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More Maple Leaf, Less CO2: Canada and a Global Geo-Engineering Regime

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11 More Maple Leaf, Less CO_2

Canada and a Global Geo-engineering Regime

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Learning Objectives

- To distinguish unique characteristics of transnational scientific issues.
- To articulate Canada's interests in formulating policy about climate change.
- To explain the potential benefits and drawbacks of geo-engineering as a response to climate change.
- To identify a role for Canada in constructing an international response to climate change.

Introduction

Since the end of the Cold War, international structural factors have become less important to states' behaviour, while social constructions have become more important. The nature of scientific knowledge, including its formation and promulgation, means that science-based policies can be strongly influenced by the input and actions of scientists, activists, and other non-state actors. In the area of **geo-engineering** to mitigate **climate change**, the stakes are high and the barriers to deployment are low. We begin by discussing unipolarity and its conceptual limitations for thinking about climate change policy-making. After introducing the perils and possibilities of geo-engineering technology, we take on two questions: first, whether Canada has a compelling interest in shaping a global geo-engineering regime; second, whether Canada's resources are suited to such a role. We conclude that Canada would benefit from taking a leadership role in the formation of a global geo-engineering regime.

Polarity

International relations scholars agree that the end of the Cold War created a unipolar international system. In the early 1990s, the United States was the world's largest economy and the engine of liberal economic norms, had the ability to project military force anywhere on the globe, and asserted cultural hegemony. By almost any measure, the United States had the preponderance of power resources. Francis Fukuyama (2006 [1992]) has argued that the failure of most command economies and state socialist governments suggested economic liberalism and democracy were likely to dominate international relations into the foreseeable future.

This sense of clarity about international relations did not endure. Within a few years, scholars had begun to question the empirical validity of characterizing the international system as unipolar (Kaplan 1994; Huntington 1999). No one questioned that the United States had the world's largest assemblage of traditional power resources such as military might and economic clout. However, to many, these capabilities no longer seemed the only or most reliable measure of an actor's international influence. While the United States may be unique in its combination of military and economic might, and is therefore *sui generis* in the taxonomy of international actors, this supremacy does not always translate into an ability to issue irresistible demands.

Samuel Huntington (1999) argues that the international power hierarchy is best understood as "uni-multipolar," in that several significant regional powers are weaker than the unipole but strong enough to be regional hegemons. (Consider, for example, the role of Russia in the Arctic as examined in Chapter 4 of this volume.) Smaller states are not thereby equals of the unipole, but they are increasingly powerful compared to their role during the Cold War. Because the unipole must become more reliant on persuasion, and persuasion is effective only by the permission of the one being persuaded, even the unipole must seek legitimation from smaller powers (Finnemore 2009: 74). This places the unipole in the paradoxical condition of being both supremely powerful and dependent on other actors' approval. Therefore, certain kinds of decisions, particularly those on which the United States is losing credibility as a leader, are increasingly likely to be made collectively. Examples of such issues include management of the global economy and actions surrounding climate change (Buzan 2011: 9–10). We argue that the latter issue is one where Canada stands to preserve its national interests and increase its international influence. The Stephen Harper government was not committed to preventing climate change because it regarded that fight as too costly for the Canadian economy. The Liberal government of Justin Trudeau, which succeeded Harper's Conservatives, places a higher priority on mitigating climate change and has already taken a higher-profile role in addressing the issue. In March 2016, less than six months after taking office, Prime Minister Trudeau met with President Barack Obama in Washington, DC, where the two leaders announced their countries would work jointly to curb greenhouse gas emissions and address climate change.

Anthropogenic Climate Change

Climate change, sometimes referred to as global warming, is driven by the greenhouse effect. Ultraviolet light from the sun passes through earth's atmosphere; some is reflected back from clouds and other surfaces, and some is absorbed by land and water. This latter portion is then re-radiated from the earth's surface as infrared heat. Some of the heat escapes the atmosphere and some is trapped by the atmosphere, resulting in a warmer planetary surface. Earth's atmosphere acts like the glass in a greenhouse, letting in most of the light but trapping most of the heat. Without this atmospheric phenomenon, life would not exist on earth, but as human activities create increasing amounts of **greenhouse gases (GHGs)** like carbon dioxide (CO_2) and methane (CH_4), the "glass" in the atmosphere is getting thicker and holding in more heat. The Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) stated: "Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased" (IPCC 2013: 4). As well, this additional heat results in increasing ambient air temperatures, thawing permafrost, changing precipitation levels, longer and more intense droughts, and changes in extreme temperatures (IPCC 2013; National Research Council 2010).

The scientific theory of climate change focuses on the concentration and behaviour of GHGs in the atmosphere. Figure 11.1 shows increases in the most common GHGs since the late 1970s; CO_2 levels alone have increased from 280 parts per million (ppm) during the pre-industrial era to 400 ppm in February 2015 (NOAA 2015). The global warming effect of these gases comes from their ability to push the earth's climate away from equilibrium, not from their mere existence in the atmosphere. This ability is called "radiative forcing," which is positive if it adds to the earth's net energy, negative if it subtracts.

Climate change is not an imagined future phenomenon. Documented changes in global ecological systems have already occurred due to greenhouse warming (IPCC 2014; Steele et al. 2008; Lobell et al. 2011). As a result, global average ambient air temperature will increase further, precipitation levels will change across the globe, sea levels will rise, and extreme weather events such as hurricanes, floods, and droughts will increase in intensity and possibly in frequency. Secondary effects from climate change are likely to include fluctuating water supplies, regional crop shortages, changing habitat for non-human species, migration of disease vectors, and the destruction of costly infrastructure.

Climate change is an environmental and economic problem, but also a foreign policy problem. The effects of carbon dioxide or any other GHG emitted in one place are felt all over the globe. This transboundary character of global environmental problems is an ecological reality, but it challenges the traditional structures and assumptions of international relations, such as the difference between internal and foreign affairs. Global environmental problems like climate change are fundamentally different from other matters of foreign affairs such as national security, international trade, or human rights. Rising sea levels, increasing temperatures, and fluctuating precipitation are not indicative of a relationship between one nation and another, but between humans and nature. Since

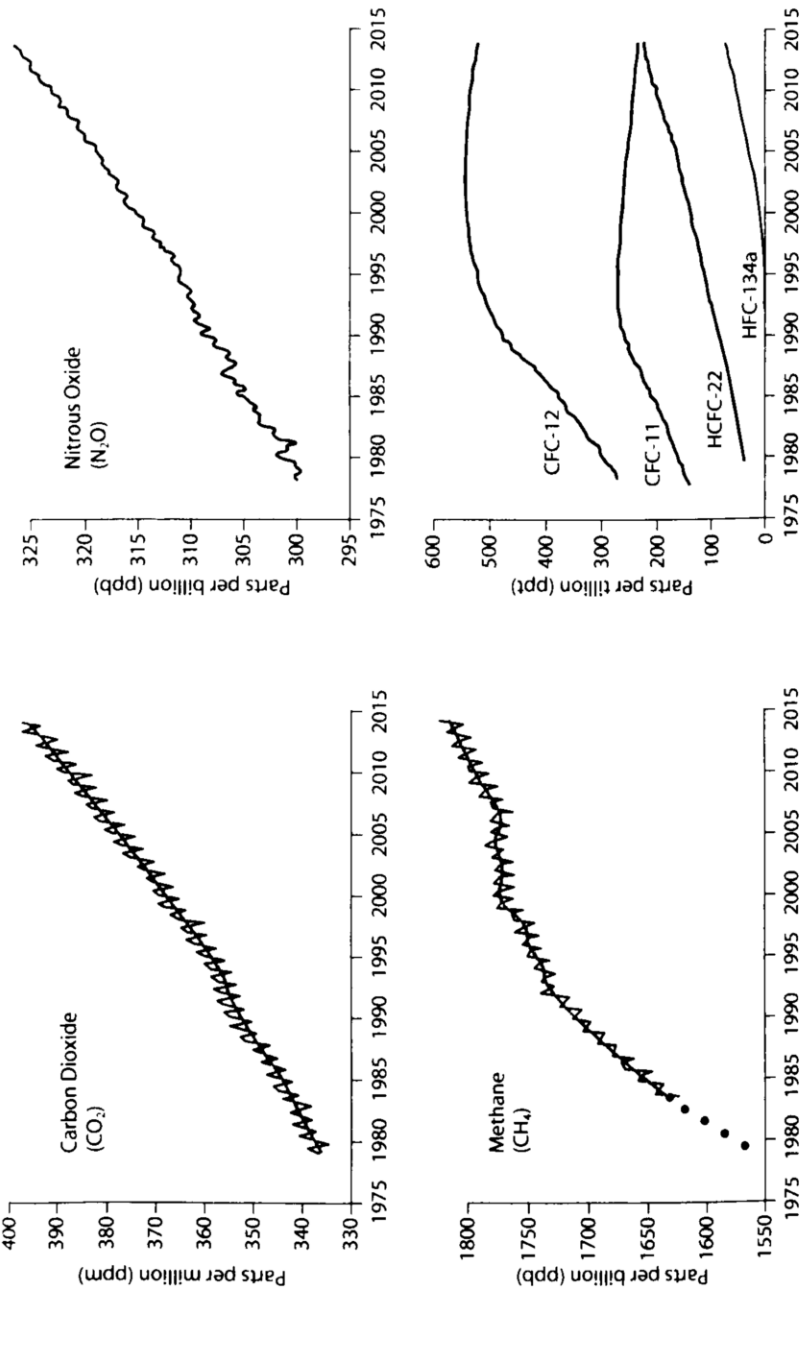

Figure 11.1 Atmospheric Greenhouse Gas Emission Levels
Source: NOAA (2015). http://www.esrl.noaa.gov/gmd/aggi/aggi.html

nature does not negotiate, a new urgency of international co-operation emerges so that the worst effects of climate change may be forestalled for all nations.

Geo-engineering the Earth's Climate

Although climate change has become a dire scientific and environmental problem, our understanding of the science has gone well beyond our political capability to address it. Currently, the international community has no international GHG mitigation regime. Two international agreements exist, but one is merely a framework convention and requires no reductions in GHGs, and the second lacks the participation of the two largest emitters as well as most of the developing world. China and the United States have recently agreed to a framework of mutual emissions restrictions, but even this positive step does not undo the fundamental dispute between the developed world and the developing world as to who bears the economic brunt of any reductions. The recent multilateral agreement signed in Paris in December 2015 is only voluntary, with each nation determining which changes, restrictions, and targets it intends to meet. Even if all the targets were met, the resulting total GHG reduction would not be enough to stabilize global temperature at the recommended 2°C above pre-industrial levels. In addition, a politically partisan disconnect exists within the United States as to whether or not anthropogenic climate change is even occurring. This lack of consensus means that a comprehensive and effective global climate change regime is not likely to emerge within the next few decades. If the issue is deeply divisive in American domestic politics, the United States is unlikely to provide momentum for developing an international regime; and the participation of strong stakeholders is important to the success of international co-operation. Consequently, geo-engineering becomes an increasingly attractive option for controlling climate change because it can be undertaken unilaterally and does not require costly GHG emissions reductions or their attendant loss of competitive economic advantage.

Currently, humans can purposefully alter the climate by two methods in an attempt to stave off the negative effects of global warming. The first method, called solar radiation management (SRM), involves preventing a certain percentage of sunlight from reaching the earth through some reflecting or scattering property. In this way, the incoming solar radiation does not have a chance to contribute to the positive forcing discussed earlier. The most common means of SRM is injection of sulphur dioxide particles into the upper atmosphere, similar to the dust and soot ejected during a volcanic eruption. This can be done via specially modified cargo planes, and the resulting haze would scatter sunlight in the upper atmosphere, reducing the amount reaching the earth. Previous volcanic eruptions like those from Mount Krakatoa, Mount St Helens, and Mount Pinatubo have produced similar effects, cooling the global average temperature and depressing agricultural production. Another means, though currently less feasible, is cloud-whitening, using sea water to increase the albedo (i.e., reflective property) of clouds. This could be done via special ships, which aerosolize sea water into a fine mist and spray it into the atmosphere. Other, more fanciful means of SRM include large or small mirrors launched into space which would reflect incoming sunlight directly back into space.

The second method, called carbon dioxide removal (CDR), involves removing CO_2 directly from the atmosphere and sequestering it where it will not escape. One widely discussed means of CDR is seeding the ocean with iron dust. Since iron and carbon are both necessary nutrients for plankton growth, increasing iron concentration will encourage plankton to take up existing carbon, lowering the concentration. When plankton die, they sink, sequestering the carbon on the bottom of the ocean. Other CDR means include planting trees, creating artificial trees and other CO_2 scrubbers, and reacting atmospheric carbon with other elements to create carbonate minerals, a process known as weathering.

Neither of these two classes of technology requires GHG-emitting nations to reduce their emissions. This makes geo-engineering an attractive economic and political alternative to a global mitigation treaty, which states have not been pursuing with alacrity. However, each has its own range of environmental, political, and legal concerns. For example, CDR is projected to be cheaper than SRM, and possibly to have less of an environmental impact, but these means cannot be deployed as an "emergency" option because the process of sequestration can take decades. SRM could be an emergency option, because its effects would be

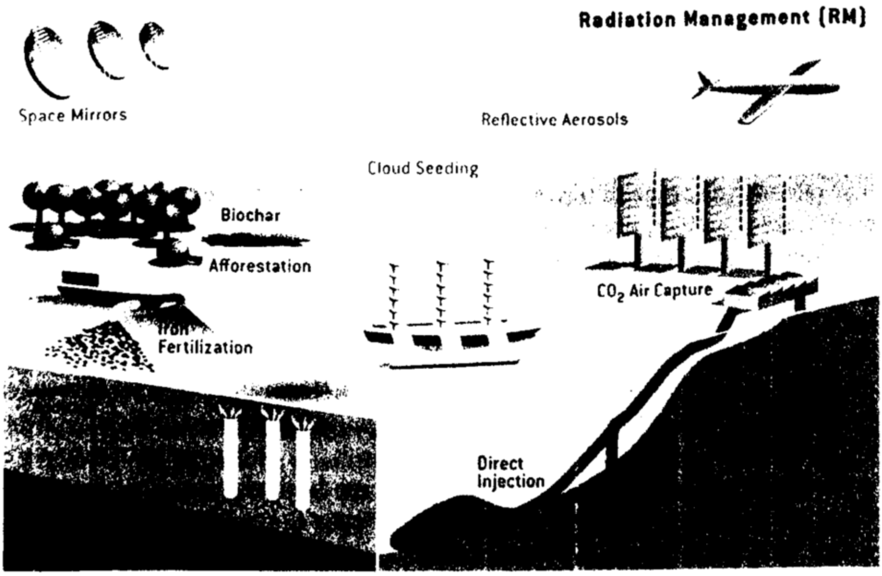

Figure 11.2 Proposed Geo-engineering Methods and Technologies
Source: By kiel-earth-institute, www.kiel-earth-institute.de; Drawing by Rita Erven

felt relatively quickly. However, SRM may alter net primary productivity at the earth's surface and alter precipitation patterns and timing (Govindasamy et al. 2002; Irvine et al. 2010; Toon et al. 2008; Bala 2009; MacCracken 2009). In addition, SRM does not mitigate the continued atmospheric buildup of GHGs or the continued acidification of the ocean. Therefore, SRM methods must be deployed continuously, because if an SRM measure fails in the absence of a GHG mitigation regime, the resulting spike in planetary temperature could be catastrophic. The costs of these options vary radically. Afforestation and reforestation are perhaps the cheapest option if measured in dollars, while the cost of launching a mirror into space could run into the trillions. As a result, some options may simply be too expensive to be pursued unilaterally. However, the options with the greatest relevance to foreign policy are sulphur dioxide aerosol dispersal and iron ocean seeding, both of which are feasible from a national cost perspective, and neither of which can be limited to the national territory of the deploying country. This means that nations wealthy enough and facing significant climate-related threats to their economy, their security, or their very existence might decide to act unilaterally without concern for the global consequences of their actions.

Geo-engineering and Unipolarity

The Republic of Science

As a method of organizing and explaining the international system, unipolarity has its greatest traction in the political, economic, and military realms. However, the existence of a unipole matters much less in the scientific and environmental realms because the knowledge and discoveries that drive scientific ability can be had on a lower level than that of a great power. Canada, Korea, Germany, Brazil, the United Kingdom, Japan, Poland, and other second-tier nations have first-rate scientific capabilities. Michael Polanyi, arguing for the independence of science from politics, notes that scientific discovery begins with the individual working in his or her laboratory, and continues with collaboration among scientists, sometimes across sovereign boundaries (Polanyi 1945). In order to form the epistemic community, or the network of professionals with recognized expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area (Haas 1992: 3), scientists must be permitted to speak and work freely across national borders. A.V. Hill (1934: 147) writes that scientific "methods of thought . . . so obviously do not depend on the opinions, or emotions, or interests of any limited group that any civilized people will admit that [science] transcends the ordinary bounds of nationality." Therefore, Polanyi's "republic of science" transcends systemic polarity. Transnational scientific collaboration is the best way to advance scientific knowledge (Polanyi 1962: 54–6), and current worldwide communication capabilities discourage political constraints on science.

In addition, the systemic structure that governs relations between nations in the areas of political, military, and economic affairs does not carry the same meaning when applied to the scientific and environmental realm, because the underlying relationship is fundamentally and qualitatively different. Transboundary ecological realities, such as the effects of ever-increasing GHG emissions on the global climate, mean that the impacts of climate change are neither limited to nor controllable by states, even a unipole. While the use of fossil fuels has correlated directly with economic development and wealth creation at the national level, the environmental output of such processes is a problem of the global commons. Because humans now have the ability to alter the planetary climate, we must address basic questions of the right of even unipolar nations to act independently versus their responsibilities towards the rest of the world (Skolnikoff 1967: 84; see also Chalecki 2009), and this is why the formation of a geo-engineering regime is becoming time-critical.

In considering geo-engineering, we will replace Huntington's geographic regions or cultural groups with scientific and environmental issue areas as the loci of multipolarity. Power dynamics and great power identities vary by issue area; but the concept of "great powers" should also be expanded to accommodate non-state actors, both as they inform state behaviour and in their own right. In the case of geo-engineering, relevant non-state stakeholders include corporations and other non-governmental organizations (NGOs), scientists, and activists. While a number of theoretical approaches to international relations take such actors into account (e.g., Haas 1992; Keck and Sikkink 1998; Kabasakal Arat 2006), the role of non-state actors in international decisions about geo-engineering contradicts a simple characterization of the international system as unipolar. The epistemic community of climate scientists makes policy recommendations to states, international organizations, and the general public, as the IPCC has done with its climate assessment reports.

Science may develop independently of national restrictions or loyalty, but deployment and use of technologies derived from science are not immune from the control of states. Given the transnational character of the scientific realm, we must assume that geo-engineering research and development will continue regardless of individual states' policies or positions on climate change. Several currently existing geo-engineering technologies are inexpensive enough that individual states or non-state actors could implement them in circumvention of any international agreement. Similarly, those costs are within reach of a few major corporations, and to more than a few if they are willing to pool resources. If states do not maintain a monopoly on the means to deploy geo-engineering programs, they could lose control over a global commons issue with profound environmental and foreign policy implications. States also do not maintain a monopoly on the means to promulgate scientific information, as Polanyi and Hill attest. Technological advances, especially in communication, have allowed greater international research collaboration, formation of activist networks, and broadcast of information. Scientists and activists have an unprecedented ability to bring information to global attention, becoming credible participants in agendas, agenda-setting, and discourse-framing for debates in both the public and private sectors. In the case of geo-engineering techniques, which are largely speculative and still in development, much of the best scientific work is being done outside of governments at institutions that focus more on basic research. Without the input of these actors, states make geo-engineering policy at their peril. With the input of these actors, states acknowledge the limitations of their own resources for effective foreign policy-making.

The best opportunity to create and institutionalize an effective, flexible geo-engineering regime is before any geo-engineering technologies are deployed. As a middle power, Canada is in an excellent position to take a leadership role in the formation of such a regime. Although Canadian relative power was a hindrance to holding a leadership role in forming institutions of the past, such as the United Nations (Chapnick 2005), both the new systemic dynamic and the transboundary scientific nature of the issue area give Canada greater latitude for action. Decreased constraint at the systemic level means that Canada may feel domestic constraints more acutely. Therefore, we consider the nature of those constraints and Canada's countervailing interests in taking a leadership role in an international geo-engineering regime.

Canadian Interests in Climate Change and Geo-engineering

The **niche diplomacy** approach to foreign policy-making suggests that middle and smaller powers need to focus their diplomatic efforts on certain areas in order to maximize their global impact. States should champion a few issues on which they have a comparative advantage—whether functional, diplomatic, or historical—and are therefore likely to be influential, rather than spreading resources thinly among a wide range of foreign policy areas. This raises two questions. First, does Canada have a compelling interest in the issue of geo-engineering governance? Second, does Canada have the resources to claim a comparative advantage on the issue?

Canada has mixed interests in addressing climate change in general and geo-engineering specifically. These interests sometimes put Canadian policy preferences at odds with those of many climate scientists, environmentalists, and other states. They may also leave Canada out of step with certain types of international consensus or the positions of valued allies. Although these tensions exist in many issue areas, we focus on two: Alberta's oil and Arctic warming. Both have implications for global environmental politics, but each considers a different balance of domestic and international concerns. The politics of Alberta oil is largely a domestic issue, although it has international trade implications. Arctic warming creates many domestic concerns for Canada, but also raises a wide range of economic and strategic questions, including ones of sovereignty.

Oil in Alberta

Alberta is critical to Canada's economic health, and the energy industry is the heart of Alberta's economy. In 2014, nearly 27 per cent of Alberta's GDP came from the energy sector. This figure is down from 36 per cent in 1985, but, then as now, energy is the single largest sector of the economy and comprises primarily the natural gas and petroleum industries. In 2014, Alberta's energy revenues totalled $111.7 billion, approximately 60 per cent of which came from production in a region known as the oil sands. That same year, Alberta exported $121.4 billion in goods, of which $90.8 billion were from the energy sector, with $76.2 billion in crude petroleum alone (Government of Alberta 2016: 14). Thus, the percentage decrease in energy as a share of provincial GDP from 1985 to 2014 does not represent a decrease in the importance of the energy sector to Alberta's economy. Energy production is likely to dominate Alberta's economy for the foreseeable future. As Alberta's natural gas and conventional petroleum reserves have been depleted, the province has increasingly looked to production from its oil sands.

The oil sands lie beneath over 140,000 km^2 of northern Alberta (Government of Alberta 2011) and the petroleum reserves contained in the sands rival those of Saudi Arabia, representing tremendous potential wealth as a Canadian export. Alberta's government forecasts a significant increase in oil production—from 2.2 million to 3.8 million barrels per day—from 2014 to 2024 (Government of Alberta 2016: 15). In 2008, investment in the oil sands topped $19 billion, and the provincial government amassed approximately $3 billion in royalties (Government of Alberta 2011). Until recently, this growth meant more companies creating more jobs for Canadians. Heavy reliance on a single sector, though, means great disruption to Alberta's economy when that sector performs poorly. Alberta has long enjoyed one of Canada's lowest provincial unemployment rates. However, the province's current employment rate reflects hiring in the public sector that is offsetting layoffs in the private sector, a trend that is not economically sustainable. Decreasing oil prices and the worsening exchange value of the Canadian dollar combined in late 2014 and 2015 to stall Alberta's economic growth and threaten province-specific recession. While all provinces struggle economically with the weak dollar, the provinces relying heavily on export revenues suffer most immediately. Based largely on the outlook for Alberta's energy sector, the Royal Bank of Canada has projected that in 2016 the province's economy will contract for the second year in a row (Royal Bank of Canada 2016).

At the same time, Canadians pay a high environmental cost for drawing economic wealth from the oil sands. The sands are a tar-like combination of water, sand, bitumen, and clay, which must be extracted by strip mining or, at deeper levels, by steam-assisted methods. Open-pit mining has destroyed large regions of Alberta's boreal forest and contaminated rivers in the region. To produce economically desirable light crude oil, workers must separate out the bitumen and refine it in upgrader plants. These processes generate high carbon emissions and use large amounts of water and energy (Schreurs 2010–11: 106; Royal Bank of Canada 2011: 3). Total GHG emissions from oil sands production are currently about 50 per cent higher than those from conventional oil production in all of Canada, and by 2020 oil sands production is projected to generate higher levels of CO_2 emissions than at any time in the 2005–10 comparison period (Environment Canada 2011: 25). Proponents of further development in the region look to geo-engineering as a way to continue business as usual without having to worry about the effect of carbon emissions.

Environmentally, and perhaps politically, Canada cannot long continue to develop the oil sands and sustain the resulting levels of CO_2 emissions. The Harper government clearly regarded further development of the oil sands as necessary to Canada's economic health (Chase and McKenna 2014), and it is questionable if the new Liberal government of Justin Trudeau feels much differently. If scaling back oil sands production is off the table, then Canada will need to seek means by which to make emissions levels, and the resulting climate change, tolerable. In 2011, Ottawa announced a new plan to monitor the environmental impact of oil sands production. From 2012 to 2015, the provincial and national governments co-operated on carrying out the Joint Canada–Alberta Implementation Plan for Oil Sands Monitoring. Since the plan was for monitoring rather than regulation—it was not geared towards a certain type of action in response to identified problems—it did not signal the Harper government's readiness to modify its long-standing prioritization of industry over environment. Harper stated in 2014 that Canada could not increase regulations on its oil and gas sector in the absence of similar changes in the United States and Mexico (CBC News 2014). Shortly after his election in October 2015, Justin Trudeau indicated that he supports building two major bitumen pipelines from the oil sands, while still seeking a national GHG-reduction plan (Mufson 2015). Environmentalists decry the degradation resulting from oil sands mining and likely to result from the two pipelines, but Canadian and international industry, as well as Canadians hurt by an economic downturn, wish to exploit the resource. This is a delicate balance, and Trudeau has indicated that he hopes to make it. Geo-engineering could offer relief from this pressure, providing near-term solutions that could appeal to politicians.

Arctic Warming

Climate change is disproportionately impacting the Arctic, as compared to other regions of the world (IPCC 2013: 24). The future of the Arctic is critical for Canada. In one sense, a warming Arctic is an economic opportunity due to the valuable oil and gas reserves currently inaccessible beneath sea ice and permafrost. As this area thaws, those resources will become more accessible. Canadian and multinational corporations are eager to take advantage of these natural resources, and the Harper government supported those interests. Geo-engineering techniques are a mixed blessing for these corporations. On one hand, the geo-engineering counteraction of climate change could slow or prevent warming, thus inhibiting access to underground deposits. On the other hand, if geo-engineering techniques can be fine-tuned, they could help regulate Arctic ice melt, allowing for optimal thawing for resource extraction, but no more. This could allow corporations to exploit the resources while building a reputation for environmental responsibility by discouraging unfettered climate change.

At the national level, the status of the Canadian North has been an important element of Aboriginal politics, most notably with the 1999 creation of the territory of Nunavut. Arctic climate change, with its impact on the livelihoods of people in the North, could have important domestic political ramifications for the territorial and national governments. Arctic thaw could generate greater wealth and more jobs in the area as new resources are extracted. But the corresponding losses of flora, fauna, and traditional ways of life have a significant value that is more difficult to quantify (see ACIA 2004). The Canadian government has acknowledged these issues, but mitigation efforts may not prevent unjust treatment of Indigenous peoples (Trainor et al. 2007).

Arctic warming and the resulting opening of Arctic sea lanes raise questions about presumed Canadian sovereignty over the area. Already, the United States has challenged Canada's claim that the Northwest Passage is within Canadian sovereign waters. In 1988, the issue was resolved relatively amicably; however, as the Northwest Passage becomes increasingly easy to navigate and thereby in greater demand as a shipping lane, Canada is likely to find that the United States will wish to revisit this position. Canada's ability to regulate transit of the Northwest Passage is also likely to be critical to Sino–Canadian relations as China seeks new shipping routes (Gilley 2011: 261).

Another, less tangible, factor in Canada's concern about Arctic warming is the significance of "the North" to Canadian identity. While most Canadians live within about 100 miles of the United States border, they also embrace the frozen frontier as emblematic of that which is distinctively Canadian (Smith 2010: 932–3). The literature on political culture suggests that Canadian national identity is often contested and largely based on the concept of Canada as a cultural mosaic (Porter 1965; Pizanias 1992). Taking action that threatens the health and integrity of the North likewise threatens to chip away at the mortar that binds the fragments of the Canadian mosaic. Such action could have tremendous symbolic, and thereby social, significance.

Thus, geo-engineering presents an attractive option to Canada on several levels. If properly deployed and managed, geo-engineering techniques could meet the near-term interests of Canadian industry, preserve an iconic Canadian landscape, and give Canada leverage in its relationships with China and the United States, two of the world's most powerful states.

Canadian Leadership in Forming a Geo-engineering Regime

No one knows whether the effects of geo-engineering will generate new environmental problems (Standing Senate Committee 2010). Since climate change is a commons issue, these consequences will be global in scope and of concern to a wide range of states. Therefore, most states and non-state actors would likely prefer an international geo-engineering regime to risking unregulated action by one state, a small group of states, or non-state actors (Humphreys 2011: 106). Institutionalized regimes can confer many benefits on participants, including decreased transactions costs, increased transparency, and uniform access to expert information. Taken together, these qualities can confer authority on the regime and its institutions, creating a power centre to challenge the policy preferences of the unipole, if necessary.

In 2015, the US National Academy of Science released two preliminary reports on geo-engineering, concluding that, while most methods of CDR do not pose major environmental or governance concerns, the risks of SRM are so significant and unquantifiable that research is the only allowable action at the present time (NRC 2015b: 121). But research is continuing, and this will require not only experimentation to be scientifically valid, but oversight and governance to ensure that it serves the public good. As experiments proliferate and scale up in size, the need for an international geo-engineering regime will become more critical (SRMGI 2011: 55–6), and this will give Canada a valuable foreign policy leadership opportunity. Geo-engineering is a commons issue that will be relevant to global actors as long as climate change is. Therefore, Canada's leadership position could be enduring and prominent, amplifying Canada's voice in international negotiations on environmental policy, and bolstering Canada's cherished self-image as a good international citizen.

A significant benefit of this leadership role would be the opportunity to shape the parameters of the new regime to Canada's interests. Arunabha Ghosh (2011: 6) argues that states desire maximum flexibility for themselves within a regime, while preferring that others are restrained to a degree that serves the first state's interests. Given the variation of states' interest in and openness to the deployment of different geo-engineering options, the range of possible agreements is also varied. This increases the chances of states creating a regime that diverges considerably from Canada's ideal. In this regard, there is some urgency to Canada's taking up the issue. The United States and United Kingdom are already forming panels to consider funding and policy concerns (see US House of Representatives 2010; Royal Society 2009). To take an agenda-setting role in the new regime, Canada must act quickly to secure its place as a global leader. In addition, both the Solar Radiation Management Governance Initiative (SRMGI) and National Research Council (NRC) reports speak of research conducted in a geographic "allowed zone" (NRC 2015b; SRMGI 2011)—if climate change causes sufficient environmental change in the Canadian Arctic, this may well become one of the designated zones for early experimentation.

In doing so, Canada gains the opportunity to frame the international debate and creates the foundation on which policy agendas are set. This can serve Canada's national interest in two ways. First, Canada would have influence on an issue of global consequence. The Harper government withdrew Canada from the Kyoto Protocol in December 2011, and, to the end of its electoral mandate, prioritized business and economic growth ahead of environmental issues (e.g., Chase and McKenna 2014). In this same period, 74 per cent of Canadians expressed a desire to limit carbon emissions, and 56 per cent agreed that Canada should be part of a new international agreement to decrease global GHG emissions, even if that meant some loss of jobs for Canadians (Environics Research Group 2011).

However, Canada may not be in a position to decide whether addressing climate change through geo-engineering is one of its policy concerns. Given the range of actors with the knowledge and resources to implement geo-engineering programs, Canada's choice to avoid decision-making on climate change may consign it to a reactive position regarding issues of national interest, such as regulating Arctic thaw. Canada would be forced to make policy choices in an environment that had been fundamentally structured by others. This is the perpetual concern of states that are not great powers, but through proactive policy-making and global leadership on geo-engineering, Canada can mitigate the problem.

The term "middle power" has also been used to signify Canada's behavioural role as an honest broker in mediating the behaviour of other states (Gecelovsky 2009). However, that reputation has been tarnished by Canada's ongoing inability, or refusal, to meet internationally proposed GHG emissions targets. To the extent that Canada desires to maintain a reputation for promoting multilateral international governance and fair treatment of all states, leadership in regulating geo-engineering is a desirable policy goal. Most Canadians are decidedly proud of their country, and Canada's humanitarianism and culture of caring consistently rank among the top three reasons Canadians cite for that pride (Environics Institute 2010: 15). Just as loss of the iconic Arctic landscape could have a negative impact on Canadians' sense of national identity, perceived loss of a reputation for trustworthiness could be damaging to national unity. Canadians take pride in their country's identity as "a peacekeeping, multilateral nation" and the international reputation that flows from that identity (Berdahl and Raney 2010: 999; see also Michaud 2007). In the realm of global regime formation, Canada's position is more credible than that of the United States. The global perception that United States hard power is declining, coupled with mistrust engendered by America's role in triggering the current global economic crisis, means that other states may be increasingly reluctant to look to the United States for institutional leadership (Layne 2009: 166). This is where Canada can leverage its historical role as a mediator into a prominent institutional position. For example, Canada has been successful in its work with institutions addressing climate change, leading the diplomatic efforts that successfully created the Arctic Council in 1996. Canada's credibility as a leader in addressing concerns about geo-engineering can be enhanced by the resources of epistemic communities of scientists and activists. Canada can provide a diplomatic action channel by which these non-state actors can participate in international policy-making. In the process, Canada would position itself as a broker of expert information on geo-engineering and would lend scientific legitimacy to its policy positions.

There are, however, serious impediments that Canada must overcome to take a credible leadership role in a global geo-engineering regime. Notably, Canada failed to meet its emissions targets under the Kyoto Protocol and remains one of the world's highest per capita emitters of GHGs, though its emissions fell to 20.1 million metric tons of CO_2 equivalent in 2012 from a historic high of 23.5 million metric tons in 2000 (Environment Canada 2012). In December 2011, the Harper government announced that Canada would withdraw from the Kyoto Accord. These choices detracted from Canada's credibility as a facilitator of global environmental agreements. Similarly, the Harper government's stated commitment to multilateralism was questionable. While Harper stated that "Canada must . . . lead by example," his government nonetheless backed down from previous governments' international environmental commitments (Smith 2009: 67–8).

Taking a leadership role in an international regime is quite different from acting unilaterally against climate change. We have argued that climate change could have some strategic and economic benefits for Canada in the short term, but would be disastrous in the longer term. By promoting a regime to limit the effects of climate change, Canada might be acting against a certain notion of its short-term interest. While this could deprive Canada of the near-term benefits of global warming, the long-term stabilization of the climate is arguably more important to Canada's national interest.

If Canada is willing to champion a geo-engineering regime now, there is greater likelihood that such a regime will be formed on the best information and will best serve the global good. We may not yet have reached a point of no return with climate change. By some measures, however, the emergency is not far away. Michael Jakob and his colleagues predict that inaction on climate change until 2020 will seriously inhibit our ability to counteract the phenomenon, and delay until 2030 may render the problem unsolvable (Jakob et al. 2011). If states address the questions of geo-engineering in advance, the likelihood is greater that scientific findings, rather than politics, will lead policy (Virgoe 2009: 117).

Conclusion

The scientific principles behind the human effect on climate are fairly well understood, but most geo-engineering technologies are still theoretical, based on computer models and lab experiments (ASOC 2010). However, if geo-engineering is to become an option for governments in mitigating the negative effects of climate change, then experiments larger than "laboratory-sized" will have to be conducted. This creates a methodological dilemma: if the experiment is too small, the results might not be scalable to planetary dimensions. If the experiment is too big, there is no practical, legal, or moral difference between an "experiment" and actual deployment of the technology. In the meantime, scientists can move ahead with developing the technologies, even without sponsorship from a government. The magnitude of cost for some geo-engineering development may mean that the work can be underwritten by private corporations, foundations, and wealthy individuals. In addition, individual states may move ahead with geo-engineering development and deployment. The financial costs are relatively low, and the effects would be relatively quick (Standing Senate Committee 2010). This means that there is still time, but not much, for a regime to be formed.

Canada has many reasons to spearhead the creation of a geo-engineering regime. The issue is one of high stakes, particularly because the Arctic is sensitive to climate change and changes in environmental policy could affect the continuing exploitation of energy resources in Alberta. The current international political system—in which the power and influence of the unipole, the United States, has clear limitations—is conducive to significant policy-making roles for smaller states and non-state actors. At the same time, Canada has important domestic and international reasons for wanting to enhance its reputation as a fair and honest political broker. That reputation, particularly with regard to environmental agreements, has been tarnished in recent years, degrading one of Canada's key power resources in the international system. Whether the Trudeau Liberal government chooses to act from a sense of the common good or from national interest more narrowly construed, Ottawa can best serve that purpose by committing to a leadership role in the formation of a global geo-engineering regime.

Under the government of Justin Trudeau, Canada should seize this leadership opportunity and encourage the epistemic community of climate scientists to engage scientific questions as objectively as possible. This should facilitate reporting of the findings that are best by scientific standards. Climate scientists are the experts on the basics of human interaction with the natural world, and need to be treated as valued partners in any geo-engineering regime. At the same time, Canada must be mindful of lessons learned from previous international regimes addressing issues requiring scientific expertise. In so doing, Canada can parlay its international reputation as an honest broker into a leadership position on an issue of nothing less than global survival.

Key Terms

climate change
geo-engineering
greenhouse gases (GHGs)
niche diplomacy

Study Questions

1. Do scientific issues differ from other types of issues with policy implications? If so, how? If not, why not?
2. Whose co-operation is important for an international response to climate change?
3. Does Canada have a compelling interest in the issue of geo-engineering governance?
4. Should niche diplomacy be a factor in Canada's foreign policy choices regarding geo-engineering?
5. How might being a "middle power" help or hinder Canada's ability to address global climate change?

Suggested Further Resources

American Association for the Advancement of Science (AAAS): http://www.aaas.org/program/center-science-diplomacy.

Forum for Climate Engineering Assessment: www.dcgeoconsortium.org.

Intergovernmental Panel on Climate Change (IPCC): www.ipcc.ch.

National Research Council. 2015. *Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration*. Washington: National Academies Press.

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The Oxford Principles: http://geoengineering-governance-research.org/the-oxford-principles.php.

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