For Permafrost

1.5°C is a limit not a target

Are compliance mechanisms strong enough to improve environmental performance through climate action before the 1.5°C limit is reached?

Report

December 28, 2022

Using compliance mechanisms to drive climate action

One of the reasons that permafrost thaw is an increasing public and policy concern is because it's recognized as one of the first tipping points to be reached (McKay et al., 2022, P.1). A tipping point occurs when it becomes self perpetuating beyond a threshold, for Boreal permafrost this is between 1 to 2.3°C warming over pre-industrial levels (McKay et al., 2022, P.5). This is because the amount of carbon stored, and that can potentially be released from permafrost, is estimated to be double what's in the entire atmosphere (Bykova, 2020; NASA, 2022; Meredith et al., 2019). An abrupt thaw could occur near-synchronously, on a subcontinental scale, which has the potential to increase emissions by 50 to 100% (McKay et al., 2022, P.5).

As the need for limiting warming becomes increasingly urgent two American Law Professors, Susan Kuo and Benjamin Means, have presented a timely argument about why corporate compliance is the most realistic option to curb emissions. They argue that it has been overlooked due to the ineffectiveness of being tied to existing laws and regulations (Kuo & Means, 2022, P.2138). This paper will review three potential compliance influencers: risk assessments, social contracts, and the regulatory environment. First, a closer look at the complexity of permafrost.

The problem of permafrost thaw

The thing about permafrost is that it's a wicked climate change problem. It's a climatic impact driver with a positive feedback loop that can be triggered by an abrupt thaw leading to increased emissions and further rapid thawing. "The permafrost carbon feedback (PCF) is the amplification of surface warming due to CO_2 and CH_4 emissions from thawing permafrost" (Schaefer et al., 2014, P.1). The PCF is particularly concerning because of the near certainty that across Northern Canada warming trends will degrade the layer of permafrost that's nearest to the surface (ECCC, 2020, P.92). Despite this certainty, permafrost is classified as a tier 3 climatic design variable, meaning that it has poorly understood processes, and limited published studies, resulting in a low confidence level in future Canadian projections (ECCC, 2020, P.90 & 70).

The impacts of permafrost thaw

With the rapid rise in temperatures, as we've seen in the Northwest Territories, where the mean annual temperature has increased between 2 and 4° C since 1950 (Huberman, 2022, P.iii), communities are already having to adapt due to the stresses that thawing permafrost is putting on ecosystems and infrastructure. On it's own, permafrost thaw is identified as low risk due to the slow thawing process, however, governments recognize that risk escalates rapidly once permafrost is disturbed (Yukon, 2022, P.18).

The Yukon government has assessed the risk from permafrost thaw and determined that there is a high likelihood of resulting critical infrastructure failures. This means the failure is likely to happen multiple times within a decade, and potentially every year. (Yukon, 2022, P.37). The Yukon mapped consequences across climate change threats to key impacts as shown in Figure 1, with infrastructure found to be the most critical for permafrost thaw.

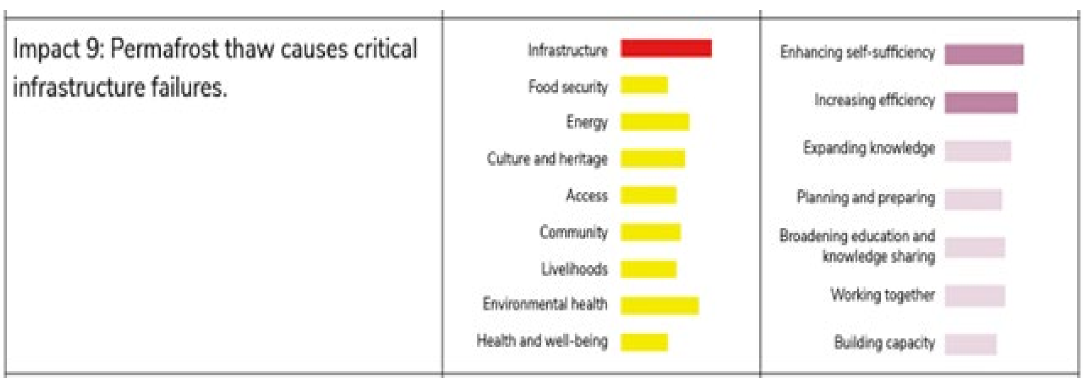

Figure 1 Infrastructure impact from Permafrost Thaw (Yukon, 2022, MR P.100)

At the same time northern communities are trying to adapt they are facing a knowledge capacity gap with the Northwest Territories reporting a reliance on academic partnerships and collaboration with federal researchers for research and monitoring (GNWT, (nd), P.40). A key point when considering the impacts from thawing permafrost is that planners need to consider different climate targets for adaptation than they do for mitigation.

Future projections

The likelihood of hitting a given temperature target can be best understood by looking at alternative Shared Socio-economic Pathways (SSPs). SSPs describe socio-economic conditions based on how the world might evolve using 5 different pathways from SSP1: Sustainability, to SSP5: Fossil-fueled Development. Each scenario projects a range of temperature increases, within a corresponding uncertainty range, based on radiative forcing. Radiative forcing, in simplified terms, is the effect of the heat from the incoming sun less that which is released into space and where a net positive difference results in a warming planet (NDAA, 2022).

The effect of radiative forcing is understood through Representative Concentration Pathways (RCPs), which are paths to stabilizing greenhouse gas concentration trajectories. Using these with Global Climate Models (GCMs) provides projections for attributes like temperature and precipitation. However, GCMs do not have enough detail to provide accurate projections for permafrost thaw (ECCC, 2020, P.77). Better estimations can be found using the surface frost index (SFI) which classifies permafrost based on extent of near surface permafrost starting from continuous to discontinuous, to sporadic and finally isolated (ECCC, 2020, P.77). To get a sense of the warming effect on permafrost extent and degradation, we can look at an estimate based on SFI from 1998 shown in Figure 2 alongside a projection based on 2° C of warming as shown in Figure 3.

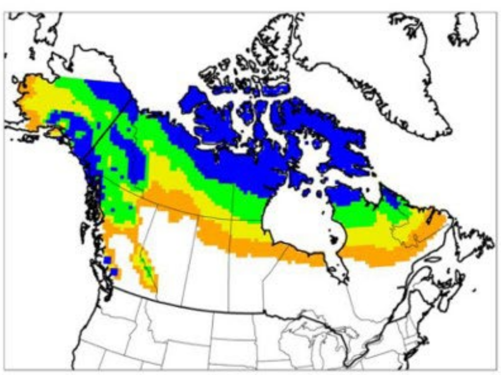

Figure 2 CanRCM4 LE 1998
permafrost extent (ECCC, 2020, P.85)

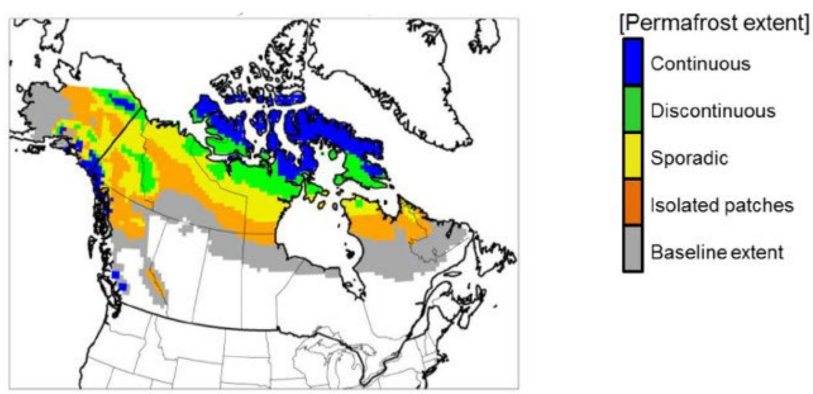

Figure 3 CanRCM4 projection
at + 2°C warming (ECCC, 2020, P.86)

The active layer of permafrost differs across the classes of permafrost as do the associated risks to infrastructure. Despite scientists having a high confidence that thawing permafrost will lead to carbon release there is an associated low confidence of the timing and magnitude as well as the relative roles of the feedback processes (Arias et al., 2021, p.97).

Mitigate to 1.5°

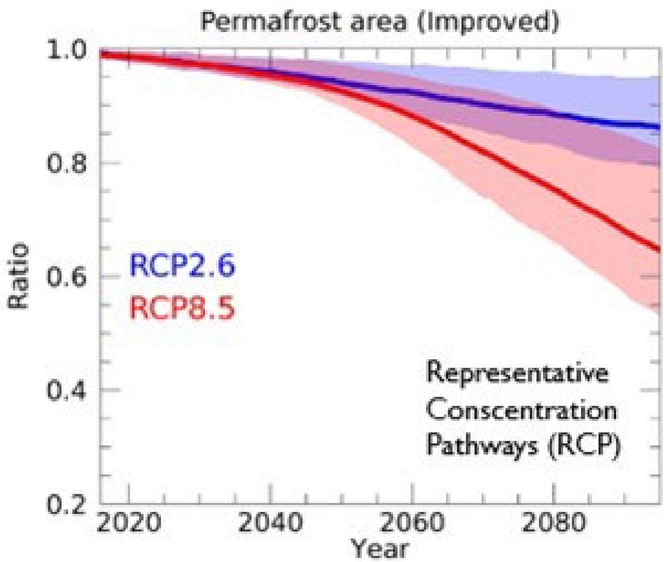

Figure 4 Permafrost Loss Projections to 2100 (Yakahota et al., 2020).

Figure 4 illustrates the permafrost thaw projections for RCP 2.6 and 8.5 based on a model with improvements for permafrost processes developed in 2019 which includes additional observational data and better accounts for the freezing and thawing of soil moisture (Yakahota, et al., 2020). The thick lines represent the mean loss of permafrost and the shaded area represents the minimum and maximum range of the loss based on model projections. The outcomes of the scenarios diverge starting around 2040 where RCP 2.6 constrains further warming while RCP 8.5 rapidly escalates due to the positive carbon feedback loop and resulting increasing temperatures.

Adapt to 4.4°

Higher emissions, warmer temperatures

RCP (2100 RADIATIVE FORCING, W/m²)	SSP1 Sustainability	SSP2 Middle of the Road	SSP3 Regional Rivalry	SSP4 Inequality	SSP5 Fossil-fueled Development
8.5*					X +4.4°C
7.0			X +3.6°C		
6.0*					
4.5*		X +2.7°C			
3.4					
2.6*	X +1.8°C				
1.9	X +1.4°C				

Table 1 Adapted from Table 1 SSP-RP combinations used in CMIP6 with "best estimate" 2081-21-00 end of century temperature anomoliy

The evidence of the low tipping point for permafrost thaw means that RCP 2.6 is needed to adequately limit warming. There's little certainty to achieving this pathway without a strong international compliance culture so populations vulnerable to the impacts of permafrost thaw must plan for the worst.

The supporting role of climate services

Analysis of climate information requires specialized knowledge and climate information services organizations work with and across diverse organizations for a broad range of applications such as government planning, establishing industry building standards, and developing climate change strategies, to name a few.

Climate Services organizations can facilitate working groups across disciplines with strategic and operational decision makers who are responsible for adaptation planning. This can be a government, a governing body, or an impacted population. The application of climate information requires a multi-disciplinary approach with contributions from across climate scientists, engineers, solution designers, indigenous peoples with traditional knowledge, and people in the communities being impacted. Each participant can help to ensure more socio-economic aspects are considered during analysis. Adaptation planners can use risk analysis to understand vulnerabilities and exposure to climate hazards.

Influencing compliance through risk analysis

Climate services play an important role in informing and enabling risk management to support organizations' adaptation efforts (Ranasinghe et al., 2021, P.1865). They can provide access to historical climate data, and future climate projections including severity, frequency, and duration of climate events. Risk analysis also requires input from across disciplines to identify the system sensitivity, response, coping, and adaptive capacity of the systems for

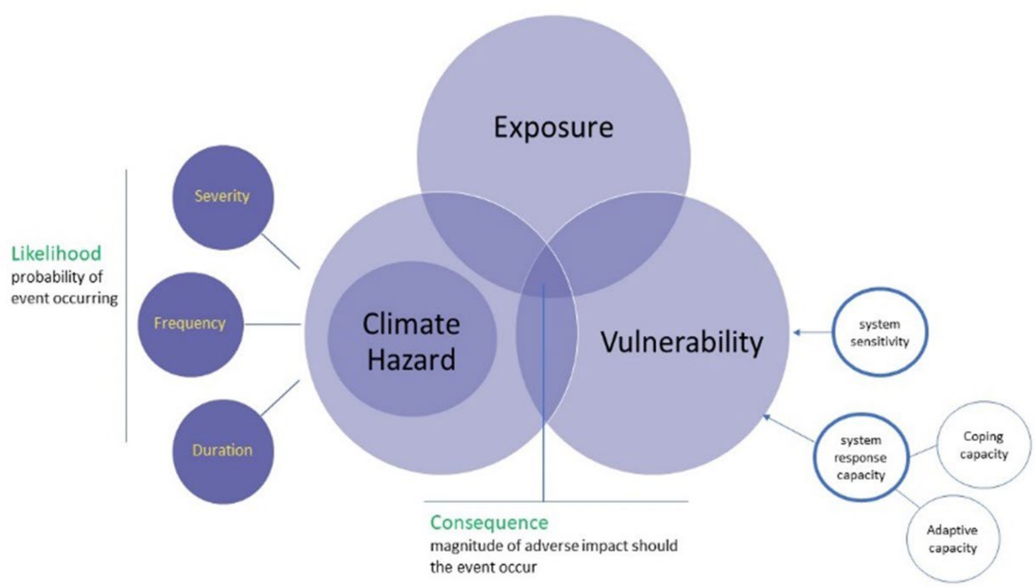

Figure 5 Recreated from Schwantes 1:29 Conference Presentation aligns to IPCC's 5th Assessemtn Report

which they are responsible. Figure 5 illustrates key components of a risk assessment that might be done by a government or corporation.

Figure 6 shows how analyzing permafrost thaw as a single hazard in a risk analysis is complex because permafrost itself is vulnerable to hazards that change the severity of degradation, extent, and rate of thaw. Complex system variables impacting the thaw include the positive feedback loop related to global warming, the impact from infrastructure built directly on permafrost like buildings and oil and gas exploration seismic lines[1] (Huberman, 2022, P.53), wildfires (Gibson et al., 2018), and even migrating species, such as beavers, whose dams can impact hydrological systems (Hancock, 2022, P.25).

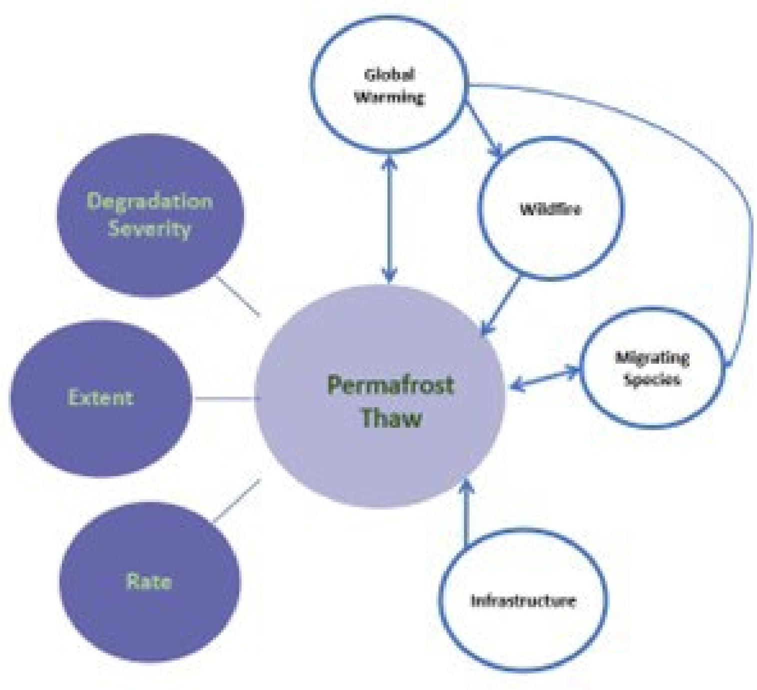

Figure 6 Variables impacting permafrost thaw

If a corporation conducted a risk assessment on permafrost it would be inward-looking and it would guide the company's adaptation actions. It would not address compliance enforcement, nor would it necessarily consider impacted populations. This means that climate change becomes just another risk to hedge against, no different than market risks (Kuo & Means. 2022, P.2137). To protect impacted populations from climate changes resulting from corporate operations, we need to go beyond risk management to a hybrid approach blending it with the benefits of a problem-solving approach that comes from a compliance framework (Kuo & Means, 2022, p.2143).

In an environment where many Corporations are allowed to self regulate with respect to climate change mitigation, a risk assessment approach on its own isn't influential enough to encourage Corporations to do their part to constrain global warming to 1.5° C. Work to strengthen social contracts and regulatory compliance is also needed to limit warming to 1.5° C above post industrial temperatures. It has been difficult to draw a straight line from global warming to a corporation's culpability, but this is beginning to change as the ability to attribute corporate pollution to climate change, is improving (Kuo & Means, 2022, P.2177). In the interim, individuals and organizations have been using social levers to influence compliance in response to the urgent need for mitigation.

Influencing compliance with social levers

From social contract theory there is an expectation that Corporations will act as good corporate citizens and this has been legally strengthened in the US with the enactment of the Foreign Corrupt Practices Act (Kuo & Means, 2022, P.2144). Looking at the challenge with a social contract theory lens, there are three levers of interest: climate change activism, corporate reputation, and Environment, Social and Governance (ESG) frameworks. Starting with climate change activism, Kuo & Means argue that companies have an added incentive to do the right thing because climate activists can harm corporate reputations by raising public awareness (2022).

We should question the effectiveness of self regulation after years of successive international government climate change pacts that have not been able to prevent the escalating amounts of carbon in the atmosphere. Peter Kalmus, a Nasa scientist and increasingly assertive climate activist, uses his social media accounts to point out failures like this (Kalmus, 2022).

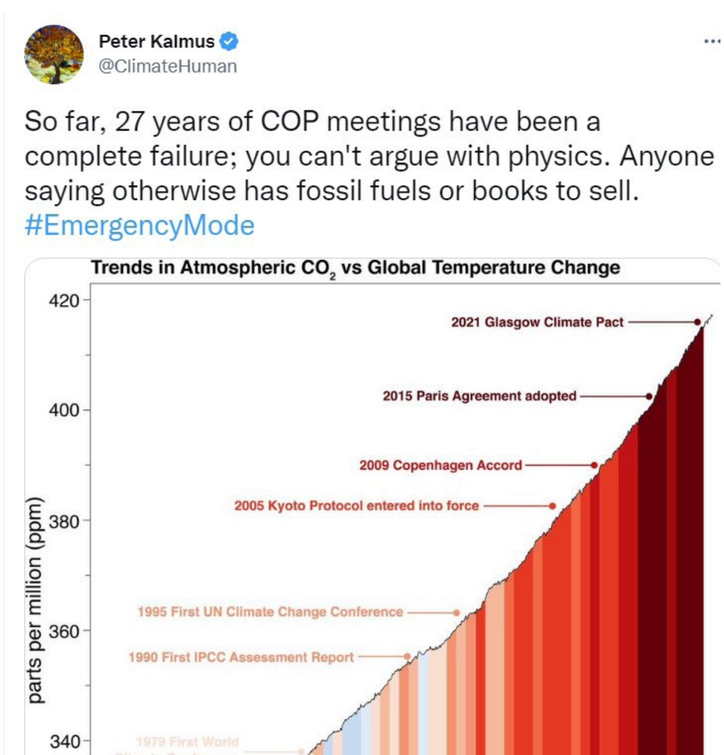

Figure 7 Peter Kalmus Tweet screen capture Nov. 2022

Kalmus has used a variety of tactics from broadcasting his invitational visit to the White House to engaging in acts of civil disobedience, with seemingly little results. It's a reminder of the limited effectiveness of the social contract in influencing the behavior of corporations. There are known limits of individual activism like this but Kuo & Means identify that the social contract can be strengthened through legislation, laws, and mandatory public reporting (Kuo & Means, 2022). The most expedient of the three appears to be public reporting through an ESG framework.

Climate change action is included in the UN sustainability goals and through ESG can become part of a companies overall environmental performance record. ESG reporting is gaining momentum as a compliance mechanism and in the event of a publicly traded corporation, can drive activism by individuals and groups of shareholders. ESG reporting is voluntary but as Kuo & Means point out, "Failures to disclose can be investigated and sanctioned as compliance failures" (2022, P.2174). Kuo & Means (2022) argue that compliance and ESG goals can be complimentary mechanisms to build climate change obligations using performance targets, staff incentives to meet the target, and public disclosure (P.2165). Kuo & Means (2022) provide multiple examples of Corporations making ESG goals public and how reporting negative results presents a risk to a Corporation's reputation. They point to successes such as shareholder actions leading to an increase in environmental sustainability experts being added as directors on public boards (Kuo & Means, 2022, P.2179).

Environmental compliance frameworks are improving and need to include social levers of reputational risk, activism, and public reporting and these can and should be strengthened further with compliance mechanisms (Kuo & Means, 2022).

Corporate Culture and the Regulatory Environment

In 1998 a research study of 1,000 workers across a mix of small and medium enterprises (SMEs) found that an industry's environmental consciousness was motivated by compliance and that management was unlikely to be proactive in looking forward to future pressures and changing company values (Petts et al., 1998, P.16). The norm was found to be reactive, and questions were raised about a company's overall capability to comply due to the need to devote resources, in terms of time and money for training, to ensure staff were capable of complying to regulations (Petts et al., 1998, P.27).

In the 1998 study, staff were concerned about environmental compliance but thought that regulation alone would not be enough to protect the environment (Petts, et al., P. 27). The research also found that staff thought the court of public opinion was an important compliance driver (Petts et al., 1998, P. 26).

Fast forward to 2022 and the arguments put forward by Kuo & Means in their analysis of the current state of climate change compliance and what it might mean for mitigation efforts. They point out that compliance is a stronger framework than risk management to support the goals of climate change (Kuo & Means, 2022, P.2138) and argue that "[t]he surest mechanism for creating a compliance obligation is to enact a statute or promulgate a rule" (Kuo & Means, 2022, P.2169). However, enacting rules around climate change uncertainty can be challenging, particularly trying to set standards for which to comply.

The Canadian Net-Zero Emissions Accountability Act was assented to in 2021 and sets requirements for national greenhouse gas emissions targets and associated reporting milestones in 2024, 2029, 2034. This was followed by Canada's 2030 Emissions Reduction Plan, a roadmap towards achieving a reduction of 40-45% emissions below 2005 levels by 2030. This is the most recent in a series of climate plans which comes with a promise of funding across multiple sectors and a promise to define a cap on oil and gas sector emissions after further consultation (Government of Canada. 2022, P.8).

Beyond compliance mechanisms, it's become increasingly important to engage in climate resilient development, in parallel, as the need to adapt to adverse climate change impacts is increasingly urgent. Given the associated uncertainty ranges inherent in climate change projections, we can look to resilient development as necessary approach. This is particularly important when addressing the problem of permafrost thaw, where adaptation is needed right now, and could get exponentially worse quickly.

Trade-offs and developing resilience

A relevant principle of climate policy is Climate Resilient Development (CRD) which evaluates various adaptation and mitigation options and how their implementation inter-relate to broader sustainability goals (Schipper et al., 2022, P.2666). It's understood that there are trade-offs across mitigation, adaptation, and the sustainable development needed to limit warming to under 1.5° C while still improving resilience (Schipper et al., 2022, P.2666). These trade-offs have resulted in criticisms, suggesting that there is still more to learn in terms of the overall impact to human and ecological systems (Schipper et al., 2022, P.2666).

Consideration for CRD is seen throughout the GWNT's Climate Strategy which has a section discussing energy and GHG mitigation plans providing a window into how a Provincial Government is navigating the complexity that comes with trying to balance adaptation and mitigation with equality.

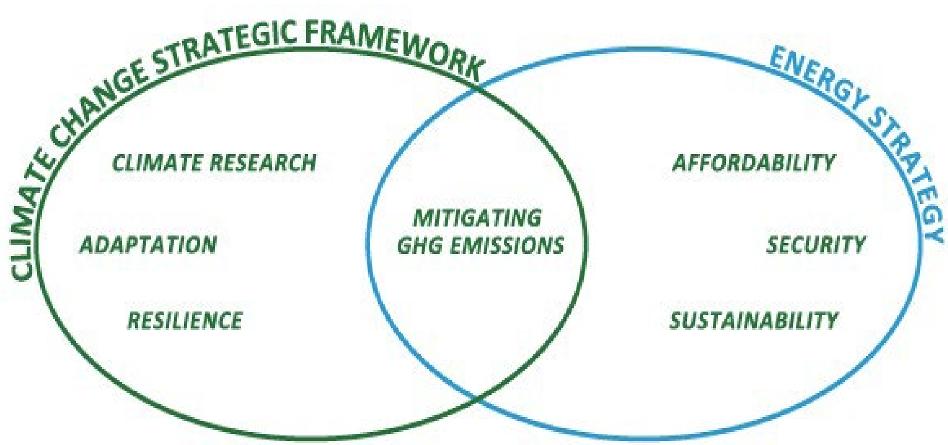

Figure 8 GNWT interconnected goals across strategies (GNWT, (nd) p.22

For CRD planning, the IPCC recommends the involvement of a third party to facilitate dialogue and negotiations across disciplines, acknowledging that there isn't one optimal path for all parties (Schipper et al., 2022, P.2667), even if it's being discussed in a single region, as is the case for the GNWT. Partnerships, which include traditionally marginalized groups, and that are financially supported, with assistance from climate services and decision support tools, improve equitable outcomes (IPCC, 2022, SPM P.29). Further, facilitation of climate resilient goals works best when there is collaboration and cooperation across political leaders, institutions, and the communities that will be impacted by Climate Change (2022, SPM P.29). In Northern Canada this is being experienced through a delegation of

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In summary, to return to the question of time, Kuo & Means summarize their article with a comforting generational perspective and sentiment on the relativity of time.

> "The work of restoring nature's cathedral will also require labor across generations. Those alive today will not see the work completed, but they can ensure that it is well and truly begun"
>
> (Kuo & Means, 2022, P.2181).

A sentiment that might be interpreted as an implication that there is time to make slow progress. In contrast, the generational perspective and sentiment of the people of the North differs, and has an urgency of a people's whose time is runing out,

> "While the adaptive capacity of Northerners, esespecially Indigenous Northerners, has allowed them to be resilient to change for generations (Pfeifer, 2020), the pace of change to which we must adapt has accelerated and is outpacing adaptive capacity (Ford et al., 2014)"
>
> (Hancock et al., 2022, P.7).

The answer to the question: Are compliance mechanisms strong enough to improve environmental performance through climate action before the 1.5° C limit is reached? remains elusive.

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