

Environmental Trends and Environmental Governance in Canada

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Depuis les années 60, les pressions sur l'environnement dans le monde industrialisé ont changé. Elles se sont mondialisées, elles sont devenues de plus en plus étroitement interreliées et, de pressions aiguës et visibles qu'elles étaient, elles sont devenues subtiles et chroniques et produisent maintenant des effets à long terme. Pour réussir une saine gestion de l'environnement, il faudra, au cours des prochaines décennies, trouver des moyens plus efficaces de tenir compte d'évaluations objectives, scientifiques, techniques et de qualité supérieure dans la prise de décisions-clés, mettre en place des processus efficaces de gestion de l'incertitude, savoir s'adapter à l'essor du savoir et coordonner efficacement le pouvoir et les compétences qui, inévitablement, sont partagés entre divers niveaux de gouvernement et les intervenants du secteur public et privé.

Since the 1960s, environmental stresses in the industrialized world have shifted from predominantly local to global scale, from separate to increasingly tightly coupled stresses, and from readily observable acute stresses to subtle, chronic, and long-term ones. Central challenges in successful governance of the environment over the next few decades will involve developing more effective ways to integrate high quality, objective scientific and technical assessment with key decision needs; learning more effective processes for managing under uncertainty and responding adaptively to advances in knowledge; and effectively coordinating inevitably shared authority and capacity across multiple levels of government and between diverse public and private actors.

Environmental protection is the most prominent new domain of politics and public policy to arise over the past few decades, in Canada and internationally. This paper considers prominent current trends in governing the environment and society's relationship to it, drawing in part on papers prepared for the Project on Trends. The paper focuses on key challenges the environment poses for governance, and significant innovations proposed to address

these challenges. The first section provides introductory material, briefly reviewing prominent environmental issues currently on the Canadian and international policy agendas. The remaining sections discuss several prominent themes in environmental governance. In the closing section, the paper draws on these thematic discussions to identify a set of priority research tasks to advance policy-relevant understanding of the problem of governing the environment.

ENVIRONMENTAL STATUS AND TRENDS: AN OVERVIEW

Trends in human governance of the environment take place against a background of trends in the biophysical environment — trends in pollution, disruption of natural systems, ecosystems protected or degraded, resources depleted or conserved — that underpin environmental concerns and environmental policy. The environment's contribution to human well-being is vast, but imperfectly known and usually taken for granted. We rarely attend to how some aspect of the environment matters to us until it is damaged or threatened. Moreover, attempts to define the state and trends of the environment must confront the diversity of ways that people value and depend on the environment. What aspects of the environment you care about depends on where and how you live, how you earn your living, your values, and your wealth. Poor or vulnerable communities, or those deriving most of their livelihood from a single resource, may be severely threatened by a single dimension of environmental change, such as rising sea levels or depletion of a fishery, whose impact on a richer or more diversified community would be insignificant. People's values and ways of life shape the relative priority they accord to protecting different aspects of the environment, such as environmental quality in cities, where most people live, versus protecting wild species and ecosystems. Our ability to identify and interpret important indicators of the state of the natural environment, or associated risks to people, are consequently limited by imperfect knowledge of natural systems, perceptual habits and biases, and disparate bases for valuing environmental attributes. Striking examples of these limits arise when new, previously unsuspected mechanisms of environmental damage are identified, revealing that activities or emissions previously thought benign can be harmful. Examples include bioaccumulation of organic pollutants in the 1960s, destruction of stratospheric ozone in the 1970s and 1980s, and endocrine disruption from synthetic chemicals in the 1990s.

Canadian environmental pressures and trends are shaped by Canada's landscape, society, and economy. Canada is a large, cold, wealthy, lightly populated country, in which most people live in cities and close to the American border, with a diversified national economy but with many regions dependent on particular natural resources. The major environmental pressures are consequently those of the rich, associated with high levels of consumption, transport, and energy use. Aggregate environmental stresses are comparatively low for a major industrialized nation, although the major metropolitan areas face the universal urban problems of air pollution, noise, congestion, and waste. Central Canada's proximity to the US industrial heartland exposes it to long-range oxidizing air pollution and to acid deposition, to which the lakes and forests of the boreal shield are especially sensitive because of their low buffering capacity. Sensitive Arctic ecosystems, and the subsistence livelihoods and cultures that depend on them, are increasingly recognized to be vulnerable to both global climate change and long-range transport of persistent organic pollutants. The regional concentration of resource industries creates a highly variable pattern of sometimes extreme local and regional environmental stresses, including loss of old-growth forest and habitat, disruption of fish stocks and marine ecosystems, and local air and water pollution. Moreover, the political power of industries that dominate local economies has in some cases allowed scandalous environmental abuses, of which perhaps the most extreme examples have been the mercury poisoning of the Grassy Narrows Band in Northwestern Ontario, and the extremely contaminated tidewater area in Nova Scotia known as the Sydney tar ponds, the largest toxic waste site in North America.

Since the 1960s, the broad character of major environmental stresses in Canada has shifted, in a manner similar to changes in all rich industrialized countries. The acute environmental stresses that provoked the emergence of modern environmentalism are mostly resolved or improving, largely due to

technological changes and investment in pollution controls that have allowed production to continue growing with reduced environmental insult. But as these stresses have been relieved and economies have continued to grow, other more complex and recalcitrant stresses have arisen that pose greater challenges to processes of assessment, decision-making, and implementation. This broad pattern is replicated in examples as diverse as water and air pollution, conservation of natural resources, and the appearance of novel global-scale issues such as ozone depletion, global climate change, and preservation of global biodiversity.

Acute pollution of major eastern Canadian freshwater bodies, for example, has declined markedly, if unevenly, since the 1970s due to reductions in toxic emissions, pulp mill and other industrial effluents, and expanded construction of municipal wastewater treatment plants. Growing population and industrial output and continuing needs for more wastewater treatment (large populations in Quebec and the Atlantic provinces still have none), however, maintain continuing pressure on these bodies, while even remote waters are increasingly suffering from long-range transport of both acidifying and toxic pollutants.¹

The story is similar for air pollution. Canada has made strong progress in controlling particulate pollution, with concentrations falling by nearly half from 1980 to 1996, but much weaker progress in controlling the precursors of tropospheric ozone, volatile organic compounds (VOCs), and oxides of nitrogen (NOx).² These are both transported hundreds of kilometres, however, so Canadian air quality depends on both Canadian and US emissions. American emissions are roughly ten times higher than Canadian emissions, but have been more effectively controlled in recent decades.³ For Canada, the combined effect has been a large reduction in the frequency of extreme summer urban air-pollution episodes, but a continuing increase in average pollution levels.⁴

Acid deposition is caused by emissions of NOx and sulfur dioxide (SO₂), which both can travel hundreds of kilometres. Canada reduced SO₂ emissions more than 40 percent from 1980 to 1994, but since more than half the sulfur deposited in central and eastern Canada originates in the United States, US reductions were also required to reduce Canadian deposition. These were finally achieved in the 1990s after years of struggle, following amendment of the US *Clean Air Act* and the Canada-US Air Quality Agreement that followed. These cuts have markedly reduced sulfate deposition, but have brought little change in overall lake acidity, principally because NOx reductions have been so much less successful in both countries.⁵

Because regional transport of air pollution is increasingly important, air pollutants are now managed at three levels: domestically, bilaterally with the United States, and under the multilateral Convention on Long-Range Transboundary Air Pollution (LRTAP). Separate protocols under this convention have controlled SO₂, NOx, VOCs, persistent organic pollutants (POPs), and heavy metals.

Most of the environmental issues prominent on the current policy agenda are global in scale, and are principally driven by international policy. These include climate change, stratospheric ozone depletion, protection of biodiversity, and most recently, international control of POPs. Anthropogenic climate change arises from emissions of several “greenhouse gases” that absorb the infrared radiation that cools the earth to maintain its temperature, thereby changing the heat structure of the atmosphere and the climate. The most important anthropogenic greenhouse gas is carbon dioxide (CO₂), which contributes about two-thirds of present warming and which we mainly emit by burning fossil fuels. The past two centuries of fossil-fuel use have increased the atmospheric concentration of CO₂ from about 280 to 360 parts per million (ppm), while present emissions cause a continuing increase of 1.5 ppm per year.⁶

In 1997, Canada contributed about 2 percent to global greenhouse gas emissions, a per capita rate of 22.5 tonnes CO₂-equivalent per person second only to the US among major nations, and a 13 percent increase in emissions since 1990.⁷ Other major greenhouse gases include methane and nitrous oxide, which are both increasing in the atmosphere (methane by 4 percent from 1987 to 1996, N₂O by 2.2 percent) but have more complex budgets that include both natural and anthropogenic sources, as does the contribution of net CO₂ emissions from land-use change. The two existing international agreements on climate change, the 1992 Framework Convention and its 1997 Kyoto Protocol, provide a minimal institutional framework to address the issue, but the basic mechanisms and political will to manage this gravest of environmental challenges are still largely undeveloped.

While climate change is essentially a problem of human disruption of the global carbon cycle, large human disruptions of other global biogeochemical cycles have not yet gained similar levels of popular and policy attention. The largest human perturbation of all is to the nitrogen cycle: global human nitrogen fixation through fertilizer manufacture, legume cultivation, and combustion already more than doubles the natural rate.⁸ This disruption causes multiple environmental effects including acidification, eutrophication of waterways, and smog, but has only recently begun to receive policy attention. A recently negotiated “multi-pollutant, multi-effect” protocol under the LRTAP convention will jointly control emissions of sulfates, NO_x, ammonia and VOCs, to limit acidification, photochemical smog, and eutrophication. Similar but smaller human perturbations are occurring in other global biogeochemical cycles.

In contrast to climate, there has been great progress in managing depletion of the stratospheric ozone layer. Commitments implemented under the 1987 Montreal Protocol and its amendments have reduced global emissions of ozone-depleting substances by about 80 percent, through production

phaseouts in industrial countries that are soon to be extended to developing countries. Canada, like all countries in the Organisation for Economic Co-operation and Development (OECD), phased out all but a few small essential uses of these chemicals by the end of 1996.⁹ The beginning of environmental recovery is now observable, and is expected to eliminate the Antarctic ozone hole by about 2050. Ozone depletion is now near its maximum with about 3 to 6 percent loss in northern mid-latitudes and 15 percent loss in the Arctic spring.¹⁰ Important challenges remain, such as ensuring developing countries are able to achieve their promised phaseouts, and controlling the CFC black market. If nations stay the course they have begun, however, ozone depletion will likely be the first global environmental problem to be solved.

Loss of biological diversity has become an issue of prominent global concern, although most threats to species, ecosystems, and biodiversity act at local or regional scales. Biodiversity is the primary modern label for the “nature” agenda, subsuming all concerns for protection of species, ecosystems, and wilderness. A biodiversity treaty was signed in 1992, but subsequent negotiations under the treaty have strayed from the mission of protecting ecosystems and habitats, into tangentially related matters of ownership of biological resources and sharing of proceeds from their exploitation, and safety from genetically modified organisms.

While confusion is widespread about the meaning, measurement, and valuation of biodiversity, a common heuristic approach is to measure biodiversity by numbers of species. It is widely believed that species extinctions are occurring at an unprecedented rate, but neither the total number nor the rate of loss is known with any precision. Worldwide, 1.7 million species have been identified. A recent assessment puts the total at 14 million, while other estimates range from 4 to more than 100 million. Species diversity is highly uneven across taxa and locations: a third of all identified species are beetles, while many regions are extremely

diverse in particular taxa and not in others. World-wide, the present extinction rate is estimated at 100 to 1,000 species per year, compared to a natural rate of about one per year. More than 30,000 species have been identified as at risk of extinction worldwide, while estimates of the true number at risk range as high as 20 percent of all species. In Canada, about 71,000 species have been identified and a further 66,000 are suspected to exist.¹¹ Of these, 340 are deemed “at risk,” including about 10 percent of known mammal species, 5 percent of birds, and 8 percent of reptiles and amphibians. Two expert committees address threats to species under a 1996 federal-provincial accord, one that determines endangerment status, and one that prepares non-binding recovery plans. Most provinces and territories now have endangered species legislation. Federal legislation was introduced in 1995 but not enacted, and a new federal *Species at Risk Act* was introduced in April 2000.

The newest environmental issue now prominent on the international agenda concerns the persistent organic pollutants, principally organochlorine pesticides. Bioaccumulation of POPs in wildlife played a strong role in arousing environmentalism in the 1960s. Through domestic regulation in Canada and elsewhere, recently supplemented by voluntary programs, environmental burdens of these chemicals declined sharply from the 1970s to the early 1990s.¹² Three new factors, however, have since brought these chemicals to prominence on the international policy agenda: a levelling off in concentration declines in the 1990s; increasing evidence of long-range transport and accumulation in seemingly pristine environments like the Arctic; and the recent hypothesis that concentrations of certain POPs previously thought benign can disrupt endocrine function. Several international initiatives to restrict a dozen of the most persistent, toxic, and accumulating POPs are underway, including the recently concluded Protocol under the LRTAP convention.

In sum, for environmental policy in Canada the past few decades have been a period of substantial

but mixed progress against persistent, uncertain, and shifting environmental problems. Canada, like most of the rich world, has thus far largely succeeded at deflecting its environmental challenges at very modest cost to income growth.¹³ Environmental problems rarely disappear, however. As human activities continue to grow, old problems re-emerge in new forms and new ones appear. They require continuing monitoring, an increasing capacity for farsighted and integrated understanding, and commitments to sustained yet adaptable management. Moreover, as human society expands, the trade-offs between the environment and economic growth are likely to grow sharper and clearer. Although the environment may be the most important long-term social problem, it is rarely the most urgent one. Personal and national security, and jobs and incomes, remain persistently at the top of policy agendas, certainly when they are perceived to be in any way threatened. In contrast, clear environmental threats that compel action are rare, making the challenge of effective and timely response all the greater.

SCIENCE, ASSESSMENT AND GOVERNANCE

The environment team in the Project on Trends considered the social and political problem of governing the environment to manage these persistent environmental trends. The challenges discussed here map onto some of the broad requirements for environmental governance. Contributors to the project have considered the governance challenges posed by the need to integrate scientific knowledge into policy-making; the cross-scale nature of environmental problems; and the need for detailed coordination of action across levels of authority, policy areas, and among groups with distinct authorities and interests. They have also considered proposed innovations to address these challenges, including a shift from coercive regulation toward voluntary and cooperative measures, and increased direct citizen involvement in environmental decision-making.

Although the conditions necessary for sustainable development are not well specified, they surely must include adequate knowledge of the properties of the natural systems on which society depends, and the means to apply available knowledge to guide development decisions. The knowledge that must be generated, synthesized, and applied may be specific or general: from the particularities of stock assessment to managing a fishery, to the broad knowledge of regional or global systems that can provide early warning of risks or help to identify responses.

Useful and legitimate synthesis of expert knowledge with democratically accountable deliberation and decision-making poses grave challenges, both conceptual and practical, to the design of policy processes and institutions. At a conceptual level, the domains of science and of democratic politics have different goals, standards of merit, norms of participation, and procedures for resolving differences. At a practical level, desired knowledge is often unavailable, and available relevant knowledge is often not adequately used. Knowledge is often inadequate to give high confidence in the consequences of decisions, and decisions sometimes cannot be delayed until high confidence is obtained. Uncertainty is thus unavoidable and pervasive in environmental governance, with two consequences of fundamental importance.

First, costly decisions to avert an environmental risk must sometimes be made without strong confidence in the magnitude or character of the risk. This insight is increasingly recognized, and expressed in the "Precautionary Principle": that precautionary measures should be taken against likely but unconfirmed risks. Although this principle seems to evoke a rational decision-analytic process, in which the likelihood and severity of a risk is weighed against the cost of action to avoid it, its operational meaning is scarcely more precise than that of sustainable development. The principle does, however, clearly reject one view of the burden and standard of proof needed to impose protective measures, which was

once dominant — at least in rhetoric, if not always in practice. According to this view, inappropriately drawn from criminal law, activities and materials (e.g., chemicals) are presumed environmentally benign until demonstrated harmful beyond a reasonable doubt. The Precautionary Principle is the slogan for the realization that sometimes activities should be restricted in absence of decisive demonstration of harm. The opposing extreme view, that activities are "guilty when charged" with any environmental harm, is of course equally insupportable — leaving ample room for discretion and dissent over what the Precautionary Principle requires in any particular case.

The second consequence is less widely recognized: that decisions carry unavoidable risk of error. Any environmental decision may, with more information or better understanding, be revealed as too stringent, too weak, or simply misconceived. Rational environmental governance consequently requires some way to adapt policies and decisions to advancing knowledge, a goal known as "Adaptive Management." The concrete meaning of adaptive management has never been fully specified, but a few of its basic requirements are evident.

First, resources must be invested in learning. Monitoring and research must continue, not cease when initial management decisions are made. Moreover, monitoring and research programs must be designed not just to advance general understanding, but for their relevance to informing potential future decisions. Often, a powerful way to advance understanding is to design policies to be *informative*, in addition to their other goals. What this requires will vary, but will certainly include that decisions should perturb the system strongly enough to generate a signal, and be sustained long enough for the system to respond.¹⁴ Loose federal systems like Canada's routinely produce potentially informative variations in management, as different jurisdictions take different paths. But this potential for learning is seldom realized. It requires unbiased,

consistent monitoring and evaluation, and ideally some way to coordinate the form, time of enactment, and duration of policy “experiments.”

In addition, policy institutions need both the capacity to assimilate new knowledge and the flexibility to respond to it appropriately. While the other conditions for adaptive management have proved challenging, this one is the hardest. It requires that systems of governance be able to distinguish between three types of supposed new knowledge: new information that shows prior decisions were so bad that it is worth bearing the cost of changing them; new information that does not meet this threshold; and supposed new information advanced as a rearguard action by the initial decision’s opponents, which a competent and impartial observer would judge to have no merit. To draw such distinctions requires that pluralistic and partisan governance processes have access to objective high quality scientific advice, including non-partisan expert judgements that weigh the importance of new findings, synthesize multiple competing claims, and assess their merits. Moreover, the ability to act appropriately on new information requires a governance process, and individuals in it, capable of acknowledging error — or, more plausibly, that the political or bureaucratic cost of acknowledging error be reduced, while still maintaining adequate standards of professional competency.

The implications of a commitment to adaptive management in public policy are not confined to government. Because regulatory decisions affect the permissible uses and commercial value of private property, a commitment to adaptive management would necessarily reduce the security of private property rights. If all decisions are subject to revision, the risk of future restrictions hangs over every activity and property. Government cannot even promise when imposing restrictions that the same activity or property will not bear stricter or different restrictions in the future.¹⁵ This conflict remains nascent in Canada for now, but is already fully engaged in the United States. Many

western property owners have negotiated agreements with the Environmental Protection Agency (EPA) over the *Endangered Species Act*, which thwart adaptive management by excluding any future restrictions in return for present accommodations. In contrast, in US regulation of chemical substitutes for CFCs, industry sought — and EPA refused — firm commercial lifetimes for chemicals once their introduction had been approved.

These conditions appear essential for systems of governance that advance understanding and act on it, but they are a tall order. Schrecker discusses several prominent failures to obtain or appropriately use essential information in Canadian policy. These cautionary tales reveal how difficult it is for government to support good, independent, policy-relevant research, and to act on it. Schrecker proposes three reforms to improve matters, but draws a pessimistic conclusion: that they would so severely limit ministerial discretion that the prospects for their realization — and hence for more responsible use of scientific knowledge in Canadian environmental policy — are slim.¹⁶

His first proposal is for “firewalls,” organizational barriers strong enough to protect publicly employed or funded scientists from suppression of results or professional retaliation when their results offend their superiors. His second and third proposals both seek to increase the transparency of government decision-making processes. Responsible officials would have to reveal both the evidence on which decisions were based, and the general guidelines they follow (assuming they know and can articulate them) in weighing evidence and deciding who they believe saying what in support of what kind of decisions. Such transparency is clearly attractive in principle, but what might its consequences be?

Public actors often have a strong interest in obscuring the actual criteria and trade-offs that guide their decisions. Indeed, it can be politically advantageous to maintain discretion to act while being able

to demonstrate, at will, that compelling argument or overwhelming force left only one conceivable choice. The *force majeure* so invoked may be an international obligation, a classic strategy of Canadian bureaucrats to overcome domestic blockage, even when they have been instrumental in creating the international commitments.¹⁷ It may be the risk of capital leaving, or not coming. Or it may be science. Any of these forces can be made to seem to bind decisionmakers' hands, forcing on them the action they in fact wish to take. In many cases, this is simple deception: power is only seemingly lost, or is voluntarily given up and can be readily reclaimed. Sometimes, however, enough delay in taking required action can lead to real compulsion: a fishing moratorium may be imposed "by the fish."

When science is the pretext used in this charade, the cost can be high. If scientific advice is made to compel policy choice, then political debate and discretion are likely to be pushed back into the processes of developing the scientific advice. Accountability is likely to be lost if the decisive political debate is moved into closed and non-representative forums. High quality, objective scientific advice is likely to be lost if advisory bodies' output is manipulated to support decisions adopted. Paradoxically, pursuit of greater transparency in political decision-making may jeopardize both the quality of advice and the accountability of decisions.

Several other approaches have been proposed to ensure that scientific advice is high in quality, independence, and relevance. Sometimes merely avoiding explicit policy conclusions may protect advisory bodies from political interference, even if such conclusions are plainly implied. But this is a balancing act: avoiding recommendations may be essential, but failing to state policy implications can be a large step toward irrelevance, particularly since advisory bodies speak to multiple audiences, and what is obvious to some is not to all. Conversely, unexplicated policy implications, or even pure statements of scientific data or theory, can sometimes be

embarrassing enough to provoke attempted suppression or disavowal.

Another approach, practised with some success in the 1990s, has been to move scientific and technical assessments to the international arena. For several global issues, including both ozone depletion and climate change, international assessments have largely supplanted national assessments. While the substantive rationale for international assessment of global issues like these is compelling, there are also political advantages. The diversity of political interests, and the reduced likelihood of control by any faction, can facilitate assessments that attain both high quality and relevance. These advantages may explain the increasing internationalization of some issues that actually have much smaller scales, such as biodiversity and desertification. Even when understanding the issue requires local knowledge, international bodies can still specify standards for national assessments or national contributions to an international assessment.

SPATIAL SCALE AND ENVIRONMENTAL AUTHORITY

The environment is extreme in the extent that it is characterized by overlapping and shared authority between governments, and between state, non-state, and inter-state actors. Such overlap arises from the complex spatial structure of environmental processes, and because effective environmental governance depends on the behaviour and knowledge of many diverse actors, which the state lacks the knowledge and authority to specify. Moreover, in Canada and most federal states, the environment is divided among many related constitutional powers, some held at each level.¹⁸

Because environmental issues are a complex mixture of local, regional, and global-scale dynamics, one cannot simply match the primary scale of a problem with the primary scale of authority to manage it. The appropriate division of small-scale and

large-scale environmental authority has been particularly hotly debated in Canada.¹⁹ Here, decision-making is simultaneously pulled outward toward international management and inward toward greater provincial authority. Paehlke examines the challenges these complex spatial linkages pose for effective sharing of authority between sub-national, national, and international levels of governance.²⁰

An enduring theme in this debate is the bioregionalist aspiration for political authority to reside in local communities organized on ecosystem boundaries. Paehlke rejects this aspiration for three reasons. First, ecosystems do not possess clear boundaries, but comprise multiple, interlinked systems whose boundaries are diffuse and do not coincide. Second, sovereign local authority can and often does violate basic democratic norms. Third and most important, the political and economic forces that dominate modern society are increasingly organized globally, so even local autarkies could not manage their economies and resources independently.

Turning to the division of environmental authority between existing levels of government, Paehlke assumes a constitutional blank slate and argues for the inherent preferability of national supremacy in the environment — while noting that nearly the opposite is occurring in Canada, as environmental authority is being ceded at once downward to the provinces and upward to international institutions. Three factors favour federal predominance, which are offset — but in Paehlke's view, only partially — by the greater knowledge and concern smaller jurisdictions are likely to have for their environment. First, federal governments have the resources and legal standing to act in the international domain, where the crucial balancing of environmental with economic authority must occur. To participate credibly at this level, a state needs the authority to deliver on its commitments. National governments are also better than sub-national governments at resisting two structural forces that systematically favour too weak environmental protection: the race to the bottom in fiscal and regulatory policy, as jurisdictions com-

pete to attract and keep investment, and the greater sectoral concentration of smaller economies.

These claims are controversial, particularly in the recent Canadian climate of provincial assertiveness and federal diffidence, but carry some force. The first is correct as a matter of law, and appears to be supported by diplomatic experience; the other two are plausible empirical claims. The argument from the sectoral concentration of small economies in particular is supported by Canadian experience, where provincial governments are highly solicitous of predominant local industry and resource sectors.

The race to the bottom claim, while observed in some policy domains,²¹ is more complex and the evidence more ambiguous. Two parts of the claim must be distinguished, concerning firms' location decisions and governments' attempts to influence those decisions, respectively. Firms must consider a host of factors in location decisions, including transport costs, quality and cost of workforce, political and currency risk, and many dimensions of fiscal and regulatory policy. The cost of environmental standards must surely influence these decisions, but as one factor among many. Empirical studies in the 1980s found that environmental standards were a strong location factor for only a few extremely dirty industries. While these studies had significant weaknesses and are now out of date, recent studies of location decisions still conclude that other factors nearly always overwhelm environmental standards. When they do not, the investment that goes elsewhere may well be investment that a rich, environmentally concerned nation would rather not have.

To observe that capital rarely leaves (or fails to come) due to environmental regulations does not, however, mean that firms rarely *threaten* to do so; abundant narrative evidence suggests such threats are made frequently. Do officials believe them? Governments do sometimes relax environmental standards, grant exceptions, or decline to enforce them. Such decisions sometimes target a particular

firm, sometimes in response to a threat, but they are often broadly targeted. When offered, the public justifications for such decisions are often, but not always, to protect jobs or attract new investment. It would appear that politicians and officials, at least some of the time, do believe that strong, effectively enforced environmental standards risk loss of investment, despite studies showing the risk to be small.

Why? Only three explanations appear plausible. Perhaps officials are bad poker players, easily misled or intimidated; perhaps empirical studies understate the true risk of capital flight; or perhaps officials use the threat of lost investment as a pretext, “forcing” them to do what they wish to do for other reasons. Those other reasons might be a sincere belief that standards are too strict, general ideological opposition to regulation, or a desire to favour friends and supporters. Determining the actual patterns of bargaining between firms and officials over environmental standards and the mix of interests that motivate each side, are important, potentially researchable questions, although the difficulties of obtaining reliable data are likely to be severe.

Paehlke contends that appropriate environmental protection is systematically more likely to be blocked at smaller scales than national, but the evidence is mixed. In Canada, the federal government has by no means always led on the environment, even considering constitutional limits on its authority. Indeed there have been occasions when the federal government had to be compelled, reluctantly, to exercise environmental regulatory authority it clearly did possess.²²

Other bodies of evidence initially appear to favour local control, although their relevance to dividing authority in a federal state is limited. For example, theory and evidence both suggest the most successful management of common-property resources is at local levels, where at most a few hundred agents must develop means of mutual restraint.²³ With competent and legitimate govern-

ments in place, however, few environmental problems have the structure of a commons. Some municipalities have shown substantial interest in global environmental issues, but their concrete actions have typically been symbolic and nearly costless, so they provide only weak evidence of local willingness to contribute to global environmental goals. Finally, the claim of a “race to the top,” in which jurisdictions seek to lead in advanced technologies by adopting strict environmental controls, appears to have highly restricted validity.²⁴

A more persuasive basis for favouring substantial environmental authority at sub-national levels is suggested by the preceding discussion of adaptive management, however. Locating authority at smaller scales allows diverse standards and approaches. While such diversity is most often proposed to respond to diverse local conditions or preferences, it also allows jurisdictions to experiment with diverse and innovative approaches. Such diversity could greatly promote learning about the effectiveness of alternate responses, *if* sufficiently controlled that the variation is informative and *if* programs and results are adequately monitored. The diversity would also carry real costs, such as allowing local jurisdictions to choose weaker standards than a national or international consensus, and bearing the risk of failed policy experiments. Moreover, as for all pursuit of adaptive management, the political challenges would be substantial. The approach would require institutional capacity to admit ignorance, admit error, and revise policies revealed to be inadequate, even after they have accreted constituencies with stakes in their continuance.

A promising direction for resolving competing claims of environmental authority at multiple scales would be to construct cross-scale networks of shared authority and negotiated joint decisions that mirror the complex cross-scale structure of the issues. Canada’s loose federal structure may facilitate such an approach, or indeed compel it if redrawing lines of constitutional authority for the environment is out of the question. In fact, Canada did experience sev-

eral years of such effective collaboration under the Canadian Council of Ministers of the Environment (CCME), following a series of decisions that strengthened its role in the late 1980s. Benefiting from strong commitments from several senior figures and careful institutional design, CCME made several contributions to effective national environmental policy. It helped build technical capacity in smaller jurisdictions, it gave provincial and territorial officials a national perspective when they held the rotating chair, and it provided key research and analysis to address shared technical problems. CCME's subsequent decline reflected weakened commitment from several key jurisdictions, for both fiscal and ideological reasons. It also followed an attempt to harmonize all aspects of environmental protection across jurisdictions, an attempt that overreached and failed, ultimately yielding a limited, face-saving agreement. The experience of CCME remains to be mined, and likely holds valuable lessons about the scope, limits, and conditions for environmental policy coordination and harmonization, both in Canada and in the international arena.

INTERNATIONAL ECONOMIC REGIMES AND ENVIRONMENTAL PROTECTION

Although the future path of domestic sharing of environmental authority is obscure, the international path is somewhat clearer, for one fundamental reason. Economic activity and its regulation are both shifting strongly toward being organized at the global level. Conversely, institutions dedicated to income growth through free movement of goods and services, capital, and labour, increasingly dominate international governance.

Consequently, as well as sharing authority across spatial scales, effective environmental governance requires sharing authority between environmental and economic institutions. At present economic regimes are paramount, strongly affecting other domains, including the environment. Present economic regimes must often resolve disputes over

environmental or conservation measures, thereby judging the acceptability of environmental measures as regards both their intent (are they disguised trade protection?) and their effect (does their harm to trade outweigh their environmental benefits?). They thereby render far-reaching judgements of the relative weighting, and the reconciliation, of liberal economic goals and environmental goals.

Juillet argues that economic regimes differ strongly in how they balance these goals. Most lack expertise or sympathy for environmental goals and make liberal trade goals supreme. Moreover, many make these judgements without accountability, rendering decisions in closed proceedings or deferring to private standard-setting bodies. Still, some do better than others. In particular, Juillet argues that the EU better balances economic and environmental values than NAFTA or the WTO. NAFTA's Chapter 11 is particularly egregious, providing expedited secret procedures through which firms can attack national environmental regulations.²⁵

More fundamentally, Juillet argues that seemingly reasonable principles to guide such decisions may inappropriately constrain national authority over the level of environmental standards, the form of policy instruments used, or the manner of implementation. For example, the principle that environmental controls must have a "scientific basis" is frequently interpreted, simplistically, to require high confidence in the severity of a risk before allowing a regulatory response — effectively reversing the hard-won, 20-year shift toward more precautionary management. Similarly, the product-process distinction might excessively restrict the scope of permissible environmental controls. The distinction implies that products made by environmentally preferable processes may not command any regulatory advantage over identical products in international trade. This principle, if fully implemented, would exclude national measures to reduce the environmental burden of foreign production, even when resources being harmed are of international consequence or concern.

So what way forward? Trying to protect the environment by resisting economic forces of globalization is clearly futile. Rather, the present imbalance between liberal trade and environmental principles must be redressed at the international level. This is an essential component of the vision of an environmentally benign globalism that Juillet and Paehlke share. For environmental issues of global significance, the way forward is relatively clear. Economic institutions must accept the legitimacy of multilateral environmental commitments, at least in their core environmental protection provisions. Trade restrictions in environmental agreements would require more careful negotiation, which might need to distinguish between trade restrictions that are essential to a treaty's environmental goals (as in CITES and the Basle Convention), and restrictions that are included to motivate states to join the treaty (as in the Montreal Protocol). While universal deference of trade regimes to environmental ones is no more likely to be acceptable than the present, nearly opposite situation, trade restrictions of both types could, under certain conditions, be compatible with a broadly liberal international economic system and granted a conditional presumption of deference.

A second requirement would be the creation of countervailing institutional strength and expertise on environmental issues at the international level, to ensure reciprocal consideration of environmental and economic values in setting policies in each domain. While it might seem preferable to graft environmental mandates and knowledge onto existing international economic institutions, this path is unlikely to succeed. The limited success of attempts to infuse environmental concern into the WTO and World Bank, like the weakness of the environmental institutions belatedly grafted onto NAFTA, speak to the difficulty of this task. Constructing parallel international environmental authority is also a tall order, but with enough initial political resolve is less clearly doomed.

For national or local environmental policies, the path is murkier. Even on issues of global scale, lead-

ing nations often enact measures stronger than their treaty obligations, which most often reflect a lower, consensus level of concern. For issues that lie predominantly within national borders, or that evoke idiosyncratically national concerns, international treaties may be neither feasible nor appropriate. In these cases, it is not clear how to protect national discretion in environmental governance, nor even how much discretion ought to be protected. Paehlke's advocacy of global environmental authority can be read as rejecting local or national divergence in protection, regardless of local conditions, as the price of elevating the political status and force of environmental protection to equal that of economic growth.

The present situation is indeed hostile to divergent national measures. The dominant presumptions are that the same level of protection is appropriate everywhere, that it should be harmonized at that level and implemented through least trade-restrictive instruments, and that this level can be determined through universally agreed processes of scientific reasoning and assessment. As Juillet argues, the EU is a partial exception, able to sustain more international diversity because its dense network of commitments permits trades on many dimensions. In other economic regimes, the forces favouring levelling now largely prevail.

But some jurisdictions may not want to harmonize standards. They may want to protect more strongly, or with more precaution, than an international consensus supports. They may seek to protect unique national resources or values, or to protect against certain risks for expressive or cultural reasons that lack strong scientific foundation, or to implement environmental protection through idiosyncratic policy instruments that fail the "least trade-restrictive" test. Alternatively, to gain political support necessary to protect a sincerely held environmental value, a jurisdiction might have to recruit protectionist groups by implementing environmental measures in a form that advances their interests. Any of these decisions might be le-

gitimate, but the emerging principles of international economic regimes would forbid all. Indeed, these would be difficult to distinguish from measures construed as environmental protection, but primarily motivated by protectionism. Drawing these distinctions would require an impartial adjudication process that grants sincere pursuit of environmental protection equivalent standing to liberal-trade principles.

These possibilities suggest that environmental measures might be understood in part as expressions of local or national cultural diversity. Framed this way, idiosyncratic local measures should perhaps be permitted, or permitted under certain conditions—e.g., when judged sincere by a neutral body, or with a requirement of compensation as assurance of their sincerity. Canada's decision to ban the gasoline additive MMT provides a useful illustration. Two descriptions of the basis for the Cabinet decision have been advanced: first, that advisers judged MMT likely to cause environmental harm, though scientific evidence was ambiguous; second, that a political decision was made to favour the automobile industry, which supported the ban, over the oil industry, which opposed it. The ban might be judged acceptable in either case: just because oil prevailed over autos in the US, it is not clear that the international trade regime should help them extend their victory worldwide. But the ban clearly appears more acceptable, and MMT's US manufacturer less entitled to compensation, if the first reason predominated.

Allowing some national discretion in such matters has much to commend it, but would create a serious moral hazard. Resolving the tension might involve two elements. First, some dimensions of environmental authority would be shifted to international bodies, even for predominantly local issues, to counterbalance the economic bias of present global institutions. Such international authority would not completely reject diverse national approaches but would delimit their scope, judging the acceptability of particular measures case by case. Unlike

the present situation, these decisions would be made from a basis of primary concern for the environment rather than liberal trade. The second element would combine international expert assessment of disputed environmental measures with graduated compensation to parties that the measures harm. The degree of compensation would reflect combined judgments of the measure's trade effects, its motivation, and the gravity of the environmental value it claims to protect.

THE PUBLIC-PRIVATE INTERFACE: REGULATION, VOLUNTARISM, AND SHARING OF AUTHORITY

As Canadian environmental institutions are challenged by federal sharing of authority and by loss of national authority to international economic regimes, they are also following a widespread trend toward intentionally devolving some aspects of their authority to non-state actors. Papers written for the Project on Trends considered different aspects of this devolution.

Harrison examines voluntary programs that devolve some authority over defining, implementing, or even enforcing environmental measures to private actors, replacing coercive state regulation. While limits to state power and knowledge inevitably imply *some* sharing of effective authority with non-state actors, she provides several grounds for caution in endorsing a major shift toward explicit reliance on voluntary measures.²⁶

She reviews present experience to ask why such measures are adopted, and how well they work. She argues that they may be adopted for various reasons, of greater or lesser legitimacy. On the one hand, firms have better access to, and information about, their operations than regulators do, so delegating implementation to them could realize environmental goals with greater efficiency and reduced burden. In contrast, such delegation may simply be regulators' response to political or organizational

weakness, or worse still, may seek the appearance of tackling an environmental problem without commitment, burden on firms, or hope of success. In the first case, the policies are adopted because they work, in the second because they do not. Which of these applies in any particular instance depends on the details.

Examining the effectiveness of voluntary measures in practice, Harrison argues that inflated claims are rampant, and that even serious attempts to assess effectiveness accurately are often obstructed by confounding factors, implementation lags, and lack of reliable information. The programs' design often exacerbates these problems, in that they typically lack clear targets, reporting requirements, or provisions for independent performance audits. Indeed, a significant effect — or even purpose — of voluntary measures may be to thwart democratic accountability, by shifting important decisions on environmental protection into closed bargaining sessions.

As Harrison points out, the term “voluntary measures” embraces a confusing diversity of approaches. In particular it is often used, misleadingly, for approaches in which the state requires firms to do *different things* than under conventional regulation, imposing environmentally relevant requirements but granting flexibility in deciding how best to attain them. Examples include shifting from technology standards to performance standards, shifting from command-and-control regulation to market-based mechanisms such as tradable emission permits, and substituting information disclosure and reporting requirements for standards. The essence of these approaches is not that they reduce state coercion, but that they seek more efficient division of responsibility: the state sets environmental goals, while firms use their greater knowledge of technical possibilities and influence over internal behaviour to find better and cheaper means to these ends.

Harrison considers a different set of instruments, which reduce or eliminate direct use of the state's

coercive authority. These remain a diverse set on many dimensions, including the extent and source of effective coercion that they retain. Few are *entirely* voluntary, relying on sincere environmental concern as the sole basis of behaviour change with *no* externally applied incentives. Rather, most manipulate incentives in one of three ways.

Some make limited but real use of state power. The state has ample resources to influence behaviour without using its coercive authority. It can offer resources, expedited processing of business, exhortation, praise or censure. Even such limited use of state authority can change targets' incentives and behaviour.

Alternatively, such measures may manipulate incentives through the perceived *threat* of state coercion if negotiations fail. As in all negotiations, the terms of negotiated voluntary measures depend in part on each party's perceived alternatives to a negotiated agreement.²⁷ Both for firms and for the state, one salient alternative to agreement is unilateral imposition of regulation by the state. Though exercising this authority may be costly and difficult for the state as well as for the targets, the threat of using it — if credible — can encourage targets to agree “voluntarily” to substantial behaviour changes to avoid the risk of its imposition. The threat succeeds although — or rather, because — it is not carried out.²⁸ Even when the threat of coercion is salient, the state and firms may still negotiate more nuanced agreements that both prefer to the blunter outcome they would likely obtain through adversarial regulatory proceedings.

Such measures may also involve coercion applied by non-state actors, acting in lieu of the state. Delegating authority to implement negotiated agreements to non-state bodies can offer several important advantages. The non-state monitors might have better knowledge or better relationships with the targets than the state, yet may perceive the threat of the regulatory alternative more clearly than some of the targets. The monitor might, for example, be

an industry association, typically allied with the largest or most technically advanced firms, who can solve their collective-action problem by disciplining small bad actors that besmirch the industry and harm them all. Moreover, in more intrusive and delicate aspects of implementation, non-state monitors might enjoy access and discretion that government officials doing the same job could never have. This might occur in part precisely because they are not backed by the blunt coercive authority of the state, in part because people would generally rather be instructed by those they know and like, than by those they do not know and do not like.

Some programs may appear entirely voluntary, including neither the use nor the threat of regulation. Ultimately, the state cannot renounce its authority to act in the public interest to protect the environment, although governments sometimes pretend to do so. Still, political or organizational weakness can render governments temporarily unable even credibly to threaten regulation. Under these conditions, the incentives states can offer are modest, and exclusively in the positive direction. These may still change behaviour: they may assist targets in undertaking environmental measures they were willing but unable to do; or they may, through learning, exhortation, or modelling, change firms' preferences for environmental conduct. But the lack of even the threat of regulatory action surely severely limits what such programs can accomplish.

A potential offsetting advantage of voluntary programs may be offered by cognitive dissonance, however: when people find themselves acting contrary to their preferences or beliefs, they are likely to adjust their preferences or beliefs to align them with their behaviour. The adjustment is stronger the less external incentive is applied to induce the behaviour. Consequently, applying the minimum coercive pressure to gain a desired behaviour change is likely to yield the greatest change in attitudes, and hence in likely future behaviour. If analogous processes occur in organizations, perhaps by changing internal values and routines, external incentives

may become less relevant over time, conferring important advantages on voluntary regulatory programs.

ENVIRONMENTAL GOVERNANCE THROUGH DIRECT CITIZEN INVOLVEMENT

A further trend in shifting relationships of authority between state and non-state actors is the increasing use of processes of Citizen Involvement (CI), to engage citizens directly in deliberation or decision-making on matters of state authority. Dorsey and McDaniels identify two historical waves of enthusiasm for such processes in Canadian environmental governance, one in the early 1970s and one in the early 1990s.²⁹ Both waves receded, due to several factors: over-promising and consequent disappointment with results; lack of clarity regarding mandate and responsibilities; and, at least in the second wave, governments' attempts to pursue too many CI activities at once. Dorsey and McDaniels predict, and endorse, a third wave of more selective use of CI, tailored to specific issues for which it is most suitable, with more routine and systematic evaluation. To realize this potential, they caution that sponsors must be more explicit than they typically have been regarding the mandate of CI processes, particularly the extent to which the process is advisory or authoritative.

CI is not a return to an idealized direct democracy, but a selectively employed augmentation to representative government. It may serve certain functions of public decision-making more effectively than representative or bureaucratic institutions. For example, it may help define questions, clarify relevant values, objectives and trade-offs, and marshal knowledge, including local knowledge, from diverse sources. CI processes can be particularly useful at explicating values, counterbalancing the widely noted tendency for representative bodies to resist clear articulation of objectives and priorities. They may even help bring ethical perspectives into public decision-making. It

has also been suggested that CI processes may have intrinsic benefits, independent of their effect on decisions, enhancing the perceived legitimacy of public decisions, or empowering citizens through meaningful participation in their communities.³⁰

Clarification of goals in a diverse polity has risks, however. If the obstacle to decision-making is that goals are obscure, then deliberative processes may help clarify them. But if the problem is that goals are deeply contested or interests persistently opposed, such elaboration may exacerbate rather than mute conflict: it can be easier to agree on actions than on goals. Expanded and effective use of CI must surmount three central challenges: the need to articulate a legitimate basis for participation, the risk of reducing the broad public interest to bargaining among stakeholders, and the need to ensure responsible use of available scientific knowledge.

The question of who participates and how they are chosen is a tension that runs throughout the CI literature. Participants might self-select for any number of reasons, or might be invited because the decision affects them, because they represent a class of affected people, or because their participation is expected to improve the quality of decisions.³¹ Each criterion is likely to yield different participants, and managing participation so CI processes are widely perceived as legitimate is likely to pose great challenges — especially for conflicted, high-stakes issues, for which CI processes may have to be limited to advisory roles.

A related tension concerns the responsibility of government in CI. All citizens have an interest in the kind of nation they inhabit and the conduct of their government, but not all citizens are stakeholders, in the sense of having a direct material interest, in any particular decision. Diverting public decisions to stakeholder bargaining can risk losing accountability for the broader public welfare and the ethics of state conduct. Government has the responsibility to seek, support, and when necessary arbitrate the public interest. It can no more escape

this responsibility than it can escape its ultimate coercive power in implementing laws. Use of CI must not let officials or legislators evade this responsibility by pretending to be only mediators among stakeholders, or bankers who facilitate agreement by bringing public funds to the table.

Dorcey and McDaniels propose correctives for each of these challenges. To mitigate the risk of biased or illegitimate participation, they charge facilitators to be alert to the risk of overrepresentation of the powerful and most acutely interested, and to take special measures to ensure important interests not participating are effectively represented. To mitigate the risk of lost government accountability, they argue that all CI processes must have clear mandates and lines of accountability, including explicit designation as either advisory or authoritative. Regarding the risk of inadequate consideration of scientific knowledge, they note that conventional decision processes also often fail in this regard, and propose mitigating the risk by using facilitators with relevant substantive expertise.

These suggestions all promise some mitigation of the risks in practical terms, but have evident limitations. To make facilitators responsible for substantive expert knowledge, and for discerning and voicing inadequately represented interests, is to give them an enormous job and rely heavily on their expertise and integrity. Clear mandates are surely advantageous, but unlikely to relieve all concern about illegitimate delegation of government authority. Where authority is explicitly delegated for decisions with primarily local implications, as in resource co-management arrangements with local communities, sufficiently broad community participation and government process oversight may suffice. But for decisions with large-scale implications, even ostensibly advisory processes can raise concerns about illegitimate delegation because the extent of the actual influence the CI process has over subsequent government decisions may be impossible to determine. Moreover, achieving enough of both legitimacy and technical adequacy, properly

integrating expertise and participation, analysis and deliberation, will surely be more difficult in CI than in conventional governance processes, with their greater reliance on the impartial authority of experts operating within democratically delimited bounds.³²

ENVIRONMENTAL PRESSURE AND PARADIGMATIC POLICY CHANGE

The increasing use of both voluntarism in implementation, and consultative processes in policy formation, represent reductions in the exclusivity of state authority for environmental governance. Howlett argues that a broader diminution of state authority is making traditional coercive policy instruments less viable in general, and indirect, procedural instruments more prevalent.³³ In this context, he examines the prospects for major change in Canadian environmental policy, proposing a theoretical scheme by which the rate and character of policy change is determined by the presence or absence of new actors and new ideas. The presence of new actors determines whether change is slow or fast; the presence of new ideas determines whether its character is “incremental” or “paradigmatic.” For the environment, the current prominence of new actors and new ideas suggests forces are aligned for rapid, paradigmatic policy change. In the face of these forces, government can only modestly adjust the pace, direction, or character of change, or make it slightly more orderly. The methods available for such fine-tuning are the procedural instruments that regulate the access to policymaking of new actors and new ideas.

New ideas clearly do matter in political and social change, and there are clearly new ideas around in environmental policy, or at least new forms of old ideas or ideas only a few decades old. Candidates for important “new” environmental ideas might include global limits (1970s); biogeochemical cycles (1930s, revived in the 1970s); geoengineering to manage the earth system actively (1960s); the tragedy of the commons (1840s, then 1970s); the

commodification of environmental insult through such instruments as tradable emission permits, the modern analog of the enclosure of the commons (1970s); the Precautionary Principle (1980s); Sustainable Development (1980s); and Adaptive Management (1980s).³⁴ New actors are also clearly present, such as environmental NGOs, especially ones of international scope; and in Canada, increasingly organized and legally empowered First Nations.

For the most part, however, these ideas and actors are not very new. Nor are claims that environmental stresses are about to transform society. Projections of rapid change must consequently be weighed cautiously against the record of similar, erroneous past predictions, asking what has changed, or what cumulative factors are now building to a break point.

Citizen concern for the environment has been persistently mixed, labile, and ambiguous, only infrequently reaching and holding the intensity required to provoke major policy change. Moreover, citizens’ declared concern for the environment often exceeds the evidence of concern discernible in their major consumption choices such as residence and transport. Consequently, governments most often treat environmental protection as a secondary priority, sometimes with active hostility. While periodic short-term environmental crises can be expected to occur, such as the 1988 PCB warehouse fire at St-Basile-le-Grand, Quebec, or the 1990 tire fire in Hagersville, Ontario, these provoke specific, narrowly targeted responses, not the proposed fundamental reorientation of thinking and behaviour.³⁵

That new environmental ideas have not yet transformed governance or behaviour does not, however, mean they cannot. Their effect might be felt over decades, rather than years. But if they cannot, two types of historical events are often proposed as able to bring the required changes. The first would be a major environmental scare — not a catastrophe, but an event like the Antarctic ozone hole — which

would vividly illustrate the possibility of sudden, major environmental transformation without causing such severe harm that society's ability to respond is impaired. The second, equally beyond the reach of calculated pursuit, would be a widespread transformation of people's ethical or religious world-view toward the environment. The longing for such a transformation may partly explain the hopes (and projections), perhaps excessive and unfair, that some environmentalists continue to vest in First Nations.

Vesting hope for large-scale behaviour change in such transformative events may set the standard too high, however, avoiding collective responsibility for more prosaic change. Major social change does happen, but outside revolutionary times it takes decades or longer. Moreover, such change is not driven exclusively, or perhaps even primarily, by government policy. Policy can help, but cannot force social change through its exclusive efforts; rather, many causal forces interact. Many distinct types of change also interact, so changes each seemingly inadequate to the task can add up. In particular, the cumulative transformative power of technological change is not to be casually dismissed. It interacts with policy and ideas, is usually industry-driven, and has already relieved a host of environmental stresses this century, at least for the rich world. The remaining contribution toward easing global environmental stresses from this source, while unlikely to be sufficient in itself, is likely to be substantial.

CONCLUSIONS AND RESEARCH PRIORITIES

The environmental trends project elaborated three sharply drawn challenges for environmental governance in pursuing sustainable development, and a set of priority knowledge needs for improving environmental governance over the coming decades. A first theme concerned the need for adaptive management, and the difficulties involved in achieving it. It will impose demanding conditions on both the institutions that advance scientific knowledge and synthesis, and those responsible for public and pri-

vate decision-making. More effective methods are needed to conduct scientific and technical assessments, and to define their boundaries with policy processes, to ensure relevance while protecting against partisan control. Prospective assessment, to identify emerging stresses, will likely require new and different methods.

A second theme concerned the need for increased institutional capacity for environmental protection at the international level, to balance the present predominance of principles of liberal trade. This further shift of environmental authority to the international level must, however, allow some diversity in environmental standards and measures, and in the specific aspects of the environment chosen to protect. A third theme concerned the need to construct networks of shared authority and continuing negotiation, to reconcile inevitable areas of overlapping capacity and authority between levels of government, and between state and non-state actors. Managing the environment over the coming decades will involve enough uncertainty and complexity that precise and static division of responsibilities is unlikely to be viable.

Priority knowledge needs for environmental governance can be grouped into five areas. The first concerns the problem of uncertain global limits. Questions of the existence and character of global limits, and the conditions under which they can be probed or anticipated, have remained unresolved for decades but still urgently require continuing attention. Priority research areas include integrated modelling and assessment of simultaneous human perturbations of multiple environmental systems and biogeochemical cycles; identifying characteristic modes of system behaviour as major thresholds are approached, to help understand how long in advance we might hope to anticipate major environmental changes; and assessing potential technical and policy interventions, such as active geoengineering, that might allow rapid reductions of specific human material or energy flows, should these come to be necessary.

Further research into governance under uncertainty is a related high-priority need. Though researchers have continually noted the need for effective means of managing and making decisions under uncertainty, few institutions have successfully developed these. Key research areas include empirical studies of the use of scientific consensus and uncertainty in environmental policy debates, and further specification of the requirements for better implementation of adaptive management, as well as identification of important associated pitfalls and obstacles.

A third area for inquiry concerns the resolution of coordination problems under conditions of shared and overlapping authority, between different levels of government and between private and public actors. Detailed empirical studies are needed of how these conditions are managed in different institutional settings and on different issues, to identify the conditions associated with more and less effective linkage of decisions, information, and authority across spatial scales. A detailed examination of the successes and failures of CCME and similar coordination vehicles, identifying their capabilities and limits and the conditions associated with success, would be of particular value. Good empirical studies are also needed of competitive dynamics among jurisdictions (municipal, provincial, and national) seeking to attract and retain investment. Such studies would complement the growing literature on firm-location decisions by examining the public side of the associated bargaining. How and under what conditions do firms bargain for favourable regulatory treatment on environmental issues? How and under what conditions do officials and politicians grant or withhold such treatment? How do environmental issues fit into broader patterns of accommodations that firms seek and jurisdictions make to attract them? Related studies would examine salient influences between environmental and economic policies and outcomes, at the domestic and international levels. These should include the effects of short-term financial flows as well as trade and direct investment, and the potential effects, scope,

and limits of international market-like policy instruments such as tradable emission permits.

A fourth area of investigation concerns the evaluation of particular innovations of environmental governance that have been attempted and proposed. The discussions of both citizen involvement and voluntary measures revealed that almost nothing is known of the conditions and scope of their effectiveness, principally because they have almost never been adequately evaluated. Further experimentation with such programs, in various forms, with thorough, systematic, independent monitoring and evaluation, is essential to correct this deficiency. Such studies might also illuminate broader questions of the conditions for effective sharing of authority between public and private bodies, between levels of government, and between representative processes and direct consultations.

More broadly, study is needed of how currently proposed innovations stack up relative to the behaviour changes needed to manage environmental stresses and pursue the grail of sustainable development. Both sides of this question are difficult. The cryptic concept of sustainable development directs us toward deep questions on one side, but gives little guidance on how to address them. How, to what extent, and with what substitution possibilities does human welfare depend on the natural environment? What social and political factors shape human development or its stagnation?

On the other side, the innovations discussed here — voluntary measures and citizen involvement — may appear rather feeble relative to expansive views of the required changes. Indeed, since these both involve renouncing certain aspects of state authority, they might appear to be movements in the wrong direction. Although market-based environmental measures have not been discussed here, their adequacy to effect similarly large-scale behavioural change also remains undemonstrated. In contrast, there is a near-unanimous consensus that conventional command-and-control regulation is an

inadequate response to present environmental challenges, for several basic reasons. It is too short term; it provides inadequate incentives for innovation; and, because it carries higher costs than other approaches, it is unlikely to be politically sustainable. The view that procedural innovations such as those discussed here are too feeble may understate their cumulative influence over several decades, particularly in conjunction with other measures and technological change. If they are judged fundamentally inadequate, however, it is not clear what kind of responses would be both feasible and adequate.

The magnitude of the challenge environmental change poses to governance remains deeply uncertain. Looking forward even a few decades, neither extreme view — that modest incremental changes in policy, technology and behaviour are adequate, or that fundamental realignment of human societies is necessary to avert global catastrophe — can be confidently rejected from the available evidence. The enormity of this uncertainty underlines how imperative it is to learn more effective ways of governing our use of the environment under uncertainty and of responding adaptively to incremental advances in knowledge.

NOTES

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¹Environment Canada, "Municipal Population Served by Wastewater Treatment," *National Environmental Indicator Series*, <http://www3.ec.gc.ca>, Spring 1998.

²Canadian VOC emissions grew 40 percent from 1980 to their 1988 peak of 3 million tonnes, and have since dropped about 8 percent. Canadian NO_x emissions have changed little since 1980 (LRTAP emission data at <http://www.unece.org>).

³American VOC emissions declined about 20 percent from their 1980 peak to about 18 million tonnes at present, while NO_x emissions decreased a few percentage points in the early 1980s and have remained relatively constant since then (LRTAP emission data).

⁴The ozone objective (0.82 ppm for 1 hour) was exceeded 5.35 days in summer 1980 and 1.55 days in summer 1996. Over the same period, annual average ozone increased 37 percent (National Environmental Indicators Series).

⁵J.L. Stoddard, D.S. Jeffries, A. Lukewille, T.A. Clair *et al.*, "Regional Trends in Aquatic Recovery from Acidification in North America and Europe," *Nature* 401, 6753 (7 October 1999): 571.

⁶J.T. Houghton, L.H. Meira Filho, B.A. Callander *et al.*, eds., *Climate Change 1995: The Science of Climate Change* (Cambridge: Cambridge University Press, 1995), p. 15.

⁷"Canada's Emissions Outlook: An Update." Analysis and Modelling Group, Natural Resources Canada, December 1999 (<http://www.nrcan.gc.ca/es/ceo/update.htm>).

⁸Robert Socolow, "Nitrogen management and the future of food," *Proceedings of the National Academy of Sciences* 96 (May 1999): 6001-6008.

⁹National Environmental Indicators Series.

¹⁰Montreal Protocol Science Assessment Panel, *Scientific Assessment of Ozone Depletion: 1998* (Geneva: World Meteorological Organization, 1999).

¹¹Environment Canada, *The State of Canada's Environment 1996* (Ottawa: Environment Canada, 1996), Tables 14.3, 14.11. (available at <http://www1.nrc.ec.gc.ca/~soer/SOE>).

¹²For example, concentrations of two monitored POPs in double-crested cormorant eggs at four sites across Canada declined 70 to 90 percent from the 1970s to the 1990s, but levelled off or reversed in the 1990s (National Environmental Indicators Series).

¹³This is emphatically not the case for most of the developing world, however, where acute local air and water pollution, including septic contamination of drinking water, remain among the most urgent environmental problems.

¹⁴Kai N. Lee, *Compass and Gyroscope: Integrating Science and Politics for the Environment* (Washington DC: Island Press, 1993).

¹⁵I am indebted to Rod Dobell's comments in the workshop for this observation.

¹⁶Ted Schrecker, "Using Science in Environmental Policy: Can Canada Do Better," in *Governing the Environment: Challenges and Innovations*, ed. E.A. Parson (Toronto: University of Toronto Press, forthcoming).

¹⁷E.A. Parson with A.R. Dobell, Adam Fenech, Don Munton and Heather Smith, "Leading While Keeping in Step: Management of Global Atmospheric Issues in Canada," in *Learning to Manage Global Environmental Risks: A Comparative History of Social Responses to Climate Change, Ozone Depletion, and Acid Rain*, ed. W.C. Clark, Jill Jager, Josee van Eijndhoven and Nancy M. Dickson (Cambridge: MIT Press, forthcoming).

¹⁸Duncan VanderZwaag and Linda Duncan, "Canada and Environmental Protection: Confident Political Faces, Uncertain Legal Hands," in *Canadian Environmental Policy: Ecosystems, Politics, and Process*, ed. R. Boardman (Toronto: University of Toronto Press, 1992), pp. 5-23.

¹⁹Grace Skogstad and Paul Kopas, "Environmental Policy in a Federal System: Ottawa and the Provinces," in *Canadian Environmental Policy*, ed. Boardman, pp. 43-59.

²⁰R. Paehlke, "Spatial Proportionality: Right-Sizing Environmental Decision-Making," in *Governing the Environment*, ed. Parson.

²¹Paul E. Peterson, *The Price of Federalism* (Washington, DC: Brookings Institution, 1995).

²²K. Harrison, "Voluntarism and Environmental Governance," in *Governing the Environment*, ed. Parson.

²³Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge: Cambridge University Press, 1990).

²⁴See, for example, M.E. Porter and C. van der Linde, "Toward a New Conception of the Environment-Competitiveness Relationship," *Journal of Economic Perspectives* 9, 4 (Fall 1995): 97-118; and K. Palmer, W.E. Oates and P.R. Portney, "Tightening Environmental Standards: The Benefit-Cost or the No-Cost Paradigm?" *Journal of Economic Perspectives* 9, 4 (Fall 1995): 119-32.

²⁵Luc Juillet, "Regional Models of Environmental Governance in the Context of Market Integration," in *Governing the Environment*, ed. Parson.

²⁶Harrison, "Voluntarism and Environmental Governance."

²⁷D.A. Lax and J.K. Sebenius, *The Manager as Negotiator* (New York: Free Press, 1986).

²⁸Thomas C. Schelling, *The Strategy of Conflict* (Cambridge: Harvard University Press, 1960).

²⁹A.H.J. Dorsey and T. McDaniels, "Great Expectations, Mixed Results: Trends in Citizen Involvement in Canadian Environmental Governance," in *Governing the Environment*, ed. Parson.

³⁰O. Renn *et al.*, *Fairness and Competence in Citizen Participation* (Dordrecht: Kluwer, 1995).

³¹This discussion draws on comments of Jeremy Rayner in the workshop.

³²Committee on Risk Characterization, National Research Council, *Understanding Risk: Informing Decisions in a Democratic Society* (Washington, DC: National Academy Press, 1996).

³³M. Howlett, "Complex Network Management and Governance of the Environment: Prospects for Policy Change and Policy Stability Over the Long Term," in *Governing the Environment*, ed. Parson.

³⁴For early references to these ideas, see D.H. Meadows, *et al.*, *The Limits to Growth* (New York: Universe Books, 1972); V.I. Vernadsky, "The Biosphere and the Noosphere," *American Scientist* 33, 1 (January 1945): 1-12; C. Marchetti, "On Geoengineering and the CO₂ Problem," *Climatic Change* 1, 1 (1977): 59-68; G. Hardin, "The Tragedy of the Commons," *Science* 162, 3859 (13 December 1968): 1243-48; John Dales, *Pollution, Property, and Prices* (Toronto: University of Toronto Press, 1968); World Commission on Environment and Development, *Our Common Future* (New York: Oxford University Press, 1987); C.S. Holling, ed., *Adaptive Environmental Assessment and Management* (Chichester: Wiley, 1978).

³⁵"Toxic fire forces 3,000 from homes," *The Globe and Mail*, 25 August 1988; "Stigma of disaster clings to region affected by tire fire," *The Globe and Mail*, 5 March 1990.