Appendix A

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Climate Change in High North 2035

Climate change in the High North and Arctic is the subject of many academic research projects. This annex aims at describing, buy using input from current research, the situation in 2035 as a starting point for the discussions in the events of the High North research project in September 2023. It does not aspire to capture the most likely development of climate change, but the worst case, albeit still possible.

Both scenarios in the September events describe a future where emissions have not been constrained, and the globe is on track to well above what climate scientists deem "safe" levels of warming. In the Arctic, temperatures could rise as much as 3-5°C by mid-century, and as much as 9°C by 2100, compared to pre-industrial levels. This level of swift warming, due to the lack of a global energy transition, would create an ice-free Arctic for much of the year, rocked by rapid environmental changes, and crowded with commercial shipping, drilling, mining, and potentially military activities. The most intense climate impacts of this scenario will begin in the 2030s and become increasingly severe approaching mid-century and beyond.

There are several areas of activity that will be affected, but below are some examples: **sea transportation, melting permafrost, commercial activities, and infrastructure.**

SEA TRANSPORTATION: THE NORTHERN SEA ROUTE (NSR) HAS INCREASE IN IMPORTANCE

There has been much discussion of the economic and strategic potential for the Northern Sea Route (NSR), as it reduces costs and time of sea transport from Asia. The melting of ice has and will continue to increase commercial activity in the Arctic. China, for example, is interested in developing the NSR as part of its "Polar Silk Road," linked to the Belt and Road Initiative. Future ice melting will extend the period each year in which NSR risks are manageable, leading to an increase in the use of the route. One constraint that will remain unchanged, however, is the seasonal variation in sunlight, including the persistence of Polar Night where the region is in perpetual night for extended periods of time, increasing operational complexity.

In 2035 both transit cargo and destination cargo via the NSR has increased dramatically to **XXXX ships/tones.** Already before 2035, the latter type of cargo, for activities in the Artic, placed the NSR as a game changer for international transport, with clear commercial and security implications for Arctic states. The destination cargo has been with ships transporting supplies to infrastructure projects and gas installations in the Arctic. Two examples of the drivers of traffic are Russia's Yamal LNG facility, in which China and France. This type of traffic continues, but the transit cargo is rapidly growing in volume and importance.

The NSR route is in 2035 closed only a few months per year due to ice but has not yet reached the intensity of billions of tons of cargo like the traffic through the Suez Canal (over 20 000 ships

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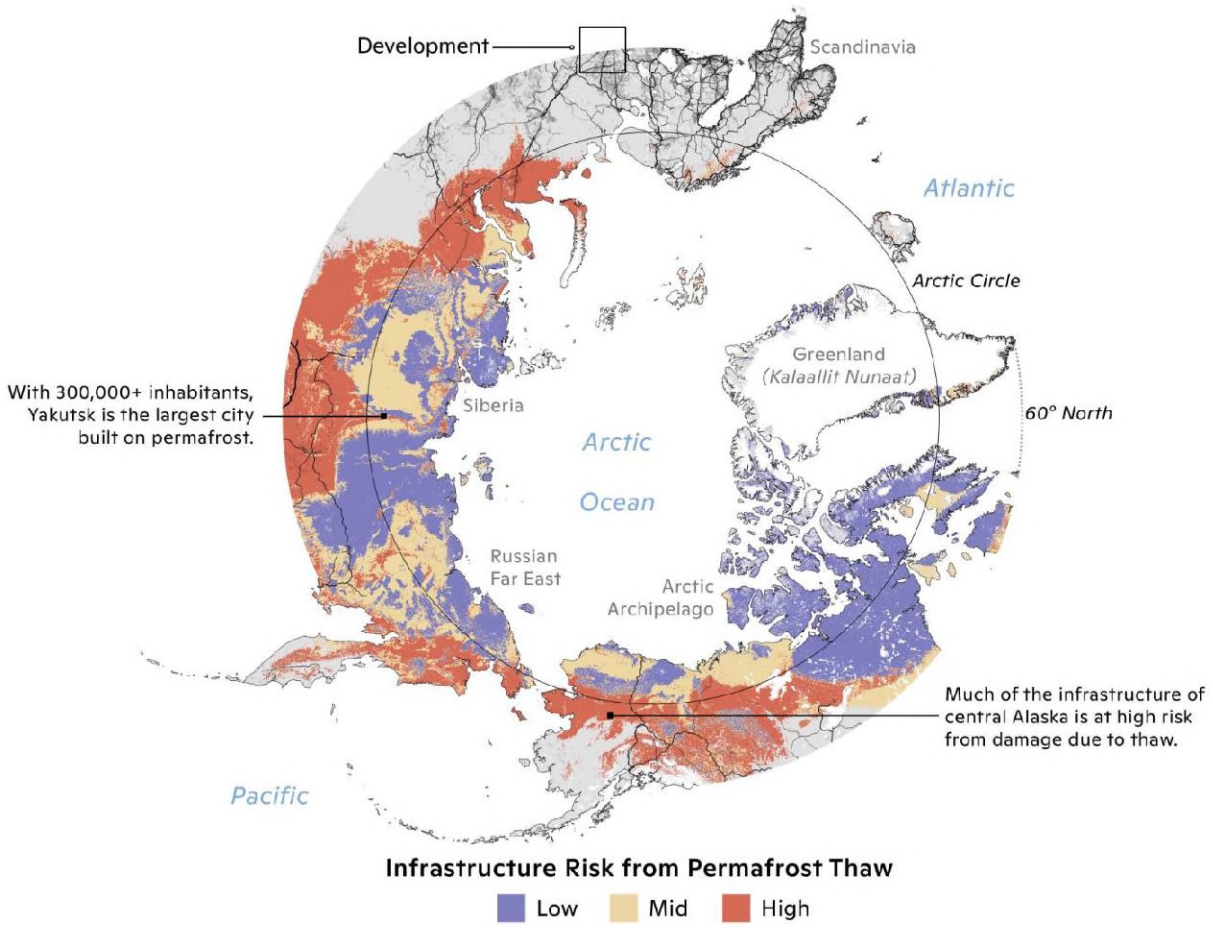
in 2022), but the trends are clear. To save weeks of time (a 40% reduction of time for some vessels) more and more transports between China and Europe utilize the NSR.

MELTING OF PERMAFROST

Throughout the Arctic, regions of permafrost thaw are particularly susceptible to subsidence (the sinking or collapsing of ground), which could have dangerous and costly consequences. In 2035 the areas marked as High (Red) and Med (Yellow) are severely affected by thawing permafrost.



Appendix A

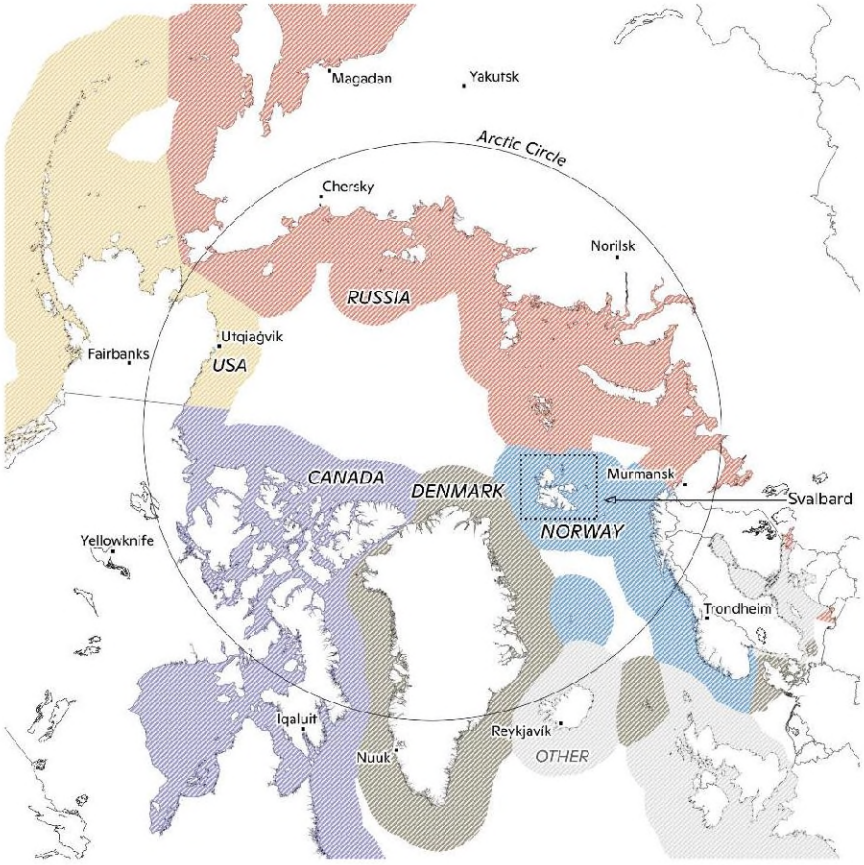
Strategic Implications and Innovation Center

Swedish Defence University

REGIONAL COMMERCIAL ACTIVITY INTENSIFIES

With increased temperatures, ice melting, accessibility and new technology, commercial activity in the Arctic has intensified in 2035. The increased economic activity is mainly in oil and gas (see map below), but mineral extraction, including sub-sea extraction has started (see map below), commercial fishing (see map below) and tourism have also emerged as areas for commercial expansion. The Russian Arctic economy is significantly larger than the Arctic economies in Canada, Norway, and Finland. The sectors which dominate the respective Arctic economies vary; oil and gas extraction minerals, fisheries (harvest, farmed, processing), and resource sectors each play significant roles in different states.

Economic zones of Arctic costal nation (below).



Appendix A

Strategic Implications and Innovation Center

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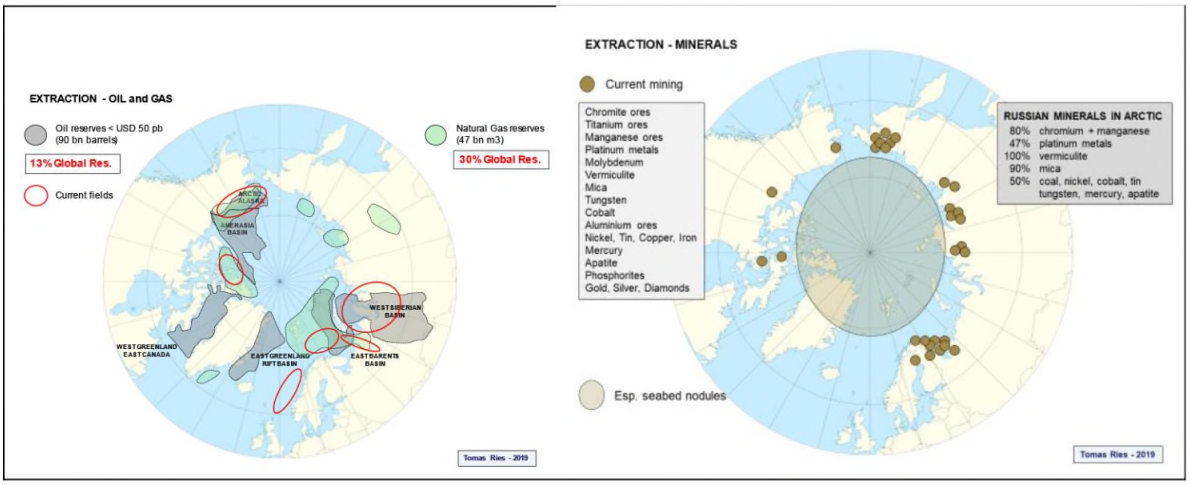
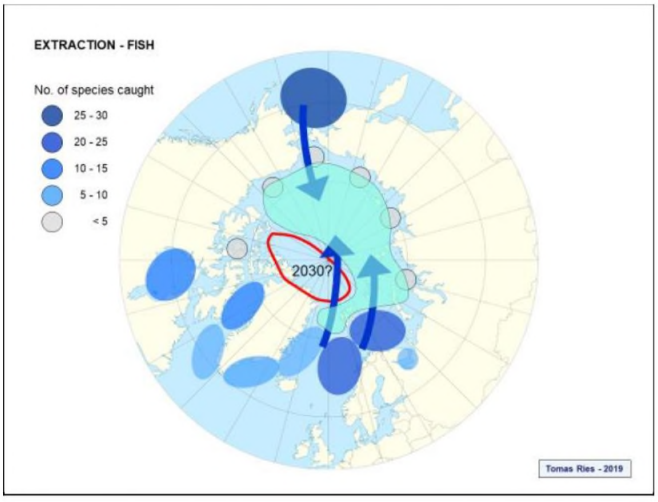


In 2035 extraction of gas and oil has moved into the green areas. Extraction of minerals has started on the seabed of the Arctic.



Fishing has in 2035 increased into the green area of the Arctic due to melting ice giving increased accessibility. Warming ocean temperatures have also pushed fish stocks northward into the Arctic Ocean thereby increasing its relative importance for global food supply. China and Russia have the largest fishing fleets.

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Appendix A

Strategic Implications and Innovation Center

Swedish Defence University

INFRASTRUCTURE

One of the more direct and noticeable effects of climate change in 2035 is on infrastructure in the Arctic. As detailed above, states and private companies are likely to expand infrastructure development as warming occurs, including plants, pipelines, ports, roads and railroads. Also, affected is critical telecommunications infrastructure and satellite coverage with polar orbits.

The costs of maintaining such infrastructure will increase with warmer temperatures and more extreme weather, such as heavy rain which causes flooding, melting of permafrost, rising sea levels, and stronger winds. The effects in 2035 is a 27% increase in infrastructure lifecycle replacement costs across the circumpolar permafrost regions. This will imply a significantly higher cost of building and maintaining the necessary military infrastructure in the region.

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