ESTIMATING FUTURE COSTS FOR INFRASTRUCTURE IN THE PROPOSED CANADIAN NORTHERN CORRIDOR AT RISK FROM CLIMATE CHANGE

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EXECUTIVE SUMMARY

Northern Canada is one of the world's regions most affected by climate change (CC). Climate change-related warming in the North has the strength to change air masses locally, regionally and continentally, affecting several climatic variables (i.e., liquid and solid precipitation patterns and extremes, humidity, maximum and minimum temperature means and extremes, surface winds, jet stream's location and strength and so on) producing negative cascading effects to ecosystems and the human communities that depend on them. More extreme events in temperature and precipitation hasten physical processes such as the thaw of permafrost, increase the severity and intensity of drought, which may fuel more intense wildfires, and can shift extreme episodes of freezing rain to more northern latitudes, and increase the strength of storms. Such events can increase the risk of infrastructure decay by boosting the degradation of materials at a much faster rate, and push infrastructure past critical thresholds. This decrease in the life cycles of infrastructures will consequently increase investment and repair costs now and in the future.

This paper reviews current climate change projections for northern Canada and considers what these mean for infrastructure development in the proposed Canadian Northern Corridor (CNC). It focuses on particular chokepoints along the corridor's national route and estimates future costs of infrastructure along the chokepoints. We draw upon CC projections at the end of the century (2081–2100) using information from several climate variables sourced on the CMIP6 and CMIP5 reports. Climate variables include median, 10th and 90th percentiles and extreme values for temperature, precipitation and wind. Baseline information for climate-related physical features including permafrost and wildfires was also collected. In terms of infrastructure costs, we investigate investment costs and the useful life of nine sectors within transportation, energy and built infrastructures. To calculate our costs, we used several references from the literature adapting previous CC cost calculation methods on infrastructures in North American and Arctic regions using a combination of climate variables and infrastructure investment costs indicators in Canada. Our analysis is mostly focused on a high-level cost where we include the infrastructure investment costs data for Alberta, British Columbia, Manitoba and the Northwest Territories. A high score in the accumulation of climatic stressors, referred to as "chokepoints" within the CNC route, influenced our choice of these four regions.

Our results considered a discount rate of three per cent and include the following key findings. Adding a climatic layer to investments costs such as the CNC chokepoints can increase infrastructure costs by more than 101 per cent. Transportation engineering infrastructure, electric power infrastructures and the institutional buildings sectors are the ones to be most impacted. Baseline variables using current information (not including climate projections) showed that internalizing the climate lenses to cost analysis increased costs to $12 billion for freezing precipitation (especially Alberta and BC), $7 billion for wildfires (especially BC) and more than $400 million for permafrost (especially Alberta and BC). CC costs are higher for hazards related to extreme rainfall, surface winds and changes in mean temperatures. Extreme rainfall within a period of five days caused higher costs for BC and Manitoba, indicating a possibility of increased damage related to floods. Rainfall within a one-day period had higher costs for Alberta and BC, indicating that infrastructure could be more prone to flash floods or landslides in these locations.

Projected increases in CC costs were higher when considering extreme rainfall in five days in Manitoba by +200 per cent. Other significant increases include extreme rainfall in one day in Alberta by +90 per cent. Thawing degree days (TDD) influencing permafrost changes is the most important variable for all regions with costs increasing by more than 1,000 per cent with most cost impacts on institutional buildings and oil and gas engineering construction.

In terms of study limitations, the lack of data for certain areas of the CNC limited cost function development that aimed to foresee costs at a finer scale. Furthermore, we were unable to add costs related to delays in transportation, freight and other indirect delay costs associated with possible infrastructure chokepoints due to a high uncertainty in the available cost values and issues with the reliability of data in uninhibited/remote regions of northern Canada.