrastructure. A survey by the National Association of Water Companies of 84 investor-owned water utilities serving 5.7 million households and businesses found that the firms had invested almost US$983 million in 1998 and planned further capital expenditures of almost US$4.2 billion in the following five years (National Association of Water Companies, 1999). While less common, some operations and maintenance contracts have also involved large investments. United Water, for example, invested almost US$10 million in advanced technologies for Atlanta's drinking-water system. The firm and at least one rival have stressed that they have the resources to meet the capital needs of any Canadian municipality (Brubaker, 2002: 82).

Availability aside, private capital has several advantages over public capital. It frees up public funds for other purposes, and its use transfers financial risks from the public to the private sector.[1] Furthermore, it is likely to be used more efficiently than public capital (Poole, 1996: 14–15; Levac and Wooldridge, 1997: 32–38). Private firms' incentives and abilities to reduce capital costs were illustrated in Moncton, where USF Canada built the water plant for at least 25% less than the city was planning to spend (Brubaker, 2002: 88).

1 The private sector's borrowing costs may appear to be higher than governments' borrowing costs because taxpayers do not guarantee the former. As one economist explains, if the costs of the credit insurance that taxpayers provide for free were taken into account, "it would no longer be clear that government credit is cheaper" (Klein, 2000: 25; also see Levac and Wooldridge, 1997; Prokopec, 1997). The use of private capital reallocates risks from taxpayers to shareholders. Furthermore, reducing governments' financial liabilities may strengthen their credit ratings and reduce borrowing costs for other projects.

> Expertise and effective, efficient performance

Another argument for involving the private sector in Canada's water and wastewater operations is that doing so will inject expertise into the systems.[2] Large international water companies, several of which have been in the business for more than a century, have developed considerable expertise. They invest hundreds of millions of dollars a year in research and development. They have thousands of specialized employees, whose skills can be harnessed to solve local problems. As the director of public works said of Indianapolis's decision to hire a private firm to operate its sewage system, "These guys have resources our guys could only dream of." The city's mayor added that the arrangement "brought us some of the best technical experience in the world—the companies comprising the partnership employ more Ph.D. civil engineers than the city of Indianapolis has employees. They literally wrote the book on water treatment" (Brubaker, 2002: 37).

A desire to share in water companies' expertise contributed to the decision to engage a private operator for the systems in Walkerton and the nearby communities that make up the municipality of Brockton. Keenly aware of the deficiencies in the public utility commission that operated the systems when tainted water killed seven people and sickened 2,300, and fearing that it could not afford to keep specialized expertise in house, the municipality turned to private professionals. The mayor explained, "In the name of safety, and to keep everyone happy, we have to get someone we can rely on" (Brubaker, 2006: 17). The municipality concluded a service agreement with Veolia Water Canada in June 2006. The fixed-fee contract, renewable after five years at the municipality's discretion, includes operations, maintenance, and management of the municipality's three drinking-water systems and its wastewater treatment plant.

Although Brockton has partnered with a water giant, small specialized firms can also bring expertise to many communities. When *E. coli* contaminated Kashechewan's water, prompting the airlift from the reserve of more than 1,100 residents, the federal government called in Northern Waterworks, a firm that operated 11 plants in northwestern Ontario. The firm's technician flew into the community and repaired the malfunctioning chlorination system in less than six hours. The firm now operates the system.

Private firms have a variety of incentives to put their expertise to use, ensuring that plants perform effectively and efficiently. Municipalities and other facility owners can build incentives into operating agreements with private service providers, structuring contracts to reward good performance and to penalize bad performance. Milwaukee established a system of performance

2 Many small systems are overseen or operated by poorly trained staff who are ill-equipped to meet the challenges they may face. Several provinces have required increased training and certification for operators of municipal water plants in recent years. However, as of 2006, Newfoundland, New Brunswick, the Northwest Territories, and Nunavut still had no requirements for training or certifying operators (Christensen, 2006: 25, 55). The lack of operator expertise is especially acute in aboriginal communities. An INAC assessment revealed that just 10% of the 1,200 people working in First Nations water and wastewater facilities met industry certification requirements, and that just 65% had received some form of training to operate the systems (Indian and Northern Affairs Canada, 2003: 16).

payments and penalties related to the quality of effluents from its two wastewater treatment plants. For example, it rewards the contractor for reductions in annual average biochemical oxygen demand, adding US$100,000 to the contractor's service fee for every milligram per litre of improvement. For its first year of operations, the contractor earned a US$50,000 bonus, along with kudos for consistently meeting national permit requirements for the first time in five years. It repeated this performance the following years (Brubaker, 2002: 28). Even without contractual incentives, competition for contracts and their renewal motivates bidders and operators to perform well and to continually discover and implement cost-effective alternatives.

In the United States—where, in 2002, more than 2,400 publicly owned water and wastewater systems were privately operated (Reinhardt, 2003)—competition has prompted efficiencies in both the construction and operation of facilities. By streamlining finance, design and engineering, procurement, and construction practices, private firms have reduced construction times and costs. Free from political constraints, they have cut staffing levels. They have invested in costly equipment promising long-term savings. They have developed innovative management information systems and data processing technologies to improve cash flows, accounting, metering, billing, and debt collection. Large firms have taken advantage of bulk prices for chemicals and other supplies and have benefited from economies of scale in design, expertise, and equipment. The savings resulting from various efficiencies have been impressive. The Reason Foundation has repeatedly found private operators to be between 20% and 50% more efficient than their public counterparts. *Public Works Financing*'s estimates of the operating savings resulting from outsourcing, based on 45 operations and maintenance contracts with terms of over 10 years, have fallen in roughly the same range: 20% to 45% (Brubaker, 2002: 25–26).[3]

As long as the quality of service is regulated, efficiencies do not come at the expense of good performance. Indeed, as a rule, private firms are less likely than their public counterparts to violate safe drinking water standards (Moore, 2004: 6). A survey by the Water Partnership Council of officials in 31 American communities engaged in public-private partnerships found that regulatory compliance improved under 74% of the partnerships (Reason Foundation, 2006: 177).

Given the performance of private water operators in the United States, it is unsurprising that municipalities seem to be pleased with their water and wastewater

3 It appears that competition rather than ownership is key to reducing costs (Kitchen, 1993: 22). A study prepared jointly by the American Enterprise Institute and the Brookings Institution noted that most comparisons of operating efficiency in publicly and privately owned water utilities in industrialized countries have used fairly small datasets and have been inconclusive. The authors, analyzing data for every community water system in the United States, found that households served by privately owned systems pay, on average, $14 a year less than those served by publicly owned systems, and that benchmark competition among private utilities yields annual household savings of up to $33. Such modest savings are consistent with the understanding that "Competition drives innovation and efficiency improvements, but in the water sector is not nearly as robust as in other industries" (Wallsten and Kosec, 2005: 28). Dramatic savings in the United States have resulted not from private ownership but from private firms competing to operate publicly owned systems. Where competition is absent, regulation may achieve similar results. In England, for example, incentive regulation promotes efficiency improvements (Brubaker, 2002: 150–53).

partnerships. *Public Works Financing* reported that, from 2000 to 2005, more than 94% of the water and wastewater contracts that had come up for renewal had been renewed either with the incumbent or, occasionally, with a competitor. Fewer than 6% had reverted to municipal operations. The Water Partnership Council's survey likewise found community representatives to be very satisfied—or, at the worst, satisfied—with their new arrangements (Reason Foundation, 2006: 177).

> Accountability

A private owner or operator is inherently more accountable—to provincial regulators, the public, municipal governments, and the market—than a public owner or operator. Governments that finance water and wastewater infrastructure understand that if they enforce the law, they may have to help pay for necessary upgrades. Likewise, governments that own or operate plants understand that prosecuting poor performance may require them to prosecute themselves. Such conflicts often result in regulatory paralysis (Davies and Probst, 2001; Christensen, 2006: 44–45).

Although people often associate privatization with deregulation, or a loss of control, the privatization of water utilities does not in any way imply deregulation. On the contrary, it goes hand-in-hand with a new focus on regulation. As explained in a review conducted by the federal Policy Research Initiative, "Privatization is not a simple retreat of the state, but rather a redefinition of its role as a regulator in a market-oriented economy" (Ouyahia, 2006: 17). Ontario's limited experience with privatization confirms this. Enforcement improved dramatically during Hamilton's 10-year experiment with private operations; although the city's sewage-treatment facilities exceeded provincial pollution limits for many years, not until after privatization did the environment ministry lay charges and seek fines against the operator. The same thing has happened in other jurisdictions, most notably in England and Wales. Before privatization, the government's conflicting roles as (in its words) "poacher" and "gamekeeper" constrained enforcement. Privatization separated the operator from the regulator, producing what one regulator identified as the most significant gain of privatization. Since privatization, the system of water regulation in the United Kingdom has become one of the toughest in the world, with impressive results (Brubaker, 2002).

Of course, privatization will not solve all regulatory problems. Governments tolerate private pollution as well as public pollution. For this reason, it is useful to create another level of accountability: accountability to the public through legal liability. Legal liability differs for those who work in private and public systems. Governments are often immune from tort liability for the consequences of policy and budget decisions—a protection without parallel in the private sector. The consequences of liability also differ. They tend to be more serious in the private sector, threatening not only the jobs of those responsible but also the firm's profits. Because private decision makers will bear the costs of their decisions, liability has a great deterrent value.

Privatization creates other forms of accountability as well. Enforceable contracts with specific performance criteria provide municipalities with powerful tools to compel compliance. Contracts can guarantee water quality, maintenance levels, or capital expenditures and

can include financial penalties for non-compliance. A Moncton representative described the protection built into his city's deal with a private water firm in this way: "If they don't meet the specs, then they ain't getting paid" (Brubaker, 2002: 89). In a privatized system, the market itself also provides accountability (Spulber and Sabbaghi, 1998: 194, 234). A poorly performing water company will be unable to increase its shareholder returns or its market share. As investors hold the firm accountable for bad performance, stock prices will fall. Clients and potential clients will refuse to work with an irresponsible firm. In the prescient words of then president and CEO of Azurix North America, "If you are negligent, you are history" (Brubaker, 2002: 136). In contrast, public service providers rarely face the threat of being put out of business. Lacking a "financial survival imperative" (Alesch, 1997: 13–14) makes them less accountable.

> Avoiding pitfalls

An increasing number of municipalities, understanding that competitive contracting often offers a "good solution" to a variety of problems, are contracting out plant operations (Expert Panel on Water and Wastewater Strategy, 2005: 20, 35). The extent of private operations can only be estimated, since no publicly accessible database of private operations is maintained and some private firms are reluctant to share information on their operations for fear of exposing themselves to unwanted competition. Whatever the exact number, it is growing in several provinces. In Ontario, the number of water or wastewater facilities operated by private firms increased from 26 in 1998 to 42 in 2001. By 2006, one service provider estimated that between 50 and 75 Ontario systems were privately operated (Brubaker, 2006: 15).

Despite its distinct advantages and its increasing popularity, partnering with a private firm will not automatically solve a community's water problems. Although there have been many successful contracts in recent years, there have also been a number of failures (Brubaker, 2003). Some contracts have failed because of inadequate baseline information. A lack of comprehensive data about the state of the infrastructure, the costs of providing services, the quality of influents and effluents, or work pending has led to expensive surprises and disputes over who should pay. Failures have also resulted from flaws in the contracting process, such as an absence of competition when contracts have been sole-sourced. In other cases, the contracts themselves have been flawed, perhaps because the parties had insufficient expertise to draft or assess them, or perhaps because they evaded difficult issues rather than forcing resolutions. Some contracts have lacked clarity about which party is responsible for what or have failed to spell out contingencies. Inadequate government regulation and insufficient public oversight stemming from limited access to information have also contributed to failures. Some failures have been more political, reflecting labour conflicts, public opposition, or a loss of support on municipal councils.

Most contracts have been structured with two core imperfections: they have been short-term contracts and have assigned responsibility for operations and maintenance to the private firm, while leaving responsibility for capital improvements with the municipality. Dividing responsibility for maintenance and capital improvements has led to disputes about the category in which

various expenditures should be placed. It has created incentives to put off small repairs until they have grown large enough to qualify as capital investments. More generally, it has created incentives to reduce operating costs at the expense of capital costs. Furthermore, by enabling the operator to blame poor performance on the municipality's lack of investment, it has made it difficult to enforce performance requirements.

Municipalities may avoid both problems by entering into long-term concessions that assign to the contractor responsibility for all aspects of the system. When a single party is responsible for both operations and capital investment, it has an incentive to reduce total costs over the long term. Moreover, it is far more difficult for the operator to pass the buck or point the finger when something goes wrong. It can only look to itself to correct the problem.

A role for the federal government

The provinces bear primary responsibility for drinking water and sewage treatment and have generally delegated all but their regulatory responsibilities to municipalities. Although the federal government funds and oversees water utilities in aboriginal communities and in other areas under its jurisdiction, such as military bases and national parks, its role in the rest of Canada is more "strategic" (Infrastructure Canada, 2004: 1). In the past, it has influenced provincial and municipal policies and practices through environmental and health regulations, subsidies to infrastructure, and the funding and coordination of research and policy development, some of which has promoted greater private-sector involvement.

Although the federal government cannot dictate policies on the financing and operations of water utilities to the provinces or municipalities, it can lead by example. Most obviously, it can encourage private operation or oversight of Canada's worst-run water and wastewater facilities: those on reserves. The government is sensitive to native communities' desires to determine for themselves how best to solve their widespread water and wastewater problems. However, discretion in moving towards locally appropriate solutions must not come at the expense of health and safety. When health and safety are at immediate risk and when a community is unable to address that risk, the federal government should be prepared to intervene and to appoint an expert operator to provide safe water until the community is able to do so itself. In some cases, it may be appropriate for the government to engage a professional water-services provider to monitor, supervise, and otherwise support (through training, troubleshooting, and emergency assistance) locally run plants.

The federal government can do much else to encourage private-sector participation in the provision of water services in non-native communities. It can educate both decision makers and the public about the potential benefits and risks of private involvement. The public is understandably confused about these issues.[4] By providing

4 According to the Canadian Union of Public Employees, one of the country's harshest critics of privatization, polls show that the majority of Canadians oppose the private provision of public services. And yet, the public places considerable confidence in private water providers: in 2003, the average Canadian, often citing concerns about the safety of tap water, consumed 47 litres of bottled water (Christensen, 2006: 36). The widespread use of home filtra-

unbiassed information about partnerships and the partnering process, peer-reviewed research papers, and case studies of privatization's successes and failures, the federal government can get the facts out, demystify the privatization process, and counter the misinformation often offered by privatization's critics. For several years, Industry Canada's Public-Private Partnership Office played such a role, albeit modestly, posting on its web site a wide selection of resources on privatization. With one exception, Industry Canada stopped updating the site in early 2004. That year, it also discontinued its *P3 Media Scan*—an email service that, in providing a continuous stream of articles about private-sector involvement, not only supplied invaluable current information but also created a sense of momentum. Such services may now be best provided by Infrastructure Canada, whose mandate includes building and sharing research and knowledge about infrastructure issues and working with provincial and municipal governments.

Furthermore, the federal government can help ensure the success of privatizations that do occur. Many municipal governments, especially smaller ones, lack the knowledge or skills required to negotiate and oversee complex contracts. The federal government can help prevent municipalities from bungling the process. It can help ensure that contracts are drafted and implemented in ways that protect the long-term interests of municipalities, workers, consumers, and investors. It can help municipalities navigate the privatization process, and it can prepare model Requests for Expressions of Interest and Requests for Proposals, along with information to guide municipalities through the bidding process. It can distribute model contracts that create incentives for adept and efficient performance and include effective monitoring and enforcement mechanisms.

The federal government can also help develop models for the effective economic regulation of public-private partnerships. Municipalities have failed as regulators. Canadian water rates—among the world's lowest—are generally well below the full costs of providing services.[5] Municipal governments tend to ignore the long-term needs of water infrastructure, divert to other uses funds earmarked for water systems, and focus on social or political concerns rather than the business-like operation of water services (Expert Panel on Water and Wastewater Strategy, 2005: 31, 37). These deficiencies in municipal governance prompted Ontario's Expert Panel on Water and Wastewater Strategy to propose the establishment of an impartial economic regulator to oversee business planning, rate setting, and service quality for all water service providers, public and private (Expert Panel on Water and Wastewater Strategy, 2005: 11, 37–42). Such a regulator could also oversee contracts between municipalities and private providers. Few models for the economic regulation of water utilities—or, more generally, for the oversight of public-private partnerships—exist in Canada. The federal government would do well to commission and disseminate research into the regulation of water utilities and other public-private partnerships in other jurisdictions, such as the United States and England, and the regulation of other utilities, such

tion systems also suggests suspicion of municipal water and trust in private alternatives.

5 The water revenues of Ontario's municipalities provided just 64% of the full costs of providing services in 2003 (Expert Panel on Water and Wastewater Strategy, 2005: 53).

as those supplying and distributing natural gas, here in Canada.

The federal government can also promote economically sustainable systems—and encourage greater private-sector involvement—by reducing water and wastewater subsidies. The government recognized the hazards of subsidies as early as 1987, when it noted in the *Federal Water Policy*—which has yet to be updated or replaced—that subsidies, in making possible low prices, had fostered the overuse of water and created an artificial need for costly treatment infrastructure (Environment Canada, 1987: 5). In the intervening decades, other adverse effects of subsidies on municipalities have emerged: while the expectation of grants has encouraged municipalities to delay necessary work, once they have materialized, grants have encouraged municipalities to undertake unnecessary work, resulting in excess capacity and higher upkeep and operating costs (Expert Panel on Water and Wastewater Strategy, 2005: 50–51, 54). Furthermore, the availability of grants and low-cost loans has left municipalities with few incentives to seek private capital. Thus, the federal government, by reducing subsidies, can motivate consumers to use water more efficiently, prompt municipalities to make more timely and efficient infrastructure choices, and encourage municipalities to seek investment by the private sector.

Finally, the federal government can create a regulatory environment that both encourages private-sector participation and ensures that it is successful. Although regulations that could be effective are currently in place, the government rarely enforces them. It rarely requires municipal sewage plants, for example, to comply with the federal *Fisheries Act*, which forbids the deposit of deleterious substances into water frequented by fish. Enforcing existing health and environmental standards will prompt many municipalities to seek assistance from those with greater expertise and will ensure that those providing that expertise perform satisfactorily.

Water infrastructure, the federal government understands, is not only a key determinant of public health and quality of life but is also key to economic growth and prosperity (Infrastructure Canada, 2004: 3–4). When successfully implemented, it further understands, public-private partnerships "are an innovative approach to enabling governments to carry out projects unlikely to proceed without private assistance, and are a useful tool to assist in working towards meeting infrastructure needs" (Infrastructure Canada, 2004: 13). Such understanding is not enough. It is time for action.

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Adaptive Management of Climate Change Risks

Indur M. Goklany

Under most scenarios of the future world, including those developed by the Intergovernmental Panel on Climate Change (IPCC) in its *Special Report on Emission Scenarios* (SRES) (IPCC, 2000), the world should be getting more populated and wealthier during this century. While this ought to advance human well-being, it should also increase greenhouse gas emissions, which may cause climate changes that may have negative consequences, with the potential to at least partly offset the advances in human and environmental well-being. The IPCC reports in its assessment of 2001 that modest global warming (of the order of 1° to 2° C over 1990 levels) could increase global economic product with gains in developed areas such as Canada and Northern Europe that are situated in the higher latitudes more than offsetting losses in developing countries (IPCC, 2001b: 943–48). However, global temperature increases beyond that could reduce global economic product and wreak substantial environmental damage.

Implicit in calls for aggressive reductions in greenhouse gases is the premise that a richer and more populous world will have lower human and environmental well-being because it would lead to greater climate change. These calls are further strengthened by repeated claims by highly regarded policy makers ranging from ex-President Chirac, ex-Prime Minister Blair, and ex-President Clinton that climate change is the most important environmental challenge facing the globe this century (Clinton, 1999; *Cordis News*, 2004, Nov. 19). Joining in this chorus, Canada's National Round Table on the Environment and the Economy (NRTEE) recently "concluded that climate change is the most significant threat we face as we enter this century."[1]

Based on analyses of the global impacts of climate change through the year 2085 on various threats to human and environmental well-being, this chapter will investigate whether climate change is, indeed, likely to be the world's most important environmental problem over the foreseeable future, and whether richer-but-warmer worlds will necessarily have lower human and environmental well-being than poorer-but-cooler worlds. It will then compare the global benefits and costs of reducing the impacts of climate change either through mitigation strategies (i.e., reductions in greenhouse gas emissions) or through strategies to reduce society's vulnerability to these impacts (i.e., adaptation). This comparison will show that in the near-to-medium term, reduction of vulnerability, appropriately focused, will provide greater

1 Glenn Murray, Chair, and Alexander Wood, Acting President and CEO, National Round Table on the Environment and the Economy, personal communication, August 16, 2006, to Mark Mullins, Executive Director, Fraser Institute.

benefits at lower costs than mitigation. In the longer term, however, mitigation may be inevitable, depending on the emissions path we find ourselves on and what is learned in the future about the social, economic, and environmental impacts of climatic changes induced by greenhouse gases. Finally, the chapter will offer a set of policies that will allow adaptation and mitigation strategies to evolve and be integrated over the different time scales to manage, effectively and efficiently, the future global risks from climate change, despite uncertainties about the magnitude and timing of these risks.

> Wealth, technology, well-being, and adaptive capacity

Economic growth broadly increases human well-being by increasing wealth, technological development, and human capital. These factors enable society to address virtually any kind of adversity, whether it is related to climate or not, and increase society's capacity to reduce damages from climate change through either adaptation or mitigation (Goklany, 1995, 2006; Yohe, 2001; Smit et al., 2001). It is well-established that many determinants of human well-being—hunger, malnutrition, mortality rates, life expectancy, the level of education, and spending on health care and on research and development—improve along with the level of economic development, as measured by GDP per capita (Goklany, 2002).

Increasing wealth also improves some, though not necessarily all, indicators of environmental well-being. Wealthier nations have higher cereal yield (an important determinant of cropland, which is inversely related to habitat conversion), greater access to safe water and sanitation, and lower birth rates (Goklany, 2006).[2] Notably, access to safe water and access to sanitation double as indicators of both human and environmental well-being, as does cereal yield since higher yield not only means more food and lower hunger, but it also lowers pressure on habitat (Goklany, 1998; Green et al., 2005). Cross-country data also indicate that, for a fixed level of economic development, these indicators of human and environmental well-being (e.g., malnutrition, mortality rates, life expectancy, access to safe water, crop yields, and so forth) improve with time, indicating the likely beneficial effect of technological advances (Goklany, 2002).

In other words, for any given level of per-capita income, human well-being as measured by either life expectancy or infant mortality improves with time because of new technologies and broader diffusion of existing technologies. Similarly, one should expect, all else being equal, that society's ability to cope with any adversity, including climate change, should also increase with the passage of time. That is, over time, society's adaptive capacity should increase and thus, barring inadvertent maladaptation, should reduce the future impacts of climate change (Goklany, 2006).

2 One indicator that, so far at least, has not shown an improvement with wealth is total CO_2 emissions. Also, some environmental indicators (e.g., air pollutants such as sulfur dioxide and particulate matter) generally worsen initially as incomes increase before declining at higher income levels (Shafik, 1994; Grossman and Krueger, 1995; Dasgupta et al., 2006).

The IPCC's scenarios for the future

The information in this chapter is drawn for the most part from the "Fast Track Assessment" (FTA) of the global impacts of climate change sponsored by the UK Department of Environment, Forests and Rural Affairs (DEFRA), and reported in a special issue of *Global Environmental Change* edited by Dr. Martin Parry (Parry, 2004), and supplemented, as necessary, by other DEFRA-sponsored studies. Many, if not most, of the authors of the papers in that special issue have served as coordinating lead authors, lead authors, or contributing authors of the IPCC's Third and Fourth Assessment Reports. Dr. Martin Parry is, moreover, the current Chairman of the IPCC's Work Group II, which oversees the impacts, adaptation, and vulnerability sections of Assessments.

Like all estimates of the impacts of climate change, the results of the FTA are plagued with uncertainties resulting from, among other things, the fact that such estimates are based on a series of linked models with the uncertain output of each model serving as the input for the next model. Socioeconomic assumptions are used by emission models to generate emission scenarios extending 100 or more years into the future. These scenarios are then used to drive yet other models to estimate future trends in atmospheric concentrations of greenhouse gases. This information is then fed into coupled atmosphere-ocean general circulation models (GCMs) to estimate spatial and temporal changes in climatic variables. These are used as inputs to simplified and often inadequate biophysical models that project location-specific biophysical changes (e.g., crop or timber yields). Next, depending on the human or natural system under consideration, the outputs of these biophysical models may have to be fed into additional models to calculate the social, economic, and environmental impacts on those systems.

Despite the resulting cascade of uncertainties associated with such impacts assessments, for the purposes of this chapter I will, for the most part, take the results of the FTA at face value, because it has figured prominently in the international debate about global warming.[3] Like the FTA, this chapter does not consider low-probability but potentially high-consequence outcomes such as a shut down of the thermohaline circulation. They are deemed unlikely to occur during this century (see, e.g., DEFRA, 2004; Gregory, 2005; Wunsch, 2004).

The FTA employed scenarios developed by the IPCC's *Special Report on Emissions Scenarios* (IPCC, 2000) to project future climate change. The dominant characteristics of the "storylines" used in the SRES are shown in table 1. These characteristics describe the demographic, technological, economic, and social trajectories driving emissions in the four scenarios that were used by the

3 For example, results of the FTA's results for the impacts of climate change on food, agriculture, water resources, and coastal flooding were a prominent part of a symposium, *Avoiding Dangerous Climate Change*, sponsored in 2005 by the UK Government as part of the run-up to the 2005 Gleneagles Summit of the G-8 (DEFRA, 2005), and which also informed the more recent Stern Review of the Economics of Climate Change. Prior to that, the claim by Her Majesty's Government's Chief Science Advisor Sir David King's (2004) that "climate change is the most severe problem that we are facing today—more serious even than the threat of terrorism" was based, in part, on older FTA estimates that were published in another special issue of *Global Environmental Change* (Parry and Livermore, 1999; Arnell et al., 2002; see Goklany and King, 2004).

Table 1: Characteristics and assumptions for the various scenarios

	A1FI	A2	B2	B1
Population in 2085 (billions)	7.9	14.2	10.2	7.9
GDP growth factor, 1990–2100 (1990 $US)	525 to 550	243	235	328
GDP/capita in 2085, global average (1990 $US)	$52,600	$13,000	$20,000	$36,600
GDP/capita in 2100 (1990 $US)				
Industrialized countries	$107,300	$46,200	$54,400	$72,800
Developing countries	$66,500	$11,000	$18,000	$40,200
Technological change	rapid	slow	medium	medium
Energy use	very high	high	medium	low
Energy technologies	fossil intensive	regionally diverse	"dynamics as usual"	high efficiency
Land use change	low-medium	medium-high	medium	high
CO_2 concentration (ppm) in 2085	810	709	561	527
Global temp change (°C) in 2085	4.0	3.3	2.4	2.1
Sea level rise (cm)	34	28	25	22

Note: Global temperature change is based on the HadCM3 model. The columns in this table are arranged by scenario in the order of decreasing global temperature changes. Using the labels provided by the IPCC, these scenarios from left to right are A1FI (warmest), A2, B2 and B1 (coolest).

Sources: Arnell et al. (2004: tables 1, 6, 7); Arnell (2004: table 1); Nicholls (2004: tables 2, 3).

FTA. This table also provides corresponding estimates of atmospheric CO_2 concentrations in 2085, and climate change (as represented by increases in globally averaged temperature) and sea-level rise between 1990 and 2085 (Arnell et al., 2004). The columns in this and most subsequent tables are arranged by scenario in the order of decreasing change in global temperatures. Using the labels provided by the IPCC, these scenarios from left to right are A1FI (warmest), A2, B2 and B1 (coolest).

The FTA used these climate-change projections (Arnell et al., 2004) to estimate the global impacts on various climate-sensitive threats that also serve as determinants of human and environmental well-being. The FTA analyzed hunger (Parry et al., 2004), water stress (Arnell, 2004), coastal flooding (Nicholls, 2004), and malaria (van Lieshout et al., 2004) as threats affecting human well-being; and projected net biome productivity (a measure of the strength of the terrestrial biosphere as a carbon sink) and the global extent of coastal wetlands and croplands (Levy et al., 2004) as threats to environmental well-being. In this chapter, I will use the FTA's climate-change impact estimates for 2085 or 2100 while noting that 2085 is at the outer limit of the foreseeable future since socioeconomic scenarios are not deemed credible beyond that (Arnell et al., 2002).

Examination of table 1 suggests that, on one hand, the impacts of climate change should decrease as one goes from scenario A1FI on the left to B1 on the right (in accordance with the pattern of declining climate change, other things being equal).[4] On the other hand, economic and technological development—both critical determinants of adaptive capacity (Goklany, 1995, 2006; Smit et al., 2001; Yohe, 2001)—ought to attenuate the impacts through a combination of autonomous and proactive adaptations. Considering future levels of economic and technological development this attenuation should be greatest for the A1FI scenario, followed by the B1, B2, and A2 scenarios, in that order. Thus, even though the A1FI scenario has the highest climate change it would not necessarily have the worst outcomes, because it should also have the highest adaptive capacity, since it leads to the richest world.

The threats to human and environmental well-being examined by the FTA—hunger, water stress, malaria, coastal flooding, and loss of habitat and carbon sinks—are not unique to climate change. Factors unrelated to climate change also contribute to these threats. In the following, the magnitude of the threat or problem in the absence of climate change will be denoted by $P_{o,}$ while the magnitude of the problem due to climate change will be indicated by ΔP. Thus, the magnitude of the total problem $[P_T]$ with climate change equals $P_o + \Delta P$.

In consonance with the FTA, the magnitude of the problem (P) due to each climate-sensitive threat affecting human well-being (namely, malaria, hunger, water stress, and coastal flooding) will be measured by the global population at risk (PAR) or suffering from the specific climate-sensitive threat. For these threats, P will henceforth be used interchangeably with PAR, as will ΔP with ΔPAR. With respect to environmental well-being, P will be measured by various indicators of habitat loss, which is generally acknowledged to be the most important threat to global terrestrial biodiversity (e.g., Green et al., 2005; Goklany, 1998), and by the global terrestrial-sink capacity (i.e., the capacity of the earth to absorb carbon dioxide from the atmosphere).

4 The "FI" in "A1FI" indicates that this scenario is fossil fuel intensive.

> Population at risk for various climate-sensitive threats, with and without climate change

In this section, I present the FTA's estimates of the populations at risk in 2085, with and without climate change (i.e., ΔPAR and P_o, respectively), for four climate-sensitive threats to human well-being (namely, hunger, water stress, coastal flooding, and malaria) under each scenario summarized in table 1.

In comparing P_o and ΔPAR under the various scenarios, it should be noted that, first, the A1FI and B1 scenarios are assumed to have the same population in 2085 (see table 1). In fact, in the real world, lower total fertility rates are generally associated with higher levels of economic development. Arguably, therefore, the A1FI world should have a lower population in 2085 than the B1 world. Accordingly, the emissions and climate change for the A1FI scenario are probably overestimated relative to the B1 scenario, as are P_o and ΔPAR.

Second, while the FTA studies assume that no new governmental policies and measures will be implemented to reduce damages from climate change, some of them (e.g., the studies for hunger and coastal flooding) allow for some "spontaneous" adaptive responses because it should be expected that, even in the absence of new governmental policies, people would employ existing technologies to protect themselves from economic or bodily harm under a "business-as-usual" world. However, even where the FTA studies allow for such adaptation, they limit the range of available technological options to currently available technologies (see, e.g., Parry et al., 2004: 57). But we should expect that the menu of technological options would be much broader, more cost-effective, and more affordable in the future under any SRES scenario because: (a) the world will be wealthier under any of the scenarios (table 1) and, therefore, better able to develop, afford, and adopt new as well as improved technologies; (b) technology will advance through the accretion of knowledge, even if society does not become wealthier; and (c) even in the absence of specific policy changes, new and improved technologies will inevitably be developed to cope specifically with the negative impacts of climate change. Thus, the FTA studies tend to overestimate both P_o and ΔPAR, with the upward bias increasing with the future level of economic development: that is, the overestimates are greatest for the A1FI scenario, followed by B1, B2 and A2, in that order.

Hunger

The FTA's estimates of PAR for hunger in 2085, both with and without climate change, for the various scenarios are shown in table 2 in terms of both millions of people and the percent of global population. These estimates, taken from Parry et al. (2004), show that whether or not climate changes beyond 1990 levels, no matter which scenario we choose, through 2085 the future world will be better off with respect to hunger than it was in 1990. In 2085, the warmest scenario might actually result in lower levels of hunger than some cooler scenarios. Hunger in 2085 will be lowest in the B1 scenario, followed by A1FI, B2, and A2 (in that order). Thus, the warmest scenario (A1FI) does not lead to the lowest level of well-being, despite the tendency to overestimate its impacts. For some scenarios (A2 and, possibly, B2), climate change might, in fact, reduce the incidence of hunger at least through 2085. Finally, for each scenario,

Table 2: Population at risk (PAR) in 2085 for hunger, with and without further climate change

Baseline 1990	A1FI 2085	A2 2085	B2 2085	B1 2085
Population at risk in the absence of climate change (P_0) (millions)				
798 to 872 (15.1% to16.5%)	105 (1.3%)	767 (5.4%)	233 (2.3%)	90 (1.1%)
Additional population at risk because of climate change (ΔPAR) (millions)				
N/A	28 (0.4%)	−28 to −9 (−0.2% to −0.1%)	−11 to +5 (−0.1% to 0.05%)	10 (0.1%)
Total population at risk (TPAR = P_0 + ΔPAR) (millions)				
798 to 872 (15.1% to 16.5%)	133 (1.7%)	739 to 758 (5.2% to 5.3%)	222 to 238 (2.2% to 2.3%)	100 (1.3%)

Note: Figures in parentheses are in percent of global population.

Source: Parry et al. (2004).

ΔPAR is smaller than P_0, which shows that through 2085 at least, the impact of climate change is secondary to the impact of other environmental factors that are unrelated to climate change.

The estimates shown in table 2 are based on the assumption that direct CO_2 effects on crop yields would be realized. If, however, these direct effects are not realized, then Parry et al.'s analysis indicates that climate change would exacerbate the total population at risk (TPAR) under all scenarios while ΔPAR would still be less than P_0 for all but the A1FI scenario. But such outcomes are unlikely. First, the probability that direct CO_2 effects on crop growth are zero or negative is virtually non-existent, particularly since future societies should have a greater capacity to adapt (IPCC, 2001b: 254–56; see, also, Long et al., 2006). As noted, the FTA most likely systematically overestimates P_0 and ΔPAR for tomorrow's wealthier and more technologically advanced societies, especially for the A1FI world, which has the highest level of wealth, because yields generally increase with greater wealth (Goklany, 2000). Moreover, the population of the A1FI world might be an overestimate relative to the B1 world. Had these factors been given their due, the A1FI scenario might have resulted in the lowest overall levels of hunger.

Finally, the estimates provided in table 2 indicate that, in order to compare the consequences of various scenarios, it is insufficient to examine only the impacts of climate change. One should look at the total level of hunger. Otherwise, based merely on an examination of ΔPAR, one could conclude, erroneously, that, with respect to hunger, A2 is the best of the four scenarios. But, based

Table 3: Population at risk (PAR) in 2085 for water shortage, with and without further climate change

Baseline 1990	A1FI 2085	A2 2085	B2 2085	B1 2085
Population at risk in the absence of climate change (P_0) (millions)				
1,368	2,859	8,066	4,530	2,859
(25.8%)	(36.2%)	(56.8%)	(44.4%)	(36.2%)
Additional population at risk because of climate change (ΔPAR) (millions)				
NA	–1,192	–2,100 to 0	–937 to 104	–634
	(–15.1%)	(–14.8% to 0%)	(–9.2% to 1.0%)	(–8.0%)
Total population at risk (TPAR = P_0 + ΔPAR) (millions)				
1,368	1,667	5,966 to 8,066	3,593 to 4,634	2,225
(25.8%)	(21.1%)	(42.0% to 56.8%)	(35.2% to 45.4%)	(28.2%)

Note: Figures in parentheses are in percent of global population.

Source: Arnell (2004: 41, table 8).

on total PAR, A2 would be the worst. This also illustrates that efforts focused on minimizing the consequences of climate change to the exclusion of other societal objectives might actually reduce overall human welfare.

Water stress

The FTA's estimates of PARs for water stress in 2085 with and without climate change are shown for each scenario in table 3 in both millions of people and the percent of global population (Arnell, 2004).[5] A population is deemed to be at risk if its available water supplies fall below 1,000 m^3 per capita per year. The ΔPARs in table 3 account for the fact that because of climate change some populations will move in and out of the water-stressed category.

Information in table 3 indicates that, for each scenario, P_0 exceeds ΔPAR in 2085. In other words, with respect to water stress, factors unrelated to climate change are more important than climate change under each scenario, at least through the foreseeable future. As with hunger, climate change by itself might, in fact, *reduce* the total PAR for water stress. In the absence of climate change, A1FI and B1 have the smallest PAR in

5 Arnell (2004) also uses the "10-year return period minimum annual runoff" as a measure of water availability. Even under this variation, climate change relieves water stress in 2085 (compared to the "no climate change" condition). Hence, those results are not shown.

2085, while A2 generally has the highest. This is true in terms of both absolute numbers and the percent of total population for the relevant scenario. In the absence of climate change, the A1FI and B1 scenarios have identical PARs due to the population assumptions built into the story lines. With climate change, the A1FI world continues to have the lowest PAR, but that for B1 falls to second place.

Notably, Arnell's analysis totally ignores any adaptation despite the ready availability of time-tested adaptive responses on both the supply and demand side: for example, water storage facilities to augment water supplies during drier periods, or water pricing and other conservation measures (Goklany, 2005). Thus, it overestimates both P_o and ΔPAR. These overestimates are greatest for the A1FI (richest) scenario and lowest for the A2 (poorest) scenario and, although the ranking among the scenarios would not change, the differences in both P_o and PAR among the various scenarios would have been magnified.

Coastal flooding

The FTA's estimates of the PAR for coastal flooding with and without any rise in sea levels induced by climate change between 1990 and 2085 are shown in table 4. Note that sea level will rise relative to the land not only because of climate change but also because the land may subside for a variety of reasons not related to climate change: for example, extraction of water, gas, or oil under the coastline. In this table, PAR is measured by the average number of people who would experience coastal flooding by storm surge in 2085, with and without climate change, assuming that populations would be attracted preferentially to the coast,[6] and "evolving" protection with a 30-year lag time. The low and high end of the ranges for PAR for each entry in table 4 assume low and high subsidence due to human causes unrelated to climate change.

Nicholls (2004) makes a creditable effort to incorporate improvements in adaptive capacity due to increasing wealth. Nonetheless, some of its assumptions are questionable. For instance, it allows societies to implement measures to reduce the risk of coastal flooding in response to 1990 surge conditions, but ignores conditions caused by subsequent rises in sea level (Nicholls, 2004: 74). But one would expect that whenever any measures are implemented, society would consider the latest available data and information on the surge situation at the time the measures are initiated. That is, if the measure is initiated in, say, 2050, the measure's design would at least consider both the sea level and *trends* in the sea level as of 2050, rather than merely the 1990 level. Nicholls also allows for a constant lag time between a rise in sea level and a society's initiating protection. But one should expect that if sea level continues to rise, the lag between upgrading protection standards and higher GDP per capita will be reduced over time. Moreover, it is conceivable that the richer a society, the faster this reduction. In fact, if future empirical data confirms that trends in the rise in sea level are robust, it is possible that protective measures may be taken in advance, i.e.,

6 The scenario of high growth in coastal populations assumes that coastal population grows twice as fast as the general population or, if populations are projected to drop, it drops at half the pace of the general population (Nicholls, 2004: table 6).

Table 4: Population at risk (PAR) in 2085 for coastal flooding with and without further sea-level rise (SLR) induced by climate change

Baseline 1990	A1FI 2085	A2 2085	B2 2085	B1 2085
Population at risk in the absence of climate change (P_0) (millions)				
10	1 to 3	30 to 74	5 to 35	2 to 5
(0.2%)	(0.0% to 0.0%)	(0.2% to 0.5%)	(0.0% to 0.3%)	(0.0% to 0.1%)
Additional population at risk because of climate change (ΔPAR) (millions)				
NA	10 to 42	50 to 277	27 to 66	3 to 34
	(0.1% to 0.5%)	(0.4% to 2.0%)	(0.3% to 0.6%)	(0.0% to 0.5%)
Total population at risk (TPAR = P_0 + ΔPAR) (millions)				
10	11 to 45	80 to 351	32 to 101	5 to 39
(0.2%)	(0.1% to 0.6%)	(0.6% to 2.5%)	(0.3% to 1.0%)	(0.0% to 0.5%)

Note: For coastal flooding, PAR is measured as the average number of people who experience flooding each year by storm surge or "average annual people flooded" (AAPF). The low (high) end numbers are based on an assumption of low (high) subsidence. Figures in parentheses are in percent of global population.

Source: Nicholls (2004).

that lag times may even become negative, even under a "business-as-usual" world.

In addition, Nicholls (2004) does not allow for any deceleration in the preferential migration of the population to coastal areas, which is not unlikely if coastal flooding becomes more frequent and costly. Alternatively, if the preferential migration continues unabated, a country's expenditures on coastal protection might increase because its coastal population increases relative to its total population, an outcome that would be consistent with democratic governance.

Nicholls (2004: table 7) also suggests that subsidence is more likely under the A1FI and A2 worlds than the B1 and B2 worlds. Although this assumption conforms with the SRES's storylines regarding the priority given to environmental issues, it contradicts real-world experience, which indicates that once richer countries are convinced of a problem, whether it is related to the environment or to health, they generally respond quicker to remedy the problem, spend more, and have greater environmental protection than poorer countries, especially at the high levels of development that are projected (table 1) to exist virtually everywhere later this century under all the IPCC's scenarios (see also Goklany, 2002). Hence, one should expect that the richest (A1FI) world would spend more and be better protected from whatever subsidence occurs, than would the B1 (and A1 and B2) worlds.

Putting aside these shortcomings, the information in table 4 shows that in the absence of climate change, the PAR for coastal flooding in 2085 under the A1FI and B1 worlds would be lower than what it was in 1990, but it would be higher under the A2 world; and it may or may not be higher under the B2 world. With climate change, the PARs would increase under each scenario, with A2 having the highest total PAR by far, followed, in decreasing order, by B2, and perhaps A1FI and B1. Notably, the difference in PAR between A1FI and B1 scenarios is not very large, despite the several assumptions that downplay the adaptive effects of wealth.

Malaria

The report by van Lieshout et al. (2004) on the FTA's analysis for malaria only provides estimates for changes in global PAR due to climate change (i.e., ΔPAR), but not for PARs in the absence of climate change or for total PARs with climate change.[7] But we saw in table 2 that the scenario with the highest ΔPAR does not always have the highest total PAR and that the latter is a more relevant measure of human well-being. Thus, the analysis by van Lieshout et al. sheds no light on whether well-being (as measured by the total PAR for malaria) would be greater in a richer but warmer world than in poorer but cooler worlds.

Accordingly, to compare the relative contributions to PAR from climate change and factors unrelated to climate change, I use the results of an earlier (pre-SRES) version of the Fast Track Assessment of the global impact of climate change (Martens et al., 1999; Arnell et al., 2002) that was also sponsored by DEFRA. That earlier analysis used a "business-as-usual" scenario, the so-called IS92a scenario, which was developed for the 1995 IPCC impact assessment. It neither included any additional greenhouse-gas controls nor allowed for any adaptation. Under this scenario, the global population and average GDP per capita in 2085 were projected at 10.7 billion and $17,700 (in 1990 US$). The UK Meteorological Office's HadCM2 model projected that, under this scenario, the globally averaged temperature would increase by 3.2° C between 1990 and 2085 (Parry et al., 2001), which approximates the temperature increase using HadCM3 under the A2 scenario (see table 1).[8]

The results from the study by Arnell et al. (2002) for malaria are summarized in table 5. They indicate that the global population at risk of malaria transmission in the absence of climate change (P_o) would double from 4,410 million in 1990 to 8,820 million in 2085, while ΔPAR in 2085 would be between 256 million and 323 million.[9] In other words, climate change would contribute only

7 The author contacted various co-authors of the paper by van Lieshout et al. to obtain their results for PAR with and without climate change, but to no avail.

8 HadCM2 and HadCM3 are general circulation models used to project climate under different concentrations of CO_2. These models were developed at UK's Hadley Centre, Bracknell, England; the latter is an update of the former. Further details on these can be obtained from the IPCC Data Distribution Center at <http://www.ipcc-data.org/is92/hadcm2_info.html> and <http://cera-www.dkrz.de/IPCC_DDC/IS92a/HadleyCM3/hadcm3.html>.

9 While these estimates for the numbers of people at risk from malaria (with and without climate change) are taken directly from Arnell et al. (2002), they seem excessive given that they imply that 83% to 85% of all inhabitants on the globe are at risk.

Table 5: Population at risk (PAR) in 2085 for malaria, with and without further climate change

Baseline 1990	2085
Population at risk in the absence of climate change (P_0) (millions)	
4,410	8,820
Additional population at risk because of climate change (ΔPAR) (millions)	
NA	256 to 323
Total population at risk (TPAR = P_0 + ΔPAR) (millions)	
4,410	9,076 to 9,143

Note: This table is based on a pre-SRES scenario. HadCM2 estimates that, under this scenario, globally averaged temperature will increase about 3.2° C. between 1990 and 2085.

Source: Arnell et al. (2002).

a small portion (no greater than 3.5%) of the total PAR for malaria in 2085 (Goklany, 2005).

Note that the current range of malaria is dictated less by climate than by human adaptability. Despite any global warming that might have occurred so far, malaria has been eradicated in richer countries although it was once prevalent there in earlier centuries, and sometimes extended into Canada and as far north as the Arctic Circle (Reiter, 2000; Fallis, 1984; Watson, 2006). This is because wealthier societies have better nutrition, better general health, and greater access to public health measures and technologies targeted at controlling diseases in general and malaria in particular. In other words, today's wealthier and more technologically advanced societies have greater adaptive capacity, and that is manifested in the current geographic distribution of malaria around the globe (Goklany, 2006).

This reaffirms the importance of incorporating adaptive capacity—and changes in adaptive capacity due to economic growth and technological change—into impact assessments. In fact, analysis by Tol and Dowlatabadi (2001) suggests that malaria is functionally eliminated in a society whose annual per-capita income reaches $3,100. But as shown in table 1, even under the poorest (A2) scenario, the average GDP per capita for developing countries is projected to be $11,000. Hence, few, if any, countries ought to be below the $3,100 threshold in 2085. In addition, given the rapid expansion in our knowledge of diseases and development of the institutions devoted to health and medical research, the $3,100 threshold will almost certainly drop in the next several decades as public-health measures and technologies continue to improve and become more cost effective.

> Ecological changes from 2085 to 2100, with and without climate change

In table 6, I provide information on the variation in three specific ecological indicators across the different scenarios: net biome productivity (a measure of the terrestrial biosphere's net carbon sink capacity); the area of cropland, a crude measure of the amount of habitat converted to agricultural uses (perhaps the single largest threat to global terrestrial biodiversity) (Goklany, 1998); and the global loss of coastal wetlands relative to 1990. Under each scenario, the biosphere's sink capacity is higher in 2100 than in 1990 mainly because, according to the projections, the positive effect of carbon fertilization will not be offset by the negative effects of

Table 6: Ecological indicators under different scenarios, 2085–2100

	Baseline 1990	A1FI	A2	B2	B1
CO_2 concentration (in 2100) (ppm)					
	353	970	856	621	549
Net biome productivity with climate change (in 2100) (Pg C/yr)					
	0.7	5.8	5.9	3.1	2.4
Area of cropland with climate change (in 2100) (% of global land area)					
	11.6%	5.0%	NA	13.7%	7.8%
Global losses of coastal wetlands in 2085					
Losses due to SLR alone (% of current area)					
	N/A	5 to 20%	3 to 14%	3 to 15%	4 to 16%
Losses due to other causes (% of current area)					
	N/A	32 to 62%	32 to 62%	11 to 32%	11 to 32%
Combined losses (% of current area)					
	N/A	35 to 70%	35 to 68%	14 to 42%	14 to 42%

Sources: Arnell et al. (2004); Nicholls (2004); Levy et al. (2004).

higher temperatures. Sink capacities under the A1FI and A2 scenarios are approximately the same in 2100, and greater than the sink strengths under the B1 and B2 scenarios. Partly for the same reason and also because of its low population, the amount of cropland is lowest for the A1FI world, followed by the B1 and B2 worlds (estimates of cropland were not provided for the A2 scenario). Thus, through the foreseeable future, the A1FI scenario would have the least habitat loss and, therefore, pose the smallest risk to terrestrial biodiversity from this particular threat, while the B2 scenario would have the highest habitat loss.

The estimated losses of coastal wetlands due to sea-level rise (SLR) for each scenario are substantial, but the contribution of climate change to total losses in 2085 are smaller than losses due to subsidence from other man-made causes, confirming the results of earlier studies (Nicholls, 1999). Table 6 shows that total wetland losses are much higher for the A1FI and A2 scenarios than for the B1 and B2 scenarios, but this is due mainly to the assumption that the first two scenarios would have higher subsidence unrelated to climate change (Nicholls 2004: 76), an assumption that, as noted, is suspect.

> Is climate change the most important environmental problem for the foreseeable future?

A recent review paper in *Nature* claims that global warming may have been responsible for about 0.17 million deaths worldwide in 2000. This estimate is based on an analysis by McMichael et al. (2004) put out under the auspices of the World Health Organization. However, its authors themselves acknowledge that

> climate change occurs against a background of substantial natural climate variability, and its health effects are confounded by simultaneous changes in many other influences on population health … Empirical observation of the health consequences of long-term climate change, followed by formulation, testing and then modification of hypotheses would therefore require long time-series (probably several decades) of careful monitoring. *While this process may accord with the canons of empirical science, it would not provide the timely information needed to inform current policy decisions on GHG [greenhouse gas] emission abatement, so as to offset possible health consequences in the future*. (McMichael et al., 2004: 1546, emphasis added).

In other words, the estimate of 0.17 million deaths should be taken with a large dollop of salt since science was admittedly sacrificed in hot pursuit of a pre-determined policy objective. But, absent serendipity, one cannot base sound policy on poor science.

Nevertheless, for the purposes of this chapter, I will accept this problematic estimate at face value. Notably, 0.17 million deaths per year would constitute 0.28% of global mortality, according to the *World Health Report 2002* (WHO, 2002). The same report indicates that climate change is not even among the top 10 global health-risk factors related to food, nutrition, and environmental and occupational exposure. Specifically, it attributes 1.12 million deaths in 2001 to malaria; an additional 3.24 million deaths to malnutrition;[10] 1.73 million deaths to unsafe water, and inadequate sanitation and hygiene; 1.62 million deaths to indoor air pollution from indoor heating and cooking with wood, coal, and dung; 0.8 million to urban air pollution; and 0.23 million to lead exposure. Climate change is clearly not the most important environmental problem facing the world today.

Is it possible, however, that in the foreseeable future, the impact of climate change on public health could outweigh that of other factors? To shed light on this question, I will translate the PAR and ΔPAR in 2085 shown in tables 2, 4, and 5 for hunger, coastal flooding, and malaria into "ball park" estimates for mortality, assuming that mortality due to the various threats scales linearly with PAR between 1990 and 2085 and that there has been no change in mortality for these threats between 1990 and 2001.[11] The results are shown in table 7.

10 This estimate excludes an estimated 0.51 million people who died from malaria but whose deaths were attributed in the report to their being underweight (WHO, 2002).

11 This assumption is necessary because data on mortality from hunger and malaria are not readily available for 1990. According to the FAO (2004), the number of people suffering from chronic undernourishment in the developing countries was virtually unchanged between 1990/1992 and 2000/2002 (going from 824 million to 815 million in developing countries between these two periods). According to WHO (1995), malaria killed 2 million in 1993

Table 7: Deaths (in thousands) in 2085 due to various climate-sensitive threats, with and without further climate change

	Baseline 1990	A1FI 2085	A2 2085	B2 2085	B1 2085	IS92a 2085
Hunger						
M_0						
	3240	404	2,845	892	364	
ΔM						
	N/A	108	–104 to –33	–42 to 19	40	
Total mortality						
	3,240	512	2,741 to 2,812	850 to 911	404	
Coastal flooding						
M_0						
	8	1 to 2	24 to 59	4 to 28	2 to 4	
ΔM						
	N/A	8 to 34	40 to 222	22 to 53	2 to 27	
Total mortality						
	8	9 to 36	64 to 281	26 to 81	4 to 31	
Malaria						
M_0						
	1120					2,240
ΔM						
						82
Total mortality						
						2,322

M0 = mortality in the absence of climate change; ΔM = change in mortality due to climate change.

Hunger: 1990 baseline mortality based on WHO (2002); M0 and ΔM calculated from table 2.

Coastal flooding: 1990 baseline from EM-DAT; M0 and ΔM calculated from table 4.

Malaria: 1990 baseline from WHO (2002); M0 and ΔM calculated from table 5.

In this table M_o is the mortality in the absence of climate change, while ΔM is the incremental change in mortality due to climate change. This table shows that, *for each scenario*, hunger is responsible for a greater burden of mortality than coastal flooding, and the total burden due to factors unrelated to climate change substantially exceeds that due to climate change.

These results, in conjunction with those from table 6, indicate that climate change is unlikely to be the most important environmental problem confronting human or environmental well-being, at least through the foreseeable future.

> Is a richer but warmer world worse off than poorer but cooler worlds?

In table 8, I rank the four SRES scenarios for the year 2085 using the various indicators of human and environmental well-being that were addressed above. Rankings shown in the top portion of the table are based on indicators of human well-being, namely, wealth (for which GDP per capita is a surrogate), hunger, water stress, and coastal flooding, using data from tables 1 to 4. Rankings are provided separately for the scenarios both without and with climate change.

In the ranking scheme used in table 8, "1" indicates the best level of well-being while "4" indicates the worst. If two scenarios show the same level of well-being, then they share the same ranking. For example, in the absence of climate change, scenarios A1FI and B1 are both ranked at the top with respect to water stress in 2085 (because they both have the same low population in 2085). Accordingly, they split the number one and two rankings, and their joint ranking is indicated as 1.5.

In constructing table 8, I assume that the relative ranking of the scenarios with respect to GDP per capita will be maintained despite any climate change. This is likely because the gaps in GDP per capita from one scenario to the next are quite large (see table 1), and the impacts of climate change are relatively small from 2085 to 2100. Consider that under the A1FI scenario, the average GDP per capita for developing countries in 2100 is 65% higher than under the B1 scenario (that with the next highest GDP per capita). It is unlikely that any drop in income levels by 2100 due to climate change will close this gap (IPCC, 2001). Moreover, the other entries in table 8 suggest that the drop in GDP per capita due to climate change will be largest for the A2 world and least for the A1FI world (because these scenarios are likely to result in climate change having the largest and smallest impact on human well-being, respectively). Hence, if there is any re-ordering of the rankings for GDP per capita, it would probably be due to B2 and B1 trading places (because B1 is wealthier and, therefore, likely to have greater adaptive capacity; see table 1)

(compared to 1.12 million in 2001). Thus, to the extent that the ratio of deaths-to-PAR may have declined between 1990 and 2001, future deaths due to malaria would be underestimated. Finally, according to EM-DAT (2005), there were 7,100 fatalities due to floods, windstorms, and waves/surges in 1990, and an average of 7,500 for the period from 2000 to 2004 (excluding deaths due to the Christmas tsunami of 2004). Table 7 assumes: (a) an estimate of 8,000 deaths in 1990 due to these extreme weather event categories, and (b) that all deaths for these categories are due to coastal flooding. Thus, table 7 underestimates the relative importance of malaria compared to the other threats, while overestimating future deaths as a result of coastal flooding.

Table 8 suggests that human well-being in 2085 would, in the aggregate, be highest for the A1FI scenario and lowest for A2. Reinforcing this conclusion is the possibility that compared to the B1 scenario, populations at risk for the A1FI scenario might be overestimated (as might the amount of climate change). Applying the same logic and considerations, it would seem that human well-being should be better under B1 than B2. These findings are based on the assumptions that: (a) GDP per capita—or more accurately, the logarithm of GDP per capita (Goklany, 2002, 2006)—should be given greater weight because it is a surrogate for numerous, and more appropriate, indicators of human well-being (e.g., life expectancy, mortality rates, access to safe water and sanitation, and level of educational attainment), and (b) impacts analyses have a general tendency (discussed previously) to underestimate changes in adaptive capacity as a function of both economic development and technological progress (or time). These aggregate rankings would stay the same whether or not climate changes, or whether they are based on PAR in terms of absolute numbers or the proportion of global population (see tables 1 to 4).

In the last three rows of table 8, I rank scenarios based on the three environmental indicators addressed previously (see table 6). Based on the capacity of the terrestrial carbon sink and cropland area, environmental quality would be superior under the A1FI scenario than under either the B1 or B2 scenarios through 2100, but these rankings would apparently be reversed for coastal wetlands, at least through 2085—"apparently" because, as noted, that could be an artifact of the assumption that subsidence should or would be lower under the B1 and B2 scenarios than the A1FI scenario.

Table 8: Ranking of scenarios in order of future well-being per each indicator, 2085–2100

	Without climate change				With climate change			
	A1FI	A2	B2	B1	A1FI	A2	B2	B1
Indicators of human well-being								
GDP/capita	1	4	3	2	1	4	3	2
Hunger (PAR in 2085)	2	4	3	1	2	4	3	1
Water stress (PAR in 2085)	1.5	4	3	1.5	1	4	3	2
Coastal flooding (PAR in 2085)	1	4	3	2	2	4	3	1
Indicators of environmental quality								
Terrestrial carbon sink capacity (in 2100)					1.5	1.5	3	4
Cropland area (in 2100)					1	N/A	3	2
Coastal wetland area (in 2085)					3.5	3.5	1.5	1.5

Note: "1" indicates the best level of well-being while "4" indicates the worst. If two scenarios show the same level of well-being, then they share the same ranking. For example, in the absence of climate change, scenarios A1FI and B1 are both ranked at the top with respect to water stress in 2085. Accordingly, they split the number one and two rankings, and their joint ranking is indicated as 1.5.

Sources: Tables 1 through 7

To summarize, the SRES scenario that the IPCC projects will lead to the greatest risk of climate change over the coming century is also the one that leads to the greatest gains in human welfare over that period. And the gains in human welfare from increasing wealth are

sufficiently large compared to the FTA's assessment of the risks of climate change that the ranking of scenarios in terms of human well-being does not change by adding in the impacts of climate change. Notwithstanding climate change, through much of this century human well-being is likely to be highest in the richest but warmest (A1FI) world, and lower in poorer but cooler worlds. Consequently, even if proponents of aggressive controls on greenhouse gases are correct in their view of the environmental impact of greenhouse gases, human welfare could be worsened by policies that would sacrifice economic growth over the next several decades in order to pursue poorer but cooler worlds. With respect to environmental well-being, matters may be best under the richest but warmest world for some critical environmental indicators through 2100, though not necessarily for all.

> Comparing the costs and benefits of mitigation against those of adaptation

The foregoing assumes that climate change does not create major new classes of problems but rather mostly exacerbates existing ones, such as malaria, hunger, coastal flooding, water stress, and various threats to biodiversity. Hence, the magnitude of the total problem ($P_o + \Delta P$) will generally exceed the contribution of climate change to that problem (ΔP). Consequently, policies that would reduce the total problem itself are more likely to enhance human well-being than policies that would try to mitigate climate change. Equally important, measures that would reduce the vulnerability to the portion of the problem unrelated to climate change (P_o) could also reduce the component due to climate change (ΔP).

For example, a strategy to reduce society's vulnerability to malaria through, say, the development of a malaria vaccine, would reduce the risk faced by the entire population at risk for malaria in 2085, which is estimated to be 9,143 million (table 5). On the other hand, a policy to mitigate climate change would at most reduce risks to 323 million people (i.e., ΔP) or 3.5% of the total problem in 2085. Thus, strategies that would reduce the total problem are more likely to advance human well-being with regard to malaria than any mitigation policy, regardless of how deep the mitigation efforts (Goklany, 2005).

Mitigation

In table 9, I show the decreases in total populations at risk (TPAR) from malaria, hunger, water stress, and coastal flooding, as well as decreases in global average temperature and in sea-level rise that would be obtained under the A1FI, A2, and the IS92a scenarios in 2085 using two mitigation scenarios at either end of the spectrum in terms of stringency, namely, the Kyoto Protocol at the low end of effectiveness and cost and, at the high end, a scenario that would ensure no climate change beyond 1990 levels. These decreases are shown relative to the unmitigated case, that is, no emission controls whatsoever.

Information on the two SRES scenarios is derived from tables 2 to 4, while that for IS92a is based on Arnell et al. (2002). To construct this table, I optimistically assume that by 2085 the Kyoto Protocol would reduce climate change, as represented by the changes in global temperature and sea level, by 7%, which would then

Table 9: Decline in total population at risk, temperature, and sea level rise in 2085 under the Kyoto Protocol and no-climate-change scenarios using A1FI, A2, and IS92a emission scenarios

	A1FI		A2		IS92a	
	Kyoto Protocol	No climate change after 1990	Kyoto Protocol	No climate change after 1990	Kyoto Protocol	No climate change after 1990
Decline in total population at risk						
Malaria					0.2%	3.5%
Hunger	1.5%	21%	−0.1% to −0.3%	−1.2% to −3.8%	1.5%	21%
Water stress	−5.0%	−72%	−2.5% to 0%	−35% to 0	−4.1% to 0.8%	−59% to −12%
Coastal flooding	19% to 20%	91% to 93%	13% to 17%	63% to 79%	18%	86%
Decline in ΔT (°C)	0.3°	4.0°	0.2°	3.3°	0.2°	3.2°
Decline in sea level rise (cm)	2	34	2	28	3	41

Note: ΔT is the globally averaged temperature rise between 1990 and 2085, assuming no mitigation. SLR is the sea level rise induced by climate change between 1990 and 2085, assuming no mitigation.

Sources: Tables 1 to 5; Goklany (2005).

reduce the impacts of climate change on malaria, hunger, and water stress by a like amount, and the impacts of coastal flooding by 21% (Goklany, 2005).[12]

In the following discussion, I will assume that the Kyoto Protocol will cost $165 billion per year in 2010.[13] On the other hand, the cost of the no-climate-change

12 This is based on Wigley (1998) which estimates that if the Kyoto Protocol were to be fully implemented, that would reduce the amount of warming in the 2080s by no more than 7%, which, then, should also reduce ΔPAR for hunger, malaria and water stress by approximately 7%, and by thrice that (21%) for coastal flooding. The latter two assumptions are derived from a visual inspection of figure 1 in Parry et al. (2001), which is based on an earlier version of the FTA (see Goklany, 2003). That figure suggests that the dependence of ΔPAR on the increase in temperature is linear or less-than-linear for each of the risk factors except coastal flooding, for which the dependence is closer to quadratic or even cubic. The 21% change in ΔPAR for coastal flooding owing to a 7% change in temperature (ΔT) assumes that the dependence is cubic. As will become evident, the precise functional form does not affect the validity of the arguments or conclusions in this chapter.

13 The IPCC (2001) estimates that in 2010 the Protocol could cost between 0.1% and 2.0% of the GDP of Annex I countries. I will assume that its cost is 0.5% of their cumulative GDP, which is at

scenario, assuming that it is even feasible, would be astronomical.

Malaria

In 2085, even the most drastic reduction in emissions (i.e., the no-climate-change scenario) would not reduce total PAR for malaria by more than 3.5%. Reductions under the Kyoto Protocol would be marginal at 0.2%, despite its considerable cost.

Hunger

The maximum reduction possible in total PAR for hunger through mitigation would be 21% under both the A1FI and IS92a scenarios; however, under the A2 scenario, mitigation might, perversely, increase the total PAR. Again, changes, whether positive or negative, would be minimal under the Kyoto Protocol. But while the contribution of climate change to total PAR seems large, it results from a small (1.9%) climate-change-related drop in future global food production between 1990 and 2085 (Parry et al., 2004). In other words, unmitigated warming would reduce the annual growth in food productivity from 0.84% per year to 0.82% per year.

Water stress

Mitigation would, more likely than not, increase the total PAR for water stress because, as table 3 shows, climate change may reduce the PAR. This also illustrates one of the major shortcomings of mitigation—namely, that it is indiscriminate, reducing all impacts, whether they are positive or negative.

Coastal flooding

In contrast with the other threats listed on table 9, mitigation would substantially reduce the total PAR for coastal flooding—by as much as 93% under the no-climate-change scenario and 19% to 20% under the Kyoto Protocol.

Reducing current vulnerabilities via focused adaptation

Measures that are focused on reducing current vulnerabilities to these climate-sensitive threats—or "focused adaptation," for short—would provide greater aggregate benefits than halting climate change—a practically impossible task—at a fraction of the cost even of the inconsequential Kyoto Protocol.

Malaria

At an additional cost of $3 billion per year, malaria's current global death toll of about 1 million per year could be reduced by 75%, according to the UN Millennium Project (UNMP). These expenditures may have to be doubled by 2085 to keep pace with the projected increase in the global population at risk in the absence of climate change (see table 5).

Adaptations focused on reducing current vulnerabilities to malaria include measures targeted specifically at malaria as well as measures that would generally enhance the capacity to respond to public-health problems and deliver public-health services more effectively and efficiently. Measures targeted specifically at malaria include indoor residual (home) spraying with insecticides, insecticide-treated bednets, improved case management, more comprehensive antenatal care, and development of safe, effective, and inexpensive vaccine(s)

the lower end of this range. This translates to $165 billion (in 2003 dollars). See Goklany (2005).

and therapies (WHO, 1999; UNMP, 2005b). Moreover, if these measures are even partly successful, they could further reduce the likelihood of outbreaks because the risk of exposure would be lower.

Hunger

An additional $5 billion annual investment in agricultural R&D—approximately 15% of global funding of agricultural research and development during the 1990s (Goklany, 2005)—should raise productivity sufficiently to more than compensate for the 0.02% annual shortfall in productivity caused by climate change. This should reduce total PAR by significantly more than the largest estimate under any scenario for ΔPAR of 21% (see table 2), particularly if the additional investment is targeted toward solving developing countries' current agricultural problems that might be further exacerbated by warming.

An alternative cost estimate can be derived from the work of the UN Millennium Project, which estimates that somewhere between 5% and 8% of the extra funding needed to realize the Millennium Development Goals would be required to reduce global hunger by 50% in 2015 (UNMP, 2005c: 18). This works out to less than $12 billion in 2010 and about $15 billion in 2015 (calculated using UNMP, 2005c, and UNMP, 2005a: 57). For purposes of this discussion, I will assume $15 billion per year.

Current agricultural problems that could be exacerbated by warming and should be the focus of vulnerability-reduction measures include growing crops in poor climatic or soil conditions (e.g., low soil moisture in some areas, too much water in others, or soils with high salinity, alkalinity, or acidity). Because of warming, such conditions could become more prevalent, and agriculture might have to expand into areas with poorer soils, or both. Thus, actions focused on increasing agricultural productivity under current marginal conditions would alleviate hunger in the future whether or not climate changes. Similarly, since both CO_2 and temperatures will, like it or not, increase, crop varieties should be developed to take advantage of such conditions as, and when, they come to pass. Notably, in the initial stages at least, progress on these approaches does not depend on improving our skill in forecasting details of the impact of climate change in particular locations. These measures of focused adaptation should be complemented by the development of crop varieties and agronomic practices giving higher yields with lower impact so that more food is produced and used by consumers per unit of land or water devoted to food production. This would help reduce hunger while providing numerous ancillary benefits for biodiversity and sustainable development (see below).

Water stress

Although climate change could relieve water stress (table 9), there are, nevertheless, many measures that would help societies cope with present and future water stress, regardless of the cause. These include institutional reforms to treat water as an economic commodity by allowing market pricing and transferable property rights to water. This should stimulate widespread adoption of existing but underused conservation technologies and lead to more private-sector investment in R&D that would reduce the demand for water by all sectors. For example, new or improved crops and techniques which make more efficient use of water would

enhance agricultural productivity and reduce the risk of hunger.

Improvements in water conservation following such reforms are likely to be most pronounced for the agricultural sector, which is responsible for 85% of global water consumption. A reduction of 18% in agricultural water consumption would, on average, double the amount of water available for all other uses, including household, industry, and in-stream uses (such as recreation and conservation of aquatic species). The last would reduce pressures on freshwater biodiversity as a result of water diversion, which is the greatest threat to freshwater biodiversity (Goklany, 2005).

Coastal flooding

According to estimates provided in IPCC (1996), an annual investment of $1 billion per year is sufficient to adapt to a sea-level rise of 0.5 meter in 2100. Considering that the sea-level rise under the various SRES scenarios is estimated at between 0.22 and 0.34 meter for 2085, this ought to reduce the total PAR by more than ΔPAR, regardless of the specific scenario (table 1). Governments could, moreover, discourage maladaptation by refusing to subsidize insurance and protective measures that allow individuals to off-load private risks to the broader public.

The benefits of focused adaptation

Thus, at a cost of less than $22 billion per year, focused adaptation could deliver far greater benefits than would halting climate change, at less than one-seventh of the cost of the Kyoto Protocol. It will not only reduce present-day, climate-sensitive problems, but it will also help reduce these problems in the future, whether they are caused by climate change or other factors. This is because the technologies, practices, systems, and human and social capital devised to cope with these problems today will aid societies in coping with these problems in the future. Such focused adaptation can be implemented without detailed knowledge of the impacts of climate change. Cases in point are the development of malaria vaccines, drought resistant crops, transferable property rights for water resources, and early warning systems for climate-sensitive events ranging from storms to potential epidemics of various kinds.

Further, focused adaptation will start to provide a steady stream of benefits in the very near term while, because of the inertia of the climate system, the benefits of mitigation will not be significant until decades have elapsed. One might, nevertheless, argue that under the precautionary principle it would be appropriate to pursue mitigation. Such an argument would be valid but for the fact that there are plenty of unsolved problems that afflict current generations that could use the economic and human resources that might otherwise be diverted toward aggressive mitigation (in contrast to "no-regret" mitigation measures[14] that would help solve current urgent problems while also limiting greenhouse emis-

14 "No-regret" actions are cost-beneficial actions that would or should be undertaken for economic or environmental reasons unrelated to climate change. Examples of no-regret actions include eliminating subsidies, replacing inefficient processes or appliances for business reasons, or replacing coal with natural gas in order to reduce air pollution. Note that the suite of no-regret actions is constantly expanding as societies' technological options increase due to greater wealth and technological change. Thus, an action that does not fit that description today may appropriately be classified as a no-regret action tomorrow.

sions). In fact, focused adaptation can itself be viewed as a no-regret action since, as we have seen, it can substantially reduce existing problems such as hunger and malaria that currently beset the developing world while simultaneously helping to ensure that the world prepares to cope with the future impacts of climate change.

The indiscriminate effect of mitigation and the ancillary benefits of adaptation

Mitigation has the additional problem that it indiscriminately reduces all impacts of climate change, whether they are positive or negative. But adaptation can selectively capture the positive aspects of climate change while reducing the negative. And while the impacts of global warming are uncertain, there is no doubt that malaria, hunger, water stress, and coastal flooding are real and urgent problems here and now. Thus, focused adaptation is far more likely to deliver benefits than is mitigation, and to deliver those benefits sooner rather than later.

Co-benefits (or ancillary benefits) of adaptation focused on reducing vulnerability to malaria and hunger include better health, increased economic growth, and greater human capital, which should advance human well-being and the capacity to address a much wider variety of problems, in addition to climate change (Goklany, 2000, 2006; UNMP, 2005a). These co-benefits, in fact, are among the goals and purposes of sustainable development, as explicitly articulated in the Millennium Development Goals.

Several measures to reduce current hunger and water stress would also provide co-benefits by enhancing agricultural productivity per unit of land and water. In turn, that would reduce human demand for agricultural land and water, which is the greatest current threat to both terrestrial and freshwater biodiversity, and is likely to remain so through the foreseeable future (Goklany, 1998, 2000). It would also aid mitigation by limiting land under cultivation, thereby reducing losses of carbon stores and sinks, and reducing the socioeconomic costs of reserving land for conservation or carbon sequestration. These co-benefits would, moreover, advance sustainable development in their own right.

Finally, the conclusion that focused adaptation is for the foreseeable future superior in terms of both global benefits and global costs is robust to the choice of discount rates,[15] including a zero discount rate. This is because the benefits of focused adaptation will generally follow relatively soon after its costs are incurred. On the other hand, the climate system's inertia ensures that costs of emission reductions will have to be borne for decades before any benefits accrue.

15 Discount rates are used to compare costs and benefits that might occur in the future to costs and benefits that occur now. The premise behind discounting is that the value of costs and benefits are worth more if they occur now as opposed to some time in the future. The discount rate reflects the time value of money. The higher the discount rate, the lower is the present value of future costs and benefits. Frequently costs are concentrated in early periods of a program while benefits follow later. There is much debate regarding the appropriate choice of discount rates since its magnitude influences whether or not early costs will be outweighed by future benefits.

> Integrating mitigation, adaptation, and sustainable development

The foregoing examined two approaches to address warming through the foreseeable future. The first, mitigation, would reduce impacts—positive and negative—across the board. This entails significant near-term costs and the pay-off, if any, will be delayed far into the future. The second approach, focused adaptation, would reduce vulnerability to climate-sensitive effects now and to 2085 by focusing on the individual threats and attacking these threats simultaneously.

Developing countries are most vulnerable to warming, not because they will experience greater climate change, but because they lack adaptive capacity to cope with its impacts. Hence, a third approach to addressing climate change would be to enhance their adaptive capacity by promoting economic development and the formation of human capital, which, of course, is the point of sustainable development. Moreover, since the determinants of adaptive and mitigative capacity (IPCC, 2001; Yohe, 2001) are largely the same, enhancing the former should also boost the latter (Goklany, 1995, 2006). Thus, pursuit of sustainable development would simultaneously advance the capacity to adapt to, or mitigate, climate change. Perhaps more important, that would also advance society's ability to cope with all other manners of threats, whether they are related to climate or not.

One approach to estimating the costs and benefits of sustainable development is to examine the literature on the Millennium Development Goals, which were devised explicitly to advance sustainable development in developing countries. The benefits associated with these goals—halving global poverty, hunger, lack of access to safe water and sanitation; reducing child and maternal mortality by 66% or more; universal primary education; and reversing growth in malaria, AIDS/HIV, and other major diseases—would generally exceed the benefits flowing from focused adaptation or even the deepest mitigation (see table 10). Yet, according to the UN Millennium Project (2005), the additional annual cost to the richest countries of attaining the Millennium Development Goals by 2015 is pegged at about 0.5% of their GDP. That is approximately the same cost as that of the ineffectual Kyoto Protocol.[16]

Moreover, since measures to advance sustainable development would address urgent problems that developing nations currently face (e.g., malaria, hunger, HIV/AIDS, and poor access to safe water and sanitation), while mitigation would only address future and less certain damages due to climate change, the benefits associated with sustainable development would be obtained sooner and more certainly than through mitigation alone. In addition, increased adaptive capacity would either raise the level at which GHGs would need to be stabilized to forestall warming from becoming "dangerous" or allow mitigation to be postponed, or both. In any case, costs associated with any eventual stabilization of greenhouse gas concentrations could be reduced, particularly if, in the interim, resources are

16 Note that the conclusion that broadly and substantially advancing sustainable development would provide greater benefits at lesser costs than mitigation (at least through 2085) is independent of whether the Millennium Development Goals are, in fact, met by 2015. Even if the goals of the Millennium Development Goals were postponed, say, to 2085, as table 10 shows, their benefits would still outweigh those obtainable through mitigation and, presumably, at a lower cost than estimated by UN Millennium Project.

Table 10: Comparing benefits and costs for various risk factors associated with advancing sustainable development, mitigation, and focused adaptation

Dependent on climate change	Reduction in total problem[a]			
	Due to Kyoto Protocol (in 2085)	Due to halt in climate change (in 2085)	Focused adaptation (in 2015)	Due to sustainable development (in 2015)[h]
Malaria[b, c]				
Yes	0.2%	3.5%	75%[f]	75%
Hunger[b, c]				
Yes	2%	21%	50%[d]	50%
Water shortage				
Yes	−5%	−72%	+	Not addressed explicitly
Coastal flooding[c]				
Yes	~ 20%	~ 92%	>92%[g]	+
Poverty[b, c]				
Indirect	Unknown, but small	Unknown sign	++[b, e]	50%
Child mortality rate[b, c]				
Indirect	Small +	+[e]	++[b, e]	67%
Maternal mortality rate[b, c]				
Indirect	Small +	+[e]	++[b, e]	75%
Lack of access to safe water[c]				
No	No effect	No effect	No effect	50%
Lack of access to sanitation[c]				
No	No effect	No effect	No effect	50%
Lack of primary education[b, c]				
No	Minor +[e]	Small +[e]	+[b, e]	100%
AIDS, TB[b, c]				
No	No effect	Zero to small +[e]	+[b, e]	++
Annual costs	~ $165 billion in 2010	> $165 billion	~ $22 billion	~ $145 billion in 2010

Notes: (a) + denotes a positive reduction in P, while ++ denotes a larger positive reduction. (b) Reductions in malaria and/or hunger should directly or indirectly reduce risks associated with each other, poverty, child and maternal mortality rates, educability, AIDS and TB. (c) Risks associated with these categories should decline with economic development. (d) Assumes same measures to reduce hunger as used to meet Millennium Development Goals. (e) Indirect improvements because hunger/malaria would be reduced under focused adaptation. (f) Assumes $6 billion per year spent to reduce malaria mortality by 75%. (g) Assumes $1 billion per year spent on protection (IPCC, 1996a). (h) Assumes costs and benefits match those estimated for the Millennium Development Goals.

Sources: For costs, IPCC (2001); World Bank (2005); and UN Millennium Project (2005a, b, c); for reduction in risks due to mitigation, table 9 using the A1FI scenario for hunger, water stess, and coastal flooding and the IS92a scenario for malaria; for risk reduction due to adaptation and development (UNMP, 2005a, b, c).

expended to improve the cost-effectiveness of mitigation options. Advancing sustainable development would also advance mitigative capacity so that mitigation, if it becomes necessary, is more affordable or more effective. In fact, such an approach would be entirely consistent with the objectives outlined in Article 2 of the UN Framework Convention on Climate Change: "to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner" (United Nations, 1992: 4).

> The adaptive management of the risks from climate change

Climate change is not now, nor is it likely to be in the foreseeable future, the most important environmental problem facing the world. As a factor affecting human well-being, it will continue to be outranked by pre-existing problems such as hunger and malaria and, with respect to environmental well-being, by habitat loss and other threats to biodiversity. Through 2085, human well-being is likely to be highest in the richest but warmest world (A1FI) and lowest in the poorest world (A2). Matters may be best in the A1FI world for some critical environmental indicators through 2100, but not necessarily for others. Either focused adaptation or broad pursuit of sustainable development would provide far greater benefits than even the deepest mitigation—and at a cost that is less than that of the barely-effective Kyoto Protocol.

These conclusions cast doubt on key premises underlying calls to take aggressive actions now that would go beyond "no-regret" policies in order to reduce GHG emissions in the near term:[17] namely, there is no greater environmental problem in the twenty-first century than climate change, that a richer but warmer world will soon be worse for the globe than a poorer but cooler world, and that the adverse impacts of climate change would be more efficiently and effectively reduced through mitigation rather than adaptation. The above analysis suggests these premises are unlikely to be valid before at least the period between 2085 and 2100. Even assuming that it takes 50 years to replace the energy infrastructure, that means we have a few decades before we need to commit to an aggressive GHG reduction program that goes beyond "no-regrets."

Only if new information emerges suggesting that the adverse impacts of climate change induced by greenhouse gases are growing more rapidly or are likely to be greater than currently indicated would aggressive mitigation measures become justifiable. The issue is not whether adaptation or mitigation should be the sole approaches to addressing climate change. Clearly, the two approaches are not mutually exclusive. The issue, in fact, is one of the magnitude and relative balance of resources expended on these strategies, and how that balance might shift over time to ensure that well-being is optimized. Accordingly, in the near to medium term, we should focus on the following policies that, together, constitute an adaptive-management approach to addressing climate change. Such an approach would help solve today's urgent problems while bolstering our ability to address tomorrow's climate change challenge.

17 See footnote 14.

Increase adaptive capacity

Increase adaptive capacity, particularly of developing countries, by investing in efforts now to reduce vulnerability to today's urgent climate-sensitive problems—malaria, hunger, water stress, flooding, and other extreme events—that might be exacerbated by climate change (Goklany, 1995, 2005). The technologies, human capital, and institutions that will need to be strengthened or developed to accomplish this will also be critical in addressing these very problems in the future if they are aggravated by climate change. This might also increase the level at which GHG concentrations would need to be stabilized to "prevent dangerous anthropogenic interference with the climate system," which is the stated "ultimate objective" of the UN Framework Convention on Climate Change.[18] Alternatively, it could postpone the deadline for stabilization. In either case, it could reduce the costs of meeting the ultimate objective.

Strengthen institutions

Strengthen or, where needed, develop the institutions necessary to advance or remove barriers to economic growth, human capital, and the propensity for technological change. These factors underpin both adaptive and mitigative capacities, as well as sustainable development (Goklany, 1995, 2000, 2006).

Adopt "no-regret" mitigation measures

Adopt "no-regret" mitigation measures now while expanding the range and diversity of future no-regret options through R&D to improve existing—and develop new—technologies that would reduce atmospheric concentrations of greenhouse gases in a more cost-effective manner than currently possible. Should new information indicate more aggressive mitigative action is necessary, future emissions reductions might then be cheaper, even if they have to be deeper to compensate for a delay in a more aggressive response in the short term.

Allow the market to provide options

Allow the market to implement no-regret options as their range expands with improvements in cost-effectiveness. Among other things, this implies reducing subsidies that directly or indirectly increase energy use, land clearance, use of fertilizers, or other activities that contribute to greater greenhouse gas emissions, and reducing other perverse subsidies that encourage maladaptation. As part of this effort, OECD nations should also reduce, if not eliminate, agricultural subsidies and barriers to trade. Not only are such subsidies and barriers expensive for consumers in these nations, but they also damage the economies and well-being of many developing nations whose economies and employment are dominated by the agricultural sector (Goklany, 1995, 2006).

Develop a more robust understanding of climate change

Develop a more robust understanding of the science and impacts of climate change, and of the policies proposed

18 Article 2 of the UN Framework Convention on Climate Change (UNFCCC) specifies that its "ultimate objective … is to achieve … stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" (United Nations, 1992: 4).

for dealing with it, in order to find response strategies that would forestall "dangerous" impacts of climate change (per the UNFCCC's Article 2) while advancing human well-being at the same time.

Monitor the impacts of climate change

Monitor the impacts of climate change to give advance warning of "dangerous" impacts and, if necessary, to rearrange priorities for mitigation and adaptation should the adverse impacts of warming on human and environmental well-being occur faster or threaten to be more severe or more likely than is currently projected.

Priorities for Canada

Consistent with the adaptive-management framework outlined above, Canada should, first, focus on its climate-sensitive sectors like agriculture, timber, water resources, fisheries, and tourism, ensuring that their vulnerability to climate change is reduced even as their ability to take advantage of new opportunities created by climate change is enhanced. Canada should also be prepared to take advantage of new commercial opportunities in trade and natural resources that may arise should the Northwest Passage indeed open up, although, given the vagaries of nature, it is probably premature to invest heavily on this in the short term. Second, it should implement "no-regret" policies, such as eliminating natural resource subsidies and other policies that can be justified without necessarily referring to climate change. Third, it should continue to participate in national and international efforts to (a) monitor and research climate, climate change, and their impacts, and (b) research and develop more cost-effective technologies for mitigation and adaptation. Finally, to the extent that Canada funds efforts in developing countries aimed at adapting to climate change, it should direct funds to projects that reduce the vulnerability of these populations to urgent, climate-sensitive problems that may be exacerbated by climate change.

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Property Rights: The Key to Environmental Protection

Elizabeth Brubaker

The importance of private property rights in a market economy is widely understood. Property rights play a critical role in motivating and organizing economic activity, and in adjudicating disputes. The free exchange of private property is credited with facilitating cooperation among individuals with widely varying interests, and encouraging adaptation to changing circumstances. Secure rights are also valuable because they increase confidence in returns and strengthen incentives to invest, fuelling economic growth. As summed up by one legal scholar, "It is generally agreed that a system of private property helps to bring about economic prosperity" (Sunstein, 1993: 911).

Less commonly appreciated is the role property rights play in protecting the environment. Secure property rights provide both powerful incentives for the preservation of natural resources and effective tools to resolve differences over resource use. Although the Canadian judiciary has traditionally been committed to protecting property rights, few governments (federal or provincial) have acknowledged the importance of such rights or have allowed them to thrive. Indeed, successive governments have systematically overridden property rights to the detriment of both the economy and the environment. Because of their economic and environmental value, environmental policies that restore, protect, and strengthen property rights are likely to create considerable benefits.

Other chapters in this book address the merits of establishing property rights in natural resources. This chapter focuses on the need to restore the common-law property rights that have empowered people to protect the quality of their air, land, and water for centuries. Although it proposes a number of means to this end, it advocates one principal reform: the enshrining of property rights in the *Canadian Charter of Rights and Freedoms*.

> Defining property rights

William Blackstone, the famous eighteenth-century English jurist whose commentaries on the common law continue to influence legal thinking, defined the right of property as "that sole and despotic dominion which one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe" (1765-9, Bk 2, Ch 2: 2). Although Blackstone called the right of property "absolute," he understood both its multi-faceted nature and its subjection to the law. The right of property, he explained, "consists in the free use, enjoyment, and disposal of all [one's] acquisitions, without any control or

diminution, save only by the laws of the land" (1765-9, Bk 1, Ch 1: 134).

Today, property rights are often thought of as a "bundle" of rights that may include distinct rights to acquire something, to possess it, to control the way it is used, to enjoy the benefits of its use, to exclude others from it, and to transfer it to others. In the context of environmental protection, the most useful "stick" in this bundle is the right, long-protected by the common law, to use and enjoy one's property and to be free of interferences with it.

The right to use and enjoy one's property has a significant corollary: the obligation not to interfere with others' rights to use and enjoy their property. This obligation has been a cornerstone of the common law since medieval times. Henry of Bratton, a thirteenth-century English judge, wrote of the prohibition against a man's "doing on his own land what may damage a neighbour" (1230: 189–90). More than 500 years later, the maxim, "use your own property so as not to harm another's," which has been cited in numerous legal decisions, was described as "the rule" by Blackstone (1765-9, Bk 3, Ch 13: 217).

The rule retained its importance as common law evolved in Canada. Indeed, Canadian courts have been remarkably consistent in adhering to this central principle (Brubaker, 1995, 2007). Although different theories of property rights have come in and out of fashion over the years (Fox, 2006), Canada's judiciary has rarely strayed from the rule that one must not harm another's property or interfere with his enjoyment of it. Of particular interest to environmental policy makers is the courts' consistent application of this rule when resolving disputes about pollution.

> Common-law property rights in an environmental context

Depending on the nature of the dispute, environmental conflicts have traditionally been addressed under one of three branches of the common law: trespass law, nuisance law, or the law of riparian rights. Trespass law has been used when pollutants have constituted direct, tangible invasions. A trespass has traditionally been understood to mean the placement of anything—even a small amount of a harmless substance—on someone else's property. As an Alberta judge explained in 1976, citing a ruling made 200 years earlier, "Every invasion of private property, be it ever so minute, is a trespass" (*Kerr et al. v. Revelstoke Building Materials Ltd.*). Over the years, trespassing invasions have included straying animals, waste products, flood waters, sawdust, and pesticide sprays (Brubaker, 1995).

In general, nuisance law has been applied to indirect invasions and other less tangible interferences with the use or enjoyment of private property. In order for an activity to constitute a nuisance, it must create an unreasonable and substantial interference. Furthermore, unlike a trespass, it must cause harm, be it physical damage, financial harm, annoyance, discomfort, or inconvenience.[1] The character of the neighbourhood in which

1 Courts have also determined that exposures to risks may constitute nuisances and have ordered *quia timet* ("because he fears") injunctions to prevent such nuisances from continuing. Weighing both the probability and the consequences of apprehended harms, Canadian courts have tended to issue injunctions against proposed or ongoing activities if they have posed a real and substantial risk of harm, if the harm would have been irreparable, and if a mone-

the interference occurs also plays a part in determining whether something is a nuisance. Despite these constraints, courts have found a variety of interferences, including smoke, fumes, foul smells, noises, vibrations, and a plethora of pollutants, to be nuisances (Brubaker, 1995). In 1928, Supreme Court Judge Thibaudeau Rinfret went so far as to say, "Pollution is always unlawful and, in itself, constitutes a nuisance" (*Malcolm Forbes Groat and Walter S. Groat v. The Mayor, Aldermen and Burgesses, being the Corporation of the City of Edmonton*).

A third branch of the common law, the law of riparian rights, has traditionally been used to protect surface water. Under the common law, the people who own or occupy land beside lakes and rivers have the right to the natural flow of the water. They have the right to receive the water, substantially unaltered in quantity or quality. The broad reach of these rights has made them powerful tools, enabling riparians to protect their lakes and rivers from sanitary sewage, storm-water runoff, mine discharges, mill wastes, industrial effluents, dams, water diversions, thermal pollution, the discolouration of water, and even the hardening of water (Brubaker, 1995).

Despite its broad applicability, the common law has not been used frivolously. Courts have refrained from ruling on trifling amounts of pollution, allowing the rule of "give and take, live and let live" to govern minor inconveniences or temporary irritants. Even in cases concerning more significant pollution, courts have not automatically sided with plaintiffs. They have considered the specific circumstances of each conflict, including the severity of the impacts cited in the complaint, the sensitivity of the plaintiffs, and the reasonableness of the disputed activities. Such an approach has deterred plaintiffs with unfounded claims from using the courts. Canada's tradition of awarding costs against losing parties has further discouraged frivolous lawsuits.

Where it has been used, the common law has successfully balanced the conflicting interests of neighbours, allowing sustainable land uses and enjoining those that unreasonably harm others. The frequent use of the injunction (a court order prohibiting the continuation of an activity or compelling a particular action) has encouraged bargaining between parties and enabled them to work out efficient, mutually acceptable solutions (Yandle, 1997). Although guided by firm principles and precedents, the common law has adapted to an infinite variety of new circumstances, effectively controlling the adverse environmental impacts of countless activities (Brubaker, 1995).

> From common law to statute law

Sadly, the common law has proven *too* effective for many governments—especially provincial governments. Lawmakers have worried that the common law puts costly constraints on polluting industries and municipalities. As a result, in the last century, lawmakers have gradually legalized many nuisances, replacing the common law and its determined protection of property with more permissive government-made statutes and regulations.

The process of overriding the common law with statutory law is as old as the common law itself. Parliamentary

tary payment could not have adequately compensated for the harm (Sharpe, 1992: 1.27–1.32; Brubaker, 1996: 7–8).

supremacy has always given statutes precedence over the common law and has, for centuries, shielded parties from common-law liability for the inevitable consequences of statutorily authorized activities. Even the most rights-conscious judges have understood that "the legislature is supreme, and if it has enacted that a thing is lawful, such a thing cannot be a fault or an actionable wrong" (*Canadian Pacific Ry. Co. v. Roy*).

As early as the eighteenth century, British courts determined that the public interest warranted indemnifying public works authorized by Parliament. In the nineteenth century, government-authorized railway companies frequently benefited from protections from common-law liability. It wasn't until the mid-twentieth century that government-sanctioned property rights violations became commonplace. Modern governments, driven by interest group politics, have conferred liability limitations with abandon,[2] sometimes on one particular polluter—such as a pulp mill whose pollution had been enjoined by the Supreme Court of Canada (*K.V.P. Co. Ltd. v. Earl McKie et al.*)—and sometimes on entire classes of polluters, such as nickel and copper smelters, the operators of sewage works, or the nuclear industry (Brubaker, 1995). Some of the most recent beneficiaries of such laws have been farmers. Between 1976 and 2003, every province adopted "right-to-farm" legislation, which shields farmers from common-law liability for the nuisances they create (Brubaker, 2007).

By substituting statute law for the common law, governments have transformed not only the manner in which environmental conflicts are resolved, but also the incentives driving the processes and the results themselves. Statutes have shifted decision making from courts, which hear the cases of individuals who are directly affected by pollution, to governments that are far removed from the disputes. Unlike the neutral judges who traditionally "discovered" rather than "made" the law, politicians and bureaucrats, driven by political ends, choose sides, creating winners and losers. Furthermore, unlike traditional common-law principles, which were simple, long-standing, and knowable in advance, political rules are often subjective and unpredictable.[3] As one political theorist explains, "'law,' a body of stable, predictable rules, is being replaced by legislation, directives geared towards public ends" (Barry, 2004). In addition to creating tremendous uncertainty, such changes encourage polluters to invest in lobbying politicians, rather than in curbing their pollution, acquiring insurance, or working with those they harm to find mutually agreeable solutions.

2 Nobel Prize-winning economist Ronald Coase has pointed out the extent to which the nuisances we commonly confront have been legalized by governments that are intent on protecting businesses from the claims of those they have harmed. He notes that economists widely—and wrongly—assume that immunity from liability for damage is the fault of too little government regulation rather than too much intervention (Coase, 1960: 23–28).

3 Traditional common-law courts, adhering to published precedents, may be thought of as putting new facts into a black box containing all prior law, and almost mindlessly withdrawing from that box the proper answer to a dispute. In this way, at least ideally, disinterested judges worked within an objective and predictable law (Manne, 1997: 20–21). Perhaps somewhat paradoxically, however, the common law is also known for its flexibility and adaptability. Its timeless principles have continually had to respond and adjust to new circumstances (Pejovich, 2006).

Laws overriding property rights have had a number of other adverse consequences, as well. All have reallocated valuable rights from one set of citizens to another. While those living downwind or downstream from polluters have lost their age-old right to enjoy their property, polluters have gained a new right: the right to harm others. This new right subsidizes polluters by enabling them to externalize some environmental costs. In violation of the principle of polluter pay—a principle at the heart of environmental sustainability—it shifts costs to the polluters' victims. In so doing, it removes polluters' incentives to minimize adverse effects. Furthermore, it favours polluting practices over other uses of land and resources that may be more valuable and more benign.

Constitutional protection for private property

Despite the many advantages of robust private property rights, almost nothing protects them against unreasonable legislative override. Conversely, despite the damaging effects of the many statutes overriding property rights, almost nothing restrains federal or provincial governments from enacting such statutes. Property rights exist at the whim of governments. Most developed countries have constitutions that limit government expropriation of private property. Under the Fifth Amendment to the US Constitution, "No person shall be … deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation." The First Protocol of the European Convention on Human Rights, although weaker, nonetheless specifies, "Every natural or legal person is entitled to the peaceful enjoyment of his possessions. No one shall be deprived of his possessions except in the public interest and subject to the conditions provided for by law and by the general principles of international law." No such protections exist in Canada.

Property rights have been protected under federal statute since 1960, when the government of John Diefenbaker enacted the *Canadian Bill of Rights*. The Bill of Rights includes the individual's right to enjoyment of property as one of the human rights and fundamental freedoms that "have existed and shall continue to exist" in Canada. An individual may not be deprived of this right except by due process of law. Regrettably, the Bill of Rights has been of limited practical value for environmental protection. It is widely seen as ineffective (Magnet, 2001). It restricts only federal laws, and even they may find relief in the bill's notwithstanding clause.

Although the *Canadian Charter of Rights and Freedoms*, incorporated into the *Constitution Act of 1982* by the government of Pierre Trudeau, replicated and enshrined many of the provisions of the Bill of Rights, it did not enshrine property rights. This was a grave omission, and one that should be remedied as soon as possible. Enshrining property rights in the Charter would help safeguard individuals from inappropriate government interference in environmental disputes. It would limit politicians' ability to protect favoured industries or to arbitrarily transfer the costs of industrial activities to those living downstream and downwind. It would confirm the government's duty to protect citizens from harm by others, and to compensate them for harms that are permitted.[4] It would help restore the "government

4 There is a common-law presumption in favour of compensation where land has been taken. However, governments may enact

of laws and not of men" that was the norm before the regulatory state exploded (Massachusetts, 1780: Article XXX). It would, in short, regulate the regulators, both federal and provincial.

Of course, there is no guarantee that entrenching property rights in the Charter would provide the desired protections. The Charter can offer only what James Madison described as a "parchment barrier" against encroachment. The protection of Charter rights depends on their interpretation by judges.[5] Section One of the Charter gives judges leeway to override rights if they determine that doing so is "reasonably necessary in a free and democratic society." Despite such limitations, Canada's legal history provides reasons for optimism. For centuries, judges have shown themselves to be fierce protectors of individual rights. They have been far less susceptible than governments to political pressures and have consistently rejected overriding individual rights to benefit particular industries or the public at large. In the words of Supreme Court Justice John Sopinka, "The courts strain against a conclusion that private rights are intended to be sacrificed for the common good" (*Tock et al. v. St. John's Metropolitan Area Board*). Enshrining property rights in the Charter would further enhance their status, making it even less likely that courts would override them.

The federal government has acknowledged the value of enshrining property rights in the Charter. The Prime Minister has advocated such a change. In 2005, Stephen Harper stated, "We believe in property rights … and we believe they should be protected in our Constitution … As a government, we will seek the agreement of the provinces to amend the Constitution to include this right, as well as guarantee that no person shall be deprived of their just right without the due process of law and full and just and timely compensation" (Harper, 2005). In its platform for the 2006 federal election, the Conservative Party went further, pledging not only to propose a constitutional amendment, but also to "enact legislation to ensure that full, just, and timely compensation will be paid to all persons who are deprived of personal or private property as a result of any federal government initiative, policy, process, regulation, or legislation" (Conservative Party of Canada, 2006: 43).

Many environmentalists oppose enshrining property rights in the Charter. Their concerns largely stem from a fear that stronger property rights could weaken environmental legislation. They point to the United States, where property rights protections have been used to overturn environmental laws (Sierra Club, 2006). Such fears are overblown. In most states, only in extreme

statutes denying compensation. Protecting property rights in the Constitution would limit Parliament's ability to take away owners' rights to compensation.

5 The notorious decision in *Kelo v. City of New London*, issued by the US Supreme Court in June 2005, highlighted how unfavourable judicial interpretation can be. The Court ruled that New London, Connecticut, could take private land to facilitate private economic development. It reasoned that since the creation of office space, parking, and retail services was expected to create jobs, increase tax revenues, and revitalize the city, this action would serve a public purpose. Sandra Day O'Connor, one of the four dissenting justices, lamented that with this decision the court abandoned a long-held, basic limitation on government power. She warned, "All property is now vulnerable to being taken and transferred to another private owner, so long as it might be upgraded in the process … Nothing is to prevent the State from replacing any Motel 6 with a Ritz-Carlton, any home with a shopping mall, or any farm with a factory" (*Kelo v. City of New London*).

cases have laws or regulations been found to violate the Constitution's prohibition against taking private property without compensation. Prohibitions against activities that threaten public health or safety or create nuisances have not been deemed regulatory takings. Such harmful activities were not previously permitted, and thus their prohibition by regulation requires no compensation. Nor has the American Constitution's respect for property rights prevented the United States from adopting stronger and more effective environmental regulations than those found in Canada.

Since 1922, when the US Supreme Court ruled that "while property may be regulated to a certain extent, if regulation goes too far it will be recognized as a taking," courts have struggled to define "too far" (*Pennsylvania Coal Co. v. Mahon*). In 1992, the Supreme Court issued one of its most important decisions on this matter, concluding that if legislation deprives an owner of all economically viable use of his land, then compensation is required, unless the planned development would have violated state property laws or nuisance laws (*Lucas v. South Carolina Coastal Council*). A decade later, the court noted that regulations that permanently deprive property of all value are the "extraordinary case." It refused to treat all land-use regulations or all moratoria on development as compensable takings, or to propose a precise formula for determining when a regulation goes too far. Instead, it advocated an ad hoc approach that weighs all relevant circumstances (*Tahoe-Sierra Preservation Council Inc. v. Tahoe Regional Planning Agency*).

Individual states continue to grapple with the issue of when regulation requires compensation. Some of the most restrictive requirements are now found in Oregon, where a successful ballot initiative, upheld by the state's highest court in February 2006, requires state and local governments to compensate landowners if land-use regulations imposed after they acquire their properties reduce their property values (*Hector Macpherson et al. v. Department of Administrative Services et al.*). Alternatively, under the new law, governments may modify the regulations or refrain from applying them. The law does not apply to regulations that prevent public nuisances, protect health and safety, or are required to comply with federal law.

Successful challenges to laws that amount to regulatory takings do not override the laws. They simply require that affected property owners be compensated for their losses. In this way, these challenges shift costs from individual property owners to taxpayers. Such a shift is appropriate. If individuals must forgo their property rights in order to produce social benefits, it is only fair that the public at large bear the costs. Enshrining property rights in the Charter could move Canada closer to this more equitable distribution of costs and benefits.[6]

6 The prospect of enshrining property rights in the Charter raises questions about what forms of property would be protected. Some have raised the possibility that the easements obtained by polluters who have been given statutory permission to violate their neighbours' property rights would themselves be defined as property rights meriting protection. Others have noted that welfare benefits, jobs, or agricultural production quotas could be defined as a new kind of property, also meriting protection. Inevitably, courts would have to separate genuine rights from privileges masquerading as rights. They would have to distinguish between "what really is property deserving of protection and what is merely an illegitimate creation of the state implemented by the use or

Statutory protection for private property

Constitutional reform has been a difficult process in Canada. A commitment to stronger property rights could take other forms, should amending the Charter prove beyond the reach of the current government. The federal government should adopt a policy not to enact any legislation or regulation that allows federal bodies to override private property rights without (1) a demonstration that doing so is unavoidably necessary for an essential public use;[7] (2) due process of law; and (3) full and fair compensation. Although such a policy would not bind provincial governments, the federal government should refuse to fund provincial schemes that violate any of these three requirements.

The federal government should also incorporate principles from the common law into its regulatory regimes (Yandle, 1997). Such principles include the right to be free of harm from one's neighbours, the responsibility to use one's own property so as not to harm another's, the importance of internalizing the costs of pollution, and the value of decentralized decision making. Exemplary common-law practices also include stopping polluting activities through injunctions (rather than merely fining polluters) and, when fines are levied, directing them to polluters' victims rather than to governments. Incorporating such principles and practices into environmental statutes and regulations would make them far more sustainable.

Many environmental statutes and regulations will be required, even if property rights are more fully protected. Stronger property rights alone cannot fully protect the environment. Traditional common-law property rights work best when a polluter can be identified, when its victims can be identified, and when the harm is substantial. The joining together of victims in associations that file lawsuits—or, in appropriate cases where many people are involved, class action suits—can address the challenges of pollution that affects many people. However, when many people suffer minor, cumulative damages from many small polluters (for example, those driving smog-producing automobiles), no one has an incentive to sue because each suit would be costly and ineffective. Likewise, common-law property rights will not effectively protect people from pollutants of foreign origin, those that are difficult to track,[8] or those whose adverse effects do not appear for many years. Such cases call for statutes, regulations, and, in some cases, international cooperation. Ensuring that such regulations are based on sound science and economic analysis will doubtless remain difficult in the inevitably politicized realm.

threat of brute force—in effect, stolen property" (Selick, 2001). Should courts seriously err in defining property, governments would have the authority to override their decisions by evoking the "notwithstanding" clause found in Section 33 of the Charter. A discussion of the merits and drawbacks of doing so is beyond the scope of this chapter.

7 The concept of public use is admittedly problematic. Too often, governments and courts have failed to distinguish private from public uses. In response to the Kelo decision, many American states have limited the definition of public use (see notes 5 and 9). The coming years will provide invaluable information on how effective different definitions may be in preventing the concept from being abused.

8 The field of environmental forensics is improving, making pollutants easier to track. Stronger property rights would create stronger incentives to trace pollutants, spawning further advances in the field.

Reviving and nurturing a culture of property rights

As important as they are, constitutional and legislative measures are no panacea. Ultimately, the protection of property rights, be it by courts or by legislatures, depends on a culture of respect for rights in the public at large. As a US court recently noted, "Although the judiciary and the legislature define the limits of state powers, such as eminent domain, the ultimate guardians of the people's rights … are the people themselves" (*Norwood v. Horney*). Americans are well known for their attachment to individual rights.[9]

Although Canadians' attitudes towards property rights may be more nuanced, and while their understanding of them may have weakened from disuse, Canada's common-law tradition of deep respect for property rights is, if anything, stronger than that of its southern neighbour.[10] All of the reforms proposed above, constitutional and statutory alike, would be in keeping with that strong legal tradition. Perhaps more importantly, they would help revive and nurture a culture of property rights in Canada. They would help restore not only the legal principles and practices, but also the cultural milieu that, for centuries, empowered Canadians to protect their air, land, and water. Strong property rights would once again provide individuals with the tools to protect the resources on which their health and well-being depend. Finally, they would create powerful incentives for industries to reduce pollution. No other single right, law, or regulation could preserve the environment more effectively.

9 The public reaction to the Kelo decision (see note 5), illustrates the importance of property rights in American culture and the passion with which citizens will defend those rights. The decision ignited a firestorm of opposition to expropriation. When the Court stated that "nothing in our opinion precludes any state from placing further restrictions on its exercise of the takings power," citizens lobbied state legislatures with a vengeance. In the 17 months following the decision, 34 state legislatures moved to limit takings (Institute for Justice, 2006). Some states prohibited or limited the use of expropriation for private projects, urban renewal, economic development, or the enhancement of tax revenue; others changed expropriation procedures to make the process fairer and more transparent. Some of the changes were the subject of extraordinarily successful citizen ballot initiatives. When initiatives were voted on in November 2006, 83 percent of Georgia voters approved a state constitutional amendment to limit eminent domain to public use; in South Carolina, 86 percent supported such an amendment (Christie, 2006).

10 Canadian courts have been less willing than American courts to compromise individual rights to promote industrial development. They have less readily considered the economic importance of polluting industries, they have less often substituted damages for injunctions, and they have rejected the coming-to-a-nuisance defence—a defence that, in the United States, strengthens established polluters' rights over new neighbours.

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Canadian Fisheries Governance: The Good, the Bad, and the Ugly

R. Quentin Grafton

Canada has one of the world's largest exclusive economic zones; it spans three oceans and encompasses some highly productive fisheries. Despite these blessings, many of its marine resources suffer from overregulation, overcapacity and depleted stocks.

In this chapter, I will briefly review the state of affairs of fisheries governance in Canada. In particular, I will outline the good (the few outstanding successes that represent "best practice" management), the bad (poor governance that has resulted in depleted stocks and poor economic returns), and the ugly (decision making and political interference that has led to the collapse of fish stocks). Following this review, I will outline the strategies the regulator—the Department of Fisheries and Oceans (DFO)—has adopted to address current challenges. I will conclude with separate recommendations that, if implemented, would promote resilient ecosystems, sustainable fisheries, and a self-reliant fishing industry.

> The Good

Despite the many "bad news" fishing stories, Canada has a small number of fisheries that are examples of the best practices in the world. These fisheries are characterized by an incentives-based approach to governance. In contrast to input-controlled fisheries, where there is an imperative for fishers to catch as much as they can during a limited fishing season with little regard to quality or costs, appropriate incentives help minimize harvesting costs per quantity of fish landed and maximize the value of the product. Moreover, where incentives are engendered through individual harvesting rights, transferability allows more profitable fishers to harvest a greater share of the total allowable catch (TAC).

Several Canadian fisheries have adopted an incentives-based approach through the implementation of individual transferable quotas (ITQs). These rights are denominated as a proportion of the TAC and are tradable among licence holders. Where these rights have been adequately enforced and monitored, and with appropriately set TACs, they have proved successful at improving profitability and have prevented a downward spiral of increasing effort and ever more input restrictions that are common among input-controlled fisheries.

ITQs can change the dynamic of fisheries management. Providing fishers with proprietary incentives that allow them to reap the benefits of conservation, but also suffer the consequences of overharvesting, can transform harvesters into proponents of sustainable fishing practices. For example, in the British Columbia sablefish fishery—managed by ITQs since 1990—the Canadian Sablefish Association was advised by an independently

contracted scientist of substantial falls in the stocks in 2001. Shortly thereafter, fishers asked the DFO to reduce the catch so as to reduce the chances of overharvesting (Grafton et al., 2006). As well, the industry association has funded research that has led to the development of trap escape rings that have dramatically reduced juvenile harvesting.

The BC halibut fishery, which has had individual vessel quotas since 1991, is an outstanding example of the economic successes of the incentive-based approach. These rights were introduced with the support of 70% of fishers (Grafton et al., 2000). Under this system, individual vessel quotas are provided to appropriately licensed halibut fishers based upon a formula that includes catch history and vessel size. Although the rights were initially not transferable, by 1993 the vessel quotas could be traded, thus allowing for consolidation. A detailed quantitative analysis of the changes in the fishery over the period 1988 to 1993 reveals (1) short-term gains in economic efficiency over the period 1991-1993; (2) substantial increases in producer surplus and rents to fishers; (3) large increases in productivity; and (4) improved safety at sea, decreased wastage of fish, and reduced loss of fishing gear (Fox et al., 2003; Grafton et al., 2000).

Much of the economic gains in the BC halibut fishery arose from a change in the length of the fishing season from two openings (the first, six days long and the second, four days) before ITQs were introduced, to the current 245 days. This change has allowed fishers to be much more selective about when and where they go fishing, and has permitted them to sell fresh and high quality halibut at a premium price relative to the frozen product that previously represented the bulk of sales.

Multi-species trawl fisheries have also reaped the benefits of increased fish prices due to a longer fishing season. For instance, in the Scotia-Fundy mobile gear fishery, managed by ITQs since 1991, price gains occurred in the ITQ species, but not in their non-ITQ counterparts in the year individual harvesting rights were first introduced (Dupont et al., 2005).

Examples of improvements in the performance of fisheries due to ITQs are not limited to so-called single species fisheries. In the BC groundfish trawl fishery, for example, fishers have voluntarily invested millions of dollars in research to ensure that TACs are set at sustainable levels (Rice, 2003). In this fishery, on-board observers calculate fishery mortality rates that count against quota that is owned or leased by fishers. This, along with individual quota reconciliations, has created an incentive for fishers to reduce the catch of less desirable species and to avoid locations where there may be high concentrations of non-target species. It has also encouraged selective fishing and the use of shorter tows that reduce bycatch (marine creatures caught unintentionally), and has dramatically reduced the ratio of at-sea releases to total catch (Grafton, Nelson, and Turris, 2007).

Several factors contributed to successes of incentive-based approaches in Canada:

- The industry supported and agreed on how the rights should be initially allocated, increasing compliance;

- The TACs set were binding in order to promote sustainable practices and to ensure that rights were valuable;

- Redundant input controls, such as season length, which were intended to reduce harvesting costs and inefficiencies were removed or relaxed;

- Harvesting rights were transferable, allowing less profitable or older fishers to sell their rights and leave the fishery, thereby reducing the fishing effort; and

- Rights were adequately monitored and enforced in order to protect the integrity of the rights.

The importance of proper monitoring cannot be overstated as early experiments in the use of individual harvesting rights, such as in the western Newfoundland otter-trawl cod fishery that began in 1984 (Crowley and Palsson, 1992) or in the 4WX herring fishery in the Bay of Fundy (Campbell, 1981), failed to deliver better outcomes because of misreporting and discarding.

The successes of ITQs in Canadian fisheries provide a model of how fisheries management can be improved with the use of incentive-based approaches. Although these approaches are by no means a panacea for all the problems in fisheries, they create fisheries that avoid many of the ongoing problems that occur in Canadian fisheries that operate under a "command-and-control" approach.

> The Bad

One measure of the overall performance of fisheries is the amount of government financial transfers (GFT) to the sector as a proportion of the total value of landings. Although a crude measure, this ratio provides an indication of the overall financial viability of the fishing industry. Countries with high ratios are often characterized by overcapacity and low economic returns. This is because economic and social problems encourage subsidies and make it much more difficult politically to reduce catches in response to declines in stocks.

The Organisation for Economic Co-operation and Development (OECD) has undertaken comparisons of its members in terms of GFTs as a proportion of the total value of landings in marine capture fisheries. The countries that have been at the forefront of implementing incentive-based fisheries management—New Zealand and Iceland—have a GFT to value of landings ratio of about 3% to 5%. By contrast, the average for all OECD countries in 2003 was about 20%, while Canada's ratio is over 30% (OECD, 2006). This suggests that despite the "best practice" performance of some Canadian ITQ fisheries, the overall performance of Canadian fisheries is inferior to that of many of Canada's peers, and is well below the fisheries' potential.

The BC salmon industry illustrates what is wrong with the management of many Canadian fisheries: a failure to consider the incentives faced by fishers. Collectively, salmon have provided annual landings in excess of 100,000 metric tons in the 1980s, although this amount has decreased greatly in recent years (Grafton and Nelson, 2007). A decline in catch, as well as a drop in the price of wild salmon because of increased supplies of farmed salmon, has caused the value of landings to drop from a peak of around $250 million in 1994 to around $50 million in 2004 (Grafton and Nelson, 2007).

Not all of the problems of the BC salmon fishery can be attributed to poor management, as it is likely that environmental changes and upstream habitat damage have contributed to the decline of some important salmon runs. Nevertheless, traditional input-controlled management has failed to promote resilience in the industry, which would allow it to cope with declines in prices and catches. Moreover, controls have prevented fleet rationalization which would have improved economic efficiency and net returns.

The DFO has tried to address chronic overcapacity in the salmon industry primarily through vessel buybacks and fishing licences. There were five major buybacks between 1970 and 2000, the most substantial of which was a 1998-2000 buyback that reduced the number of vessels by half. Despite real expenditures of almost $300 million over the past three decades, the buybacks have failed to deliver long-term benefits or a resilient fishery because fishing effort is able to creep back so long as the "race to fish" remains. In 2005, the DFO announced yet another reform package in response to "conservation concerns, [and] very poor returns in the salmon fishery" and, for the first time, was exploring elements of quota management (DFO, 2006a).

Notwithstanding its successes in other fisheries, the introduction of ITQs into the salmon fishery is problematic given the highly variable nature of salmon runs, and the need to ensure that enough salmon swim up river to spawn (escapement). Because of the nature of the fishery, the fishing season is necessarily short, irrespective of the management regime. Consequently, there is a critical need for in-season adjustments to guarantee that the escapement will be adequate.

> The Ugly

Much has been written about the collapse of the northern cod fishery in the early 1990s, which is perhaps the greatest disaster to befall any Canadian natural resource. Reviews of the two adjustment packages in response to this crisis—The Northern Cod Adjustment and Recovery Program (NCARP) and The Atlantic Groundfish Strategy (TAGS)—have been provided by the Auditor General of Canada (1997). A later program, called the Canadian Fisheries Adjustment and Restructuring (CFAR) Plan, was instituted between 1998 and 2001 to encourage fishers to leave the industry by offering a further buyout of licences, as well as income replacement (DFO, 2006b). In addition to these adjustment packages, yet another program was implemented following the second closure of the cod fisheries in 2003. Combined, these programs have provided over $3 billion dollars of assistance. These programs, which have included buybacks of fishing licences, cancellations of inactive licences, and the creation of a "core," or a professional group of fishers, have provided income support to fishers and processing workers. Unfortunately, they have failed to change the underlying incentives that have led to excess fishing effort and overharvesting, which in turn have contributed to the stock collapses.

Despite massive expenditures and a 40% decline in the number of groundfish licences since the early 1990s, there remains a large capacity "overhang." As well, many cod stocks remain in very poor shape, a fraction of their levels in the 1980s, with little or no expectation of a rapid recovery (Gough, 2001; Schott, 2004). To make matters worse, years of structural adjustment have left the

fishing industry no more resilient to cycles of nature and overharvesting than it was before the stock collapses (Grafton, Kompas, and Ha, 2005).

The primary cause of the unfortunate state of affairs in Atlantic Canada's groundfish fisheries is poor governance (DFO, 2004). Despite a shift towards co-management in the past decade (Foster et al., 2005; Schott, 2004), fisheries management remains essentially hierarchical.

In recent years, the government has interfered in the industry by giving fisheries licences to out-of-work groundfish fishers, with little consideration of the problems that would be generated in terms of overcapacity or overharvesting, and despite warnings of the economic consequences of such actions (Grafton and Lane, 1998). Such a situation occurred in the 1980s, when crab licences were used to "compensate" fishers who were no longer able to make a living from groundfish. As a result, the number of crab licences went from about 70 in the early 1980s to 600 by 1988. This type of compensation—using access to a public resource to address social and regional development problems—accelerated during the 1990s following groundfish harvesting moratoria. Because of the government's interference, the present number of licences in Newfoundland and Labrador now exceeds 3,400, which is almost 50 times the number of licences 25 years ago (Fisheries Resource Conservation Council, 2005). The huge expansion in snow crab licences has resulted in tens of thousands of extra traps in the water and chronic overcapacity, which will eventually generate another Atlantic fisheries crisis when stocks decline due to the cyclical nature of the resource and high exploitation rates. When this occurs, crab fishers will, quite understandably, blame the federal government for the decline and demand their own structural adjustment package.

The role of elected officials is to help set policy and establish higher order goals, not to make operational decisions. As the example of Atlantic Canada's groundfish fisheries shows, political interference that uses a public resource to foster social objectives, such as employment maximization, eventually leads to unsustainability, low returns, and government bailouts. To create a sustainable fishing industry, fisheries must be viewed as a valuable natural asset that should be managed for the present and the future in order to provide a positive rate of return to its owners—the Canadian public.

> Ways forward

The foregoing examples of Canadian fisheries governance provide important insights that can help us overcome the challenges currently faced by the industry. Before outlining the ways forward, we will briefly review the vision and strategies proposed by the DFO.

The DFO vision

The vision for DFO, as stated by Minister of Fisheries and Oceans Geoff Regan to the Standing Committee on Fisheries and Oceans in 2004, is to ensure the sustainable development and safe use of Canadian waters (Regan, 2004). This vision will be implemented via integrated management plans, a network of marine protected areas (MPAs), the promotion of ocean technologies that avoid destructive fishing practices, a science-based ecosystem approach to decision making, and new policy frameworks for the Pacific and Atlantic fisheries as part of an Oceans Action Plan (Regan, 2004). These developments

build on other positive innovations since the collapse of the groundfish stocks, such as the establishment of the Fisheries Resource Conservation Council (FRCC) which provides independent advice to the minister of fisheries and oceans on groundfish conservation issues, and on the setting of TACs.

The DFO proposals are a step forward, but without a fundamental change in the hierarchical structure of decision making, little progress will be made. For instance, policy decisions in Atlantic Canada have traditionally been made in the following manner: fishers are consulted via special advisory committees, DFO staff subsequently prepare confidential recommendations for higher management, and then industry groups lobby the DFO and the minister of fisheries and oceans to make decisions that will best serve the interests of their particular groups (Fisheries Resource Conservation Council, 2005: 36). The resulting decisions are not transparent and are not widely accepted. The level of accountability under this system is insufficient.

To move forward, Canadian fisheries must adopt incentive-based approaches to prevent overcapacity; effectively manage uncertainty to avoid stock collapses; and connect higher-levels goals, such as sustainability, to day-to-day decisions in a transparent, accountable, and adaptive way so that operational errors are identified and corrected in a timely manner.

Building resilience

To move forward, Canadian fisheries must try to ensure that marine ecosystems are able to return to their former state quickly following adverse environmental shocks. The fishing industry needs to become self-reliant and strong enough to withstand cycles of abundance, rising fuel costs, and the ups and downs of fish markets. Reaching these goals will entail effective decision making (accountability, transparency, and political independence at the operational level); systematic risk assessment and management; and incentives-based approaches to sustainable fisheries.

The recommended approach requires appropriate ecosystem, fishery, and economic performance indicators to evaluate and improve management actions, as well as precautionary reference points to ensure high-risk decisions are avoided. It also requires a radical change from the traditional top-down management practised at the DFO, and a greater shift toward rights-based management to encourage sustainable fishing practices. Under this new approach to governance, elected officials would not be able to interfere with operational tactics, and professional managers would be held accountable for their actions, but would also be given the authority to make informed decisions (Grafton, Kompas, McLoughlin and Rayns, 2007).

To ensure sustainable fisheries, managers must explicitly account for uncertainty over the current and future state of marine environment, and for the effects of their actions. Taking this approach requires risk assessments of management strategies that consider how, when, and what fish are caught, as well as mixed strategies that provide options, whatever the state of the world may be (Grafton and Silva-Echenique, 1997). For example, this approach could involve greater use of spatial management to complement the traditional control of TACs. Spatial closures could also increase resilience in the presence of adverse environmental shocks (Grafton, Kompas, and Ha, 2005; Grafton, Kompas,

and Lindenmayer, 2005), but only if marine reserves are developed in the context of fisheries management. Currently, reserves are viewed as permanent set asides to conserve biodiversity and critical habitat with little or no consideration given to the impacts (positive and negative) on fisheries.

Sustainable fisheries are complemented by a viable and profitable fishing industry. The history of management in Canada and elsewhere shows that, in general, trying to control fishers through coercion does not effectively promote self-reliant fisheries. By contrast, incentives-based approaches in Canada, New Zealand, and Iceland have produced profitable and sustainable fisheries. However, the successful expansion of incentives in the form of ITQs, community rights, or territorial user rights in Canadian fisheries is dependent on setting the appropriate TACs or escapement, and on adequate monitoring and enforcement. Beyond rights for target species, incentives can also be developed to reduce bycatch, as shown with the successful use of dolphin mortality limits in the Eastern Tropical Pacific, and to reduce habitat damage (Grafton et al., 2006).

> Conclusion

Canadian fisheries are a proverbial "tale of two cities," exemplifying both the best and the worst of times. To achieve better outcomes, the underlying governance of Canada's fisheries must be changed from a top-down hierarchy to a system in which managers are held accountable to independent boards of experts and stakeholders. Furthermore, major decisions, and the information on which they are based, must be fully transparent, and management must undertake explicit risk assessments and systematic strategy evaluations. Equally important, a system of governance must be developed in all Canadian fisheries to give fishers and/or their communities the appropriate incentives to promote sustainable fishing practices and to create a self-reliant fishing industry.

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A breath of fresh Air

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Professor Grafton has over 20 years experience in environmental economics and fisheries. He is the author or editor of 10 books, more than 60 articles in some of the world's leading journals (such as *Science*), and numerous chapters in books. He is the senior editor of a major fisheries volume entitled *Handbook of Marine Fisheries Conservation and Management*, to be published by Oxford University Press in early 2009.

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Opening the Door to Environmental Goods and Services

Glenn Fox[1]

A decade ago, the agricultural policy agenda in Canada did not reflect the idea that agricultural lands produce ecological goods and services.[2] This is no longer the case. After a June 2006 meeting of Canada's federal and provincial ministers of agriculture in St. John's, Newfoundland, Agriculture and Agri-Food Canada issued a news release that stated,

> Ministers also received a report on progress to date on the development of an Ecological Goods and Services policy framework and agreed to continue policy development and implementation of pilot projects. (Agriculture and Agri-Food Canada, 2006b)

This policy framework is not yet available, but pilot projects are underway, and more are being proposed, to explore the feasibility of provision of environmental goods and services from rural lands. The Soil Conservation Council of Canada (McKell, no date), the Canadian Federation of Agriculture (no date), and the Christian Farmers Federation of Ontario (2005) have prepared policy statements regarding payments for environmental goods and services. The Agricultural Policy Framework (APF) Review Panel recommended that every future Canadian agricultural policy framework give consideration to "the implementation of society's purchase of Environmental Goods and Services (EGS) from farmers" (APF Review Panel, 2006). The George Morris Centre's Canadian Agri-Products Policy Project included environmental goods and services as one of seven strategic elements of a comprehensive approach to reforming Canadian agricultural policy (Martin and Stiefelmeyer, 2006).

The Commission for Environmental Cooperation (Mayrand and Paquin, 2004) and the Agri-Environmental Policy Branch, Ministère de l'Agriculture, des Pêcheries et de l'Alimentation of the government of Quebec (Gagnon, 2005) have produced extensive international surveys of policies and programs in order to promote the provision of environmental goods and services from agricultural lands. Agriculture and Agri-Food Canada (2006a) organized a national symposium on ecological goods and services in Winnipeg in February 2006. The 2006 annual meeting of the American Agricultural Economics Association included a principle paper

1 I would like to thank Nick Schneider and Maria Klimas, as well as two anonymous referees, for their comments on earlier versions of this chapter.

2 I will use environmental goods and services and ecological goods and services as synonyms in this chapter. The latter seems to be the preferred term of the federal government while the former is generally used elsewhere.

session on "Cultivating Ecosystem Services from Agriculture" with presentations by Scott Swinton et al. (2006), Katherine Smith (2006), John Antle and Jetse Stoorvogel (2006), and Robert Wolcott (2006).

Several general themes have emerged in policy and academic discussions of this topic in Canada. First, compensation for landowners that is commensurate with their contributions to the provision of environmental goods and services is generally recognized as a legitimate goal, particularly in light of the prevailing approach to policy and regulation in this area. A coalition of farm and environmental organizations is emerging in support of this goal. For the most part, arguments in support of this goal are stated in terms of fairness, rather than efficiency. However, the challenge of arriving at a value for the environmental goods and services provided by farmland owners—a value that would serve as the basis for compensation—is formidable.

There appear to be several motivations for increasing interest in environmental goods and services from rural lands in Canada. Technological change, farm subsidies, and other policy distortions, as well as weather variability and inelastic demand, have contributed to falling and unstable prices for farm products. Opportunities to enhance revenues, or to stabilize incomes through diversification or compensation for providing environmental goods and services, have attracted the attention of farm groups, as well as governments.

The more vigorous application of environmental regulation of agriculture in recent decades has also contributed to this growing interest. In the early 1970s, environmental regulation in Canada and the United States tended to focus on large-scale industrial emissions sources, emissions from the transportation sector, and municipal waste management. Agriculture was largely overlooked by this first wave of environmental regulation. That began to change in the mid- to late 1980s as agriculture began to be seen as both a source of emissions and a category of land use that created tradeoffs with habitat protection for endangered species. More recently, regulation of agricultural production activities to protect ground and surface water has been introduced in many jurisdictions. In addition, disputes over odour and other environmental issues surrounding the development of large-scale livestock production facilities have become more common and more acrimonious.

This rise in policy attention has not gone unnoticed in rural areas. An increasingly vocal rural property rights movement is one expression of a reaction to this shift in policy. Rural landowners speak more frequently about regulatory takings[3] under this emerging environmental policy regime, and leading farm organizations have called for compensation. Opportunities to generate revenue for the provision of environmental goods and services have been seen as a way to resolve emerging conflicts in this area.

James Buchanan (1964) and Carl Dahlman (1979) have both argued that the primary purpose of economic research should be to identify opportunities to extend market exchange relationships into realms where they

3 The term "regulatory takings" has been applied to many types of government actions. In general, the term is applied to situations where government regulation of property use reduces the market value of land. It is beyond the scope of this chapter to review the depth and breadth of the controversies found in the regulatory takings literature. A seminal contribution to this literature is Richard Epstein's 1985 book, *Takings*. For a Canadian perspective on some of these issues, please consult Schwindt (1992).

do not currently exist. One implication of this view is that the common practice of economists to distinguish between market goods and non-market goods is at best a short-term distinction. Innovations in institutions and technology, as well as changes in values or ideology, can move this boundary. It is generally accepted in Canadian discussions that ecological goods and services currently fall into the non-market category. But the international surveys of experiences compiled by Mayrand and Paquin (2004) and Gagnon (2005) illustrate that there is no intrinsic characteristic of environmental goods and services that relegates them permanently to this fate.

Much of the literature on environmental goods and services, and the closely related literature on natural capital from which it is derived, is metaphorical. According to this metaphor, natural capital is somewhat like capital and environmental goods and services are somewhat like the goods and services that are exchanged in markets. This metaphor helps us to appreciate that these things have value to humans. The purpose of this chapter is to explore how we can move beyond the metaphor and facilitate the transformation of environmental goods and services in Canada from non-market goods to market goods.

> Environmental goods and services

Agriculture and Agri-food Canada defines ecological goods and services as "the benefits that human populations derive, directly or indirectly, from healthy functioning ecosystems, which encompass air, water, soil and biodiversity" (qtd. in McKell, no date). The Soil Conservation Council of Canada identifies ecological goods as potable water, quality food, fuel, wood, fibres, genetic resources, pharmaceuticals, and ecological services such as greenhouse gas mitigation, carbon sequestration, erosion control, soil quality improvement, ecosystem enhancement, water purification, and waste treatment. Other definitions and taxonomies have been proposed by Olewiler (2004), Gagnon (2005), and Mayrand and Paquin (2004).

In general, the terms "environmental goods and services" or "ecological services" are used to describe a wide range of items. From a property rights perspective, it is important to distinguish between two subcategories of environmental goods and services. The first subcategory includes reductions in what Rothbard (1982) describes as physical invasions of persons or their justly owned property by others. Such situations include trespassing, making a nuisance, and violating riparian rights under customary common law (see Brubaker, 1995, and Yandle, 1997). Agricultural examples that fall under this subcategory include a reduction in off-farm water quality due to soil erosion, manure storage and application, or farm chemical use; a reduction in off-farm air quality due to dust or odour; and noise from transportation or production activities. The second subcategory of environmental goods and services includes the protection of wildlife and endangered species habitats; outdoor recreation; the maintenance of scenic views; the prevention of the conversion of farmland to non-farm uses; and most forms of wetland protection.

The distinction between these two types of environmental goods and services is critical to understanding the potential role of market exchanges in the provision of those goods and services. This distinction also helps clarify the nature of regulatory takings. Government

regulations that impose sanctions on things that would qualify as nuisances under customary common law should not be described as regulatory takings because the right to private property does not include the right to commit trespasses or nuisances against other property owners. Many air and water emissions regulations fall under this category and thus do not qualify as regulatory takings. Determining whether an apparent pollution trespass or nuisance is an actual trespass or nuisance depends on history (Rothbard, 1982).

Wetland protection policies occupy a grey area with respect to regulatory takings. In some instances, regulation to protect wetlands can constitute a measure to protect the riparian rights of downstream property owners, and this type of regulation would not constitute a regulatory taking. However, not all wetland protection policy is justified under this rationale. Wetland regulation that is intended to provide wildlife habitat or scenic amenities would constitute a regulatory taking.

> Approaches to promoting environmental goods and services

There are two broad categories of approaches to promoting the provision of environmental goods and services: taxpayer-financed government programs and beneficiary-financed market programs. These two categories could also be described as government regulatory approaches and free-market environmentalist[4] approaches. The first category would include government ownership of land and other resources, as well as regulatory takings and taxpayer-financed payments to landowners for the provision of environmental goods and services.

Government regulatory approaches

When a regulatory takings approach is adopted, the resulting prosecution, implementation, and enforcement are financed by taxpayers. However, compliance costs, including losses in property values, are borne by property owners. If property owners are compensated for these costs and losses, then the policy comes closer to an expropriation approach. Variations on this approach[5] include expropriation of land for parks, conservation areas, and wildlife preserves; purchase of development rights and conservation easements; full or partial cost-sharing programs; income, capital gains, estate, property, or other tax credits; differential property tax rates[6]; conservation set-aside payments; and multi-functionality payments.[7] The terms of these measures may take the

4 The term "free market environmentalism" has been used by Terry Anderson and Donald Leal in their 1992 book *Free Market Environmentalism*, published as a second edition in 2001 and further developed in their 1997 book *Enviro-Capitalists: Doing Good While Doing Well*, to represent a market-based approach to environmental stewardship.

5 Some of these methods, such as the purchase of development rights or conservation easements, can also be used by private voluntary associations. In this case, these methods would fall under the free-market environmentalist category as club goods.

6 Typically, for property tax purposes agricultural land is subject to a lower assessment rate than residential, commercial, or industrial land.

7 Multi-functionality is a term that has been popular in the European Union. The term has become controversial in international

form of purchases, involving a one-time lump sum payment for a permanent commitment, or a lease or rental arrangement that secures a commitment for a limited time period. Terms of sale or lease arrangements sometimes involve competitive bidding processes.

One type of government program, which is sometimes misleadingly described as a "quasi-market" (or even a market) approach, is emissions permit trading schemes. This approach was first proposed by University of Toronto economist John Dales in 1968. There are several variations on emissions trading schemes, but the general idea is that a regulatory agency sets an overall level for emissions of a particular type for a water body or region. The then government issues emissions permits, which are usually based on historical levels of emissions from sources in the relevant area or location. These permits can be bought and sold. If the cost of reducing their emissions is low, emitters have an incentive to adopt those mitigation practices and sell their excess permits. If non-emitters were allowed to participate in permit markets, they would be able to buy permits and retire them, reducing the overall level of emissions in the area. Furthermore, the government agency response for the program sometimes assesses a tax on traded permits, so that some proportion of the emissions allowed under a permit reverts to the regulatory agency each time a permit is exchanged, a process that also leads to an overall reduction in emissions over time.

Some further government-based approaches to promoting the provision of environmental goods and services include moral suasion, technical assistance, and technology development or education and training. Under these types of approaches, firms and land owners are presented with taxpayer-financed information, new technologies or production systems, and advice that is meant to encourage them to adopt management and production practices that reduce environmental "bads" or increase the supply of environmental goods and services.

Free-market environmentalist approaches

There are three main free market environmentalist approaches to promoting the provision of environmental goods and services: club goods, bundled goods, and litigation. These approaches are based on the classical liberal or libertarian understanding of the right to private property, which includes the rights of self-defence against trespass and nuisance, as well as alienation rights. The economics of club goods is generally traced to a paper by James Buchanan (1965). Cornes and Sandler (1986: 159) define a club as a voluntary group that pools the resources of its members and provides an excludable benefit to those members. However, I have in mind a more expansive idea of a club in the present context. In North America, there are voluntary associations that provide financial and in-kind support for environmental goods and services, and this support generates benefits that are not exclusive to club members.[8] But a club is

trade discussions, however. The United States, in particular, views these types of payments (at least when they are made in the EU) as thinly disguised agricultural subsidies.

8 The provision of non-excludable benefits is not unique to environmental stewardship initiatives. Any club that stands ready to admit new members in the future provides an option value for potential future membership that is not exclusive to current members. Current

still, in the way that I will use the term here, a voluntary organization. Individuals may chose to affiliate themselves with the club—which usually entails a cash contribution or similar support—or they may choose not to affiliate themselves. Examples of environmental goods and services provided as club goods include the programs of Ducks Unlimited and Delta Waterfowl, which use club revenues to provide payments to landowners in exchange for maintenance of wetland areas. As well, there are many types of recreation-based clubs and associations that either own or lease land that is used to provide environmentally based recreation.

In general, bundled goods combine the provision of an environmental good or service with the sale of a conventional good or service to enhance the value of that conventional good or service on the basis of the attributes of the product or the production process. Examples of bundled goods[9] include organic food, grass-fed beef, free-range poultry, and shade-grown coffee. Bundling can take place through efforts to brand a product or through third party certification.

Litigation is the third subcategory of free market environmentalist approaches. Although litigation might appear to be out of place here, I would argue that litigation belongs with club goods and bundled goods. While the relationship between common law and legislative law is currently complex and full of contradictions, Hayek (1973, 1974, 1976) and Benson (1990) have shown that, historically, this has not always been the case. Customary common law emerged as a voluntary conflict mediation process. The alternative to this process was physical self-defence. If a person's neighbour committed a trespass or a nuisance, then the putative victim would retaliate. Customary common law emerged as respected leaders in the community came to provide a mediation service that stopped chains of action, retaliation, and revenge that could continue for several generations. Today, civil or common law is confounded with legislative law and the operation of civil courts is financed by taxpayers.

The litigation approach is limited to what I referred to earlier as the category of environmental goods and services that involves reducing environmental "bads." Emissions from farms, such as dust, noise, odours, displaced sediment from erosion, and runoff of pesticides and nutrients, could constitute trespasses or nuisances. Thus, affected property owners could seek compensation or injunctive relief under customary common law.

Coming to the nuisance and "right to farm"

The legal history of disputes over agricultural emissions is complex and conflicted. Applying the distinction between government regulatory and market approaches, however, requires at least a limited examination of some critical issues in this controversial

members, by contributing to the maintenance of the organization, make this benefit available to current non-members.

9 I recognize that the environmental goods and services bundled with the products in this list are controversial. Some people believe that positive environmental benefits are associated with these products while others do not. From the vantage point of the subjective theory of value, however, the objective nature of the bundled goods is not of primary concern. The subjective theory of value indicates that the purchasing decisions of buyers are based on their subjective preferences, perceptions, and expectations. Perceptions of environmental benefits, similar to perceptions of other categories of benefits, are subjective and can differ between individuals.

history. Under customary common law, a question of fundamental importance when adjudicating disputes is, "Who was there first doing what?" Rothbard's insightful analysis of property rights and air pollution (1982), which he applied in an essay on airports, is applicable here.[10] Rothbard explains that if an airport is established in a remote area, its operation establishes for its owners a "noise homestead" in the air and surrounding land. If people subsequently purchase land adjacent to the airport and construct homes, they have come to the nuisance. They have paid less for their land than they would have paid in the absence of the airport's noise homestead. Under customary common law, if those new property owners were to litigate against the airport, claiming trespass or nuisance for noise, the airport owners could effectively defend themselves by claiming that the plaintiffs had come to the nuisance. As Rothbard (1982) points out, however, the scale of the historical operations of the airport limits the scale of the noise homestead. If the airport wants to add a runway or otherwise increase capacity at its facility, and that increase in capacity will result in additional noise, then the "coming to the nuisance" defence will not work.

The same argument can be applied, and has been applied in the past (see Brubaker, 1995), in situations involving odours and other emissions from livestock operations. But, for reasons that are not clear to me, at some point courts began to be persuaded by the coming to the nuisance defence less often, abandoning inquiry into the critical question of who was there first doing what. Plaintiffs who arrived after a farm had been in operation for some time began to be more successful at litigating nuisance complaints. Subsequent political action on the part of the farm community led to so-called right-to-farm laws and agricultural zoning. Under these legislative measures, farm operations in designated areas were largely exempted from liability for nuisance.[11] These measures have generally gone beyond the protections previously embodied in customary common law because they did not generally limit operations to the historical scale protected under the coming to the nuisance defence.

For this reason, agricultural zoning and right-to-farm laws currently constitute an impediment to the use of customary common-law approaches to the provision of environmental goods and services since they discourage litigation that is intended to reduce the level of environmental "bads." Legalized nuisance, a term introduced to the economics literature by Ronald Coase in 1960, shields farms that discharge emissions into air and water and would otherwise be potentially liable for trespass or nuisance.

One of the common criticisms of the litigation approach to the provision of environmental goods and services is that the costs of litigation are high and only the lawyers benefit. This view ignores the incentives that arise once a precedent is established. Once a sufficient number of cases establish the precedent that coming to the nuisance is an effective defence for an enterprise

10 Maria Klimas (2006) has developed an application of Rothbard's (1982) approach to nutrient management planning in agriculture.

11 It is beyond the scope of this chapter to discuss the legal and historical development of right-to-farm laws and their implications, but an excellent treatment of the topic, from a primarily Canadian perspective, is available in Brubaker (2007). Brubaker rejects the coming to the nuisance defence on legal positivist grounds.

whose size and scope has not changed recently, but that it is not an effective defence for an enterprise that has expanded, a message is sent throughout a jurisdiction. There is little incentive to litigate similar cases once a precedent establishes a benchmark. In general, litigation only makes sense economically when there is some uncertainty regarding the outcome. The establishment of precedent significantly reduces that uncertainty.

> Why don't we see many markets for environmental goods and services?

Transactions in environmental goods and services are a relatively new and limited phenomenon in Canada. Normally, we expect that when demand for a good or service becomes stronger, entrepreneurs will perceive this latent opportunity and coordinate factors of production to attempt to serve this emerging market. There are some indications that the demand for environmental goods and services from rural lands is growing, as incomes rise and values change in Canadian society. But the supply side, at least at this point, does not seem to be responding.

The public goods explanation

There may be something peculiar about environmental goods and services that prevents the normal entrepreneurial process from taking place. Economists have frequently have suggested that environmental goods and services are examples of what economists call public goods. Perhaps public goods present a situation in which there are incentive problems that discourage entrepreneurs from supplying them in a normal market fashion. As a result, any firm that attempts to provide a public good will likely fail.

The term "public goods" is used in a variety of ways in policy discussions. It is often designates goods or services that are provided by governments and financed by taxpayers. However, the technical economic definition of a public good is different. These goods are non-rival in consumption in that one person can consume as much of a good or service as he or she wants but this consumption does not reduce the quantity of that good or service available for others to consume. It is costly or impossible to exclude people who have not contributed to the provision of a public good from experiencing the benefits of that good.[12]

Many things that are described as public goods—even by professional economists who ought to know better—do not fit this definition. There are few goods or services that are non-rival in consumption. This is an unusual property, and, despite claims to the contrary in many leading economics textbooks, almost no goods or services fit this definition. It is sometimes claimed that clean air, clean water, and outdoor recreation are public goods. However, two people cannot drink the same glass of clean water at the same time or breathe the same lung-full of clean air simultaneously. Clean air and clean water are rival in consumption and are not, therefore, public goods. Likewise, two cross-country skiers cannot occupy the same spot on the cross-country ski trail at the

12 There is a persistent inconsistency in the economic literature on public goods, since costly exclusion and impossible exclusion are different concepts. Alan Randall (1985) has pointed out that non-rivalry and costly exclusion are independent characteristics.

same time, and two canoes cannot occupy the same spot on the river at the same time. Thus, outdoor recreation services are rival in consumption and, therefore, cannot be public goods.

Costly exclusion is also problematic. Exclusion costs are a function of history, culture, and institutions. The ability to exclude non-contributors is directly related to how hard people have worked to exclude others in the past. Furthermore, the extent to which they have had an incentive to devote effort to exclusion is a function of institutions. Consequently, the fact that exclusion may be difficult for a particular good or service at the present time does not actually tell us anything about how difficult exclusion for that good or service might be in the future. Ultimately, there is nothing peculiar about public goods that explains why market transactions in environmental goods and services are underdeveloped.

Five economic explanations for the lack of market transactions in environmental goods and services

Understanding, economically, why market transactions in environmental goods and services are rare can play an important role in designing strategies to facilitate the provision of this category of goods and services. In addition to the public goods explanation, there are five economic explanations for the limited extent of market transactions in environmental goods and services in Canada: transaction costs, insufficient demand (relative to supply), policy constraints, price distortions, and government ownership of natural resources.

The theory of exchange, which dates back to Carl Menger (1871/1994), explains that, at the level of a single voluntary market transaction between two individuals, if individual A exchanges an item of property for an item of property owned by individual B, then we can safely conclude that individual A valued the item of property formerly owned by B more than the item of property that A owned herself, and vice versa for individual B. Both A and B expected to gain from the exchange, since they both valued what the other person owned more highly than they valued what they owned themselves before the exchange. The subjective theory of value reminds us that it is a fool's errand to try to observe and measure utility, since utility is a subjective magnitude that exists, unobservable and unmeasurable, in the minds of people. Consequently, utilities cannot be added together across individuals and they cannot be compared.[13] As Hayek (1973, 1974, 1976) and Barnett (1992) have explained, these valuations lie forever hidden from view, with one and only one exception: when voluntary exchanges of private property take place and generate prices. Prices are an objectively measurable magnitude that provide us with a glimpse of that hidden valuation information. Hayek and Barnett acknowledge that this glimpse is not perfect, but it is the only measure we have.

Transaction costs

If an expectation of mutual benefit can be inferred after the fact with voluntary market exchange, and if there is a growing demand for environmental goods and services, then why don't we see markets emerging more robustly?

13 It is beyond the scope of this chapter to assess efforts to measure willingness to pay for environmental goods and services which use survey or interview techniques. James Buchanan's (1969) *Cost and Choice*, a book that has not received the recognition it deserves, anticipated many of the more important criticisms of these techniques.

One factor is transaction costs. Carl Menger (1871/1994) and, more recently, Nobel Prize winner Ronald Coase (1960) explained that there are costs associated with using market exchange relationships as a means of social coordination. Menger referred to these costs as marketing costs. Coase used the term transaction costs. Coase defined transaction costs[14] as the value of the resources used up in making a market exchange. According to Coase's exposition, there are three subcategories of transaction costs: search costs, negotiation costs, and concluding costs. Search costs are incurred during the process of looking for potential partners for a market exchange. These might include the cost of advertising, travel, and communication. Negotiation costs arise when a potential exchange partner is identified and the terms of that exchange are being explored. In a fixed-price retail sale environment, negotiation costs may be inconsequential. For example, most people do not bargain over the price of a lift ticket at a ski hill. This is a familiar type of transaction. But many potential market transactions for environmental goods and services are not so familiar. Negotiating the terms of an agreement with a farmer to maintain a songbird habitat on part of his farm might be a different matter entirely. Concluding costs, according to Coase, arise as the parties verify that the terms of the exchange were met.

The significance of transaction costs, in the present context, is that even when market conditions appear favourable, market exchanges may not take place if transaction costs are high enough. Therefore, high transaction costs, relative to potential gains from exchange, are one explanation for the limited development of transactions in environmental goods and services in Canada to date. In any emerging market or industry, transaction costs are a significant impediment until potential buyers become aware of potential sellers and vice-versa. In these new markets, communication networks, including advertising, are undeveloped and search costs are high. Furthermore, since transactions in an emerging market are, by definition, novel, negotiation costs can also be high due to the wariness of first-time buyers and first-time sellers. After progress has been made, standardized transactions can be made in less time and with less effort devoted to the negotiation of terms.

Weak demand

Transaction costs are not the only reason why markets do not exist. A second explanation of the lack of emerging markets for environmental goods and services is that, even if demand for these goods and services is growing, that demand may not yet be sufficiently strong to prompt supply. Given the relatively recent emergence of this issue in Canada, it could be the case that there has not been enough time for people to perceive and act on entrepreneurial perceptions of market opportunities. In some cases where demand is strong enough relative to supply conditions, transactions take place in a manner that is not officially reported. These transactions could be arranged through informal networks or through a more organized "black market."

14 The term "transaction costs" has been stretched far beyond its original meaning by economists since Coase introduced the term in 1960. Costs involved in the political process, costs of institutional change generally, adjustment costs, and even charges for various types of services have been lumped into this category. In this essay, I attempt to maintain Coase's original definition.

Policy constraints

Policy constraints are another reason that the development of a market for environmental good and services may not be taking place. Sometimes government regulations prohibit market transactions in environmental goods and services, even on private land. An example would be a regulation that prohibits land owners from charging hunters to hunt game on their land. If the consequences of selling an environmental good or service are negative—for example, fines or imprisonment—it is hardly surprising that such transactions are not commonplace, or that they tend to be done informally when they do occur.

Price distortions

Price distortions are another possible explanation for limited market transactions. Distortions can arise if there is a regulated maximum price for some good or service, as in the case of rent controls or maximum gasoline price regulations. This type of quantity-rationed situation results in buyers wanting to buy more than suppliers are willing to offer at the regulated price.

Price distortions can also arise when the provision of a good or service is subsidized, keeping the price below that which would prevail in a free market. In this case, the government either supplies the goods or services directly, or it subsidizes firms to provide them at a price that does not reflect the full costs of provision. An example of this situation in Canada would be camping services. The national and provincial parks provide recreation services to Canadians, but the user fees that are charged are not enough to allow the parks to recover their costs. There is little incentive for independent operators to compete in this market, since the subsidized price that prevails because of government provision of this service is so low.

State ownership of natural resources

Finally, a fifth explanation of the lack of market exchanges in environmental goods and services is state ownership of natural resources. Government ownership of natural resources in Canada is extensive. Governments act differently than private citizens and voluntary associations when they participate in markets. Because they have the power to tax, governments are not subject to the financial constraints that private citizens and voluntary associations face. Moreover, governments in Canada have often been reluctant to sell these resources, at least in the twentieth century.

> Diagnosis and treatment

Determining what is responsible for a lack of observed market transactions in environmental goods and services is a challenging undertaking. Economists have not devoted much effort to this diagnostic task. The subjective theory of value reminds us of this difficulty. According to this theory, if preferences are subjective mental states that exist only in human minds, whether these are the minds of buyers or sellers, then the economist must acknowledge that there is no objective process for measuring these valuations, independent of observed actions.[15] Therefore, it could be that, in the absence of market exchanges, the subjective valuations of buyers

15 Murray Rothbard's (1956/1997) "Toward a Reconstruction of Utility and Welfare Economics" examines this issue in detail.

are not high enough to result in attractive terms relative to the subjective valuations of sellers. Or, it could be that the subjective valuations of buyers and sellers are not high enough jointly to overcome the subjective valuations of transaction costs.

Unfortunately, very little economic research has been undertaken to identify factors that influence the magnitude of transaction costs, let alone how to reduce them. However, it is possible to identify some legislative and regulatory barriers that discourage transactions. Government ownership of natural resources and the subsidized provision of competing goods or services are probably the easiest barriers to observe.

> Policy issues

For political, financial, and environmental reasons, rural lands in Canada are attracting increasing attention as a source of environmental goods and services. At the same time, the traditional regulatory takings approach is facing increasing resistance from rural land owners. However, current discussions of alternative approaches to facilitating the provision of environmental goods and services have not made a careful enough distinction between taxpayer-funded programs and beneficiary-funded (user-pay) market programs. Beneficiary-funded programs, which take a free-market environmentalist approach, enjoy a critical informational advantage over government-funded programs when it comes to the identification of the value of environmental goods and services.

To illustrate the nature of this advantage, these two approaches can be compared to what Hayek called a planned order and a spontaneous order. A spontaneous order, which corresponds to the free-market approach, is a pattern of human social interaction that is the product of human action, but not the product of human design. There is no one in charge of a spontaneous order. Hayek's 1945 essay, "The Use of Knowledge in Society," comparing spontaneous and planned orders illustrates the informational advantages of spontaneous orders, especially when the subjective theory of value is taken into account. If preferences are subjective and can't be objectively measured, and if information about preferences, expectations, and opportunities is widely dispersed among the members of a society, then the coordination of human action under a planned order approach faces significant challenges. How can the coordinating agency possibly know what it needs to know about this inaccessible information?

Contrary to many suggestions in policy statements about environmental goods and services, this is not a matter of scientific approach, nor is it a hurdle that can be overcome with comprehensive consultation. Hayek's insight, clarified later by Barnett (1992), is that voluntary transactions among consenting adults—that is, market exchanges—offer us an opportunity to see aspects of this subjective and dispersed information, to which we would otherwise not have access. Historical prices are our only window into this subjective knowledge. Without access to this price information, how could we possibly know what specific environmental goods or services were worth, and to whom? Hayek's essay may have been concerned with the problems of comprehensive economic and social planning, but his concerns are equally applicable to the task of facilitating the provision of environmental goods and services from rural lands.

The challenge is to determine what institutional changes are needed to allow spontaneous order

approaches to emerge. What role should research play in resolving this issue? James Buchanan (1964) argued that the primary purpose of economic research should be to identify ways to extend market exchange relationships into realms where they have not previously operated. Carl Dahlman (1979) suggested that the primary focus of economic research should be to find institutional innovations the would reduce transaction costs so that more potential market exchange arrangements could lead to the realization of the latent mutual gains from exchanges that markets make possible. Both views are relevant to the topic of environmental goods and services and the role of economic research in terms of facilitating the interaction of the willing buyers and sellers of those goods and services. Case studies, pilot projects, and feasibility studies may help identify the institutional changes that would be required to extend market exchange relationships more deeply into the realm of environmental goods and services.

In addition to its information disadvantage, the planned order approach to the provision of environmental goods and services faces another challenge. Ultimately, this approach relies on tax revenues to operate. This pits the provision of environmental goods and services against other increasingly strong demands for tax revenues. It puts environmental goods and services in competition with health care and education. In the long run, it is likely that other demands for revenues will win.

> Conclusion

In order to advance the agenda on environmental goods and services in Canada, we must take a number of steps. First, we need to acquire a better understanding of the critical differences between planned order and spontaneous order approaches to the provision of environmental goods and services. Access to personal subjective valuation information is necessary to address the question of how much these goods and services are worth. Second, trial markets and pilot programs should be implemented, as they are a good, practical first step towards exploring alternative approaches. These social experiments may lead to a reform of the policy-based impediments to the emergence of market approaches discussed earlier. Third, the government may have some role in reducing transaction costs by helping to develop communication and advertising tools. This function, however, may also be accomplished by other types of organizations such as associations and cooperatives composed of similar interests. Either way, transaction costs are likely to decrease as markets develop. Fourth, if the culprit turns out to be insufficient demand, then, at least for now, we may need to accept that it would not be beneficial to coerce transactions. Finally, we should take steps to restore customary common law, following Elizabeth Brubaker's (1995) agenda, which in this context would include a repeal of right-to-farm legislation and agricultural zoning.

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A breath of fresh Air

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Urban Sprawl and Smart Growth

Randal O'Toole

It has been said that North Americans "don't have any serious problems, so they have to invent them"(Working, 1999, Dec. 3). Considering that less than 0.5% of Canada's land area has been urbanized, urban sprawl—low-density development at the fringes of urban areas—is one of those invented problems.[1]

There are two major objections to sprawl: first, that it uses too much land, and second, that it leads people to drive too much. The proposed solution to sprawl is "smart growth." This public-relations term represents a variety of policies and actions aimed at increasing urban densities and reducing urban driving. According to smart-growth advocates, land use and transportation are connected in such a way that increasing density and making other design changes will save land and contribute to a reduction in driving.

Many smart-growth policies are highly coercive, requiring large tax subsidies, severe restrictions on the rights of property owners, and various overt or covert disincentives to discourage driving. For these reasons alone, smart-growth advocates often encounter strong resistance from some members of the public. Yet most people accept that coercion is needed sometimes to achieve the public good—especially if they do not have to bear the brunt of the coercion.

To decide whether smart-growth policies are worthwhile, we need to answer three questions using data for cities in Canada, the United States, and Europe:

1. Is sprawl—that is, low-density development and automobility—really a problem?

2. Will smart growth effectively save land and reduce driving?

3. What are the negative effects of smart growth?

> Is sprawl a problem?

At first glance, it seems absurd to suggest that low-density development could be a problem in a nation where more than 99% of its land area is rural, open space. Sprawl opponents point out, however, that the most productive farmland in Canada is found along its southern border, where most Canadian cities are also located. Thus, they claim, urban development threatens Canada's agricultural production.

1 Statistics Canada (2005) reports that Canada's land area is 9,984,670 square kilometres. Nancy Hofmann (Statistics Canada, 2001: 5) reports that 28,045 square kilometres, or about 0.3% of Canada's total land area, were urbanized as of 1996.

"Urban uses have consumed 12 thousand square kilometres of land since 1971," reports Nancy Hofmann (2001) of Statistics Canada. "One-half of this—equivalent to the size of Prince Edward Island—was 'dependable' farmland."[2] Hofmann adds, "In Ontario, over 18 percent of class 1 farmland is now being used for urban purposes." This "consumption" of farmland "is partly due to the growing urban population," writes Hofmann, and "partly due to new urban households consuming more land per dwelling" (Statistics Canada, 2001: 1). In other words, the consumption of farmland is due to low-density urban sprawl.

Note that this supposedly objective government publication uses various charged terms, such as "consumption" when, in fact, land is not consumed, but it is merely converted—usually not irreversibly—from one use to another. The comparison with Prince Edward Island is also misleading. Canadians may know that it is the smallest province, but they may not know that it is only about 1% of the size of all "dependable" farmlands in Canada.

A somewhat more level-headed view can be found in another Statistics Canada bulletin that observes, "between 1951 and 2001, the supply of dependable agricultural land declined by four percent" (Hofmann et al., 2005). That change is equivalent to a conversion rate of less than 0.1% of Canada's dependable farmland per year.

The full reality is even less alarming than a 0.1% annual decline might suggest. Statistics Canada reports that Canadian farmers only grow crops on an area equal to about 80% of the nation's dependable farmland. Moreover, between 1981 and 2001, the area used for crops steadily increased by about 17.5%—about 10 times faster than the rate at which urbanization converted farms to developments (Statistics Canada, 2007). Urbanization obviously did not hinder this increase.

Even if the demand for crops grew to the point where 100% of "dependable" farmland was needed, urbanization would not be a problem. Statistics Canada (2007) reports that Canada actually has about 50% more land that could be used for farming than land that is considered dependable for farming. This 50% may be less productive, but it may cost less to improve the productivity of such lands than to restrict urban development. Such decisions can be made by individual landowners in response to market forces and do not require government intervention to "preserve" farms from supposedly rapacious urban developers.

To the extent that some farmlands are converted to urban uses, the value of those uses is often significantly higher than the value of the land for farming. Low-density urban uses produce many benefits. In particular, access to low-cost land at the urban fringe has made homeownership much more affordable. Whereas a century ago only upper- and middle-class families could afford to own their own homes, post-automobile suburbanization made homeownership possible for working-class families (Kahn, 2001). Surveys show that the vast majority of people aspire to own a single-family home with a yard. Consequently, it is not surprising that as more people could afford such homes, urban densities declined (National Family Opinion, 2002).

2 Dependable farmland is defined as capability classes 1, 2, or 3, meaning lands that have no, moderate, or moderately severe limits to crop production.

Such homeownership provides many benefits. First, it allows people to use the equity in their homes to start small businesses. Peruvian economist Hernando de Soto (2000: 6) traces the wealth of Western nations, in part, to high homeownership rates and the many private firms that were started by borrowing against the business owners' homes.

Second, homeownership provides many benefits for children, particularly those of lower-income families. Children who live in owner-occupied homes are less likely to drop out of school (Harkness and Newman, 2003). After adjusting for income and other factors, such children score 7% to 9% higher on standardized math and reading exams (Haurin, 2003). The effect is so great that some economists have suggested that increasing homeownership is a more cost-effective way of improving educational outcomes than spending more on the schools themselves (Haurin, 2003: 14).[3]

Homeownership also gives people incentives to take better care of their dwellings. This means that people who own their homes tend to live better than those who rent. The opportunity to own a home and the need for a down payment encourage people to save money—which is good for the economy—and the tendency to save more money seems to continue after the home is purchased. Homeownership also leads to measurable increases in neighbourhood stability and self-esteem (Rossi and Weber, 1996).

Many of the benefits of homeownership are related to the benefits of automobility, which smart-growth advocates seek to curtail. Without cars, workers could not easily commute from their homes to their place of employment. It is no coincidence that US inflation-adjusted personal incomes have increased more than sevenfold since the automobile was invented (United States Census Bureau, 1976; BEA, 2007; BLS, 2007). Several studies have shown that auto ownership is key to helping low-income families out of poverty (see, for example, Raphael and Stoll, 2000: 2, and Sullivan, 2003). Automobiles have also reduced the cost of consumer goods and greatly increased the average Canadian's social and recreational opportunities.

By comparison to the huge benefits gained from automobility, the costs are small and diminishing. Opponents point to air pollution and traffic fatalities, but both have declined dramatically in recent years. Between 1985 and 2004, for example, Canadian motor vehicle fatalities fell from close to 4,400 to less than 2,800, despite a huge increase in kilometres driven by Canadians (Transport Canada, 2006). The total amount of air pollution emitted by motor vehicles in the United States has declined by more than 60% in the last 40 years, even though Americans today drive nearly three times as many miles as they did then (EPA, 2005). Controlling pollution at the tailpipe has proven extremely successful, while controlling pollution by trying to get people to drive less has been a dismal failure.

University of California economist Mark Delucchi (2000: 17) estimates that the total social cost of automobiles averages only about 3.5 cents per kilometre of travel. Given that public transit subsidies are many times more than this, further subsidies aimed at encouraging people to drive less could cost society significantly more than they would save.

In short, low-density development and automobility are not serious threats to the environment. On the

3 See Randal O'Toole (2006: 8–10) for an explanation of how automobiles are largely responsible for this increase in incomes.

contrary, they have significantly improved the quality of life in Canada.

> Does smart growth work?

Urban planner Douglas Porter argues that there is a "gap between the daily mode of living desired by most Americans and the mode that most city planners and traffic engineers believe is most appropriate" (1991: 65). According to Porter, "Americans generally want a house on a large lot and three cars in every garage," while planners object to the "low-density sprawl and dependence on roads and highways." In response to this gap, planners have evolved a set of proposals aimed at reducing sprawl and driving. These include:

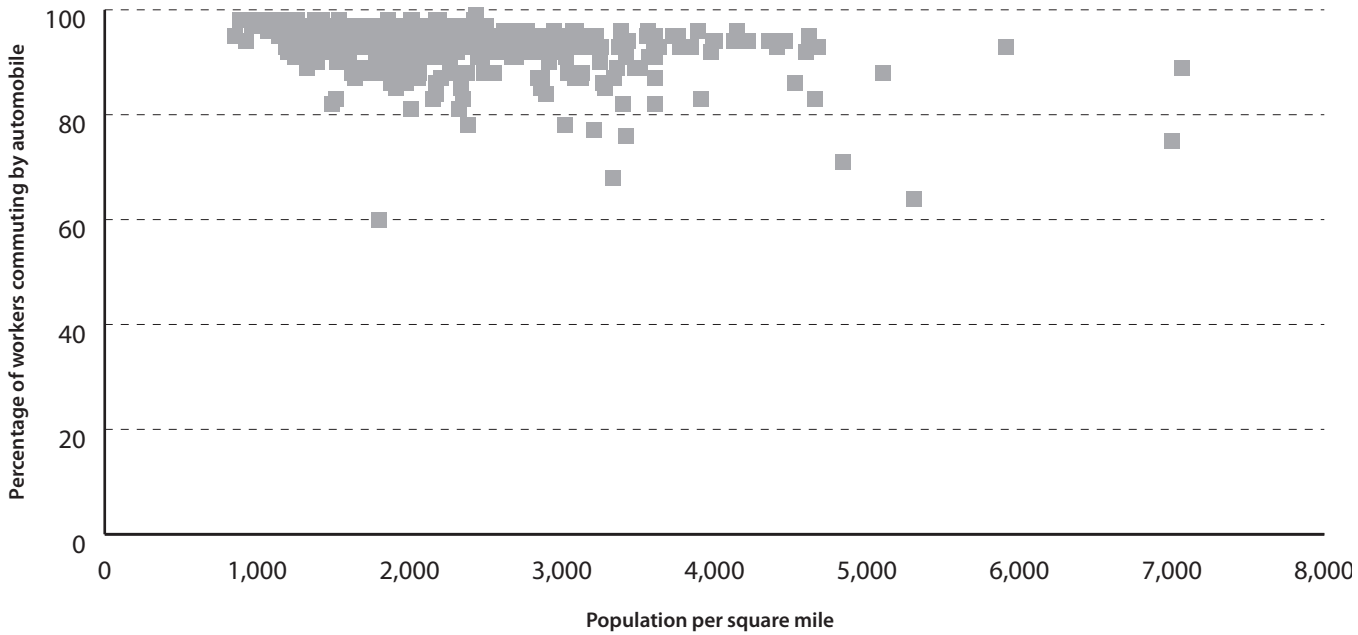
- Restrictions on rural development, either through low-density zoning (40- to 160-acre minimum lot sizes that effectively prevent development at suburban densities), or purchases of land or development rights to create open space, greenbelts, or agricultural reserves;
- Minimum-density zoning of urban areas requiring that all new development achieve some density that is higher than homebuyers would prefer;
- Mixed-use zoning combining residential, retail, and commercial uses in the same development so that residents will not have to drive to shops;
- Tax breaks, grants, and other subsidies to high-density and mixed-use developments;
- Design standards that require the fronts of new shops to be on sidewalks and parking, if it is allowed at all, to be hidden;
- Diversion of transportation funds from the highways that most travelers use to rail transit, bike paths, and pedestrian facilities; and,
- "Traffic calming," which entails redesigning existing streets to reduce their flow capacities by putting various barriers in the roads.

These ideas were combined—perhaps for the first time—by the planning-advocacy group 1000 Friends of Oregon (1997: 8–10) in an influential 1989 publication titled *Land-Use Transportation Air Quality* (LUTRAQ). In 1996, Maryland's Governor Parris Glendening first applied the politically attractive term "smart growth" to these practices. As one of Glendening's staff members later noted, this term made it "hard to oppose" density and disincentives to the use of automobiles because anyone who opposed them could be accused of favouring "dumb growth" (Frece, 2004-2005).

One of the main problems with smart growth is that it has little effect on issues such as automobile use. Los Angeles has been called "the granddaddy of sprawl" and is widely known as one of the most "auto-dependent" cities in the world (Sierra Club, 1998: 4). Yet it is, in fact, denser than any other urban area in the United States or Canada. This calls into question one of smart growth's principal claims—that increased density reduces driving.

Figure 1, which compares the density of several hundred US urban areas with the percentage of commuters

Figure 1: Density and automobile commuting in United States urban areas



Source: United States Census Bureau (2002).

who drive to work, reveals that the densest urban area, Los Angeles, is about seven times denser than the least-dense areas. Yet only about 8% fewer commuters drive to work in Los Angeles than in the lowest-density areas.

While the figure shows some areas in which a smaller share of people drive to work, density does not seem to be a factor. Instead, close examination reveals that these areas have in common either a very high concentration of downtown jobs (which encourages transit usage), or are university towns with a high proportion of young workers who tend to walk or bicycle more often than older workers. Many smart-growth plans call for creating a balance of jobs and housing in various communities in a region, which actually reduces the effectiveness of transit systems that are designed to serve downtown workers.

Some researchers claim to have proven that density does reduce driving. These studies typically compare the transportation choices of people living in higher-density areas with people living in low-density areas (Holtzclaw et al., 2002). But this overlooks a self-selection issue: people who want to drive less tend to live in denser neighbourhoods. This does not mean that forcing density on people who want to drive more will lead them to drive less.

One study that examined neighbourhoods in several urban areas claimed to have proven that denser neighbourhoods caused people to drive less. But the data in

the study revealed that, of the urban areas reviewed, the one with the highest density and most intensive transit service, which was rated as having the most pedestrian-friendly design, also had the most driving per capita (Holtzclaw et al., 2002: 14). This shows that self-selection, not urban design, is what causes people in some neighbourhoods to drive less than people in others.

Mixed-use developments also seem to have little effect on people's transportation choices. Portland, Oregon, has provided hundreds of millions of dollars in subsidies for the construction of dozens of mixed-use or transit-oriented developments. However, these developments only work if they have plenty of parking available—inadequate parking translates into extremely high vacancy rates (Charles and Barton, 2003). Surveys of the residents of these areas reveal that moving into the developments did not lead them to significantly alter their transportation habits (Podobnik, 2002: 1).

Furthermore, smart growth's policy of increasing residential densities does little to protect open space. This is partly because such a policy can only be applied incrementally to an urban area, and partly because only a portion of any urban area—often as little as one-third—is residential.

Two-thirds of Oregon's population lives in the Willamette Valley, a productive agricultural area that includes just one-seventh of the state's land. A study of the Willamette Valley's future commissioned by a smart-growth group found that 5.9% of the valley is currently urbanized. With the valley's population expected to increase by 50% over the next 50 years, the study estimated that, under Oregon's strict land-use planning rules, urbanization would extend to 6.6% of the valley. But if the rules were all repealed, the study estimated that 7.6% of the valley would be urbanized (Willamette Valley Liveability Forum, 2001: 5). Thus, the rules made only a 1% difference in the amount of land that would be urbanized.

Smart growth is not working well in Canada either. A "smart-growth report card" published by the Canada Mortgage and Housing Corporation (CMHC) found that many cities have passed stringent rules, but actual "performance is lagging behind considerably" (Grammenos, 2005: 1). The report card reached a number of conclusions:

- "Suburban densities in most areas of the study regions continued to fall far short of the levels needed to support high quality transit services" (2005: 2).
- "Every region adopted a transportation plan based on the need to move away from car dependency … Despite this planning effort, four of the six study regions saw an increase in the car's modal share" (2005: 4).
- "Transit modal share was higher for downtown trips but extremely low for trips in suburban locations. This suggests that the decentralization of employment … will further erode transit share" (2005: 4).
- "Although all six study regions had adopted plans and policies to encourage the creation of a wider range of housing types [a euphemism for reducing the share of people living in single-family homes], most regions in fact saw an evolution

> in the opposite direction. Only Vancouver saw a significant reduction in the weight of single-detached housing" (2005: 5).

Smart growth's failure did not lead researchers to question whether these policies make sense, or whether they are necessary at all. Instead, it led them to conclude that "much work remains to be done," no doubt in the form of even more restrictive land-use policies (Grammenos, 2005: 7).

Many North American planners look enviously at Europe as a place where urban populations are dense, transit ridership is high, and people seem to be less dependent on the automobile (Kenworthy and Laube, 1999). Indeed, since shortly after World War II, most European nations have pursued smart-growth-like policies, emphasizing dense residential development, discouraging driving with high taxes, and heavily subsidizing both urban transit and intercity rail.

However, a close look at trends in Europe should discourage anyone from thinking that smart growth can work in North America. European nations spend about $100 billion per year subsidizing intercity rail and urban transit, while European auto drivers pay some $150 billion per year in taxes.[4] (Unless otherwise specified, all figures are in 2007 Canadian dollars.)

Despite this policy of punitively taxing auto drivers in order to subsidize rail passengers, intercity rail's share of travel has declined from 8.2% in 1980 to 6.3% in 2000, and urban rail's share has declined from 1.4% to 1.1% in the same years. Meanwhile, the automobile's share of travel increased from 76.4% in 1980 to 78.3% in 2000 (European Commission, 2003: 52). When the automobile's share in Europe is compared with its share in the United States (88%) and Canada (91%), it becomes evident that Europe is not that different from North American after all.

The same is true with urban densities. Despite strict planning regimes, almost all European cities are losing density as people move away from the dense cores to low-density suburbs. Planning historian Peter Hall observes that the suburbs of Stockholm are "indistinguishable from its counterparts in California and Texas," and the same can be said, with minor architectural variations, of the suburbs of Paris, London, and Frankfurt (Hall, 2002: 877–88). In short, even as North American planners fail in their efforts to make American and Canadian cities look more like European ones, European cities are looking more like North American ones every year.

> What are the costs of smart growth?

While producing few real benefits, smart growth imposes enormous costs on the regions that apply it. The five most important costs are: costs to taxpayers; costs to homebuyers; costs to businesses; costs to travelers and shippers; and costs of increased crime.

Costs to taxpayers

Gasoline taxes and other highway user fees cover most, if not all, of the costs of building, maintaining, and

4 Rémy Prud'homme (2005) estimates that subsidies to intercity rail alone amounted to €68 billion (about $96 billion) in 2002, while excess taxes collected from auto drivers amounted to €107 billion (about $150 billion) that year.

operating roads. But transit fares cover only part of the costs of operating transit systems and none of the capital costs. Smart-growth plans call for huge subsidies to transit systems, often emphasizing new transit services in suburban areas where residents rely primarily on automobiles. The result is high costs and low revenues.

Smart growth's emphasis on density and mixed-use developments can also lead cities to heavily subsidize such developments, especially when, as the CMHC's smart-growth report card notes, "developers appear convinced that retail uses will not be commercially successful and that homebuyers will want to avoid being adjacent to non-residential uses" (Grammenos, 2005: 2). To overcome these issues, Portland, Denver, and other American cities have spent hundreds of millions of dollars subsidizing these developments.

Costs to homebuyers

The artificial land shortage created by restricting the development of lands on the urban fringe, combined with other smart-growth rules, can significantly increase housing costs. In 2007, a four-bedroom, 2,200-square-foot home in Houston, which has no zoning and where planning is done mainly by homeowner associations, would cost homebuyers US$170,000. The same home in Portland, which has been practicing smart growth since the early 1990s, would cost US$320,000. In the San Francisco Bay Area, which has severely limited development since the 1970s, the same house would cost between US$800,000 and US$1.2 million dollars (Coldwell Banker, 2007). Several researchers have found that higher prices in some urban areas in the United States are due mainly to land-use regulation (see, for example, Glaeser and Gyourko, 2002; Jud and Winkler, 2002; Somerville and Mayer, 2002). In the United States as a whole, smart growth and similar planning rules added at least US$275 billion to the cost of homes sold in 2005 (O'Toole, 2006).

A similar pattern can be found in Canada. Vancouver probably has the nation's strictest smart-growth policies. It also has the least-affordable housing. The 2001 census found that the average value of a home in the greater Vancouver area is $295,000. In contrast, the national average is less than $163,000. As a result, Vancouver has the lowest rate of homeownership of any Canadian metropolitan area outside of Québec (Statistics Canada, 2002). Ironically, the increases in housing costs that result from land-use regulation usually lead to calls for more regulation to force developers to build more affordable housing, which inevitably makes housing even less affordable (Powell and Stringham, 2004).

Planners see high land and housing prices as a virtue of smart growth because such prices encourage people to live on smaller lots and in multifamily housing instead of single-family homes with large yards. But it is extremely doubtful that the negligible benefits of smart growth exceed the high costs imposed on homebuyers, most of whom prefer to live in single-family homes with yards. After all, should cities be designed to meet the needs and desires of their residents or the desires of planners and other elites, most of whom already enjoy their own houses with yards?

Costs to businesses

High land prices and strict land-use regulation also impose costs on businesses that are seeking to locate

retail, commercial, or industrial facilities. Such businesses tend to seek locations where land is more affordable and there is less regulation, as well as locations where their employees can find affordable homes. As a result, regions that adopt smart-growth policies tend to see slower growth than regions with fewer restrictions. As Harvard economist Edward Glaeser has written, "places with rapid [housing] price increases over one five-year period are more likely to have income and employment declines over the next five-year period" (2006: 1).

Costs to travelers and shippers

Congestion is also a major cost of smart growth. The Texas Transportation Institute estimates that the cost of urban congestion in the United States has quintupled over the past two decades and is now greater than US$60 billion per year (Schrank and Lomax, 2005). Much of this increase is due to smart-growth policies which have diverted highway funds to expensive but little-used rail transit projects. This US$60 billion cost does not include the cost to shippers resulting from delayed freight shipments, or the cost of having to put more trucks on the road because of longer turnaround times.

Smart-growth planners see congestion as a virtue. Planners in Portland have stated that "congestion signals positive urban development" (Metro, 1996). Similarly, planners in Minneapolis-St. Paul have argued that "as traffic congestion builds, alternative travel modes will become more attractive"(Metropolitan Council, 1996: 54). Yet there is little evidence that congestion reduces driving. Despite a near-quadrupling of per-capita delays caused by congestion, major American urban areas saw a 43% rise in driving per capita between 1982 and 2003 (Schrank and Lomax, 2005). The cost of congestion is, in fact, far greater than any benefit obtained from getting a few people to reduce their driving.

Costs of increased crime

Smart growth also makes neighbourhoods more vulnerable to crime. Researchers have found that limiting the "permeability" of a neighbourhood is key to reducing crime. This means favouring cul-de-sacs, minimizing alleys or pedestrian paths that are separated from streets, and separating retail areas from residential areas (Newman, 1973). Ironically, smart-growth prescribes exactly the opposite: banning cul-de-sacs, maximizing permeability with alleys and pedestrian paths, and promoting mixed-use developments. One study from England found that smart-growth neighbourhoods suffered five times the crime and cost three times as much to police as neighbourhoods that North Americans would consider to be conventional suburbs (Knowles, 2002).

Altogether, smart growth adds billions in dollars in costs to taxpayers, homebuyers, and businesses. Considering that its benefits are questionable and that the problems it addresses may not even exist, one has to wonder why it has become so popular in many urban areas.

The answer is that smart growth is attractive to certain special interest groups who benefit from the policies at everyone else's expense. These groups include downtown interest groups, central city officials who view the suburbs as rivals, builders of rail transit lines,

and owners of existing homes who want to boost their property values. The people who are harmed include suburban businesses, auto travelers who face increased congestion, and future homebuyers.

The biggest losers may be young and low-income families who lose both mobility and the ability to buy a home in the future. Peter Hall calls smart growth "environmentally conscious NIMBYism," adding, "it is very difficult to combine it with any concept of social equity" (2002: 421–22).

> Recommendations

The national, provincial, and local governments in Canada should do the following:

- Relax land-use restrictions in both rural and urban areas;
- Abandon policies aimed at changing people's land-use and transportation choices in favour of policies that simply make sure that people pay the full cost of their choices;
- Devolve land-use planning to the lowest possible level of government, preferably to neighbourhood or homeowner associations;
- Reduce urban congestion through the use of self-funding toll roads, preferably ones that are designed and administered by regional toll-road authorities, and require that all toll revenues be spent on highways, not transit;
- Address social equity concerns by providing subsidies to low-income transport users, not to the bureaucracies that are supposed to serve those users.

Applying these principles could greatly improve the quality of life in Canadian cities while reducing the cost of providing urban services in those cities that is borne by taxpayers.

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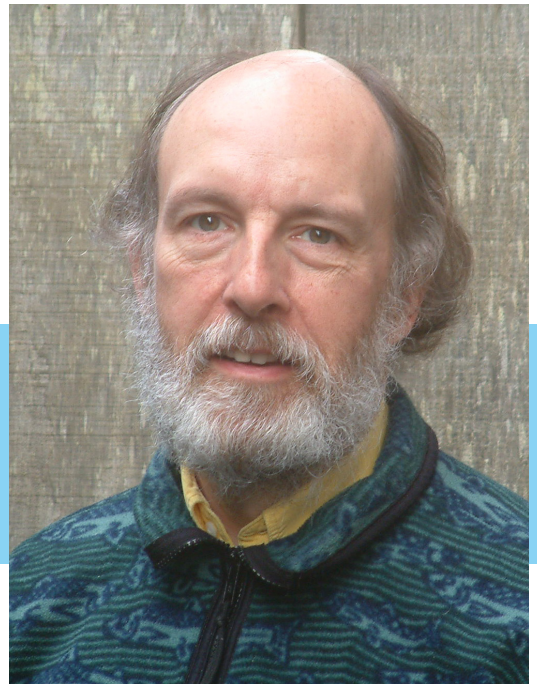

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Solid Waste and Recycling

PAYT and Options for Cost-Effective Integrated Waste Management

Lisa A. Skumatz

Over the last 30 years, cities across North America have instituted various types of curbside and drop-off recycling programs. The programs have been instituted for a wide variety of reasons: to reduce landfill usage, meet community diversion goals, expand community services, help meet greenhouse gas reduction goals, and reduce costs. Regardless of the reasons for implementing programs, city managers are encountering two major problems: stagnating recycling (and diversion) rates, and tightening municipal budgets. To address these concerns, program managers are finding it increasingly necessary to consider strategies to improve the effectiveness and cost-effectiveness of their recycling and diversion efforts.

Encouraging additional recycling and diversion requires an investment—to change a system, to change behaviours, and to modify infrastructure. Some work may require national attention; other changes may be necessary at the provincial/state or local level. This chapter examines several opportunities for change which can be achieved at the local or provincial/state level. These include:

- Improving residential incentives through "pay as you throw" (PAYT);
- Options for increasing residential diversion through program changes and policies; and
- Suggestions for tackling diversion from the non-residential sector.

> Residential sector initiatives: pay as you throw (PAYT)

In most parts of the country, garbage is removed once or twice a week. In some areas, customers pay for this service through their property taxes; in others, they are billed a fixed amount that does not vary according to the amount of garbage taken away.

Neither of these payment methods provides any incentive to reduce waste. In fact, when the service is supported by property taxes, customers never see a bill and generally have no idea how much it costs to have their garbage removed regularly. Areas that use this method of payment have sometimes implemented mandatory recycling programs to reduce the amount of garbage.

Over the last 20 years, a growing number of communities across North America have switched to a user-pay approach, which is commonly used for water, electricity, and other services. User-pay, which is also known as variable-rate pricing or pay as you throw (PAYT), is a

strategy by which customers are provided with an economic incentive to reduce the amount of waste they throw away because their garbage bills increase along with the volume or weight of waste they dispose. PAYT is being adopted in thousands of communities to create incentives for additional recycling in the residential sector. A recent count shows that these programs are in place in about 7,000 communities in North America, and are available to more than 20% of the population (Skumatz and Freeman, 2006).[1]

> PAYT or variable-rate programs

PAYT or variable-rate programs are very flexible and have been implemented in many different forms. The most common types of variable-rate programs are can programs, bag programs, tag and sticker programs, and hybrid programs (Skumatz and Breckinridge, 1990). Other less common programs include weight-based programs. Each of these is briefly summarized below.

Variable can or subscribed can programs

Customers select the number or size of the containers (one can, two cans, etc., or 30-35 gallons, 60-65 gallons, etc.) necessary for their standard weekly disposal amount. Rates for customers who are signed up for two- or three-can service are higher than rates for one-can customers. Some communities have introduced mini-can (13-20 gallons) or micro-can (10 gallons) service levels to provide incentives for aggressive recyclers.

Bag programs

Customers purchase bags imprinted with a particular logo, and any waste they want collected must be put in the appropriately marked bags. Bags that can hold 30 to 35 gallons are most common, but some communities also sell smaller bags at a discounted price. Bags can be sold at city hall or community centers, but more commonly communities work with grocery stores or convenience store chains to sell the bags. In some cases, the retailer is given a commission; in others, the foot traffic is enough of a reward.

1 There is a substantial amount of literature on PAYT and related topics in solid waste economics in both the United States and the international community. Some of this literature is produced by individual cities and states to explain the concepts, summarize community experience, and reprise frequently asked questions (see, for example, Solid Waste Action Team, no date, and Woolwich Solid Waste and Recycling, 2007). A summary of PAYT literature has been provided by the United States Environmental Protection Agency (no date). Various academic studies have examined aspects of solid waste economics, although not specifically PAYT (including Abert et al., 1974; Beede and Bloom, 1995a, b; and Kinnaman and Fullerton, 1999). A number of research institutes have conducted work on PAYT and market-based incentives pertaining to solid waste (for example, Cornell Waste Management Institute, 2001; Stavins, 1988; Scarlett, 1993; Skumatz, 1993a). In addition, there are numerous articles in trade publications (for example, Skumatz, 1989, 1993b, 1994, 1996b, 1999a, 1999c, 1999d, 1999e, 2000b, 2001a, b, c, 2002a, b; Skumatz and Bicknell, 2004; Corley and Dickerson, 2000) that discuss PAYT at the community, as well as the national, level.

The price of the bag incorporates the cost of collecting, transporting, and disposing of the waste in the bag. In some communities, the bag program is used in conjunction with a customer charge or flat-fee program charge. In those cases, the bag price reflects only a portion of the cost of collection and disposal; the remainder is collected through a monthly charge.

Tag or sticker programs

These programs are almost identical to bag programs, except instead of a special bag, customers affix a special sticker or tag to the waste they want collected. The tags need to be visible to collection staff to signal that the waste has been paid for. Like the bag program, tags are usually good for 30-gallon increments of service. Pricing and distribution options are identical to bag programs.

Hybrid programs

These programs are a hybrid of the current collection system and a new incentive-based system (Skumatz, 1993b). Instead of receiving unlimited collection for payment of a monthly fee or tax bill, the customer receives a smaller, limited volume of service for the fee. Typical limits for the base service are one or two bags or cans. Limits usually vary based on the maturity of the program, disposal behaviour, and the availability and comprehensiveness of recycling and diversion program options. Customers are required to buy bags or stickers, as described above, for any additional garbage.

Under this program, the base service level can be tailored to suit the community or to achieve a variety of objectives. No new billing system is needed, and bags only need to be purchased for service above the base. Current collection and billing are retained with minimal changes, and many customers see no change in their garbage fee. This system provides a monetary disincentive for those who are putting out larger amounts of garbage.

Weight-based and drop-off systems

Called "garbage by the pound" (GBTP) while being tested in the United States (Skumatz, 1989, 1991, 1994; Skumatz and Van Dusen, 1995), this system uses truck-based scales to weigh the garbage set out for disposal and charges customers based on this weight. On-board computers record weights by household, and customers are billed on this basis. Special "chips," called radio frequency (RF) tags, are affixed to garbage containers to identify households. These are read and recorded electronically by the on-board computer, along with the weight of the garbage for that household. Certified scale systems are now available and have already been put in place overseas; however, despite multiple pilot tests in North America, they are not in full-scale use in the United States or Canada (except in one community which uses GBTP for commercial businesses).

Summary of PAYT options

Some communities or haulers (garbage collection companies) offer variable rates as an option along with their standard unlimited system. Waste drop-off programs, programs that charge by the bag, and programs that use punch cards or other customer tracking systems are also in place in some communities, particularly in rural areas.

Systems summary and conclusions

Each system has strengths and weaknesses. By using these systems, communities realize savings through reduced landfill usage; efficiencies in routing, staffing, and equipment; and higher levels of recycling. However, there are some downsides to these programs. Collection changes can lead to additional costs and new administrative burdens (such as those associated with monitoring, enforcement, billing, etc.); rate-setting and revenues are more complex and uncertain; and significant spending on public education outreach is necessary for successful implementation of a variable-rate program.

In addition, some systems are more appropriate than others, depending on local conditions. Larger communities, as well as urban and suburban communities, tend to use can programs—especially if they have automated collection. Smaller and more rural communities are more likely to use bag, tag, or sticker programs. Bag and drop-off programs are most prevalent in the East, can and bag programs are most common in the Midwest and the South, and can programs are the most popular in the western United States. Many communities are implementing the hybrid system, which is probably the easiest form of PAYT to implement because it provides the PAYT incentives (and potential savings) while requiring minimal capital and billing system investment.[2]

One emerging trend in waste management is the rise of a program called RecycleBank™, which is a variation on the weight-based system. This option has shown promise in areas where PAYT has been hard to implement due to political reasons. Instead of weighing trash and charging more for larger amounts of garbage, the system weighs recycling by household and provides rewards and coupons at participating stores for those who put out more recycling (up to a limit). This system, which can be implemented with or without one of the PAYT options, works on a more direct incentive principle to achieve an outcome that is similar to PAYT.[3]

> Tonnage impacts of PAYT

In order to assess PAYT as a waste management option, the impacts that can be expected if the program is introduced—specifically, the tonnage and diversion impacts—must be identified. This is trickier than it sounds, as most communities do not make changes in isolation. Changes in PAYT are usually accompanied by concurrent modifications to recycling programs, costs, or outreach. To provide specific information regarding the effects attributable to PAYT requires statistical analysis to control for differences beyond the PAYT change.

The effects of PAYT were examined in a series of studies that used information gathered from more than 1,000 communities (Skumatz, 1996a, 1999b, 1999c, 1999d). According to this research, conducted by Skumatz Economic Research Associates (SERA), the

2 Under this system, a community would probably distribute bags at the town hall and at convenience and grocery stores. In this case, only stores would be invoiced for bags (individual households would not).

3 The RecycleBank™ option provides a useful reward, and it does not require a change in garbage collection or billing as it only affects the recycling program or system. However, it only rewards recycling; PAYT rewards composting, reuse, and recycling.

key impacts observed by communities that have implemented variable-rate programs include a reduction in disposal tonnage, an increase in recycling and yard-waste diversion, and source reduction.[4] These studies found that variable-rate programs decrease residential disposal, in terms of weight, by about 17%. This reduction is comprised of several pieces. About eight to 11 percentage points are diverted directly to recycling and yard programs, and another six percentage points of this decrease are the result of source-reduction efforts (Skumatz, 2000a, 2000b) for a total reduction in average residential disposal weights of 17%. The reports also found that:

- Five to six percent of residential waste generation (by weight) goes to recycling (with similar increases for both curbside and drop-off programs) (Skumatz 1996a, b, 1999a, b, 2000a, b);
- Four to five percent of generation (by weight) goes to yard-waste programs, if any (Skumatz 1996a, b, 1999a, b, 2000a, b);
- About 6% of residential waste generation (by weight) is removed via source reduction efforts, such as buying in bulk and buying items with less packaging (Skumatz 2000a, b);
- Introducing variable rates was the single most effective change that could be made to a curbside (or drop-off) program. Implementing variable rates had a larger impact on recycling than adding additional materials, changing the frequency of collection, or making other changes and modifications (Skumatz 1996 a, b, 1999 a, b).

These results are confirmed by other work. For instance, a survey in Iowa found that after variable rates were introduced, recycling increased by 30% to 100%; the average increase was about 50% (Frable and Berkshire, 1995). If the average recycling rate prior to PAYT were, perhaps, 8-12%, then a 50% increase would be 4-6%, a figure very comparable to the SERA findings.

Given that recycling programs alone do not encourage source reduction, investing in a variable-rate program has significant advantages, including high levels of source reduction, environmental benefits, strong program paybacks, and recycling and yard-waste diversion impacts that provide significant progress toward meeting diversion goals.

Ultimately, PAYT can help reduce the burden on the disposal system and lead to more efficient use of resources, reduced environmental impacts, and lower long-term solid waste system management costs. PAYT programs also enhance community recycling and waste reduction programs. While variable-rate programs may not be appropriate in all communities (for example, where recycling markets are far away and transport is expensive), many communities can benefit from variable rates—and the discussions in this paper can help communities examine the feasibility of PAYT for their solid waste system.

4 Source reduction, or waste prevention, occurs when people avoid the need to dispose of material. For instance, it may include avoiding disposal by donating materials to charity for reuse, or buying in bulk to reduce packaging, etc.

The advantages of PAYT

User-pay or PAYT programs provide a number of advantages for communities and residents, which are discussed below.

Equity

PAYT programs and variable rates are fair: customers who use more service pay more. In this way, PAYT is fairer than tax-based systems. Research has shown that after implementation, more than 95% to 98% of households say they prefer the new system and prefer not to return to the old program, likely due largely to improved equity (Skumatz, 1993a, 2001d).

Economic signals

Without variable rates, avid recyclers pay the same amount as large disposers. Under PAYT, a household's behaviour affects the bill they receive. Thus, PAYT provides an ongoing economic signal that encourages customers to modify their behaviour, and allows customers who dispose less to save money.

Maintaining choice and linking it to behaviour

Variable rates do not restrict the choices of customers. Customers are not banned from putting out additional garbage, but those who want to put out more will pay more.

Efficiency

PAYT programs are generally inexpensive to implement and, unlike recycling programs, do not require additional pick-up trucks. They also help prevent overuse of solid-waste services. Rather than fixed charges, which encourage over-use of the service, volume-based rates encourage customers to use only the level of service they need.

Waste reduction

Unlike recycling programs, which only encourage recycling, variable rates reward all behaviours—recycling, composting, and source reduction—that reduce the amount of garbage thrown away. Encouraging source reduction should be the highest priority because is the least expensive waste-management strategy and it is not directly encouraged by recycling and yard-waste programs.

Speed of implementation

PAYT programs can be implemented very quickly—one community installed a variable-rate program in less than three months (although most installations take longer).

Flexibility

PAYT programs can be implemented in many different sizes and types of communities, under a broad range of collection arrangements.

Environmental benefits

Because they encourage increased recycling and waste reduction, variable-rate programs are broadly beneficial to the environment.

Concerns regarding PAYT

However, there are also concerns. The most frequently mentioned are discussed below.

Illegal dumping

Though some fear that PAYT will lead to an increase in illegal dumping, research (Skumatz et al., 1994) shows that it is a problem in only about 20% of communities, and it usually lasts for about three months or less after the program is implemented (Skumatz, 2001d). Further, analysis of the composition of illegally dumped material finds that only about 15% originates from households, and that the largest component of this household garbage is bulky items or appliances (or "white goods") (Skumatz et al., 1994). Enforcement of illegal dumping ordinances usually keeps the problem at bay. PAYT programs should introduce methods of disposing of bulky materials, such as sticker programs.

Concerns about large families or the poor

Some communities worry that PAYT will be a burden to large families. Large families routinely pay more for groceries, water, and other services than other households do. Under PAYT, large families can recycle and reduce their trash in order to reduce their bill. Instead of focusing on large familes, it may be prudent to focus on whether fixed billing is fair to small households or households with fixed incomes—that is, is it fair for small disposers and those on fixed income to subsidize large disposers? In some cases, communities offer low-income households "lifeline" discount rates for essential services, such as energy and telephone. These types of discounts could be extended to garbage fees through discounts or allocations of some free bags or tags. Special arrangements for the poor or infirm are made in less than 10% of the communities with PAYT programs (Skumatz and Breckinridge, 1990), but are often in place in communities that have policies for other services.

Revenue uncertainties

The number of bags or cans of trash set out for collection decreases dramatically after PAYT is implemented, due to the combined effects of reduced disposal and stomping or compaction. Consequently, communities and haulers that adopt PAYT need to adjust their expectations regarding the number of garbage cans or bags that will be set out in order to ensure that they will be able to cover the fixed costs of collecting solid waste. In addition, PAYT programs that charge a great deal more for a second or third container ("aggressive rates") can encounter revenue problems. The large cost of sending trucks to pick up garbage is not dependent on how much waste (or how many cans or bags) is collected. Aggressive rate structures may succeed in causing households to put out fewer cans, but if they are more successful than anticipated, the system may not be able to cover the costs of sending trucks out to collect garbage. Research indicates that most of the incentive to recycle is maintained, even if the differentials between the rates per container are 80% more for double the service (Skumatz, 1999a, 2000c, 2001d).[5]

Increased administrative burden or workload

Studies conducted in Wisconsin and Iowa (Frable and Berkshire, 1995) show that workloads stayed the same or decreased in 60% to 70% of the communities that implemented PAYT. A city's administrative workload (which includes responding to queries) increases dur-

5 Low differentials do not provide a noticeable incentive, and if higher differentials will not be supported, then the PAYT system should not be implemented.

ing implementation and, as a result, temporary staff are likely to be needed.

Multifamily buildings

PAYT has been tested most often in single-family situations, including garden apartment complexes with up to perhaps eight units. These programs have not been tested widely in large, multifamily buildings (with trash chutes), but practical technological approaches are being researched (Skumatz, 1999e). However, multifamily buildings that are serviced by dumpsters already receive a better volume-based building-wide incentive to recycle than single-family households under a non-PAYT system receive. Nevertheless, the implementation of PAYT should not be delayed because its application to the multifamily sector is not yet effective.

Ultimately, it is anticipated that using variable rates will lead to more efficient use of services, reduced burdens on disposal systems, improved use of resources, and lower long-term solid waste system management costs.

PAYT legislation and ordinances

Though PAYT has, for the most part, spread on a community-by-community basis, a number of US states—as well as counties and cities—have implemented legislation or ordinances that require communities to implement PAYT. Canadian provinces that are interested in moving forward with PAYT may find the following examples of state legislation or involvement useful (Skumatz, 1993a, 2001e, 2000c).[6]

- Some states have made PAYT mandatory—all communities must implement PAYT.
- Several states have made PAYT mandatory if certain goals are not met. For example, some require communities that do not reach 25% or 50% diversion by other means to implement PAYT.
- One state lists PAYT as one of a small menu of recommended waste management strategies. Urban areas must implement more of the listed strategies than rural areas.
- Some states offer financial incentives (grants) to encourage communities to adopt PAYT.
- Some actively promote PAYT through education or workshops about the program.
- Some states have put PAYT into their state's master plan or comprehensive plan.
- Counties and cities have implemented legislation (local ordinances) that require garbage collection companies (haulers) to follow a PAYT system. Haulers seem willing to cooperate as long as the system creates a level playing field for all haulers.[7]

6 PAYT is often called user pay in Canada.

7 Haulers repeatedly make it clear that they will do what their customers want. They are willing to compete under a variety of situations, as long as the same rules apply to all haulers.

If a community considers instituting PAYT legislation, there are a number of elements that should be included in the language to increase recycling and help ensure that the program is successful (Skumatz, 2001e, 2000c):

- The legislation should require that curbside recycling containers be provided for all households, and that the cost of the containers be embedded into the garbage fee. This does not mean that the service would be available for no cost; the garbage collection fees would be adjusted to cover recycling costs.

- The legislation should require that a small trash container—no larger than 35 gallons—be available. (Larger containers would also be available.) A small bag of approximately the same size should also be available for small disposers.

- The new regulations should give customers incentives to reduce their disposal. For example, in one state, the rates for increments of garbage service must vary with the amount of service provided (weight or volume both work as measures). The legislation could suggest rates that would be (no less than) 70% or 80% higher for double the service. Small differentials do not provide recycling incentives and are not worth implementing. Such an arrangement would not actually set rates for the haulers, but would achieve key incentive objectives.

- Requiring periodic education to be provided by haulers could help ensure the success of a PAYT program; cooperation between haulers and communities may become even more successful. In addition, communities should track the progress and impacts of their programs by requiring the reporting of garbage and recycling tonnages.

> Successfully implementing PAYT

Getting variable-rate programs approved is often harder than actually designing and running the system. City councils are sensitive to concerns about fixing a system that does not necessarily need to be fixed. One city council, for example, approved variable-rate pricing as a concept, but left it for the next council to determine how the rates would be charged. It is critical to provide information to residents, the media, and stakeholders regarding the purpose of the change, what the community hopes to achieve through the change, and how the program will work for residential customers.

Strategies and activities

There are several key strategies and activities that may be useful in helping communities move in this direction (Skumatz and Breckinridge, 1990; Skumatz, 1993a, 2000c).

Political support

One of the most important ways to ensure the success of a PAYT or variable-rate program is to gather political support for the program. A champion for the system on a city's council can be particularly effective. Support from citizen groups (including politically sensitive

groups such as retirees and low-income households) can help.

Hauler input

Haulers, who are generally familiar with these programs, should be included in the discussion and design of a PAYT or variable-rate system. Haulers know the community and can help design and revise the system so that it will work better for all parties involved.

Customer education

Providing information about the new PAYT system to members of the community is essential. This outreach should tell customers about the problem that is solved by the new system; describe how the system works; suggest opportunities to reduce waste (and relevant ordinances); and tell customers where they can find more information (Skumatz, 2001b).

Consider a pilot program or implementing the program gradually

This can help ensure that the program has minimal glitches when it is implemented system wide.

> Beyond PAYT: residential program changes and policies

It is in the interest of communities to continually refine their programs to achieve higher diversion and improve cost-effectiveness. However, identifying the impacts of individual program changes is difficult because changes almost always take place concurrently. In the late 1990s, a number of studies which analyzed data from over 1,000 communities across the United States and Canada were published (Skumatz, 1996a, b, 1999a, b). These studies found that there were a number of key factors affecting diversion that were beyond the control of a community. Specifically, communities with more "favourable" demographics tended to have higher levels of recycling than communities with identical diversion programs but less favourable demographics. In this context, "favourable" demographics means a well-educated population with high income levels, a high percentage of single-family homes, and a small population of people who speak English as a second language (that is, a high population of English speakers). Non-tourist and non-college communities were also considered to have favourable demographics.

Fortunately, communities with less favourable demographics can still improve diversion, efficiency, and the cost-effectiveness of their programs through better program design and incentives. The effectiveness of various program designs and other factors—including information on both diversion and cost impacts—are highlighted in table 1.

Examining these trade-offs illustrates the rationale behind some trends in recycling program changes. Some communities are moving to biweekly recycling collection. They collect garbage and recycling one week, and then collect garbage and yard waste the next. The resulting recycling savings make it possible to fund most of the yard-waste program, especially when fully automated trucks that can lift the larger wheelie bins are used. The decrease in recycling tonnage is more than offset by the yard-waste diversion. Communities across North America have been able to use this information to identify changes that increase diversion or decrease costs to improve cost-effectiveness.

Table 1: Most effective recycling and yard waste program changes

Encourages recycling	Encourages yard waste diversion/composting
Large effect (5-8 percentage points of diversion)	
• PAYT is the single most effective option. These programs work as part of both curbside and drop-off recycling programs.	• Combining yard waste and garbage costs into one fee (that is, not charging extra for yard waste) leads to more compost diversion than if a separate fee is charged. However, not charging for yard waste eliminates the incentive to compost (a viable household option) and may lead to overuse of the yard-waste program. • PAYT provides strong incentives to keep cut grass in the yard or the backyard compost—the cheapest ways to manage this waste.
Medium effect (2-5 percentage points of diversion)	
• Reducing the number of recycling streams—moving from a three-stream to a dual-stream system, or from a dual-stream to a single-stream system—makes recycling more convenient and tends to increase diversion from households. Some worry that the recycled materials that are sold in the market will be "dirtier"; however, modern processing facilities seem to sort well. In addition, this option saves collection costs. • Combining recycling and garbage costs into one fee leads to more recycling than charging a recycling fee separately (line item or per bag). • Collecting recyclables more frequently (weekly instead of biweekly or monthly) may increase recycling diversion by several percentage points; however, this option costs up to 40% more than collecting half as frequently. Some communities are taking these savings and adding alternating yard-waste collection, which more than makes up for the lost recycling tonnages on an overall basis.[1] • Requiring households to sign up for garbage service, or changing the frequency of garbage service from twice a week to once a week increases recycling substantially. Reducing garbage frequency reduces costs as well. • Collecting garbage and recycling on the same day—making the two services "parallel" and thus more convenient—increases recycling.	• Mandatory yard-waste programs or bans on putting yard waste into garbage containers are effective methods of diverting additional material. • Collecting yard waste more frequently (weekly instead of biweekly or monthly) increases diversion; however, this option costs up to 40% more than collecting half as frequently. As mentioned in the recycling section, some communities are finding greater value in alternating recycling and yard waste collection, which sometimes costs only a little more[2] and collects much more material.
Low effect (2 or fewer percentage points of diversion)	
• Providing recycling bins, and/or providing large recycling bins increases recycling. However, these bins can be costly. • Higher landfill fees also seems to increase recycling levels.	

[1] However, other communities feel that biweekly collection of yard waste is not optimal. Consideration of local conditions is important.

[2] Some communities with heavy yard waste have suggested that the drop in yard-waste collection with an every other week system is quite significant, and the alternate week option may not be optimal in these locations.

Sources: Skumatz (1996 a, b, 1999 a, b).

> Non-residential sector programs and strategies—spreading the responsibility

If a community hopes to increase diversion or to meet recycling or diversion goals, it must devote some attention to the commercial sector, since the residential sector accounts for only 40% to 60% of the waste generated in a community (or even less if construction and demolition debris is considered as part of the commercial sector). However, addressing the problem of commercial waste can be challenging. The commercial sector is typically served by multiple private haulers who protect these services tightly. They rarely share information about who they serve, what they charge, and what recycling services are available, so communities have trouble determining how much recycling is already happening. Regulation or "interference" from the community, which often has limited authority over the sector, is usually fought aggressively by private haulers.

Nevertheless, if a community hopes to increase diversion, considering options beyond residential curbside recycling and yard-waste programs is crucial. The best option may be to share the responsibility for solving the solid waste problems among those who have roles in waste management—including haulers, municipalities, and residential and commercial generators—rather than continually asking for cooperation from the same few actors (mainly haulers). Spreading the responsibility fosters greater participation and cooperation because responsibility is shared more equitably among all the actors—each party bears only part of the burden, and all similar actors face a level playing field. Furthermore, spreading the responsibility can also lower overall costs because recovering 100% of the recyclable materials from any sector (e.g., residential) is likely to be more expensive and difficult than getting 25% (or some other percentage) of the available recyclables from each of a variety of sources.

Strategies for implementing shared responsibility include mandating change, and offering incentives or other kinds of assistance. Communities or states may adopt a variety of strategies, or they may try incentives first and invoke mandates later if voluntary or incentive approaches are not sufficiently effective (Skumatz, 1999a, 2001c; Skumatz and Gordon, 2006).

There are a number of actions a community can take to help improve the development of their waste management program (Skumatz, 1999a, 2001c; Skumatz and Gordon, 2006). First, communities should consider creating a well-selected task force to discuss and help select strategies. The task force should be comprised of knowledgeable mid- to upper-level representatives from successful and unsuccessful cities and counties, recycling businesses, haulers, non-profits, academics, and facility managers. The group can bring different views, concerns, suggestions, and practical local issues to the discussion, and can help convince decision makers to support the program. Communities must emphasize the need to develop coalitions—in-fighting will only undermine the support of decision makers or legislators.

Second, communities should identify local barriers and opportunities, and tailor recommendations and impacts to local conditions. They should conduct groundwork ahead of time to ensure that these recommendations are known and supported. The support of high-ranking political or legislative groups will give the project the greatest momentum. If legislation is required,

communities should identify supportive legislators and groups (preferably groups that are viewed favourably by legislators) that are willing to bring forward and lobby for the legislation.

Finally, communities should identify revenue sources as part of the project—these discussions should not be left until the end. Funding issues often create the most discord and can derail strategies, even if they have many supporters.

There are many examples of communities that have moved towards implementing a shared-responsibility system, including San Jose, California; Seattle, Washington; Portland (Metro), Oregon; Fort Collins, Colorado; Boulder, Colorado; and many others.

Jump-starting diversion

There are five key actions that can "jump-start" recycling and diversion in many types of communities (Skumatz and Freeman, 2008). These actions are as follows:

1. Establish a citizen recycling/sustainablity committee

Their charge should include assessing options, setting a goal, providing advice on specific programs, and other objectives that support local decision makers and leveraging staff. The requirements to support and empower such a committee are small.

2. Identify the status quo and set and monitor community diversion goals

This includes measuring the current recycling rate (by simply weighing trash and recycling set-outs for a random sample of households on garbage day); conducting residential and commercial surveys to understand current behaviours, desirable program changes, and willingness to pay for new options; looking for grants; and other activities.

3. Implement key programs and local ordinances to improve opportunities to recycle

Local ordinances should require that space for recycling be equal to space for trash in new and remodeled commercial and multifamily buildings. New regulations may also include ordinances that require businesses to file recycling plans or that require recycling clauses in business tenant leases.

A few "easy" commercial programs, including technical assistance or "green audits" and recognition programs may also be effective. Drop-off recycling and/or yard-waste programs are particularly effective enhancements where they do not already exist.

4. Undertake education and outreach efforts

Communities or counties can develop flyers, brochures, web pages, newsletters, newspaper articles, and other forms of outreach to keep citizens informed about recycling and diversion options.

5. Adopt variable rates or a PAYT program

An even more effective option, if feasible, is a combination of ordinance mandating (or local service offering), curbside recycling with no separate fee ("embedded cost"), and PAYT.

The combination of the five above-noted actions can be extremely effective at changing a community's diversion rate from low to relatively high very quickly.

Summary

As the experience of more than 7,000 communities in the United States and more overseas has demonstrated, PAYT programs can successfully increase diversion and reduce household garbage disposal (Skumatz and Freeman, 2006). These flexible systems work in large and small communities, with any type of collection system. Depending on the system, billing can be very straightforward, and if sufficient political will is behind the change, PAYT systems can be implemented very quickly. Problems with these systems are rarely technical but can be political; however, surveys show that once the system is in place, more than 95% of households do not want to go back to the older, less fair system. While perhaps not suited to every community, the vast majority of communities would benefit from examining PAYT as an effective and cost-effective augmentation to their recycling and source reduction programs.

A host of strategies can increase the effectiveness and cost-effectiveness of residential recycling and diversion. As this chapter has noted, the performance of programs can be improved by changing the frequency of collection, the method of collection, and by creating policies and incentives (including PAYT) that improve the climate for recycling.

Finally, because the residential waste stream only represents 40% to 60% of the total municipal solid waste stream, communities should consider programs that address the non-residential portion of the stream. These programs can provide excellent opportunities to jump-start stagnating recycling levels. Involving multiple actors and generators—including haulers, builders, developers, communities, multifamily buildings, and others—in these programs can help increase cooperation because the burden of recycling is spread equitably among all parties involved.

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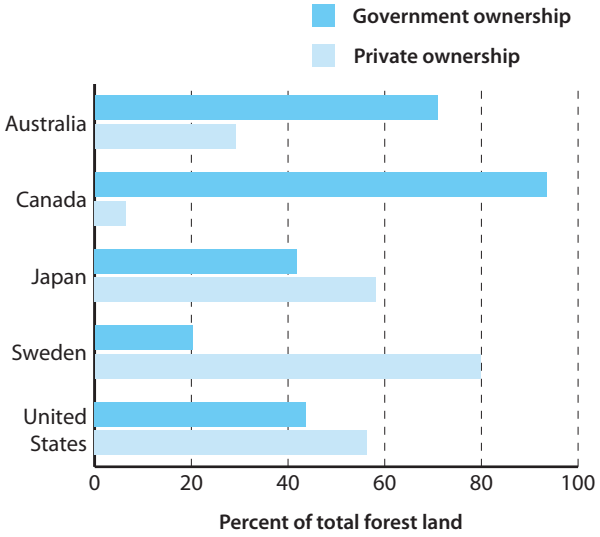
Forests: The Private Role in Public Rights

Alison Berry & Holly Lippke Fretwell

In the minds of many, Canada and forests are almost synonymous. With forests covering nearly half of its landscape, the nation is the world's largest exporter of timber-based goods (Drushka, 2003). Canadian forests also protect water quality and yield, while providing a vast number of recreational opportunities and habitats for a great diversity of wildlife, in addition to performing many other functions. Canada's forests are vital to the nation and her people.

While Canada has much in common with other developed nations such as the United States and many European countries, it is unique in terms of the amount of forested land that is privately owned. As shown in figure 1, less than 10% of forestlands in Canada are privately owned,[1] a tiny portion in comparison to private ownership in other countries such as Australia, Japan, Sweden, and the United States (White and Martin, 2002: 5). The vast majority of Canadian forests (77%) are owned by the provincial governments, and the remaining public land is federally owned (Natural Resources Canada, 2006: 6). Despite the prevalence of public ownership in Canada, much of the management responsibility is delegated to the private sector.

Figure 1: World forest ownership



Source: White and Martin (2002: 5)

Canada's unique ownership structure is a result of the manner in which Crown lands were transferred to Canada from Britain. Since the beginning of the European settlement until the early nineteenth century, the majority of Canada's forests were the domain of the British Crown. Beginning in 1837, rights to resources on Crown lands were transferred to the provinces as they formed governments. The provinces sold timber to

1 In some provinces and in some areas, the percentage of private ownership is above 10%.

finance government operations, while retaining ownership of forestlands. This system continues today under the timber-tenure system, which transfers responsibility for public land management to the private sector (Drushka, 2003: 30).

How forests are managed and cared for, in Canada and throughout the world, is dependent upon who owns them and the laws governing their use. The predominance of publicly owned forests in Canada magnifies the importance of public land policies, which can have huge environmental and economic impacts. The bureaucratic nature of public land management throughout much of Canada has resulted in misdirected incentives, which has led to the inefficient management of one of the country's greatest natural resources.

This chapter compares public forest management policies in Canada and the United States. It analyzes the different mechanisms used to motivate forest stewardship and provides policy implications. Canadian provincial timber tenures provide a unique set of tools for Canadian timber management. This chapter focuses on this policy application and on specific areas where it can be improved.

> The private role

Before taking a look at Canada's vast, publicly managed forests, it is important to examine how private forest owners steward their land and why. Canada is fortunate to have clearly outlined private property rights which allow these forest owners to benefit from their land when it is healthy and productive or, in some cases, to suffer the consequences of poor land stewardship. For example, a private forest owner has the right to the proceeds from timber harvesting and can reap financial benefits year after year if the forest is well managed. When poorly managed, the land may become less productive and the owner will suffer the burden of lower proceeds. It is in the best interest of the private owner to enhance the land's productive ability.

In addition to timber productivity, forest owners also benefit from other forest values. Well-maintained forestland will retain its value or even increase in value, while a poorly maintained forest will lose value. Because the value of a forest depends on what others are willing to pay for it, a wise owner will manage the land not only to ensure timber production, but also to maintain clean air, good water quality and plentiful supplies, wildlife habitats, and scenic beauty. All of these are augmented by good stewardship and will add value to the land.

One of the impediments to developing markets for non-timber forest values in Canada is government ownership of fish, wildlife, and water. This is also true in many countries throughout the world. For example, in the United States, fish and wildlife are owned by state governments. Nevertheless, these amenities can enhance the future resale value of the property and can be enjoyed in the present by the current owner. Thus, a private timberland owner who is seeking to maximize his personal benefits should be motivated to be a good steward of his land.

Private forestland owners, whether they are producing wood products or not, realize the value of alternative land uses. The United States, with its higher percentage of private forest owners, provides numerous examples of the benefits available from land uses that are not exclusively tied to timber harvest.

International Paper (2006), once one of the largest timberland owners in the United States, earned 25% of the revenues from its southern region during the 1990s by charging recreation and hunting fees for the use of its land. Hunters first secured permits from the state wildlife agency, and then paid International Paper for access to its lands for the purpose of hunting. As a result, the company became a wildlife manager in addition to a timber producer (Anderson and Leal, 2001: 66).[2] Rather than clear-cut large rectangular swaths, the company left corridors of standing trees to enhance wildlife populations and buffer streams to improve fisheries. Where timber was harvested, the harvest edge was feathered to provide a more natural appearance.

Similar to International Paper, smaller plantation owners protect the timber amenities they value. Chuck Leavell owns a tree plantation in the southeastern United States. His Charlane Plantation gains revenues from both harvesting timber and providing a prime bird hunting experience. Many other non-industrial timber land owners harvest little or no timber but enjoy the other amenities of their forest. Adirondack Park in the state of New York, for example, is a patchwork of public and private lands. Within the boundary of the six-million-acre park, 3.5 million acres are privately owned. Many of these private forestlands are maintained for personal recreation opportunities.

Worldwide, there are forests owned by non-governmental organizations (NGOs). The Nature Conservancy and the Audubon Society both own and manage timberland to enhance wildlife habitats and diversity. The majority of their revenues come from member donations, so they must satisfy members' desires for habitat protection in order to maintain or increase financial support. In order to meet their conservation goals, they must practice good stewardship.

Some of these NGO-owned lands are working lands, such as the Nature Conservancy's Pine Butte Ranch in Montana where cattle still graze and vacationers can enjoy learning about this habitat along the Rocky Mountain Front. On other Conservancy-owned lands, timber is harvested to enhance habitats. The Nature Conservancy's Washo Reserve in North Carolina is one of the oldest wading bird rookeries in the world. It is also home to the endangered red cockaded woodpecker. The woodpecker excavates cavities in old, large, long-leaf pines. To encourage faster tree growth, managers mechanically thin the trees and use prescribed burning to inhibit undergrowth. The timber revenues help pay for the management of the reserve (Fretwell, 1999a: 24).

The vast public ownership of Canadian forests leaves little land for such private initiative. Instead, the use of the majority of forests, whether for wood products, wildlife, water quality, or recreation, is determined by government agencies and personnel. No individual receives the benefits from their own good stewardship, nor does anyone suffer the full burden of lost value due to degradation. As a result, forest management is based on government plans that are vulnerable to the demands of special interest groups—plans that do not respond to the changing values of forest uses.

Government management of Crown forestlands in Canada is implemented largely through the timber-

2 In a move to transform the company and focus on uncoated papers, as well as industrial and consumer packaging, International Paper sold nearly 80% of its US land holdings in 2006 (International Paper, 2006).

tenure system. Non-timber uses are either managed by the provincial governments or provided through separate tenure agreements. Forest tenure holders do not have the right to balance timber harvests with alternative forest uses to meet their goals. The timber-tenure system needs to be reformed—through either private ownership or more complete rights to forestland—so that managers can respond better to the demands of forest users. The next section describes in detail the timber-tenure system, and identifies areas for improvement.

> The timber-tenure system

Timber tenures are agreements between provincial governments and the private sector. Through tenures, private companies gain access to Crown lands for the purpose of timber harvest and, in return, must pay fees and assume management responsibilities. This system has advantages for both the provincial governments and the forest industry. The provinces retain ownership of forestland and generate revenues from the timber tenures that help finance other provincial operations. The forest industry gains access to timber, often for long periods of time, but it does not have to pay the full costs of ownership as it would if it actually owned the land.

Not all tenure agreements are the same. Some tenures carry strong incentives for stewardship, while others provide little incentive to maintain a long-term interest in the land. Each province has a unique array of timber tenures, but most harvesting rights are allocated through one of two types of tenure agreements (Haley and Luckert, 1990). One is a long-term, area-based tenure which confers significant management responsibilities. An area-based tenure restricts the holder to logging within a particular area, which can be sizeable. For example, in Ontario, the average area-based tenure covers 509,000 hectares (Ontario, Ministry of Natural Resources, 2004: 23). Area-based tenures generally last from 20 to 25 years, and are often renewable (Haley and Luckert, 1990). This encourages tenure holders to manage the land with the future in mind.

Other tenures are short-term, volume based, and confer fewer management responsibilities. Volume-based tenures allocate a specified amount of timber to the holder, but do not restrict the location of harvests within a broad area of Crown land. Under this arrangement, tenure holders might harvest from a specified site only once. Also, most volume-based tenures last for 10 years or less (Haley and Luckert, 1990). As a result, volume-based tenure holders have little incentive to manage with the long-term productivity of the land in mind.

Economic theory suggests that the stronger property rights associated with long-term, renewable, area-based tenures will result in better stewardship of forest resources (see, for example, Demsetz, 1967). Scientific research supports this theory. University of British Columbia researchers Daowei Zhang and Peter Pearse investigated the effect of tenure on reforestation practices, financial investments into silviculture, and compliance with environmental guidelines in British Columbia (Zhang and Pearse, 1997, 1996; Zhang, 1996). They found that offering more secure tenures—area-based, long-term, and renewable tenures—resulted in faster reforestation, greater financial investments, and stronger compliance with environmental guidelines. Offering secure property rights to public resources through long-term, renewable, area-based tenures improves stewardship

incentives (see Berry, 2006). While area-based tenures are prevalent across Canada, some provinces continue to allocate a significant portion of the allowable harvest to volume-based tenures.

However, long-term stewardship incentives can be undermined by the power of the government to breach contracts at any time. For example, since the 1970s, forest policies have increasingly regulated forest practices in some areas such as riparian zones, critical wildlife habitats, and on steep slopes. As well, provincial governments now require more public participation in the forest planning process (Drushka, 2003: 67–68). These new policies aim to enhance environmental quality and to garner public support for forest practices, but the ability of the provincial governments to regulate forest management undermines the expertise of professional forest managers and weakens the incentives for long-term management. As the risk of losing rights increases, the incentives for long-term management decline (see Alchian, 2002).

Canadian timber tenures need to be reformed in order to better encourage stewardship of forestlands. Changes in forest policy should focus on increasing property rights and private sector involvement in forest management, through either transfer of ownership or transfer of more secure and complete rights to forest resources within the timber-tenure system.

> Non-timber forest resources

Timber tenures apply strictly to the harvest of timber. They do not convey rights to non-timber forest products such as water and wildlife, or to forest uses such as recreation. These are controlled by the provinces, either through non-timber tenures or through government management. For example, in British Columbia, non-commercial recreation is managed by the Ministry of Tourism, Sport and the Arts, sometimes in partnership with local groups. Commercial recreation, such as guiding and outfitting services, is controlled through a variety of recreation tenures. Provinces also offer permits for fishing and hunting, which are generally required for these activities on all lands and waters within the province, including Crown lands in timber tenures.

Because holders of timber tenures do not control non-timber forest resources, they cannot benefit by making trade-offs between harvest and other forest values, even when it would be to their advantage. Unlike private owners who are able to choose the use that will provide the greatest return, the timber-tenure holders must rely solely on the value of the timber for revenue generation.

Usually provincial regulations do require holders of timber tenures to consider non-timber forest values in their planning and management activities. But timber is typically the only way for tenure holders to generate revenues to cover fees and the costs of management. This command-and-control management system emphasizes timber production, even though the values of other forest uses are growing over time as both incomes and the population are increasing.

A clash between timber and non-timber values came to a head in the 1990s during the "war in the woods." This "war" involved large-scale disputes between loggers, environmentalists, and First Nations in western British Columbia. The conflict centered on the temperate rainforests of Clayoquot Sound on the west coast of Vancouver Island. When logging intensified in the

Clayoquot area in the 1970s, First Nations and environmental groups took note of damage to fisheries and other resources that was caused by the prevailing logging practices (Iisaak Forest Resources, 2000). Logging protests were staged throughout the 1980s, escalating into a 1993 event in which more than 800 protesters were arrested for blocking access to a logging road. A resolution to the Clayoquot dispute was eventually reached in 1999 (Stefanick, 2001), but the debate continues over logging rates, in Clayoquot and across Canada. The message is clear: residents of Canada demand a wide array of values from their forests—not just timber, but also recreation, wildlife habitats, clean water, and wilderness. In order to meet these demands, Canadian forest policies need to better address non-timber forest resources.

> Geographical separation of commercial forests from conservation forests

Many observers suggest that forest management problems could be solved by designating separate commercial and conservation areas within Crown forests (Sahajananthan et al., 1998; Sedjo and Botkin, 1997). Commercial areas—the most suitable for that purpose—would be managed for timber production, while conservation areas would be managed more for environmental or amenity uses.

New Zealand recently acted on this idea by separating commercial timberlands from conservation forests. Commercial timberlands are managed mostly for timber harvest by private companies, and the conservation lands are mainly indigenous forests, reserved from logging and managed by New Zealand's Department of Conservation. This approach has been quite successful at alleviating some problems arising from conflicting forest uses, and at engendering more efficient timber management.

It is not clear, however, that government ownership of non-commercial timber lands will best protect environmental values. Not having a timber harvest to cross-subsidize the conservation lands, New Zealand's Department of Conservation is struggling to manage its lands with limited funding (Peter Berg, president, New Zealand Forest Owners Association and Fellow of the New Zealand Institute of Forestry, personal communication, March 22, 2005).

Government management of parks in both Canada and the United States has had limited success at protecting environmental quality. Canada's network of national parks, managed by Parks Canada, are plagued by a maintenance backlog, misallocated funds, invasive species, and dwindling populations of many threatened and endangered species (Struzik, 2004, Nov. 7, Nov. 28).

National parks in the United States, which have a mission to preserve and protect the land, enjoy generous public support, but they are still unable to fully care for the resources. The National Parks Conservation Association, one of the largest national parks advocacy groups in the United States, notes that invasive species and air pollution threaten many of the habitats that the parks were created to protect. Decades-old battles about appropriate recreation use continue while popular parks deal with months of congestion during the peak summer season. Many argue that a lack of funding is the problem, but political earmarks ensure that pet projects and new parks are amply funded. Meanwhile, on-going maintenance at existing parks falls behind (Fretwell, 1999b).

Although it is widely accepted in both Canada and the United States that public agencies can better protect the landscape than the private sector, the facts tell a different story. The public sector is not always the best steward of the land, nor does it reliably provide what citizens want from their public lands. The public sector's bureaucratic land management agencies are slow to respond to changing demands.

> Annual allowable cut

One aspect of Canadian forest policy that could be changed is the target harvest requirement, or annual allowable cut (AAC). The AAC interferes with several aspects of forest management by forcing tenure holders to focus on timber production and preventing timely reactions to market and environmental conditions.

The AAC is designed to ensure that a steady flow of timber is produced from Crown lands in order to supply mills, sustain local communities, boost the economy, and generate revenue for the government. The level of the AAC is determined by the provincial governments on the premise of sustained yield: harvest rates across a broad geographical area must not exceed timber growth rates, which are based on past and current stand conditions and future growth expectations. Tenure holders are generally required to meet their assigned portion of the AAC over a five-year period; consequently, harvest rates are allowed to fluctuate annually.

In practice, target harvest requirements stymie tenure holders from reacting to changing market conditions and to ecological changes in the forest. This can result in reduced profits, economic inefficiency, and environmental degradation. For example, in some cases, forest conditions necessitate the removal of timber to prevent the spread of insects and disease, as is currently the case with the devastating mountain pine beetle outbreak in western Canada. On the other hand, tenure holders may want to reduce logging levels in environmentally sensitive areas, such as riparian zones, steep slopes, and critical wildlife habitats. Allowing tenure holders the flexibility to react to such conditions may result in more vital forest ecosystems, and more robust forest industries.

Many smaller tenure holders and community-based forests wish to manage more for amenity values than for timber harvest. But in most provinces, Canada's adherence to the sustained-yield principles of the AAC often discourages tenure holders from adopting alternative approaches to forest management. For example, one alternative approach is ecosystem-based forestry, which places less emphasis on timber production and more emphasis on ecosystem function, including the retention of old-growth trees, protection of biodiversity, and cycling of nutrients through decomposition and burning. Put simply, ecosystem-based forestry focuses on what is left behind in the forest, while sustained-yield forestry focuses on what is removed (Plotkin, 2004: 9). Not surprisingly, ecosystem-based forestry produces less timber. If target harvest requirements were relaxed, tenure holders would be better able to meet their own unique goals.

In 2003, British Columbia eliminated target harvest requirements, and other provinces could follow suit. In British Columbia, tenure holders may choose not to harvest without penalty. Any unused portion of AAC cannot

be carried forward to subsequent years, however. Overharvests above the level of the AAC are subject to monetary penalty and reductions in future allowable cutting rates (Dennis McPhail, senior timber-tenures forester, British Columbia Ministry of Forests and Range, personal communication, December 5, 2006).

Since the majority of tenures are held by industrial forestry companies seeking to maximize profits from timber, most tenure holders in British Columbia continue to harvest at the rate of the AAC. Data from 2004 show that the timber harvest was 105% of the AAC that year (Natural Resources Canada, 2006). But alternative tenure holders in British Columbia, such as community forests and native organizations, now have greater flexibility to practice ecosystem-based forestry.

> Recommendations for change

It is clear that Canada's forest management could be much more comprehensive and responsive to the needs of the people and the land. The current bureaucratic management encourages political decisions over scientific ones, allowing special interests to gain greater influence than the local residents who are most affected by forest management decisions. The area-based tenures that have motivated long-term stewardship in the past are becoming more susceptible to government regulations, and the changing needs of communities are not being met by the restrictive tenure system.

Our recommendations for change rely on changing the incentives for land managers. If managers receive the benefits of good stewardship directly—and bear the costs of degradation—then they will take better care of the land. By creating more incentives, we can motivate managers to look after the forest and listen to the desires of the people.

1. Transferring ownership

Private ownership can often result in better resource stewardship than public ownership. Given well-specified private property rights, individuals benefit from the use of their land as well as the increased value of their property, which results from good asset management. Forest owners have incentives to care for their land in the present and the future in order to maximize the benefits they receive, not only from timber, but also from amenity and asset values. As previously discussed, the timber-tenure system is missing, for the most part, the incentives for amenity and land values. Furthermore, many timber tenures, such as volume-based tenures, carry little incentive for stewardship even of timber resources. Private ownership is the only way to fully encourage long-term stewardship of forestland.

In addition, private ownership gives managers the opportunity to decide which forest values are most important. Timber companies may continue to manage primarily for timber production. Others, such as International Paper in the United States, may recognize the value of non-timber forest uses. Forest owners like the Nature Conservancy or Audubon Society could manage for biodiversity and wildlife habitat.

There has been an effort to transfer some of Canada's public lands to private ownership. In British Columbia, a group called British Columbians for Private Forests has proposed that 25% of the province's land be transferred

to private ownership—a significant percentage compared to the current level of 5% (McCarthy and Chittick, 2003). When compared with ownership patterns in other parts of the world, this is not an unreasonable option. Nevertheless, such proposals are often met with public opposition. A recent US proposal to sell off less than 1% of the acreage of publicly-owned forests faced strong opposition and was quickly withdrawn (United States Forest Service, 2006).

Educating the public is one way to gain acceptance of privatization. The signs of poor public management abound, but the private sector has yet to convince the general public that it can provide the good stewardship that is needed. In the meantime, there are additional steps that can be taken to enhance the stewardship of Canadian forestlands.

2. *More secure tenure*

Short of privatization, it would be beneficial to incorporate more elements of private management into Canada's public forest management. As mentioned above, some timber tenures encourage stewardship by incorporating more private property rights than others. A reallocation of cutting rights with a greater emphasis on long-term, renewable, area-based tenures could have positive economic and environmental outcomes. Financially, the provincial governments would be relieved of the burden of management. Instead, management would be the responsibility of the tenure holder, and the government would benefit from reduced costs. Furthermore, research suggests that area-based tenure holders tend to have better environmental practices than volume-based tenure holders (Zhang, 1996).

3. *Eliminate annual timber harvest requirements*

The timber-tenure system could also be improved by eliminating the target harvest levels of the annual allowable cut (AAC). Instead, harvest levels should adhere to the forest plan and be flexible to adapt to changing market and environmental conditions. Tenure holders should be allowed to operate at or below sustainable levels, or to be able to curb insect and disease infestations through timber harvest. This would enable timber managers to respond to changing community needs such as amenity values, water quantity and quality, and economic sustainability. This is already the case in British Columbia, and other provinces could adopt similar policies.

4. *Incorporate non-timber uses into tenures*

Incorporating non-timber forest resources and other forest uses into timber-tenure agreements would help enhance amenity values. Currently, timber tenures generally only grant access to the timber resources on Crown lands, while non-timber resources are addressed through bureaucratic regulations. Under this system, non-timber values are essentially restrictions on tenure rights, instead of potential sources of revenue. If tenure holders could generate income through non-timber forest uses such as recreation, water quality, fish, and wildlife, they would have an incentive to manage for multiple forest outputs. Given transferrable rights, non-timber users could negotiate with timber producers, creating a management system similar to that of International Paper in the United States.

The state of Montana has allowed for similar multiple-use lease options for some state grazing allotments.

When the leases come up for renewal, ranchers can opt to lease rights for grazing, recreation use, and logging, or they can bid on a single use, leaving the remaining rights open to the state or to alternative bidders (Fretwell, 2000: 12).

Ontario has also taken a step in this direction with Resource Stewardship Agreements. These agreements create the opportunity for timber-tenure holders to cooperate with licensed tourism establishments on forest-management issues. Together, the two parties can address issues of road use, viewsheds, and the timing of forest operations to their mutual benefit (Ontario, Ministry of Natural Resources, 2006: 13). Short of granting timber-tenure holders rights to non-timber forest resources, cooperation with other licensees could ensure that management better addresses a range of forest values.

Transferable-use rights are still subject to political manipulation, particularly in the design of parameters that define the lease rights and locations. Nevertheless, they are a feasible option that could induce recognition of the relative values of multiple uses on public lands.

> Conclusion

The public ownership of Canadian forests can sometimes lead to management practices that are guided more by politics than science. Yet, with a few changes, provincial forest policies could be restructured to encourage both economic efficiency and environmental quality. Privatization would be one logical solution, but it faces powerful opposition and is unlikely to become a political reality. The next best path to improving Canadian forest management would be to incorporate more of the incentives found in the private sector, such as a greater emphasis on more secure tenures and property rights. The elimination of annual timber harvesting requirements (AAC) would also improve management, as would the incorporation of non-timber forest resources into tenure rights. Canada, which already has innovative public forest policies, is uniquely positioned to take one step further towards better management.

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Aquaculture Property Rights in Canada

Robin Neill[1]

"We must plant the sea and herd its animals … using the sea as farmers instead of hunters. That is what civilization is all about—farming replacing hunting."
—Jacques Cousteau

Aquaculture (fish farming) has a significant advantage over wild fisheries: it provides the opportunity for farmers to invest in and control the harvesting of a stock of fish. The fish farmer can control feeding and treat diseases to ensure a high quality product, and the harvesting of farmed fish can take place when the fish have reached their optimal age and size. Further, because the farmer owns and physically possesses the fish, he or she can capture the economic benefits of such investment and control, and thus is driven by self-interest to undertake the one and exercise the other.

There are negative externalities associated with (or allegedly associated with) aquaculture, including escapes of diseased or genetically modified fish, local pollution of the ocean bed by heavy accumulation of fish feces, disruption of navigation, and visual pollution of shoreline. But there is also a singular negative externality associated with the wild fisheries: the failure to invest in the breeding and health of the fish that are to be harvested. This externality has been intensified by the race to capture fish before they are gone, a race that has led to the very thing that is feared—extinction of the stock.

The economic cost of collateral damage in fish farming has not been established with general acceptance, and the cost of the depletion of fish stocks has not been established with any precision. However, there can be no doubt that the cost of the singular externality in the wild fisheries is greater by orders of magnitude than the presumed costs of negative environmental impacts associated with fish farming because, on the East Coast and elsewhere, this externality has led to the depletion of whole species to the point of endangerment.

An appropriate set of private property rights for fish farmers would markedly raise efficiency in the production of seafood, while helping to eliminate whatever negative externalities may be associated with their operations. Even a cursory glance at the property rights structure of the two forms of producing seafood (fish farming and fishing in the wild) would indicate this point. A close look confirms it.

1 Some of the material in this presentation is taken in whole or in part from work that the author has done for the Atlantic Institute for Market Studies. The author thanks the Institute for permission to do this.

Fish farming and private property

The principal difference between wild fisheries and aquaculture is that aquaculture is farming, not fishing. With some assistance from hatcheries, wild fish are produced as nature produces coyotes and migratory birds. In contrast, fish farmers cultivate fish for harvest just as farmers produce hogs and beef cattle. As the Canadian Aquaculture Industry Alliance (2006) explains,

> aquaculture is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. The term 'farming' implies intervention in the rearing process to enhance production, such as regular stocking, feeding, and protection from predators … Farmers invest in production systems, manage livestock to optimize productivity, and coordinate sales to earn a return on investment.

Of the many aquatic animal species, only a few have been thoroughly domesticated—principally, carp, catfish, clams, mussels, oysters, salmon, shrimp, striped bass, sturgeon, and trout. Still, domestication of these few species has created the fastest-growing food production sector in the world today.

The livestock raised in aquaculture are recognized in law as the private property of farmers. The means of production—the resource base—is not. Aquaculture has only recently risen to importance in the global economy. The broader property rights conditions of fish farming are still under review, frequently in the face of opposition from those who have vested interests in the relatively declining alternative uses of the resources involved. At present, the rights of fish farmers fall far short of those that have been accorded to and have proved so successful for agricultural farmers, but progress is possible. As Elizabeth Brubaker writes,

> a further evolution could entail outright ownership of fisheries, removing owners' obligation to utilize their resources exclusively as fisheries when conservation, tourism or other uses proved more valuable … Technological advances, by facilitating the enforcement of property rights spur their development. (1995: 212)

In this passage, Brubaker hints at the possible transformation of fishing into fish culture rather than fish capture. She is proposing the privatization of a portion of the water surface, column, and floor so that it may be owned in the way a farmer owns land in pursuit of agriculture. Centuries ago, the time came to turn from nomadic hunting of animals and gathering of plants to settled agriculture. That time has now come for the production of seafood. History and the current problems with the wild fishery point to the eventual granting of full ownership of portions of the sea and inland waters to fish farmers.

Private property and investment

The principal externality of the wild fisheries is that nothing is done to improve the quality of the stock or its appropriateness to the human needs that it serves. All animals and plants can be bred and nurtured to higher standards from the point of view of usefulness to humankind. Fish are not an exception.

Fish farming civilizes[2] the sea. Open-ocean aquaculture, in particular, will reorganize the sea by reducing it to a significant degree to the controlled use to which the great central plains of North America have been reduced. Change of any kind is always difficult, but such a change in the use of the open sea must be especially shocking to anyone who is sensitive to the loss of mankind's natural environment. The concerns of environmentalists are understandable, but a "zero tolerance" stance on fish farming would be a backward and uneconomic policy. As noted above, Brubaker has proposed an alternative policy. She argues that given the correct private property rights, the market will allocate resources most efficiently—that is, to their least costly and most productive uses.[3]

While it is true that the advance of civilization has clearly changed the natural environment, it is also true that changing the environment is necessary to the advance of civilization. To civilize is to shape the raw forces of nature into compatibility with ordered human life. Certainly, there are risks; but science advances by taking risks. Problems arise and problems are overcome.

Many of the externalities associated with fish farming are untrue. For example, the existence of genetically modified "frankenfish" that could threaten the existence of all fish has not been empirically proven. It's still just an allegation. And if it seems that there are more diseases among penned fish, it is because diseases are monitored in the pens, and remedies are applied. The diseases of penned fish exist in wild fish first, but among wild fish they go undetected and untreated. Further, with respect to the charge that a greater weight of wild fish is fed to farmed fish than is harvested from the pens, it should be noted that farm fish do not eat any more fish than do wild fish. Indeed, farmed fish are less damaging in this respect. Much of what they eat is recycled offal from the gutting and filleting of commercially caught wild fish. Additionally, farm fish are trained to eat non-fish nutrients. The simple truth is that aquaculture improves the quality and quantity of product at a lower cost in nutrients (see, for example, Greenberg, 2006, June 18).

Without doubt, fish farming itself may have externalities, but a zero- or low-tolerance approach would be wrong. What is needed is objective analysis on a case-by-case basis.

> The technical advance of aquaculture

Dozens of species of fish are already being domesticated, as cattle and horses were in the past. Most recently yellow tail, red snapper, halibut, and cod have been domesticated, leading to investment in the improvement of the stock. In Tromso, Norway, cod are gathered from the wild and selectively bred to grow faster and at a lower cost in feed per pound of product. These fish are bred, born, raised, and harvested in a controlled environment. They are induced to accept a nutritious diet that includes less and less fish, and are kept from cannibalizing one another as they do in the wild.

2 The word "civilize" is used here as it is in the initial quotation by Jacques Cousteau—that is, in the broader Thorndike-Barnhart dictionary definition: "to bring out of a savage or barbarian condition."

3 Brubaker has documented the unfortunate dissipation of open-access resources under government ownership and regulation in her book, *Property Rights in the Defense of Nature* (1995).

Aquaculture will do for fish food production what scientific breeding and care has done for animal food production. For example, inland fish farms in the United States have succeeded at raising high quality catfish on an entirely non-fish diet. Further, there is no doubt that fish farming has the technical capability to expand beyond the shore line to which it has been largely confined until now.

The Atlantic Marine Aquaculture Center (2008) has established a 30-acre field site, six miles off the coast, where native finfish in submersible cages and native shellfish on submerged long lines are raised. Similar success has been reported from research stations in Hawaii, Puerto Rico, and Scotland. The cages may be anchored or free floating and locatable by transponders. If free floating and tracked by transponders, their operation is something like the grazing of branded cattle on the open prairie. Given the capabilities of global positioning systems and self-positioning, unmanned propeller systems, it is possible to "fence-off" a section of the ocean surface and water column for the exclusive use of a single farmer. All of this is well known (OSF, 2006); unfortunately, some are opposed to the application of this technology in the marketplace.

> Technological advance and property rights

Despite the present rate of technological advance, fish farming will not achieve its potential unless it can operate in a legal environment that is similar to that in which plant and animal farming has had such remarkable success. The land farmer owns his land, his crops, and his stock of animals. It is to his advantage to husband his fields and care for his stock in such a way as to gain the greatest advantage at the lowest cost over his entire planning time horizon, which, with outright ownership, extends to the lives of his descendants. By serving himself in this way, the farmer serves society well. The absence of similar property rights for fish farmers removes not only the motivation, but also the economic feasibility of a similar, generally beneficial result.

Fish farms in the United States endure a legal environment that is not much better than that in Canada. The one great hope of open-ocean fish farming in the United States is its emancipation from the control that state governments have exercised over the traditional three-mile limit. Open-ocean fish farming beyond the three-mile limit could come under exclusive federal jurisdiction, and the narrow, established interests that have dominated state regulation to the detriment of aquaculture could be bypassed.

During its 2005 session, the Alaska State Legislature unanimously passed a resolution opposing offshore aquaculture in federal waters. All the usual objections were raised, and it was claimed that a dramatic increase in fish farming nationwide would likely result in a great decline in the value of Alaska's commercial fisheries. This objection embodied an unabashed attempt to use political means to frustrate the efficient working of the market for fish and punish the rest of the world for the benefit of an increasingly obsolescent local industry. In its opposition to open-ocean aquaculture the Alaska Marine Conservation Council enlisted the support of established interests by referring to possible negative socio-economic impacts on coastal communities and fishing families. It also appealed to powerful environmental lobbies by arousing all the usual fears about collateral damage.

The text of the United States' *National Offshore Aquaculture Act of 2005* detailed the problem. If passed, it would have given the Secretary of Commerce the authority to make areas, known as "exclusive economic zones," available for fish farming to those who met certain terms. Prior to granting the permits, however, the secretary would have had to consult with all relevant interests: the states, the wild fisheries lobbies, boat owners associations, oil companies holding offshore leases, environmentalist's organizations, the Secretary of Defense, the Coast Guard, and all those who hold navigation rights. The document paid little attention to the rights of the applicant farmers. Under this act, the granting of permits would have been determined within 120 days following the application. Sites would have been permitted for a duration of 10 years, but renewable only in five-year increments and at the discretion of the secretary. Beyond this and the requirement that the secretary promulgate all relevant rules and regulations, the act put no binding limitation on what the government could do in the matter of granting and revoking permits. The government would have had to return to the farmer any equipment that it seized in the process of enforcing regulations, but this and the right of the farmer to transfer his permit by sale were the only private property concessions in the act. The principal obligations laid on the secretary pertained to all interested parties other than the farmers. Site placement, monitoring, evaluation, and all other terms of a permit were subject to the discretion of the secretary. Further, Section 7 (f) of the act specified that nothing was to "displace, supersede, limit or modify the jurisdiction, responsibilities or rights of any federal or state agency, or Indian Tribe or Alaska Native organization, under any Federal law or treaty." Perhaps most crippling, the act stated that "the law of the nearest adjacent costal State, now in effect or hereafter adopted, amended, or repealed is declared to be the law of the United States, and shall apply to any offshore aquaculture facility." The bill died in the Senate in the fall of 2006, forestalling any advance it might have facilitated.

> Aquaculture property rights in Canada

In Canada, where the system of aquaculture property rights is of old—even ancient—vintage, there is no general move towards institutionalizing open-ocean fish farming. In 1982, the surge in aquaculture enterprise associated with declining wild fish stocks and the establishment of a national 200-mile exclusive offshore fishing zone prompted a thorough review of property rights in Canadian aquaculture (Wildsmith, 1982). Much of that stocktaking involved tallying the powers of and restraints on government as outlined in the Constitution and judicial interpretation of the Constitution. The tally revealed that many of the jurisdictional problems embedded in the Constitution directly affected aquaculture. Property and civil rights fell under provincial jurisdiction, but jurisdiction over offshore areas, navigable waters, and the offshore fishery belonged to the federal government. At the time the review was conducted, the courts had not yet settled definitively on whether aquaculture was to be treated as fishing or agriculture; as of February 2003, aquaculture still had not acquired a fixed definition in case law. Accordingly, the review concluded, aquaculture would have to remain a matter of joint federal-provincial jurisdiction, and its development would depend on cooperation between the two jurisdictions.

The 1982 review found that the fish farmer's common-law rights included the usual property right to domestic—that is, penned—animals (except in the rare cases where the courts defined fish as a wild animal), but the farmer had no right to the sea bed, the water column, or the water surface. Full property rights to the foreshore—the land between low and high tide—seemed to be a possibility, and in one or two cases the courts recognized prescriptive rights when investments had been made in the absence of a lease or grant from the Crown. Rights down to high tide belonged to the owner of the land adjacent to the water, meaning that the fish farmer did not have the right of unimpeded access unless he also owned the upland. The common-law right of all citizens to fish and navigate on the surface was protected by the courts. Inland, common-law riparian rights were protected up to the middle of the body of water or watercourse, except when, as in Nova Scotia, the province had declared such rights to be inalienably vested in the Crown. In short, the review found that aquaculture, which had recently arrived on the scene, had no recognition in common law except where it conformed to existing activities.

With the exception of a 1928 agreement between Prince Edward Island and the federal government concerning the farming of live oysters and other molluscs, all aquaculture-related laws in Canada were created in the late 1980s. All of them were the product of memorandums of agreement between the federal and provincial governments, and all were intended to ensure the orderly development of aquaculture through "one-stop" licensing and leasing procedures. Still, Peter Underwood of the Nova Scotia Department of Agriculture and Fisheries told a Canadian aquaculture law and policy workshop in February 2003, that, in practice, Nova Scotia was still struggling to establish a one-stop system for leasing and licensing.

All of these agreements are similar in that they provide for the continuance of all laws established before the acts based on the memorandums of agreement. They entrench the coastal rights of upland owners to unobstructed access to adjacent waters, and they ensure passage to previous users by entrenching the strictures of the federal *Navigable Waters Act*. Except in the case of Prince Edward Island, all Canadian laws formally place the process of licensing and leasing under provincial administration, but this largely has to do with paper passing, not decision making. Through the Department of Fisheries and Oceans (DFO), the federal government retains control over the transport and export of fish and the protection of fish health (including the certification of disease-free fish farming), and is responsible for the research and development of culturable species. The DFO also determines whether applications for aquaculture licences and leases will be accepted or rejected. In other words, the federal government has not even alienated aquaculture property rights to the provinces, let alone to individual citizens.

The precise administrative arrangements stemming from the federal-provincial agreements vary in detail from province to province. In New Brunswick, for example, the Department of Fisheries and Aquaculture issues leases in consultation with the DFO. In Newfoundland and Labrador, the Department of the Environment, in its concern with the erection of shoreline facilities, issues permits to occupy Crown lands. In Nova Scotia, an Aquaculture Administrator in the Department of Fisheries, Aquaculture, and Inland Fisheries, in

cooperation with the DFO, reviews applications for licences and leases and arranges for public hearings in the local communities concerned. In every case, licences and leases are limited in terms of size, duration, and the kinds of activities that can be undertaken. In Nova Scotia, for example, sites for mussels are usually 25 hectares in size, while those for oysters are seven hectares. In Prince Edward Island, leases are issued for two to four hectares for harvesting oysters, or for a specifically prescribed size and season. In British Columbia, licences are issued for a 12-month period and are renewable. In accordance with a court decision, all land in British Columbia between the islands and the mainland is considered provincial and can be leased out by the province.

Though there are differences between the provinces' administrative arrangements, in every province, there are incentives, subsidies, and various kinds of assistance that are intended to foster the development of the industry. These arrangements do establish some property rights for harvesters, but they do so almost accidentally and certainly at random.

Hidden behind these administrative arrangements is the most striking aspect of the current status of property rights in Canadian aquaculture: the nature of the relationship between the fish farmer and the government, a relationship that defines the "spirit of the law" governing the industry. The institutionalization of aquaculture in Canada clearly follows a government-dominated administration model. Licences and leases are granted, renewed, altered, and terminated at the discretion of either a politically appointed official or, more frequently, the political head—that is, the minister—of the licensing and leasing department.

Nova Scotia's *Fisheries and Coastal Resources Act* is typical of aquaculture laws in Canada. The act repeatedly uses the phrase "the minister *may*"; it rarely says "the minister *shall*," but it often says "the lessee *shall*" (emphasis added). Both political considerations and common sense would likely direct the minister to act with circumspection in the disposition of licences and leases. Still, the situation is clear: the government acts as the overlord of the resource. No secure property rights are accorded the agent on the ground—the fish farmer.

Even the casual observer would be forced to conclude that, whether deliberately or inadvertently, lawmakers have failed to take into account the question of property rights, the structure of those rights, and their implications for investment in the breeding and care of fish. If the fish farmer had a right to the means of production, exploitation of those means would be in the hands of the agent who is undertaking the risk and the effort and has the strongest interest in the long-term viability of the enterprise. The importance of establishing appropriate private property rights in the industry cannot be overstated.

Government management of resources has been no more efficient in aquaculture than it has been elsewhere. It has failed to establish or enforce the rights of citizens, it has tended to favour special interests, it has had a blinkered concern with short-term economic development, and it has had a bias in favour of administrative solutions (Brubaker, 1995).

> The ideal solution

There are several ways in which private property rights could be established—that is, transferred or alienated

from the public (the government in right of the Crown) to private individuals—in Canadian fish farming. These ways include auction, outright sale, political fiat, and a legislated "free homestead system."

The best of these would be an approximation of the free homestead system that was used to alienate the lands of the central plains (Neill, 2003: 12–16). Governments incur costs by maintaining the legal and economic substructure of an industry. Accordingly, governments have to extract from the profits of industry sufficient revenue to meet these costs. Generally, they do so through corporate profits taxes, personal income taxes, property taxes, and sales taxes. The more prosperous the industry, the greater the return to the government through these taxes. From this point of view, the most efficient structure of property rights in aquaculture would be the one that enabled the greatest economic development—a free homestead system.

Empirical evidence points to the superiority of a prior grant of minimally limited, court-protected property rights that is based on the fulfillment of conditions related to private and social economic development. Much of the great increase in the global production of marine food sources over the past 20 years has been associated with the growth of aquaculture—growth that has taken place largely in countries that have the strongest and best-defined property rights. As Anderson notes with respect to the wild fishery,

> As property rights are strengthened, and assigned to individuals, groups, cooperatives or communities, the effort to gain control takes on a different character. Efforts to reduce costs, increase efficiency, and to produce for the market intensify. Additionally, a longer-term perspective begins to appear. What should we then observe where this is the case? All else constant, we should observe changes in gear/fishing methods and timing of harvest, increased yield, new market development, increased quality, changes in industry structure, investment in productivity enhancing technology, and a tendency toward integration. (2002: 140–142 *passim*)

In fact, this has been the result of the limited introduction of property rights in the form of individual transferable quotas in the wild fishery (Leal, 2005: 6–13). How much more likely is it to be the result if full property rights were awarded in fish farming? With complete control of property, as Elizabeth Brubaker has suggested, self-regulation becomes possible—indeed, economically imperative—and this appears to be the case in practice. In Scotland, for example, where fish-farm leases tend to be larger than in other jurisdictions, fish farmers have practiced something like crop rotation, moving pens from one location to another to restore the health of pen sites.

The free homestead system should not be imported wholesale into the coastal regions or the open-ocean exclusive economic development zone of Canada. In its historical form, that system of granting full property rights assumed that the land was "empty"—that no damage or disutility would be incurred at the moment of the grant, and that there would be no collateral damage from development and no external costs. None of these conditions would be met in the context of contemporary Canadian fish farming. Adopting a free homestead system would not mean opening all of Canada's coastline to anyone who could afford to set up a fish farm. Some external disutilities and the rights of incumbents would

have to be taken into account, and some limitation of ownership of the means of production would be in order. Sites would have to be off limits to aquaculture if they had had alternative uses that economically outweighed aquaculture, or if they were simply unsuitable for aquaculture. The industry itself would have to be protected from hopeless attempts at development. However, such limitations on rights based on usefulness to the whole of society should be embodied in the statutes in such a way as to leave them open to challenge in the courts, where basic rules of equity would be invoked. These rights should not be open to the hazards of media-fed passions in an often dysfunctional political system.

> Conclusion

Fish farms are providing an ever greater portion of the supply that goes to fish markets. While stocks in the wild are being depleted by overfishing, and expansion in the wild fishery is close to non-existent, the output of fish farms is expanding. Two major forces are driving this growth. The first is the demand for food, particularly in the developing world where populations are increasing, but also in the increasingly health-conscious developed world. The second is the application of science to the breeding and care of fish in the developed world. These two forces have come together in Norway and Chile and on the West Pacific Rim. Expertise is exported from the developed world, particularly from North America, to increase the production of seafood in the rest of the world.

North America neither lacks the waters suitable for aquaculture nor the technical know-how to make aquaculture competitive and profitable in the food industry. Rather, it lacks a government policy of development, as well as appropriate ocean space alienation and tenure institutions—that is, it lacks a set of property rights that will bring fish farming into the realm of normal, modern market activity. North America needs to follow Chile's example by granting explicit, court-enforceable property rights to holders of licences and sites.

Aquaculture will continue its rapid advance, even in North America. Technological advances and global market forces are driving its development and will continue to drive it in the future. However, without the introduction of property rights, called for by Elizabeth Brubaker over a decade ago, "fencing the seas" will take place only outside North American waters.

Fish farming is still an emerging industry. It is still not certain what the give and take of policy, law, and interpretation by the courts will produce as its legal framework, or, indeed, what its most efficient legal framework would be. Still, it is clear that the general direction of the industry's institutional evolution should be towards the creation of an appropriately articulated free homestead system of private property rights, failing which the following approximations would be in order:

- Fish farmers should have sufficiently secure leases and licences for lending agencies to support investment in water quality, equipment, and the breeding and health of fish stocks. For example, the federal government could auction off 99-year leases over the ocean surface and water column, building in appropriate conditions for environmental conservation.

- The government's interaction with fish farming should be separated from its involvement in the wild fisheries. A separate, specialized and expert fish farming agency would be best. Alternatively, fish farming could be removed from the jurisdiction of the Department of Fisheries and Oceans and put under an independent agency within the Department of Agriculture.

- Politically biased policies should be replaced with rules of operations that are based on objective cost-benefit analyses. As the Commissioner for Aquaculture has stated (OCAD, 2001), at the very least, the precautionary principle that no action should be taken when there is risk of any harm whatsoever should be abandoned. Mistakes will be made, but they will also be corrected. This is an inevitable, healthy part of an emerging enterprise. The alternative is slow progress at best, and outright stagnation and obsolescence at worst.

Aquaculture does have external effects that impinge on alternative uses of its resources. But as Elizabeth Brubaker (1995) has shown, there is every reason to believe that fish farming will make a large positive contribution to society, and that the environment will be better protected under a suitable private property regime.

A breath of fresh Air

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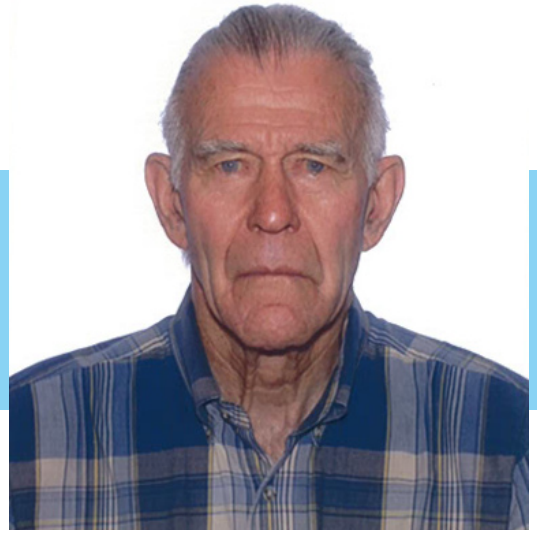

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Can America Teach Canada How To Protect Endangered Species?

Dean Lueck[1]

In addition to an 8,891 kilometre border, Canada and the United States share the ecosystems and biodiversity of North America,[2] and both have legal and political systems with English roots. These shared institutions and ecologies have also—and not surprisingly—led to common systems of wildlife management.[3] Until recently, both American and Canadian federal government involvement was limited to managing wildlife on federal or Crown lands and to species covered by treaties (e.g., migratory waterfowl, fur seals). Concerns about extinction and biodiversity conservation, however, have increased federal involvement, and this is where America and Canada have gone their separate ways.

In the United States, the federal government has enforced the *Endangered Species Act* of 1973 (ESA) for over three decades, but Canada's analogous law—the *Species at Risk Act* of 2003 (SARA)—is relatively new (see Canada, no date a). The ESA, now institutionally settled, offers lessons for Canada on how to design an effective and efficient endangered species policy. The most important lesson is that laws, especially complex and vague laws like the ESA, tend to have many unintended consequences that result from a transformation of the incentives of those governed by the new law. The American ESA is a case study in incentive shifting and interest group jockeying, which does not always lead to the protection of species, and may even lead to a reduction in the habitats for and populations of endangered species.

> The American experience: Endangered species and the ESA[4]

Prior to the enactment of the ESA, federal policy in the United States authorized the Secretary of Interior,

1 Research support was provided by the Cardon Endowment for Agricultural and Resource Economics at the University of Arizona. I received helpful comments from several reviewers.

2 The terrestrial boundary (including small portions of maritime boundaries on the Atlantic, Pacific, and Arctic coasts, as well as the Great Lakes) is 8,891 kilometres (5,522 miles) long, including 2,477 kilometres (1,539 miles) that are shared with Alaska. The term biodiversity was coined in the mid-1980s and has since become standard vocabulary. It has been a major focus of conservation policy since the United Nations Convention on Biological Diversity in Rio de Janeiro in 1992 (Jeffries, 1997).

3 In 1916, Canada and the United States signed a treaty to jointly protect and manage migratory birds.

4 For a history of the ESA and related laws, see Bean (1983) and Thompson (1997, 2005).

through the Fish and Wildlife Service (FWS),[5] to "list" species considered to be in peril and to foster protection by banning the "taking" or killing of such species, prohibiting trade of endangered species, encouraging federal agencies to protect habitat, and establishing a federal fund for habitat acquisition. The ESA broadened and deepened this policy. It expanded protection to a much larger set of species and populations, including invertebrates and plants. It broadly defined "take" to (ultimately) include the alteration of a species' habitat (see Thompson, 1997, 2005, for additional information), and it extended federal species protection to private lands. The ESA had minimal impact during its first five years, partly because the full force of the act's language was not clear in the law. Beginning in 1978, a series of federal court decisions and administrative rulings[6] transformed the ESA into the most authoritative and wide-reaching federal environmental law. By the mid-1980s, a combination of administrative and court rulings combined to make habitat modification a violation of the ESA.[7] Thus, under the ESA, it is not only illegal to destroy an endangered species, but it is also illegal to damage their habitat.[8]

Pay-to-protect or lock-in habitat

Species conservation policy exists in two basic forms.[9] The first is the ESA approach, which utilizes land use restrictions in an attempt to lock in existing habitat and penalize landowners for adverse alterations.[10] The second method, used before the ESA and for species not governed by the ESA, is a pay-to-protect program through which landowners (and other rights holders) are compensated for habitat provision. A pay-to-protect system does little to change the basic system of rights to land. The ESA, however, substantially alters the system of property rights and the incentives for environmentalists, private landowners, the FWS, and public land agencies.[11]

Environmentalists: claiming rights to land

For environmentalists, the ESA offers a mechanism through which to affect land use by changing public-land policy, halting private development, and eliminating what may be seen as pork barrel subsidies that allow certain public agencies to thrive at the expense of

5 The National Marine Fisheries Service administers the ESA for marine species.

6 In *Tennessee Valley Authority v. Hill*, the United States Supreme Court ultimately gave its famous mandate: "The plain intent of the statute was to halt and reverse the trend toward species extinction, whatever the cost."

7 This policy was further solidified by the Supreme Court in 1995 in *Babbitt v. Sweet Home Communities for a Greater Oregon*.

8 Thompson (2005) notes, however, that the modification of a "potential habitat" is not forbidden, and under section 10, permits can be granted to take species and thus allow some development.

9 Though there are two forms, all such programs prohibit the outright killing of protected species and often limit market transactions in their products (e.g., hides and feathers).

10 British Columbia's Agricultural Land Reserve is also a regulatory lock-in system.

11 Private conservation organizations such as the Nature Conservancy also use pay-to-protect methods. The predator compensation programs of Defenders of Wildlife, while not explicitly focusing on habitat, also compensate private parties for contributing to endangered species successes (The Biodiversity Partnership, 2006).

environmental quality.[12] Environmentalists can force the FWS to act by showing that federal agencies or private land use harms listed species. They can also encourage the listing of new species that inhabit land having an existing or planned land use that environmentalists desire to change. Environmentalists have successfully used the citizen lawsuit provision to invoke and strengthen the ESA,[13] and have forced federal agencies[14] to alter their land management in order to comply with the ESA. In the process, millions of acres of federal land have been managed as de facto refuges for listed species. Litigation has also expanded federal authority over interests formerly governed by the states and has broadened the definition of take. One strategy of the environmentalists is to use lawsuits to force the listing of species that are widely distributed geographically, so that the ESA's regulatory authority can be extended over enormous expanses of land, both public and private.[15]

Landowners: reclaiming rights to land

Landowners, who typically face the costs of ESA regulations, have several means by which they can frustrate the implementation, and even the intentions, of the ESA, as well as the efforts of the environmentalists. First, if the species is already present, but unknown to the FWS, they may secretly (and illegally) kill all listed species inhabiting their property, thus cleansing the land and rendering ESA regulations obsolete.[16] Second, if the species is not yet present but the potential for inhabitancy is high, landowners may alter or even destroy habitat in order to preempt the ESA's regulations. Preemptive habitat destruction might be active (e.g., bulldozing junipers that provide habitat for endangered warblers) or passive (e.g., stopping understory burning which would maintain pine forest habitat for endangered woodpeckers). Such preemption not only removes the potential for costly regulations, but it also reduces the habitat for the

12 One study suggests that this and related government subsidies have had a substantial impact on endangering species (see Opperman, 1996).

13 Rohlf (1988) found that, by 1988, there had been over 40 federal cases. The *Environmental Law Reporter* (various issues) has reported that, between 1973 and 1998, 24 cases reached the Supreme Court, 360 reached a federal appellate court, and 488 reached a federal district court.

14 These agencies include the Bureau of Reclamation, the Corps of Engineers, the Forest Service (USFS), the Bureau of Land Management (BLM), the Park Service, and the military.

15 The listing of the northern spotted owl (*Strix occidentalist*) is perhaps the environmentalists' greatest success thus far. The owl inhabits the old-growth conifers of the Pacific Northwest from northern California to British Columbia, and requires a home range of 1,000 to 8,000 acres. After a series of lawsuits in the 1980s and 1990s, nearly 11 million acres of federal land in California, Oregon, and Washington were determined to be critical habitat and are now off-limits to logging. This acreage represents a substantial fraction (as much as 50 percent in Oregon and Washington) of public forests in these three states. By invoking the ESA (and related environmental legislation), environmentalists have dramatically altered the use of public forestland in these states. The caurina subspecies of the northern spotted owl is also listed as an endangered species in Canada under SARA. British Columbia has roughly 100 breading pairs. See Canada (no date b) for additional information.

16 The compensation program of Defenders of Wildlife was established to mitigate this sort of behaviour among ranchers faced with depredation of livestock by bears and wolves (Defenders of Wildlife, no date). The Sand County Foundation (2006) also has a landowner incentive program called the Leopold Stewardship Fund. Similarly, Environmental Defense has the Back from the Brink Program. See Environmental Defense Fund (2006) for additional information.

endangered species. On public land, the ESA creates different incentives because land managers and land users do not have the effective control over land use that the private landowner has. In this case, a political battle over land use is likely to emerge, and may be quite costly.

The possibility of preemptive habitat destruction has been documented through anecdotes and case studies[17] by many students of the ESA, including biologists, bureaucrats, economists, environmentalists, and lawyers.[18] In Texas, landowners have cleared and overgrazed juniper habitats for the golden-cheeked warbler and the black-capped vireo. Forest owners clear-cut old growth Douglas fir stands in the Pacific Northwest in order to avoid logging restrictions that are designed to protect the northern spotted owl. Farmers in California have switched crops in order to eliminate habitats for kangaroo rats. In its 1996 *Developer's Guide to Endangered Species Regulation*, the National Association of Home Builders actually advised preemption: "[T]he highest level of assurance that a property owner will not face an ESA issue is to maintain the property in a condition such that protected species cannot occupy the property … This is referred to as the scorched earth technique" (Craftsman, 1996: 109). The evidence of preemption is strongest for the red-cockaded woodpecker, a non-migratory, territorial species that resides exclusively in longleaf pine ecosystems ranging from Virginia to Arkansas. Dean Lueck and Jeffrey A. Michael (2003) found that an increase in the proximity of a plot to red-cockaded woodpeckers increases the probability that the plot will be harvested and decreases the age at which the forest is harvested.[19] They found that out of 960,000 total pine acres in North Carolina, between 12,000 and 70,000 additional acres were harvested between 1984 and 1990 because of the potential effects of ESA regulations. In the summer of 2006, when the FWS announced that additional critical habitat (subject to ESA timber harvesting restrictions) would be imposed on landowners in Boiling Lakes, North Carolina, landowners predictably—and frantically—clear-cut land to avoid potentially costly restrictions (see, for example, Rawlins, 2006, Aug. 7).

In the public sphere, landowners may form interest groups and lobby for changes to the ESA or its implementation by the FWS. Groups such as the American Farm Bureau Federation and the Forest Products Association champion the causes of landowners impacted by the ESA.[20] The political pressures that emerged because the preemption incentives inherent in the ESA led to

17 See Thompson (1997), Wilcove et al. (1996), Mann and Plummer (1995), and Goble, Scott, and Davis (2005: 239, 257).

18 The idea of preemption in the face of pending costly regulations (e.g., getting development permits before fees rise, or making income and investment decisions before tax laws change) is well known among economists and legal scholars. See Dana (1995) for a study of preemption and natural resources.

19 They used a detailed set of data on forest ownership and management coupled with detailed data on the location of known colonies of RCWs to examine how the potential for ESA regulation affects the probability that a particular forest plot will be harvested. Their study also controlled for other economic factors such as timber prices and stand quality. List, Margolis, and Osgood (2007) also found similar preemptive effects for desert habitat of the pygmy owl in Arizona.

20 This property rights movement gained supporters in the Republican-led 104th Congress in 1994. It generated numerous bills to amend the ESA as well as anti-takings bills that would require

the development of new policies that were designed to mitigate these effects (see Thompson, 2005). One of the key environmental groups responsible for these policy changes was Environmental Defense (formerly the Environmental Defense Fund), which was responsible for making these incentives known to the environmental community and the public (Wilcove et al., 1995).

In 1995, the FWS established "safe harbor agreements" (SFAs) between private landowners and the FWS. Under these agreements, the FWS promises not to prosecute a landowner for taking an endangered species, so long as the landowner maintains a baseline population on his property. This allows the landowner to develop parts of his land as long as other parts of the land are enhanced enough to maintain the population. In this way, SFAs do not create an incentive to preemptively destroy habitat. By 2006 more than 325 landowners had enrolled over 3.6 million acres in 17 states in 32 safe harbor agreements.[21] But as Thompson (2005: 121–22) notes, SFAs only remove the landowner's disincentive, but do not reward them for preserving or enhancing habitat.

Candidate conservation agreements (CCAs) are a related policy tool, designed to prevent an ESA listing from occurring at all. CCAs are agreements between the FWS and other parties (private and public) to develop a plan to enhance species with the goal of avoiding a listing and the regulatory burden that accompanies it. Thompson (2005: 123) reports that there were 110 CCAs as of November 1, 2003.

> The ESA's spotty recovery record

Economists would like to see the ESA's record assessed by comparing the benefits of conserving species with the costs of doing so. However, this daunting task has not been even partially attempted. To calculate the benefits, one would have to determine the value "consumers" (i.e., citizens) place on reducing the probability of extinction or maintaining a certain level of species diversity and the associated natural environments. Because market data would generally not be available, such a study would have to rely on contingent valuation estimates which are controversial even among economists. To calculate costs, one would have to tally up the explicit resource costs of implementing and enforcing the ESA, and monitoring populations, as well as the implicit opportunity costs of land uses that are forgone because of the ESA's regulatory reach. However, the data requirements would be substantial—even for a single species. For these reasons, there are no cost-benefit studies of the ESA or even of a single species governed by the ESA.

In lieu of this there are a few studies that offer limited but important insights. As noted above, there are studies of the incentive effects inherent in the ESA (e.g., Brown and Shogren, 1998; Innes, Polasky, and Tschirahart, 1998; Lueck and Michael, 2003). There are also studies that examine the behaviour of the Fish and Wildlife Service. For example, a study by Amy Whritenour Ando (2000) found that listing decisions depend on the power of interest groups affected by the potential decisions. In another study, Andrew Metrick and Martin L. Weitzman (1998) found that FWS listing and expenditure behaviour depends on the animal's size (i.e., the

compensation to landowners if some portion of land value were lost. None of these bills became law though as of February 2007.

21 For additional information, see the FWS web site at http://www.fws.gov/endangered/ and FWS (2004).

actual length of an individual member of the species) and its taxonomic type (e.g., mammals and birds fare better than reptile and amphibians)—not on a measure of "endangerment."[22] Metrick and Weitzman conclude that the FWS spends its resources disproportionately on "charismatic megafauna," rather than on a program that would maximize biodiversity.

One way to assess the ESA is to examine its record on species recovery and how it compares to non-ESA conservation policies. Many of the American species that were driven to distressingly low numbers in the late nineteenth century have now recovered.[23] For example, the population of the whitetail deer fell to just 500,000 by 1890. But now that there are an estimated 15-25 million of these deer, they are often considered a pest. The pronghorn antelope, present in large numbers throughout the Great Plains during the Lewis and Clark Expedition, had been reduced to just over 25,000 by the 1920s. Forty years later, its population had increased more than 10-fold in both the United States (365,160) and Canada, and is approaching 500,000 in North America today.[24] Similar recoveries have occurred for bison, bighorn sheep, and elk. The bluebird, turkey, and wood duck have all experienced population recoveries at least as dramatic as the big game species noted above.

For all of these cases of recovery, similar forces were at work. Season closures for hunting and fishing were enforced and game trade was restricted. Habitat was often enhanced through refuges, especially for migratory waterfowl. Animals were captured in the wild and reared in captivity before being transplanted to extinct or depleted areas. The cooperation of private landowners to develop and protect habitat was important. For example, conservation groups built nesting boxes for wood ducks and bluebirds on private land. In most cases, well-defined species-focused interest groups, such as Ducks Unlimited and the National Wild Turkey Federation, have helped steer restoration by raising revenue and negotiating with wildlife agencies and landowners.

ESA-based recoveries are not as dramatic as those mentioned above. Of the more than 1,200 domestic species that have been listed as endangered or threatened, only 40 had been "delisted" as of September 2006 (FWS, no date a). Of these, nine were extinct and 16 were delisted because of "data error," meaning that the original listing was based on mistaken population estimates. The remaining 15 species were considered "recovered," but there is debate over the ESA's involvement in their recovery. More specially, as of September 2006, 243 species of mammals, birds, and fish were listed, and only 18 of these had been delisted. Of these, seven were recovered, seven were extinct, and four were cases of data error.

One study (Gordon et al., 1997) that examined FWS reports contends that none of these recoveries were the

22 The authors used a measure of endangerment published by the Nature Conservancy.

23 In Canada, wildlife populations generally did not decline as much because the populations were more isolated and there was much less demand to change habitat.

24 See Gorog (1999) and similar sources. The Canadian pronghorn antelope populations have been much smaller than those in the United States (they are limited to the southern reaches of Alberta and Saskatchewan), currently ranging from 20,000 to 30,000. See Alberta (2002).

result of the ESA.[25] For example, the improving status of the bald eagle is now mostly attributed to the ban on DDT and enforcement against poaching, neither of which are unique, ESA-based policies. The point here is not that the bald eagle did not recover under the ESA, but that the conservation policies unique to the ESA were not critical in the recovery. The bald eagle recovered under policies used before the ESA—namely, restrictions on killing the eagles and the prohibition of toxic pesticides. Habitat maintenance was not particularly important.

Thus far, the ESA's success record is still quite limited in comparison to the restorations that have occurred without the ESA. Few dramatic species recoveries can be claimed to be the result of the ESA. For example, the red-cockaded woodpecker, which has been listed for 35 years, has had declining populations for much of this period. Perhaps the two most successful recoveries are the grizzly bear and the grey wolf which have both experienced increasing populations (particularly the wolf).[26] Here population increases seem to be the result of restrictions on hunting (a pre-ESA tool, as noted below) and land-use changes on public lands that provide key habitat. Both of these species are thriving in Canada and Alaska, so from a global biodiversity perspective, the rather large expenditures on these two species may not be cost-effective. Furthermore, in both of these cases, the Defenders of Wildlife's compensation program may have been important in terms of mitigating land and stock-owner opposition and preemptive action, thus limiting some of the ESA's counter-productive incentives.

Wildlife restoration policy before the ESA used season closures and game trade restrictions to limit open access killing. Moreover, it used pay-to-protect methods to enhance wildlife habitat, by either purchasing or leasing land for refuges. Unlike the regulations that are part of the ESA, landowners were never penalized for altering habitat. As a result, the preemption incentive did not exist. Under the ESA, a prohibition on taking is equivalent to a season closure, a pre-ESA approach to wildlife management. But the ESA's broad definition of take, which includes harming a habitat, creates a crucial difference between the two approaches. Because of this definition, the ESA creates incentives for preemption and limits the potential for using the land market to allocate habitat. The main distinction between the two approaches is how each alters the incentives of landowners to provide and enhance habitat. Under a pre-ESA policy, a landowner has an incentive to provide and enhance habitat. Under the ESA, the landowner has an incentive to eliminate habitat. Thus, the ESA is expected to be most successful where habitat development is not important, or where the landowner's ability to manipulate habitat is limited.

> American lessons for Canada

The American experience with three decades of the *Endangered Species Act* offers some lessons for Canada and its fledgling *Species at Risk Act*.

25 Gordon et al. (1997) used FWS biannual reports, annual species spending reports, individual species recovery plans, and all *Federal Register* notices to delist or reclassify species.

26 The Aleutian Canada goose also had a dramatic recovery once hunting was curtailed and an introduced predator was removed. See *Federal Register* (2001).

Lesson 1: Laws are likely to evolve over time in unintended ways and may lead to counter-productive incentives.

In 1973, the ESA had the nearly unanimous support of the Congress and the President, yet it has become one of the most controversial environmental laws in the United States. Because administrative agencies and courts tend to have great discretion to shape and enforce laws, legislation can evolve in directions not foreseen by the architects of the legislation. More specific legislation can limit these unintended consequences.

Lesson 2: The incentives of landowners are important because they have many margins over which they can avoid or frustrate laws that penalize them for habitat alteration.

Specific attention to the incentives of landowners, both private and public, is crucial to understanding the performance of various wildlife preservation policies. Policies that do not punish landowners and those that compensate landowners for providing habitat and protecting species can be effective species protection tools.

Lesson 3: The incentives of environmentalists, agencies, and other groups are important to shaping the implementation of endangered species policy.

The ESA has created incentives for environmental groups to litigate in order to change land use on public lands. From a societal perspective, this is a costly way to affect habitat and species conservation.

Lesson 4: Interest groups will form and will be resistant to changes in species conservation policies and institutions.

Many interest groups have formed in response to the ESA's evolving incentives. Since Congressional authorization for the ESA expired in 1992, there has been political gridlock. It is important to make conservation incentives part of the initial legislation.

Lesson 5: Voluntary pay-to-protect policies are often more effective than regulatory policies.

The purchase of habitat and the use of conservation easements offer alternatives that do not punish landowners, but force conservation groups and agencies to face the opportunity costs of protecting specific habitats and species.

Lesson 6: Private groups can play a large role in recovering species and creating incentives to conserve species.

Because these groups can harness the energy of committed members and can work directly with landowners, they can often accomplish conservation goals relatively inexpensively and avoid counterproductive incentives.

> The Canadian SARA and the American ESA

The *Species at Risk Act* (SARA), which became law in 2003, has features similar to and different from the American ESA. SARA, like the ESA, establishes

a scientific committee[27] to create a list of protected (threatened, endangered, or extirpated) species. The Canadian Wildlife Service (part of Environment Canada) is charged with administering and enforcing SARA (see Canadian Wildlife Service, 2005, for additional information). SARA prohibits the killing or harming of these species, designates critical habitat, and develops recovery plans, as the ESA does. A key distinction between the ESA and the SARA relates to jurisdiction. While the ESA applies to all land in the United States, including private land, SARA applies mostly to federal land and has limited application on private lands.[28] SARA authorizes the Canadian Wildlife Service to compensate parties that are adversely affected by endangered species conservation policies; the ESA does not offer such compensation. The available evidence, however, indicates that compensation often has not been utilized and that additional use could be developed, perhaps on a regional or provincial basis, as a policy experiment.

Canadians may believe that the United States has been more progressive in its endangered species policy, but it is important to note the differences between the two countries. The United States is far more populous and more densely populated, and a much larger share of its land has been converted into farmland, commercial forests, and urban land uses (see table 1).[29] As such, Canada simply has not experienced the same pressure on wild populations. As a result, there has been less urgency to create institutions for species conservation in Canada. For example, wolves, grizzly bears, and bald eagles are still relatively abundant in Canada (and Alaska), but have been endangered (in both law and fact) in the lower-48 states for decades.

> Conclusion

Canadians are often skeptical of Americans and American policy. When it comes to endangered species policy, some skepticism is well-founded. The ESA has been a costly experiment that has had limited success at recovering endangered species. While there are no definitive studies which show that the net benefits have been negative, the existing evidence suggests that the structure of the ESA could be changed to encourage private landowner conservation and limit costly litigation and related political battles. In Canada, SARA, as it has currently evolved, seems to be more cognizant of providing incentives for conserving species and of the costs of doing so. Yet SARA is still vague enough that it could easily evolve—under the force of administrative discretion and litigation—into something similar to the ESA which is rife with counterproductive incentives.

Canada has the chance to learn from the United States before its conservation institutions are locked in by interest group politics. Indeed, Canada has the opportunity to be more innovative and to create incen-

27 The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was established in 1977. See the COSEWIC web site at http://www.cosewic.gc.ca/eng/sct6/index_e.cfm for additional information.

28 On private land, SARA applies to aquatic species, migratory birds, and to other species in special circumstances.

29 As table 1 shows, the fraction of private land in Canada is also relatively small compared to the United States, making public land management relatively more important.

tives that encourage species and habitat protection.[30] Because SARA is young and interest groups are not fully entrenched, SARA could be clarified in a way that would create positive incentives. In particular, compensation policies for private landowners and rights holders on Crown lands could be implemented, and SARA jurisdiction over private lands could be clarified so that agencies and groups have a limited incentive to engage in costly litigation. If this can be done then more conservation efforts can be realized through voluntary transactions, which can reduce costs and avoid counterproductive behaviour.

The basic problem inherent in wildlife conservation is the difficulty of establishing property rights to wild populations and their habitat. Because it is costly to coordinate the actions of various landowners, both private and public, who provide habitat, wild populations are often managed as open-access resources, leading to overexploitation (through hunting, fishing, or trapping) and the destruction of habitat. The challenge ahead is to design institutions that capture the net benefits of preserving wild population and provide the right incentives to landowners, land users, environmentalists, industry, and governments. At this point, Canada seems to be ahead of the United States. To remain ahead, Canadians should exploit their skepticism towards the United States as they consider how best to conserve and protect their species at risk.

30 Canada tends to have better-defined use rights for Crown lands than the United States has for its federal lands. This can lead to fewer political battles over land-use changes.

A breath of fresh Air

Table 1: Endangered species in Canada and the United States

	Canada	United States
General characteristics		
Area in square kilometers (acres)	9,984,670 sq km	9,631,420 sq km
Population in 2006 (density per sq. km)	33,098,932 (3.32)	298,444,215 (30.99)
Percent of land owned by government	89%	28.8%
Percent of land used as farmland	6.76%	20%
Endangered species legislation		
Primary federal law	*Species at Risk Act* (2003)	*Endangered Species Act* (1973)
Jurisdiction	Federal land, limited private land	All land
Listing process	Yes	Yes
Killing prohibited	Yes	Yes
Critical habitat protection	Yes	Yes
Compensation authorized	Yes	No
Endangered species		
Number of listed endangered species	529 (339 animals, 190 plants)	1,310 (566 animals, 744 plants)
Grey wolf population	50,000–60,000	4,816 (10,000 in Alaska)
Brown/grizzly bear population	22,000	1,110 (30,000 in Alaska)
Bald eagle population	60,000	20,000 (40,000 in Alaska)

Sources: Central Intelligence Agency (no date), Neimanis (no date), Republican Study Committee (2005), Statistics Canada (no date), Lubowski et al. (2006), FWS (no date a), Wolf Song of Alaska (no date), The Wild Ones (2000), FWS (no date b), International Wolf Center (no date), Canada (no date a), American Eagle Foundation (no date), and Fish and Wildlife Service, Division of Migratory Bird Management (no date).

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A breath of fresh Air

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Free-Market Environmentalism

Lessons from the United States

John C. Downen, Walker Asserson, Kevin Kimura, Emily Sands, Jessica Van Parys, & John Baden

Introduction

Though we are heartened by the growth of environmental consciousness in America, we recognize that it does not necessarily reflect an increase in the sophistication or success of environmental policies. Assessing the maturation of the environmental movement generates two important questions: to what extent has the American environmental movement learned about itself in its first two decades? And what can Canada learn from the United States' environmental growing pains?

The first 20 years of the American environmental movement witnessed the continuation of a progressive era central planning approach to environmental issues. This model, advocated by the young environmental movement and implemented during the 1970s and 1980s, was predicated on a flawed axiom: self-interest inevitably clashes with the interest of society. Conventional policy approaches proceeded from the assumption that markets fail to address environmental concerns. Rather than advocate for the redesign of institutions to align interests and produce mutually beneficial outcomes, environmentalists called for strong government action to curb man's destructive tendencies (for example, see Sale, 1993: 29–45).

Government intervention may be called for when market activities impact environmental quality. Yet there is no end to the range of private activities that generate environmental effects, and centralized regulatory agencies are ill-equipped to handle the complex ecological effects of economic activity. Too often governments have adopted a one-size-fits-all approach to environmental legislation, neglecting differences among diverse ecosystems and ignoring local knowledge.[1] As Harvard law professor Richard Stewart (1988: 154) notes, "the system has grown to the point where it amounts to nothing less than a massive effort at Soviet-style planning of the economy to achieve environmental goals."

In the last 15 years, however, "green" policies have benefited from two improvements in institutional design: capturing time- and place-specific information and creating incentives to improve environmental quality. Free-market environmentalism (FME) addresses this and recognizes that continued progress requires implementing superior social and institutional arrangements founded on (1) institutions, including private property rights, that create incentives for people to act responsibly; (2) prices

1 For example, the *Clean Air Act* mandated the installation of scrubbers on smokestacks to curb the release of sulphur dioxide. This policy ignored the availability of other technologies, the varying costs of different means to reduce emissions, and the success of existing state policies.

that more accurately reflect all costs, including environmental costs; and (3) a recognition that while markets coordinate wonderfully, they sometimes ignore that which is intangible and often lead people to destroy that which has no price and no owner.

> Free-market environmentalism

The intellectual roots of FME are found in the work of Nobel economics laureates F.A. Hayek (1945), James Buchanan (Buchanan and Tullock, 1962), and Douglass North (North and Thomas, 1970, 1973). Their work demonstrates why centralized, bureaucratic management often fails and why institutional arrangements, such as secure and transferable property rights, are important. Central planners lack sufficient knowledge and are motivated by their own self-interest as much as, or more than, the public interest. As North and Thomas point out, "the nature of existing economic institutions channels the behaviour of individuals within the system" (1970: 5). Bad governmental policies often exist because, unlike private decision makers, public officials are not rewarded for efficiency or punished for waste. Lacking price signals, public officials rarely have the necessary information to plan complex systems and allocate resources. As Larry Ruff (1970) observes,

> the socialist manager of the brick-cement plant, told to maximize output given the resources at his disposal, will use the People's Air to dispose of the People's Wastes; to do otherwise would be to violate his instructions. And if instructed to avoid pollution "when possible," he does not know what to do: how can he decide whether more brick or cleaner air is more important for building socialism? The capitalist manager is in exactly the same situation. Without prices to convey the needed information, he does not know what action is in the public interest, and certainly would have no incentive to act correctly even if he did know.

In sum, prices are necessary for environmentally sensitive planning, but prices alone are not sufficient. North and Thomas outline the solution: "Efficient organization entails the establishment of institutional arrangements and property rights that create an incentive to channel individual economic effort into activities that bring the private rate of return close to the social rate of return" (1973: 1). In "The Problem of Social Cost," Ronald Coase (1960) showed how well-defined and enforced property rights can lead to non-regulatory, common-law solutions to environmental problems. More recently, Jonathan Adler (2000) described the role of property rights in creating effective FME solutions:

> For incentives to work, the property right to a resource must be definable, defendable, and divestible. Owners must be free to transfer their property rights to others at will. Even someone indifferent or hostile to environmental protection has an incentive to take environmental concerns into account, because despoiling the resource may reduce its value in the eyes of potential buyers. The role of government is to protect property rights for environmental resources and secure the voluntary agreements property owners contract to carry out. Moreover, FME advocates insist on the application of common law liability rules

to environmental harms, such as polluting a neighbor's property, to protect property rights and to provide additional incentives for good stewardship. To harm someone's property by polluting it is no more acceptable than vandalizing it.

Terry Anderson and Donald Leal's *Free Market Environmentalism* (2001) has been quite influential in this field. Building on John Baden and Richard Stroup's *Bureaucracy vs. Environment: The Environmental Costs of Bureaucratic Governance* (1981), *Free Market Environmentalism* applies the principles put forth by Hayek, Buchanan, North, and others to environmental issues. Anderson and Leal are with the Property and Environment Research Center (PERC; formerly the Political Economy Research Center) in Bozeman, Montana, which was founded in 1980 by John Baden and Richard Stroup. The free-market environmentalism flag was quickly taken up by other think tanks like the Competitive Enterprise Institute and the Cato Institute. For example, the second issue of *The Cato Journal* (Fall 1981) featured no less than six articles on environmental topics.

Free-market environmentalism is a broad movement, encompassing calls for the divestiture of many public lands, including national forests, and calls for the use of market mechanisms like tradable emission quotas with limits set by government regulators. It seeks to encourage stewardship of environmental assets and discourage shifting or imposing costs, like pollution, onto others. Its focus is more on achieving outcomes than on regulating inputs. In general, the FME approach involves harnessing the incentives provided by private resource ownership to foster environmental progress.

> FME vs. the green progressive approach

The progressive movement in the United States originated in the late nineteenth and early twentieth centuries. Concerned by the perceived excesses of unbridled capitalism, it was largely guided by utilitarianism; it strove to achieve the greatest good for the greatest number of people for the longest time. Progressives believed that efficient results could be achieved through the application of scientific, centralized management. For example, the first chief of the United States Forest Service, Gifford Pinchot, along with President Theodore Roosevelt, believed that government agencies could advance conservation with efficiency and justice.

Through the early and mid-twentieth century, the United States continued its rapid industrialization and urbanization (which was slowed in the 1930s by the Great Depression). This, in conjunction with the passage of statutes overriding common law, led to serious environmental harm. Early on, environmental issues split into those of "romance" (national parks and forests, wildlife, etc.) and "sludge" (e.g., air and water quality). While romance issues such as natural resource management became the domain of federal control, environmental quality was managed through common law and state statutes (see, for example, Adler, 2002), which often imposed severe penalties on those who polluted their neighbours. With increasing prosperity, the demand for environmental protection grew (Coursey, 1992).

On April 22, 1970, federal politicians got the message when the United States celebrated the first Earth Day. It was then that politicians recognized the power of the budding environmental or "green" movement

and how linking to it would improve their political fortunes. Many in the United States consider this to be the birth of the modern environmental movement. Based upon the progressive model of natural resource management, the green approach fostered early environmental improvements. Congress passed several landmark pieces of legislation, including the *Clean Air Act* (1970), *Endangered Species Act* (1973), and *Clean Water Act* (1977). As a result, we have cleaner air and water, and people—especially young people—are more environmentally sensitive.

There are, however, three basic problems with the progressive ideal. First, it ignores the political context and realities of a centralized professional bureaucracy in an open and complex democratic structure. Second, it assumes that, over time, such organizations will remain true to their founding ideals. Third, it assumes that scientific management techniques will not need to adapt to changing social values (diZerega, 2002). The combination of these three problems has produced disastrous results. As William Cronon has pointed out, "by the 1990s, even the Forest Service was acknowledging that its own policies had helped produce catastrophic results for the very forest they were intended to protect" (1995: viii).

Over the years, political economists have attempted to explain why agencies like the Forest Service tend to go astray.[2] Over time, they say, these agencies predictably deviate from their mission. Protecting their budgets and codependent commodity interests becomes the dominant strategy (O'Toole, 1988: 118–24), and these agencies become part of an iron triangle of special interests, bureaucratic entrepreneurs, and elected officials. This unfortunate by-product was anticipated by few but exploited by many (see Baden and Stroup, 1981). The mutual interests of this alliance have come at the expense of local communities, national taxpayers, and sustainable ecosystems (Baden and Noonan, 1998).

Under political management, national taxpayers find themselves subsidizing economically irrational and environmentally destructive activities all too often. The following three examples illustrate how destructive this management can be:

- In 1997, Oregon's Mount Hood National Forest accepted blame for decades of mismanagement that devastated an entire watershed. The Forest Service proposed spending $5.4 million to restore the Fish Creek Drainage, where logging caused some of the worst landslides in the region and runs of wild salmon were nearly wiped out.

- In 1999, Senator Ted Stevens appropriated US$12.5 million to cut trees in the Tongass National Forest in southeastern Alaska. The Tongass has lost more money than any of the national forest timber programs. Between 1993 and 1997, taxpayers lost over US$200 million due to logging in the Tongass, not including the value of amenities and habitats despoiled by roads and clear-cuts.[3]

- The *Knutson-Vandenberg Act* of 1930 is an especially heinous example of perverse incentives at

2 For one of the earliest accounts, see Stroup and Baden (1973).

3 Based on data on National Forest timber sales compiled by the Thoreau Institute, available from www.ti.org/publiclands.html.

work. Intended to provide funds for reforestation over the years, K-V funds created a huge incentive to cut more trees, even at the expense of environmental values. The act requires a return to the Treasury of only 50 cents per thousand board feet (US$2.50 for an 18-wheeler loaded with logs). A purchaser may pay US$1500 for those trees; the Forest Service keeps the difference. The Forest Service uses K-V funds to cover salaries and overhead, not just reforestation.

Despite the hopes of progressives, it became obvious that politics always undermined, and would continue to undermine, the operation of government. In the end, the best-organized special interests will influence the fate of federally managed resources (see Olson, 1965: 141–48 for an explication of this process).

Enter free-market environmentalism

The development of free-market environmentalism paralleled the environmental movement launched with the first Earth Day in 1970. By the late 1960s, some began to look closely at the federal management of natural resources and realized that the problems were not merely aberrations, but were the inevitable pathology of bureaucratic management. Mainstream environmentalists believed these problems could be solved by installing better leaders and continued to advocate top-down solutions. Free-market environmentalists proposed alternative institutions to harmonize environmental goals with liberty and responsible economic growth. To overcome progressive policy deficiencies, FME emphasizes the need to align individual self-interest with society's environmental interests. While acknowledging that markets can fail, the early advocates of FME believed that market processes, including non-profit environmental entrepreneurs, can become powerful environmental tools. When effectively deployed, market processes establish institutions that create positive incentives and generate the information necessary for stewardship. Prices are one medium. As Hayek noted in 1945, "Fundamentally, in a system where the knowledge of the relevant facts is dispersed among many people, prices can act to coordinate the separate actions of different people … The marvel is that in a case like that of a scarcity of one raw material, without an order being issued, without more than perhaps a handful of people knowing the cause, tens of thousands of people … are made to use the material or its products more sparingly" (526–27).[4] The extension of property rights to new domains and the creation of wilderness trusts exemplify this model.

> Environmental policy progress

FME played a critical role in the maturation of America's environmental movement, and its intellectual tools have increasingly shaped environmental policy.

4 See also Radford (1945) for an interesting and entertaining description of the spontaneous development of markets, currency, and prices among prisoners of war.

Political pathologies and government failure

Although public servants often act in the public interest, it is naive to believe that this is always the case. Understanding environmental policies necessitates an appreciation of how institutions and self-interest shape the behaviour of politicians, bureaucrats, and special interests (Buchanan and Tullock, 1962). One way in which these forces interact involves the "short-sightedness effect" (Gwartney and Stroup, 1995). In Canada and the United States, provincial, state, and national elections are held every few years, depending on the office. Seeking reelection, politicians normally pursue policies that deliver positive results to special interests in the short-term (e.g., restrictions on imported lumber and steel).[5] Environmental concerns, however, require an appreciation for long-term processes; consequently, the short-sighted bias of politicians can undermine environmental goals.

A process known as bureaucratic capture illustrates a second conundrum (Gwartney and Stroup, 1995). Self-interest encourages bureaucrats to expand the scope of their authority and enact more projects, thereby providing more opportunities for individual promotion (Wolf, 1979). Special-interest money and influence often steer this process in the direction they desire. Whether captured by a logging company or an environmental group, the bureaucracy's activities often drift away from their avowed mission. In sum, mainstream (statist) environmental groups under-appreciate the need for institutional constraints and corrective feedbacks within governing organizations.

Gathering time- and place-specific information about ecosystems is a crucial component of sound policy. Yet ecological knowledge varies widely, constantly changes, and is understood imperfectly. As Hayek noted with regard to an industrial context, "central planning based on statistical information by its nature cannot take direct account of these circumstances of time and place … If we can agree that the economic problem of society is mainly one of rapid adaptation to changes in the particular circumstances of time and place, it would seem to follow that the ultimate decisions must be left to the people who are familiar with these circumstances" (1945: 524). Thus, a system that operates on dispersed, decentralized knowledge will be more responsive to the geographical variety of many environmental problems. But in addition to decentralized decision making, the "man on the spot" needs the information provided by prices to make proper decisions, for prices convey the value people place on a given resource.[6] Many environmentalists, however, have succumbed to "the false assumption that they could comprehend nature, and human nature, in their full complexity" (Schoenbrod, 2005: 220). This reality plagues command-and-control management for two reasons: first, all ecosystems contain unknown characteristics; and second, local knowledge is too voluminous and fleeting to convey to politicians and policy makers without some kind of price system. Thus, green policies have overlooked many important characteristics of disparate ecosystems.

5 See Benson (1981) for this argument applied to land use.

6 In come cases (e.g., SO_2 emissions) the "price" may be determined politically, with scientific input, when the government agency decides the initial supply of emission permits (i.e., sets the desired upper limit of pollution).

Successful policy making requires creating positive incentives for private individuals to pursue environmental stewardship. Yet following Earth Day, most government policies ignored incentives and relied primarily on punitive measures. The *Endangered Species Act* (ESA) is an example of such policy. Environmental advocate and economist Randal O'Toole notes its dual nature: "The law's goals are so noble and uplifting that few could disagree with them. Yet the law's means for achieving those goals are doomed to failure" (2000: 199). Wary of the potential for similar problems in Canada, Laura Jones urges that Canadians take "careful consideration of the nature and extent of the threats to endangered species as well as the likely effects (including unintended consequences) of federal legislation" (Jones and Fredricksen, 1999: 3). When an endangered species is found on private property in the United States, activities such as ranching, farming, and logging often suffer in an effort to preserve habitat. Consequently, some speculate that landowners adopt a "shoot, shovel, and shut-up" mentality toward endangered species. This perverse incentive harms long-term environmental goals. Fortunately, the United States Fish and Wildlife Service has recognized the ESA's deleterious effects and has created "safe harbor agreements," which reward landowners for species rehabilitation and reintroduction (United States Fish and Wildlife Service, 2004).

Three additional lessons can be learned from America's environmental maturation. First, environmental values constitute only one of several competing values. For example, Pete Geddes notes that "the implicit and strong implication [of the ESA] is that the creatures to be saved, each species of beetle, rat, or toad, has infinite value. There is no recognition of the necessity of tradeoffs" (Baden and Geddes, 1996, May 22). Second, good policy requires good science. An old ecological theory asserts that a "balance of nature" once existed and that man must restore it. Most ecologists now agree that ecosystems constantly change and that the "balance of nature" does not exist (Botkin, 1990: 6). Humans have a role as stewards and their involvement in the environment should reflect societal values, rather than futile attempts at Edenic restoration. Finally, Earth Day's centrally planned policies eroded the values of a free society. Heavy-handed mandates from Washington, DC, disregarded property rights and stifled innovation. Environmental policies need widespread support, yet green policy mistakes have turned some important segments of the American population against modern environmentalism.

American "greens" contributed to the growth of the environmental movement by solidifying and expressing the national environmental conscience during the first two decades following Earth Day. In some cases, environmental policies were successful despite poor institutional arrangements, incomplete information, and insufficient incentives. However, these deficiencies prevented good intentions from living up to expectations. After a century of effort, experimentation, and reform, "the Progressive legacy is starkly clear. Remote bureaucrats, allied with subsidized production interests, establish mandates both insensitive to local values and insulated from market processes. The results devastate both communities and ecosystems" (Baden and Geddes, 1996, May 22). Despite the recurrence of these travesties, blame was assigned to individual bureaucrats and faith in the progressive model persisted, perpetuating the environmental movement's growing pains.

Coming of age

Free-market environmentalism (FME) reinvigorated the maturation process, countering the stagnation of the green movement with creative new approaches to improving environmental quality. The FME approach aimed to align self-interest with society's interest—in this case society's environmental goals. To achieve this harmony, free-market environmentalists focused on constructing institutions that would generate information and create incentives (Baden and Stroup, 1983: 26–27). Privately owned goods traded freely generate prices that convey the value market actors place on those goods. Without private ownership and free markets (e.g., in the case of government ownership) accurate (if any) valuations cannot arise. On what basis can a Forest Service bureaucrat compare the value of preserving wilderness to that of logging? Thus, free-market environmentalists, including non-profit environmental entrepreneurs such as the Sierra Club, advocated market mechanisms while stressing the government's role in defining and enforcing property rights. FME emphasized the ways in which market solutions surpass government solutions: they promote diverse and innovative solutions, generate information necessary for stewardship through prices, balance society's competing goals, and engender voluntary, peaceful interaction (Stroup, 2003: 17–38). FME recognizes that there are no perfect solutions; however, its advocates claim that market mechanisms often have a greater potential to protect our environment.

The FME model produced several principles for constructing new institutions. First, local knowledge of ecosystems is best utilized if power devolves to the localities and individuals where it resides. The federal government should relinquish power to states or provinces, counties, cities, and other regional organizations to make some policy decisions (e.g., with regard to water treatment, landfills, localized emissions, and natural resources on state lands). Second, where possible, governments should replace punishments with incentives in order to guide behaviour (e.g., by setting emission limits rather than prescribing technologies). Positive reinforcement is more effective and consistent with the values of a free society. Third, individuals who experience the full consequences of their actions, both positive and negative, will make better decisions. Identifying and empowering these individuals is crucial to successful environmental policy. Fourth, environmental stewardship requires a long-term outlook. Institutional design should extend the decision-making time frame beyond politicians' fixation on the next election.

Advocates of free-market environmentalism identify property rights and trusts as institutions capable of satisfying these principles. Many of the most egregious abuses of the environment occur in areas that lack well-defined and enforceable rights of private ownership. These "commons"—such as fisheries and the atmosphere—are routinely subject to excessive consumption or contamination. When established and enforced by the government, property rights systems generate the information and incentives necessary for sound stewardship (Anderson and Leal, 2001: 8). The extension of property rights to new domains—such as fisheries and air pollutants (see Rothbard, 1990)—internalizes environmental externalities. Improvements or degradations of the environment are reflected in the value of the property. If one pollutes another's property, that

individual can be sued under common law. As Yandle writes, "[With] common law, right holders to land have the right to enjoy the benefits of land ownership or usage and to exclude from their land unwanted and unreasonable invasions by people or pollution" (1997: 91). When property rights are transferable, the price system provides information about the worth of the property and the subjective values of individuals. Property rights to environmental resources become assets for their owners, affecting their decision-making process. Abusing a forest or fishery becomes tantamount to squandering a retirement fund. Although no single way exists to implement a property rights system, FME policies include a variety of mechanisms and tactics to overcome distinct environmental problems.

Trusts or wilderness endowment boards offer an alternative to traditional political and bureaucratic management of natural resources (Baden and Stroup, 1981). These institutions pursue stated environmental goals by harnessing the methods and motivations of non-profit organizations led by a board of trustees. Examples of successful trusts include the Quincy Library Group, the Valles Caldera Trust, the Grand Staircase-Escalante Group, and the Missouri River Corridor Trust. People organize trusts in a variety of ways—some are publicly owned, others are privately owned, and some involve public-private partnerships. There are several advantages of trusts (Fairfax and Guenzler, 2001: 25–38). First, trustees must follow the guidelines established for the purpose of the trust and are legally accountable for their decisions. Second, trusts insulate decision makers from short-term political time frames and encourage an appreciation for long-term ecological processes. Third, trusts are more likely to include individuals who are intimately familiar with and concerned about the site to be preserved in the public interest. Finally, by delegating the management decisions to a board of trustees, trusts reduce the conflict inherent to politicized resource management (LeRoy and Green, 2005). Free-market environmentalists have developed a variety of ways to construct and apply wilderness trusts to improve stewardship (Fairfax and Guenzler, 2001).

> The years ahead

The success of FME policies since the first Earth Day in 1970 signals the maturation of the environmental movement. Canada's fisheries and forests have benefited from the successful implementation of FME policies. The individual vessel quota system for the British Columbia halibut fishery and the community forest agreements within the provincial forest tenure system are examples of this approach.

The contributions of FME demonstrate that the environmental movement has learned enough about itself and the world to handle important responsibilities; it may enjoy wisdom commensurate with its maturity. A variety of philosophically divergent approaches can be used to meet environmental goals. However, the extent of Canada's environmental quality depends upon policy makers' recognition of several key insights: political and bureaucratic decision makers are self-interested; ecological knowledge is local and ephemeral; and punitive measures generate perverse results. Ignoring these truths in the United States led to decades of squandered opportunities to improve environmental policy making. Policies that align individual self-interest with society's

environmental interests generate superior results by employing local, individualized knowledge and rewarding sound stewardship. Myriad institutions foster such knowledge and incentives; extending property rights to new domains and endowing wilderness trusts are just two examples. The intellectual foundation for sound environmental policy is well established in the FME literature. Canadians who wish to balance environmental and economic needs, while preserving the values of a free society, will benefit from its recommendations.

While serious problems remain, the low-hanging fruit has been picked. Americans and Canadians now confront more subtle and contentious environmental issues. Addressing them effectively will require the more nuanced and adaptive tools provided by free-market environmentalism.

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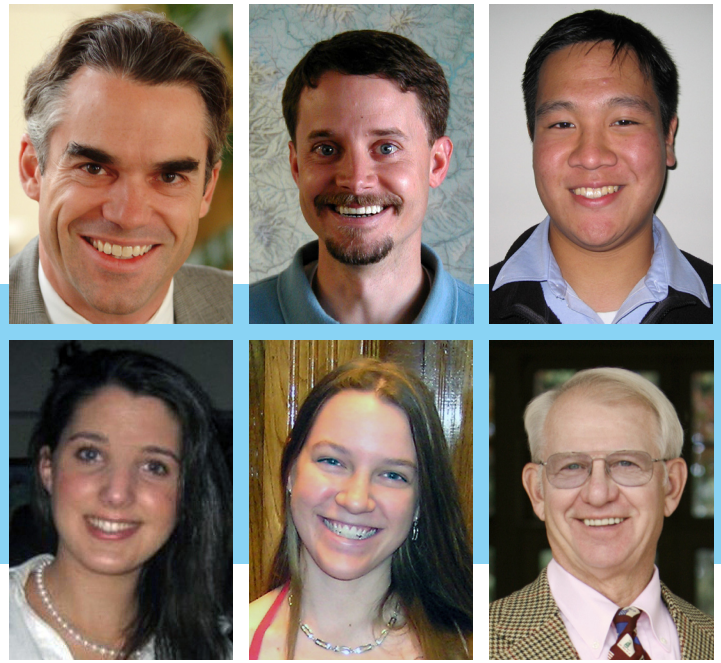
A breath of fresh Air



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Experiences with Alternative Land, Water and Biodiversity Policy Approaches in Australia

David Pannell

Introduction

Socially and economically, Australia has much in common with Canada. However, there are some considerable differences between the two countries in terms of their approach to environmental and natural resource issues. This chapter provides an overview of recent trends in natural resource policy in Australia, focusing on policies for land, water, and biodiversity conservation. The purpose of the chapter is to share the lessons from Australia's experiences in these areas, and to highlight some aspects of government behaviour that could be relevant to many Western countries. An overview of a range of recent policy programs in Australia reveals that there are few clear success stories. Successive programs have failed to fix clearly identified problems, due to politics, community expectations, and impatience. This chapter identifies ways to improve the cost-effectiveness of these programs including having a stronger focus on achieving outcomes, rather than just supporting activities; more rigorously targeting expenditures to high-payoff situations; relying more on scientific and economic information in that targeting; and using a broader range of policy tools, selected to suit the relevant bio-physical and socio-economic circumstances.

Society and government

Most Australians live in coastal cities. The population density in agricultural areas is, on average, very low by global standards. Most agricultural land is not irrigated, and is used for cereal cropping, canola, legume crops, sheep, and cattle. Irrigated and higher rainfall areas support many different industries including horticulture, vineyards, dairy, and plantation forestry.

Australia has separate governments for each of its six states and two territories, as well as a national government. Consistent with the experience of Canada, relations between state and national governments over this area of policy have sometimes been strained. In Australia, responsibility for environmental and natural resource issues rests primarily with state governments, but in the past two decades, Australia's national government has played an increasingly influential role. This influence has been created through the provision of programs that provide large financial resources to states, but with strings attached; in many cases, state governments must provide matching funds. In this way, the national government has strongly influenced the agenda and largely determined the approach to policy, to the chagrin of some state governments. Most of the programs listed below were initiated by the national government.

The environment and natural resources

Key environmental and natural resource problems in rural areas of Australia include land degradation (especially salinization and acidification), loss of biodiversity, and issues with water quality and quantity.

Land degradation

In most countries where land salinization is a problem, the cause of that salinity is irrigation. Although Australia does have a significant problem with irrigation salinity, the largest area of salt-affected land is in non-irrigated regions. In these areas, the sub-soils are naturally high in salt. Australia's native vegetation is well adapted to use all available rainfall (Pannell, 2001a). However, in large areas the natural vegetation has been replaced by European-style agriculture based on annual plants such as wheat, which allows some water to move past the root zone. This causes groundwaters to rise and, in places, bring salts to the surface (National Land and Water Resources Audit, 2001a). Around two million hectares of land are already salt-affected (Australian Bureau of Statistics, 2002), and another four million hectares are at risk. One of the key strategies to contain salinity is to reestablish perennial plants (trees, shrubs, and pastures) in order to prevent the rise of saline groundwaters (Pannell and Ewing, 2006).

Between 12 and 24 million hectares of agricultural land in Australia have strongly acidic soils (National Land and Water Resources Audit, 2001b), and agricultural activities such as the application of nitrogen fertilizer make them more so. Plants on acidic soils often suffer from aluminium toxicity, and these crops suffer yield losses (Cregan and Scott, 1998). Farmers have increasingly applied lime to counter soil acidity.

In the past, wind erosion was a serious problem for Australian agriculture. A very high level of adoption of minimum tillage systems has resulted in a dramatic reduction in this problem. For example, by 2004/2005, an estimated 70 percent of the nation's crop farmers had adopted both direct drilling and minimum tillage practices (Hodges and Goesch, 2006), and in the main crop-producing state, Western Australia, 86 percent of crop farmers were using zero-tillage systems in 2003 (D'Emden and Llewellyn, 2004).

Biodiversity

In 2000, *Nature* published an assessment of the world's 25 most important biodiversity hot spots, which were defined as areas with an "exceptional concentration of endemic species undergoing exceptional loss of habitat" (Myers et al., 2000). The agricultural region of southwestern Australia was included in the list. It is the only such hot spot in Australia, one of only four in developed countries, and one of only five outside the tropics. Protection of biodiversity in this region is of international significance. Biology in that region, and in Australia in general, is highly diverse because of the continent's great age, and because it has had a relatively stable climate for a very long period of time. For example, the glaciation that affected Canada in recent ice ages did not affect Australia.

Having especially rich flora and fauna means that there is potentially a lot to lose. Furthermore, because of the long undisturbed evolutionary processes, many

species are endemic to small areas, and so potentially susceptible to extinction. Recent biological surveys have found that there are at least 450 plant species and 700 arthropod species in southwestern Australia that exist only in those parts of the landscape that are at risk of salinization (Keighery et al., 2004). Another area of concern has been the clearing of native vegetation to increase the area available for agriculture. This directly removes native plants and reduces habitat for native animals.

Water

In common with most countries, Australia faces challenges with nutrients and sediment entering waterways and water bodies. In addition, salinization of water resources is a major concern in Australia's major river systems. There has been increasing concern about the allocation of available water among competing uses: irrigation, domestic use, industry, and the environment. Irrigation is by far the largest water user. In some waterways, the amount of water allocated to irrigators exceeds average annual flows—a problem that policy makers have been addressing in recent years (see discussion of the National Water Initiative below).

> Experiences with different policy programs and approaches

Landcare (1989)

The National Landcare Program (NLP) was launched by the national government in 1989 from the foundation of the National Soil Conservation Program. The NLP was based on the premise that land degradation in agriculture could be solved by awareness-raising, education, and catchment planning processes for groups of farmers (Curtis and De Lacy, 1997; Vanclay, 1997). A stewardship ethic was to be cultivated among farmers.

The primary instruments used within the Landcare program were the provision of paid facilitators and organizers to local farmer groups, the development of catchment plans, and subsidies for the partial funding of relatively small-scale on-ground works. Often the facilitators lacked strong agricultural or technical backgrounds, but had skills in organization and communication.

For over a decade, this paradigm was the dominant force shaping resource management policies for agriculture. The NLP approach was very successful at raising awareness of resource conservation issues among farmers, and, in some cases, this awareness led to changes in farming practices. However, the contributors to Lockie and Vanclay (1997) identified a range of problems with the objectives and underlying assumptions of the NLP, including:

- differences between the professed ideology of the program, and the way it actually operated;
- a failure of the program designers to appreciate the complexity and difficulty of the issues the program was intended to address; and
- unrealistic expectations regarding how much voluntary change in land management could be prompted through education, training, communication, and awareness raising.

Reinforcing the latter point, Barr notes the inadequacy of relying on voluntarism and a stewardship ethic: "There is a significant body of research that demonstrates that links between environmental beliefs and environmental behaviour are tenuous" (1999: 134).

To the above-noted problems, I would add:

- a lack of targeted funds to priority areas where intervention could make a major difference;
- a neglect of technical, scientific, and economic issues; and
- a focus on a particular subset of policy tools, rather than an assessment of which tools would be best suited for particular problems in particular locations.

After a decade of efforts under the Landcare banner, many farmers became jaded with the Landcare approach, and dismissive of the unrealistic expectations embodied in the program. Overall, the achievements of Landcare were disappointing relative to the hopes initially had for it. Although "empowerment" and "participation" (Landcare buzzwords) are important elements of good extension[1] practice, they are not sufficient weapons against the more intractable environmental problems, such as salinity and vegetation loss (see Pannell et al., 2006). Regarding salinity, for example, Ridley and Pannell (2005) recognize the need for more attention to technology development; regulation; direct funding of major engineering works; carefully targeted grants to support changes in land use; and serious consideration of "no action" as the most appropriate response in many cases.

Natural Heritage Trust (1997)

The Natural Heritage Trust (NHT) was intended to address a range of land, water, and biodiversity conservation issues. It was a much larger program than the NLP, perhaps reflecting a growing public concern for environmental issues.

The National Landcare Program was untargeted; almost any change to land-management practices that were perceived as being more "sustainable" could be encouraged and supported. The NHT was meant to be more discerning and targeted in its support for activities. In practice, however, the degree of rigour used to evaluate proposals for funding was often low. An inquiry by the Australian National Audit Office in 2001 expressed concern that there was insufficient knowledge about what environmental benefits were being generated by the program. Nevertheless, the identified weaknesses of the program did not seem to be of great concern to the national government, which perhaps felt that the political benefits of having a high profile environmental program were sufficient to justify its existence. A second phase of the program was announced in 2001, and concluded in 2008.

National Action Plan for Salinity and Water Quality (2001)

This program was aimed at a subset of issues concerning salinity and water quality. In response to criticisms

1 Extension is a commonly used term in agriculture, used to encompass education, communication, persuasion, awareness raising, training, and similar activities.

regarding the lack of suitable targeting of funds in the NHT, the program was another attempt at more targeted funding. As with previous programs, it failed to deliver. One reason why it failed was that the main targeting was done at too large a scale: the region. Within targeted regions, it was still possible to spend program resources unproductively, and this has happened often. Contributing to this was an ongoing neglect of scientific and economic considerations in the planning and accreditation of plans, and the use of inappropriate policy tools.

The document released to announce the program, *Our Vital Resources – National Action Plan for Salinity and Water Quality*, emphasized "Integrated Catchment/Region Management Plans" which were to be developed "by the community" (NAPSWQ, 2000). In practice, funds have been used mainly to fund extension, or to offer small, temporary incentive payments (grants) to landholders. Novel elements of the national action plan included the setting of targets for salinity, with funding to achieve these targets being given to community-based groups in the regions.

Setting targets for a catchment or region raises a number of issues (Pannell, 2001a). If they are not based on detailed empirical analyses which account for the physical and economic realities of the catchment, targets can easily define outcomes which are inferior to a business as usual approach. If they are based on scientifically credible analyses, targets for the available budget will sometimes be very modest, and may threaten the political viability of the program. For example, in the case of salinity in Australia, the current national program involves an expenditure of AU$1.4 billion over eight years; a prominent estimate of the cost of addressing salinity in a relatively comprehensive way is AU$65 billion over 10 years (Watson, 2001)—and even that is likely a substantial underestimate, in my view. Unwilling to face these hard realities, governments have allowed the available public funds to be spread thinly across many small projects, with the hope of achieving broader impacts. Instead, this has caused the funds to become diluted and relatively ineffectual.

Regional delivery

Australia's national action plan and the second phase of the Natural Heritage Trust were delivered through a set of 56 regional bodies. It was reasoned that these bodies would have (or would be able to obtain) better knowledge of local conditions and problems than governments could access. These bodies vary widely in their expertise and their size (e.g., in terms of number of staff, they range from approximately 20 to 80).

The quality of the analysis conducted to support funding allocation decisions varied widely among the regional bodies. Consistent with the government's expectations, they consulted widely within their communities, but they did not sufficiently consider sound evidence and modeling to ensure that planned interventions would actually achieve outcomes. Government funding conditions did not require them to do so.

National Water Initiative

The Economist (2003, July 19: 13) has described Australia as "the country that takes top prize for sensible water management." This is based primarily on Australia's establishment of markets for irrigation water, in

which rights can be freely traded amongst irrigators. Nevertheless, considerable challenges remain. There has been great pressure to reallocate water away from irrigators and towards environmental flows and urban water users. A number of Australian cities are suffering serious shortfalls of water due to growing demand and, in recent years, below-average supply.

There has been political resistance to making use of markets to undertake this reallocation, largely because of concerns about any relocation taking place, rather than concerns about using markets for this purpose. On the other hand, resistance to making use of markets has been evident in the debate about water allocation among urban users (e.g., Crase and Dollery, 2006).

The National Water Initiative (NWI) is Australia's current document laying out the agenda for further water reform. According to the National Water Commission's web site, the official objective of the NWI is "to achieve a nationally compatible market, regulatory and planning based system of managing surface and groundwater resources for rural and urban use that optimizes economic, social and environmental outcomes" (Australia, National Water Commission, no date). It covers eight areas: water access entitlements and planning framework; water markets and trading; water pricing; integrated management of water for environmental and other public-benefit outcomes; water-resource accounting; urban water reform; knowledge and capacity building; and community partnerships and adjustment.

The early performance of the initiative has been mixed, due to the political resistance noted above. However, given Australia's good progress in this area in the past, and the imperative to deal with current pressures, one can remain hopeful about medium-term prospects for reform.

Controls on clearing of native vegetation

In rural areas of Australia, there are many remnants of the original native vegetation, a portion of which are of high biodiversity value. State governments have increasingly sought to protect remnants on private land from clearing by farmers who wish to expand their productive farm area. More stringent regulatory restrictions on further clearing have been introduced, and in most states it is now difficult for most farmers to undertake any clearing. Two states, Queensland and New South Wales, have the largest areas of uncleared native vegetation, and the political pressure to allow further clearing is more intense in those states. Nevertheless, even there, pressure from environmental interests has been increasingly influential.

This area of policy is different from the main national programs mentioned above in terms of its reliance on regulatory restrictions to influence landholder behaviour. As a consequence, it has been a highly contentious area of policy, prompting, for example, a recent national review of costs to landholders resulting from restrictions on the management of native vegetation (Productivity Commission, 2004). The report concluded that existing regulatory approaches are not as effective as they could be in promoting objectives to retain and rehabilitate native vegetation on private land, and that they impose significant costs.

Economic policy instruments ("market-based instruments")

Apart from the creation of water markets, there has also been growing interest in the use of economic policy instruments, such as conservation tenders (see, for

example, Stoneham et al., 2003), tradable pollution permits, and offset schemes. A pilot program of "market-based instruments" was initiated in 2001, and extended in 2005. The program has supported a significant number of small but innovative trials of these instruments.

The experience so far has been encouraging, but it has also revealed some limitations. In a review of the outcomes of the first phase of the program, Grafton (2005) concluded that cost savings are possible, relative to traditional mechanisms. He argued that the mechanism with the greatest potential for widespread application is conservation tenders, which involve landholders submitting bids to undertake works in an auction-like setting. Environmental managers select the bids that offer the best value for money. Grafton pointed out that, to effectively implement these instruments, there needs to be good bio-physical modeling at the farm or paddock level, and adequate monitoring and enforcement of landholders' actions.

Pannell (2001b) has argued that there appears to be excessive enthusiasm for market-based instruments in some policy quarters, and that there needs to be care to ensure that they are applied in situations where there is market failure. "Market failure" describes a situation where a change in the way resources are managed would increase efficiency. Government intervention may be warranted to achieve that change if it does not arise spontaneously in the market. Although economic policy instruments may be useful tools to overcome market failure, in situations where resource degradation is not a sign of market failure (e.g., where it is actually more efficient to allow the degradation to occur because the cost of the degradation is less than the cost of preventing it), economic instruments usually cannot alter the equation to make resource protection economically desirable, especially in the short-term. There may be exceptions to this in the medium- to long-term if the presence of the economic instrument provides sufficient incentive for landholders to innovate and develop less expensive ways to reduce degradation.

> Lessons from Australia

The experiences related here reveal that it is difficult to design and implement a policy program for environmental and natural resource management that delivers real outcomes. Despite long-term efforts using a variety of approaches for many different issues, there are few clear success stories. Each new program has had further experience to build on, but some of the lessons seem to have been hard to learn. For example, the need to target natural resource management investments to likely high-payoff situations has been apparent and reinforced through several policy programs, but has yet to be fully acted on.

It appears that various factors get in the way of hard-nosed targeting based on likely outcomes, including politics, community expectations about how funds should be spent, and an impatience to undertake on-ground works without waiting for the analysis that is necessary for effective targeting.

When targeting funds, policy makers should consider who will benefit and who will bear the cost of abatement. Of the degradation issues discussed earlier, some are fully within the sphere of the affected landholders who bear all the costs and receive all the benefits (e.g., soil acidity, wind erosion, sometimes salinity). In these cases, economists would argue that the case for government intervention is

weak, except perhaps for information or education programs to counter information failures. If they have access to good information, farmers themselves are best placed to judge whether degradation problems that affect only them warrant the costs of abatement. Other degradation problems have substantial off-site impacts, termed "externalities" by economists (e.g., salinity affecting waterways, roads, or biodiversity), or have strong public-good characteristics (e.g., biodiversity). These examples constitute much stronger cases for government intervention. As in Canada, policy programs in Australia have often neglected this important distinction.

There has been a tendency for policy programs to follow what might be called "fashions," as different policy approaches rise and fall in esteem. We have seen a reliance on voluntarism and peer pressure in the National Landcare Program, a reliance on markets for water, and a great interest in market-based instruments for environmental programs. Overall, there seems to have been a reliance on one or a small number of policy mechanisms within each program.

Ridley and Pannell (2005) have demonstrated that a fuller range of policy mechanisms needs to be used to effectively address major environmental problems across the full range of circumstances that arise. They integrated biological, physical, economic, and social research regarding the management of salinity to develop recommendations regarding a range of policy responses: grants and other economic instruments, command-and-control regulation, communication or education, engineering works, technology development, other research, and no action. Their recommended response depends on local bio-physical and socioeconomic factors that drive the benefits and costs of taking action to manage salinity.

Successful policy programs need to be built on an approach that is more patient than is often the case. Patience is needed to conduct and learn from research and analysis in order to support the design phase of policy programs, the planning and prioritization of specific investments, and the implementation of plans. For some problems, there is a need to develop improved technologies (e.g., improved farming options), rather than persist with existing technologies, and this also requires patience. More often, programs have tended to rush into the implementation of poorly conceived plans, based on inadequate technologies.

Most of the programs discussed above have embodied unrealistic expectations regarding the financial and other sacrifices that farmers must be willing to make on behalf of the broader community, or they have overlooked these costs and their consequences for farmer participation. The farm-level economics of the proposed changes in land management are crucial, but this seems to be under-recognized by policy makers.

Of course, these lessons can be difficult to apply in situations where degradation issues have become highly politicized. The sort of catastrophic forecasts that typify this situation make it extremely difficult for advocates of the public interest to make themselves heard in their calls for a balanced policy approach.

> Policy recommendations

In light of the preceding discussion, I have a number of recommendations for policy makers with respect to the way in which policy should be designed and implemented.

- Focus on the delivery of outcomes, not activity. Ensure that the funded activities are the right activities in the right areas to achieve target outcomes.

- Recognize that different policy tools are appropriate for different circumstances—even if the environmental problem is the same.

- Conduct detailed analysis and modeling. Consultation with the community is not enough to develop effective investment plans and targets.

- Be prepared to target a smaller number of threatened assets if the analysis shows that this is more cost-effective than spreading resources thinly over many assets.

- Pay attention to the large body of existing research on what drives landholder behaviour (e.g., Pannell et al., 2006; Knowler and Bradshaw, 2006), and form realistic expectations with respect to how landholders will respond to policy (i.e., not as well as you might wish).

- Be patient. Do not rush to spend program dollars quickly, before analysis showing where funds could have the greatest impact has been done.

- If devolving decision-making powers over public funds to community-based bodies, ensure that there is rigorous accreditation of proposed investments and scrutiny of planning processes to ensure accountability.

A breath of fresh Air

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