Building Resilience in the Arctic

6 AUGUST 2025

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1.Introduction

The Arctic has become a frontier of rapid climate impacts. Sea ice is shrinking, coastal erosion is accelerating, and thawing permafrost, which holds an estimated 1.4 trillion Tonnes of carbon, threatens both local economies and global climate targets. As melting ice unlocks access to vast natural resources and new shipping routes, the region has emerged as a hotspot of geopolitical tension. Arctic settlements, fragile ecosystems, and aging infrastructure confront compounding risks from climate-induced changes, commercial activity, and geopolitical interests. Building Arctic resilience

means preparing both for the pressures of growing geopolitical focus and the effects of climate change.

2.Geopolitics in the Arctic

The resource-rich Arctic invites great power competition. Countries have launched a race to claim and extract what lies beneath the ice. The U.S. Geological Survey estimates that the region's continental shelves hold 90 billion barrels of undiscovered oil and 1,669 trillion cubic feet of natural gas (Bird et al., 2008). The Arctic Economic Council reported in 2024 that the area holds 31 of the 34 critical raw materials needed for the global clean energy transition (Arctic Economic Council, 2024). Three-quarters of the European Union's listed critical minerals are currently extracted in the Arctic (Arctic Today, 2024). The region's polar waters also contribute greatly to global fish catch. But changing migration patterns and the expanding accessibility of the Arctic Ocean are altering the commercial viability of existing fisheries.

Ice retreat and longer ice-free seasons unlock new trade and shipping routes and increase access to previously remote resources. Control of this emerging frontier hinges in part on icebreaker ships that are critical for year-round access to the region. Russia leads with a fleet of over 40 icebreakers while the U.S. presently has only two, limiting its operational capacity and geopolitical leverage (Katz, 2024; Magnuson, 2025). However, President Trump has made promises to develop or acquire 40 big icebreakers, bolstering the Coast Guard's plans to modernize and grow a capable fleet (Ferran, 2025). In 2024, the U.S., Canada, and Finland launched the "ICE Pact" to co-develop and acquire icebreakers to close this strategic gap.

The political momentum behind Arctic resource exploitation has only intensified. Since taking office in January 2025, U.S. President Trump has moved aggressively to expand Arctic oil and gas extraction, signing memoranda to reverse prior restrictions, fast-track permits, and prioritize liquified natural gas exports and infrastructure (The White House, 2025). His administration issued an executive order directing federal agencies to "fully avail" themselves of Alaska's resources, even within protected areas like the Alaska National Wildlife Refuge. Yet, the United States has squashed plans to build its first deep-water Arctic port to support America's presence in the region (Jay, 2024). Russia, which controls over half the Arctic coastline and accounts for 50–60 percent of all Arctic investments, has made the region a national priority. It has committed over 30 trillion RUB (~$380 billion) for infrastructural, industrial, and oil and gas extraction projects (President of Russia, 2025; Rumer et al., 2021). Meanwhile, China, a self-declared "near-Arctic state," has poured more than $90 billion into projects north of the Arctic Circle to position itself as a major regional player (House Committee on Foreign Affairs, 2025).

The accelerating pace of shipping, drilling, building, and mining in the Arctic is introducing new environmental and security risks to a region already facing the escalating impacts of climate change. Extreme cold, harsh climate conditions, remoteness, and lack of infrastructure bring operational challenges that make extraction, logistics coordination, and emergency response difficult and costly. Heightened activity increases the likelihood of oil spills, mining accidents, pollution, and disputes over maritime boundaries. These are far from future risks. In 2020, over 20,000 Tonnes of diesel oil spilled into rivers near Norilsk, Russia, when thawing permafrost caused fuel tank foundations to collapse ("Russian Arctic Oil Spill," 2020).

In this context, tension has begun to emerge in the region and cooperation has weakened. Since 1996, the Arctic Council, an intergovernmental forum of eight Arctic states (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States) and six Indigenous organizations, has encouraged cooperation. It has played a crucial role in facilitating dialogue, scientific collaboration, and coordination for environmental protection and sustainable development. But after Russia's invasion of Ukraine in 2022, the seven other Arctic nations condemned the operation and paused activities within the Council, essentially boycotting Russia's chairmanship. In 2023, when the chairmanship transitioned from Russia to Norway, the eight member states, including Russia, issued a joint declaration. This signaled a renewed commitment for preserving the Council's continuity.

NATO has also steadily increased its presence in the Arctic. Following Sweden and Finland's recent accession, seven of the eight Arctic states are now NATO members. In March 2025, NATO conducted the Joint Viking 25 exercise in Norway's challenging Arctic conditions, bringing together 10,000 troops from nine allied nations and underscoring its defense commitment and presence in the region.

3. Adaptation challenges in the Arctic

In the built environment, permafrost degradation destabilizes the ground underneath buildings, airstrips, homes, and critical infrastructure. Coastlines erode, and entire villages sink into thawing earth or slip into the oceans. In Alaska alone, permafrost-related damage to transportation infrastructure already costs $10 million annually—and the bill will only rise (Chapin et al., 2014). As carbon-rich soils thaw, they also fuel hard-to-extinguish "zombie fires," that smolder beneath snow all winter and reignite in spring, releasing greenhouse gases once locked in permafrost. Surging lightning strikes, fueled by more frequent thunderstorms, also increase wildfire risk. The loss of ice roads disrupts vital transport and supply routes for communities. More frequent extreme weather events stress the already limited emergency response capabilities. Communities and ecosystems alike face vulnerabilities as rapid changes degrade habitats, disrupt food

webs, and increase the risk of zoonotic diseases driven by warming temperatures.

Efforts to build resilience in the Arctic have gained momentum over the past decade, though they lag the accelerating risk picture. The 2021 Central Arctic Ocean Fisheries Moratorium, negotiated by the U.S. with nine other parties, offers a rare example of precautionary governance that placed a ban on unregulated commercial fishing in the Arctic high seas until 2037 (Arctic Council, 2021). Evolving fish stocks and melting sea ice demand more durable, forward-looking agreements to follow. The International Maritime Organization (IMO) has attempted to regulate shipping standards through the 2017 Polar Code, establishing safety and environmental standards for ship operations in waters surrounding the two poles (International Maritime Organization, 2025). Starting 2024, the IMO also banned the use and carriage of heavy fuel oil in Arctic waters—but waivers and exemptions lasting through 2029 have drawn criticism for providing loopholes and falling short on the urgency of growing environmental risks (SAFETY4SEA, 2023).

Despite increased activity, emergency preparedness remains fragmented in the Arctic. The 2011 Arctic Search and Rescue Agreement was a milestone in designating search and rescue responsibilities across borders, but enforcement and coordination remain uneven, especially given the differential capabilities of member nations. Arctic Council members have also signed a binding agreement on oil spill prevention and recovery, yet operational capacity, equipment readiness, and joint response efforts need strengthening. Even the globally celebrated Svalbard Seed Vault, housing over 1.2 million crop varieties, highlights the ambition and precarity of present resilience efforts. While it safeguards food systems against global shocks, its very location has been threatened by rapid Arctic warming. In 2017, the combination of an unusually warm Arctic winter and heavy spring rain thawed surrounding permafrost and flooded the vault's entrance tunnel, raising concerns about its long-term resilience (Carrington, 2017).

Arctic communities and their built environments demand urgent and comprehensive resilience measures against cascading changes. Responsive adaptation could include engineering stronger building foundations, using cooling systems to keep permafrost from melting around infrastructure like pipelines and power grids, and expanding early warning systems. Buildings may require elevation to avoid flooding, and shorelines may need reinforcement to reduce erosion. Monitoring systems for coastal erosion, permafrost degradation, and landslides need rapid expansion. While promising examples of these efforts exist across Arctic nations, they often remain piecemeal and underfunded.

For some communities facing coastal erosion, adaptation to changing conditions may require relocation. This is not a distant prospect. The U.S. government supported the relocation of nearly 300 residents from Newtok, Alaska, to the newly built village of Mertarvik. Although the move was

intended as a model for future climate resettlements, it revealed severe institutional gaps and governance failures. Despite the $150 million in federal funding, residents of Mertarvik face deteriorating homes, no running water, and frequent power outages due to poorly coordinated technical capacity, oversight, fragmented funding, and a lack of culturally informed planning. Newtok's experience demonstrates that relocation requires long-term, coordinated efforts to assist communities not just as they move away but also as they resettle in a new location.

Indigenous communities, often at the frontlines of Arctic climate vulnerability, have played a vital role in reviving ecosystems, guiding habitat restoration, and developing localized climate strategies. Their long-standing place-based knowledge of the environment has enabled powerful adaptation efforts, such as the Skolt Sámi's restoration of critical cold-water fish habitats along the Vainosjoki River, or Inuit-led initiatives in the North Water Polynya to manage and monitor threatened biodiversity. As traditional livelihoods face increasing disruption, some communities are also turning to less vulnerable opportunities like eco-tourism to sustain cultural and economic life. Supporting and co-producing Indigenous-led adaptation strategies is fundamental to building enduring resilience in the Arctic.

The Arctic is at a critical crossroads, facing dual forces of transformation from accelerating climate change and intensifying geopolitical ambitions. But long-term resilience cannot be achieved without balancing strategic interests with sustained investments in adaptation. Militarization, economic activity, and rapid resource extraction that outpace regulatory frameworks, adaptation measures, and ecological safeguards risk undermining long-term regional and global stability.

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DOI 10.69790/epis-rep-cpe-2/78952