Permafrost Carbon Feedback requires urgent, collaborative attention

"We must act decisively to limit permafrost thaw."

With those words, Jonathan Wilkinson, Minister of Environment and Climate Change Canada, launched the Permafrost Carbon Feedback Intervention Roadmap Dialogue series, a set of four privately sponsored virtual symposia addressing the science, technology, economics, policy, social and ethical implications of permafrost thaw.

The first dialogue, **Why Permafrost Carbon Matters**, (March 4, 2021), attracted more than 200 leading academics, government policy makers, technology investors, climate change activists and media from around the world. There were four presenters:

Ted Schuur, Professor, Center for Ecosystem Sciences and Society, Northern Arizona University

Kerry Bowman, Professor, University of Toronto Joint Centre for Bioethics and the University of Toronto Centre for Environment

Thomas Homer Dixon, Founder and Director, Cascade Institute, Royal Roads University; University Research Chair, Faculty of Environment, University of Waterloo

Candis Callison, Associate Professor, School of Journalism, Writing, and Media, and Institute for Critical Indigenous Studies, University of British Columbia

Together, they presented the case that Permafrost Carbon Feedback is a climate change accelerant with the capacity to push global climate toward a state of dangerous disequilibrium. Such being the case, the precautionary principle demands that those with the power and responsibility to do so take preventative measures, regardless that our current planning paradigm is not designed to defend against low-probability, but high-risk phenomena. It is further crucial that any response leverage the knowledge, honour the rights and incorporate the participation of those who are most likely to be affected by permafrost thaw and any efforts to mitigate – including the 500,000 indigenous people who live in the circumpolar north.

> "Permafrost thaws, it doesn't melt. Think of it like this, you take some hamburger out of the freezer for dinner and put it on the counter; you're not waiting for the hamburger to melt, you're waiting for it to thaw."
>
> **– Dr. Ted Schuur**

Dr. Schuur, whose research was central to the National Oceanic and Atmospheric Association's 2019 Arctic Report Card, opened the dialogue with an overview of the science, titled: **The scope of the problem; what we know/don't know**. Permafrost is perennially frozen ground that holds about twice as much carbon as that contained in all the world's atmosphere. But now, human activity is causing the global climate to warm – a phenomenon that is occurring almost three times faster in northern regions – and that warmth is causing permafrost to thaw, which stimulates soil activity that breaks down previously frozen organic matter, releasing the greenhouse

gases carbon dioxide and methane. Once back in the atmosphere, those gases have the capacity to further promote global warming, in an accelerating feedback cycle.

Scientists are now engaged trying to determine the magnitude, timing and form or permafrost carbon release. That is, how much carbon is being released, how quickly and in what form (CO_2 or CH_4) so they can better understand its impact in accelerating warming. Dr. Schuur quoted from the Intergovernmental Panel on Climate Change (IPCC) Special Report on the Ocean and Cryosphere in a Change Climate to describe the amount of carbon potentially to be released by the end of the 21st century. The estimates anticipate the thawing of between 24% and 69% or near-surface permafrost leading to the release of tens to hundreds of billions of ton of permafrost carbon. On that basis, Schurr has calculated that in the upper range, the permafrost could release +/- 10% of its carbon, constituting 150 billion tons equal to 75 parts per million of CO_2 in the atmosphere, or 18% of all the carbon dioxide in the atmosphere already. (Important to note, as well, that those emissions would also continue from that higher threshold.)

While the higher emission estimates are at one end of an uncertain range, the lower estimates are equally uncertain. The lower emission scenarios rely upon the warmer atmosphere supporting increased plant growth, which would then draw more carbon out of the atmosphere and sequester it in plant biomass and, perhaps ultimately, in newly frozen permafrost. Schuur, however, said he believes that calculations of this new sequestering may be "over optimistic."

Much remains unknown, and many people in science and policy, use that doubt as an argument for inaction – suggesting that we should wait until the threat is confirmed. But Schuur said many more in the scientific community are nervous about how far we may have come already. "Some people think the permafrost is already gone, some people think the situation is hopeless." Although that bleak scenario is unproven, Schuur acknowledged that in all current models permafrost declines at least to some degree.

Looking again to the IPCC, the most recent Summary for Policymakers observed that, "There is *medium evidence* with *low agreement* whether northern permafrost regions are currently releasing additional net methane and CO_2." The italicized equivocations reveal the outstanding scientific uncertainty over whether the carbon feedback mechanism is already accelerating climate change. But Schuur concluded that "strong evidence" in permafrost areas that are well studied, "suggest that we should act as a society, even in the face of uncertainty, even as we collect more data, as this issue is not likely to go away."

Schuur's parting point segued perfectly into ethicist Kerry Bowman's presentation, **How the Precautionary Principle applies; drawing lessons from poor preparation and systems resilience during the COVID-19 pandemic**. Bowman began with a definition of the Precautionary Principle: "When an occurrence raises threats of harm to human and/or environmental health, precautionary measures ought to be taken even if some cause-and-effects relationships are not fully established." The central point being, that if, in anticipating or managing a potential problem such as Permafrost Carbon Feedback, you wait for definitive, hard-core evidence, you risk delaying any response to the point where tremendous harm is done.

Bowman also noted that this risk has been anticipated in the international conversation about climate change. In 1992, at the Rio Convention where the United Nations Framework Convention on Climate Change (UNFCCC) had its origin, the founding declaration included Principle 15:

> "In order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

In Bowman's words, we simply "can't wait for bullet-proof scientific data when we have a great threat."

According to the logic of the Precautionary Principle, Bowman offered five further guidelines for action:

1. Take preventative action in the face of uncertainty.
2. Shift the burden of proof to the cost and consequences of inaction.
3. Explore a wide range of preventative strategies.
4. Increase public awareness of and participation in decision making.
5. Use the shift to create opportunities and challenges for scientists to think differently about the ways they conduct studies and communicate results.

Absent a clear application of the Precautionary Principle, even when hesitance can result in great cost, scientists tend to be conservative in how they present their findings. The whole peer review process is dedicated to limiting the communication of unproven or uncertain material.

But Bowman offered the COVID-19 pandemic as a perfect illustration of what can happen when society waits for unequivocal evidence of danger, rather than acting cautiously in the face of a threat that, while still unproven, could have devastating consequences. Having been working in Toronto hospitals during the 2003 outbreak of the first SARS virus, Bowman was already familiar with the risk; Toronto was the only centre outside Asia that suffered directly from the SARS 1 infection. Yet, when SARS CoV-2 (COVID-19) struck last year, Canada is the only country that didn't act quickly to shut its borders and call for social measures such as the wearing of masks And our subsequent infection and death rates attest to the consequences.

Bowman said: "We relied heavily on epidemiological models that were designed to show approximately what happens when a limited set of actions are made. But we were dealing with interconnected, complex systems that allow things to cascade out of control, delivering unknown outcomes."

Thomas Homer-Dixon picked up Bowman's point with a presentation that he titled, **Danger in the tail: The policy implications of underestimating the risks of permafrost carbon feedback**. Homer-Dixon's opening point was that the current paradigm for assessing and reporting scientific phenomenon – and for making policy based on that phenomenon – doesn't deal well with non-linearity, when positive feedback loops can produce enormous and sudden change.

To give context to the point, Homer-Dixon quoted the 2013 report from the U.S. National Academy of Sciences, *Abrupt Impact of Climate Change: Anticipating Surprises*:

"Arctic carbon stores are poised to play a significant amplifying role in the century timescale buildup of CO_2 and methane in the atmosphere, but are unlikely to do so abruptly, on a time scale of one or a few decades. This conclusion is based on immature science, however and a truly sparse monitoring capability."

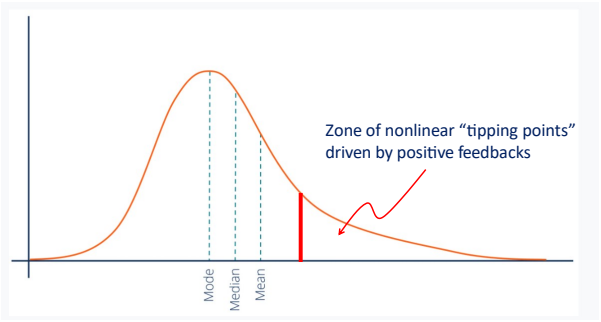
It appears however, that in the time since, policy makers paid more attention to the assurance that problems are "unlikely" to arise abruptly than to the warning that the science was immature.

Homer-Dixon also quoted the Harvard economist Martin L. Weitzman, who in a paper titled, *Fat-tailed Uncertainty in the Economics of Catastrophic Climate Change*, said:

> "I believe that the most striking feature of the economics of climate change is that its extreme downside is nonnegligible. Deep structural uncertainty about the unknown unknowns of what might go very wrong is coupled with essentially unlimited downside liability on possible planetary damages. This is a recipe for producing what are called 'fat tails' in the extreme of critical probability distributions…."

The problem, Weitzman concluded, is that "It is difficult to judge how fat the tail of catastrophic climate change might be because it represents events that are very far outside the realm of ordinary experience."

Weitzman's "fat tail" is the trailing end of a graph of the probabilities of future events, such as the release of specific amounts of carbon from the permafrost at a given temperature. Scientists or economists often base their models on such graphs, assuming that the "central tendencies" in the fat middle – the mean, median, or mode – represent what will happen in the future. But these curves often have long, fat tails that indicate that extreme outcomes, while not probable, are still possible. They should not be factored out of consideration by our mathematical models. Citing Bowman's caution, Homer-Dixon agreed that we are duty bound to act cautiously when we face "nonnegligible possibilities of very extreme temperatures that frankly would be an existential threat to human civilization."



Events in the tails of climate probability distributions will likely be associated with climate "tipping points" driven by positive feedbacks, Homer-Dixon noted. He quoted from a 2019 *Nature* article by Tim Lenton, et al., which said:

> "The clearest emergency would be if we were approaching a global cascade of tipping points that led to a new, less habitable 'hothouse' climate state … We argue that cascading effects might be common [and] examples are starting to be observed. The evidence from tipping points alone suggests that we are in a state of planetary emergency."

Homer-Dixon then presented a second key concept that should inform policy conversations about permafrost carbon feedback: climate hysteresis. Once a component of the climate system passes a tipping point—for example, once major patterns of ocean currents, such as the Gulf Stream, reorganize themselves—that component will not return to its previous state even if the factors that produced the tipping are reversed. Similarly, massive thawing of the permafrost could for all intents and purposes be irreversible.We won't be able to wind the process back. Facing such a threat, even if scientists are reluctant to sound extremist or alarmist, they still have a responsibility to articulate what extreme scenarios might look like.

Homer-Dixon said: "When we do the math, we have to multiply probability of an event by its cost to us. A small probability event is still worth mitigating if its occurrence will produce enormous costs."

The first and largest portion of that cost is destined to fall on those who live in the north, and especially on the 500,000 indigenous peoples live in the Arctic, spanning three continents, seven countries and 30 million square kilometres. Yet, in a presentation titled, **The ethical implications of governments and outsiders advancing actions and policies that affect Northern communities and residents,** Candis Callison pointed out that these are often people with no voice. Callison is a member of the Tahltan First Nation that lies on the border of British Columbia, Yukon and Alaska, and she noted the degree to which Indigenous peoples have been left out of the international conversations about how and how quickly to respond to the damaging effects of climate change in the North. For example, before the 11th Conference of the Parties to the UNFCCC (COP 11) in Montreal in 2005, Indigenous peoples had not even been mentioned in proceedings, much less consulted. Things have improved since, but marginally.

Callison quoted Patricia Cochrane, former head of the Circumpolar Council, who said,

> "Despite a keen awareness of climate change, northern Indigenous people have not played a central role in national and international assessments of climate change. To the extent that Indigenous issues are considered assessments have been largely *about* Indigenous people, not *by* them. This reflects, in part, a rejection by western science of Indigenous worldviews that integrate spiritual, biophysical, and cultural dimensions of reality."

More than merely disrespectful, this approach also sacrifices the benefit of thousands of years of Indigenous knowledge – the ways of relating to the lands and waters, and to what Callison referred to as Indigenous peoples' non-human relatives. This knowledge is also a reflection of a once sustainable set of Indigenous practices – defined by reciprocal opportunities and responsibilities – even as many of these practices are being rendered obsolete by climate damage caused by wealthy countries and massive populations that never set foot in the north and have little understanding of its issues.

In this regard, Callison also spoke of the popular notion that the north is a vast wasteland, populated primarily by "charismatic megafauna." Look to popular media and the most common visual imagery of the north is much more likely to feature a polar bear than the residents and (often climate-battered) infrastructure of northern communities.

In one of Callison's own early books, *How Climate Change Comes to Matter*, she quoted Inuuk Aqqaluk Lynge, saying,

> "With all the flurry of scientific enquiry on this issue, one could easily be led to believe that it is the researchers who are most affected by the world's changing climate, and not the Inuit. I plead with western scientists to be careful how you conduct your research on our land and on our thinning ice. Work with us as equal partners and not as the colonizers and missionaries did. Help us deal with not only your own interesting research, but with our concerns. For example, help us deal with industry, which is keen to see an Arctic sea route open up to them."

Thus, climate change, a unique and potentially existential crisis for all humanity, emerges as the most recent of many challenges that colonialism has brought for Indigenous people, Callison said – challenges that are present throughout the circumpolar north. Thus, as a guideline for future action,

Callison quoted from *Climate strategies: thinking through Arctic examples,* by Barbara Bodenhorn and Olga Ulturgasheva, who wrote:

> "Neither 'the Arctic' nor its residents should be assumed to represent homogenous entities – either in terms of the conditions that exist across the circumpolar north, nor in terms of the views local people have of their worlds. To consider effective strategies requires both a recognition and an inclusion of local-level knowledge, thinking and practices."

Callison concluded that partnerships, mutual respect and community engagement are essential.

Callison's comments touched a nerve among other presenters. Homer-Dixon, for example referred to the flawed notion of the Arctic as a remote place that others might ignore. It's not remote at all, he said. "We live in a tightly coupled socio-economic system." What happens in the Arctic "will have real consequences for the entire species."

Homer-Dixon also offered a parting call to action, on Permafrost Carbon Feedback and on climate change in general, quoting the American chemist Will Steffen: "We need to reach a social tipping point before we reach a planetary one."

Key Messages from the First Dialogue:

1. Global warming, which is occurring in the Arctic at more than twice the global average, is accelerating the thaw of northern permafrost – which itself holds more than twice as much carbon as is currently in the atmosphere.
2. Current models include credible worst-case scenarios in which the accelerated permafrost thaw contributes to the release of up to 150 billion tonnes of carbon, which alone could increase the concentration of CO2 in the atmosphere by nearly 20 per cent.
3. While this outcome remains uncertain, the precautionary principle dictates that: "When an occurrence raises threats of harm to human and/or environmental health, precautionary measures ought to be taken even if some cause-and-effect relationships are not fully established."
4. Current climate models – and thus current climate policy – are focused on outcomes that are deemed to be the most likely. But in anticipating and planning for events of highest likelihood, we fail to factor in the potentially calamitous consequences of so-called 'fat-tail' events which, while less likely, must still be considered.
5. Our average-likelihood risk analysis also fails to consider or defend against irreversible events, tipping points that make it impossible merely to back up to a previous state of safety.
6. In researching and/or making policy for the north, we too often regard it as a barren wasteland, home only to musk ox, reindeer and polar bears, rather than 500,000 Indigenous people, from seven nations spread over three continents. The people of the north deserve protection and respect and must be engaged as knowledgeable partners in addressing climate and northern issues.