From global trends to local realities: A multi-scale scenario-building methodology for community infrastructure planning

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Infra North Building Arctic Futures

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Research context

The Circumpolar North at a critical juncture

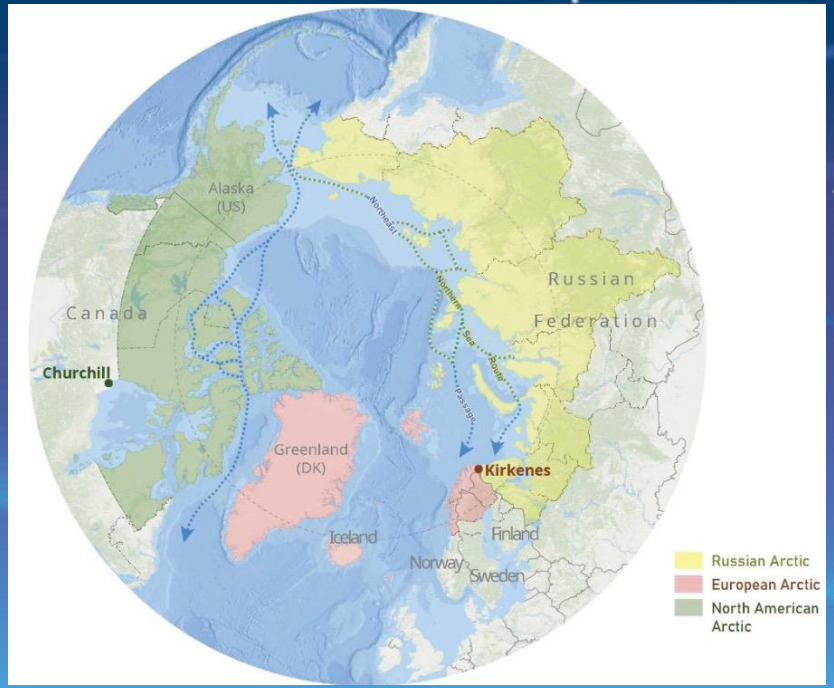
- Climate change altering landscapes and opening new shipping routes
- Surge in infrastructure development proposals
- Need to balance global ambitions with local realities
- Critical importance of Indigenous Peoples and Local Communities (IPLCs)


How to engage local stakeholders in envisioning infrastructure futures while considering global trends?

Study sites: Two Circumpolar communities

Churchill, Canada

- Population: 870
- Deep-water port
- Railway connection
- Tourism ("Polar Bear Capital")
- Community-led redevelopment



Kirkenes, Norway

- Population: ~3,500
- Border town (Finland, Russia)
- Strategic location
- Mining heritage
- Green innovation potential

Methodological innovation

Multi-scale scenarios

- Global → Regional → Local
- Coherent storylines
- Morphological analysis

Ethnographic research

- Community workshops
- Stakeholder engagement
- Local knowledge integration

Artistic visualizations

- Local artists
- Scenario illustrations
- Enhanced engagement

Multi-scale scenario framework

GLOBAL & PAN-ARCTIC

Arctic shipping scenarios (Rovenskaya et al., 2024)

REGIONAL

Canadian & Norwegian Arctic contexts

LOCAL

Churchill & Kirkenes community futures

Factor-Actor-Sector Framework applied at each scale

Factor-Actor-Sector framework

GLOBAL FACTORS: Geopolitics • Climate Action • Technology • Resource Markets

REGIONAL FACTORS: Arctic Governance • Economic Policy • Climate Impacts

LOCAL FACTORS: Population • Economic Activity • Infrastructure

Four global scenario archetypes

Global Resource Base

Geopolitical blocs, fossil fuels

Transportation Route

Cooperation, low-carbon economy

Abandoned Land

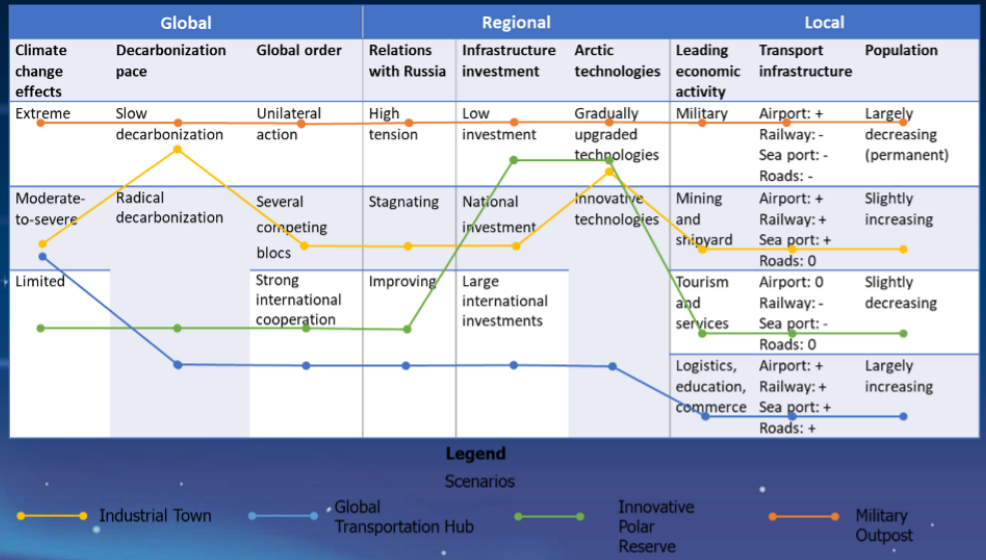
Recession, climate impacts

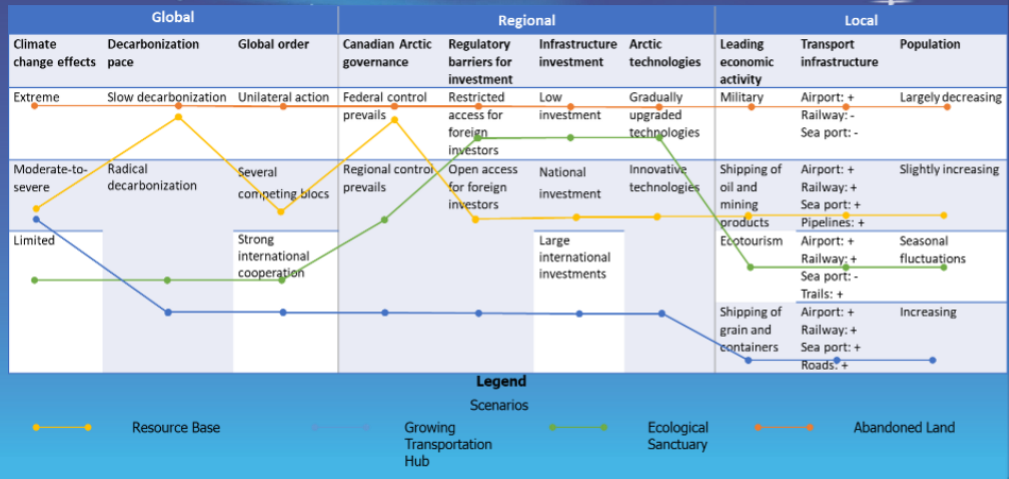
Sanctuary

Environmental protection

Morphological Analysis

Four coherent scenarios developed for each community using morphological analysis to ensure consistency across global, regional, and local scales





Churchill in 2050

RESOURCE BASE

- Strategic fossil fuel export hub, pipeline expansion
- Extended 6-month shipping season
- Military presence, population growth
- Wildlife degradation impacts tourism

GROWING TRANSPORTATION HUB

- International multimodal transportation center
- Double-tracked railway, year-round road connection
- Diversified cargo: grain, containers, energy
- Tourism adaptation and airport expansion

ABANDONED LAND

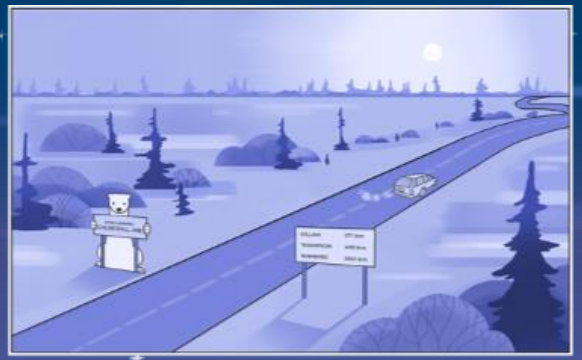
- Severe climate impacts, infrastructure failure
- Ecosystem collapse, disappearing wildlife
- Military outpost only, civilian population exodus

ECOLOGICAL SANCTUARY

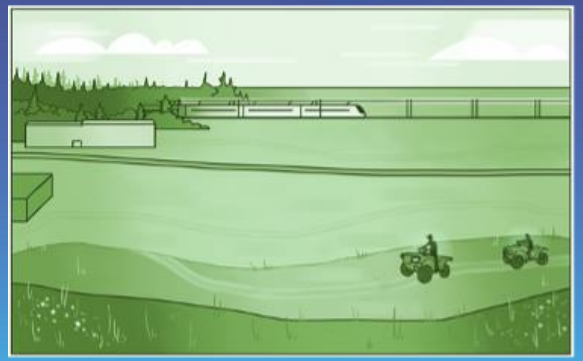
- Environmental protection priority
- Sustainable ecotourism focus, electrified rail
- Resource extraction bans, expanded protected areas
- Population decline with seasonal fluctuations

Churchill in 2050

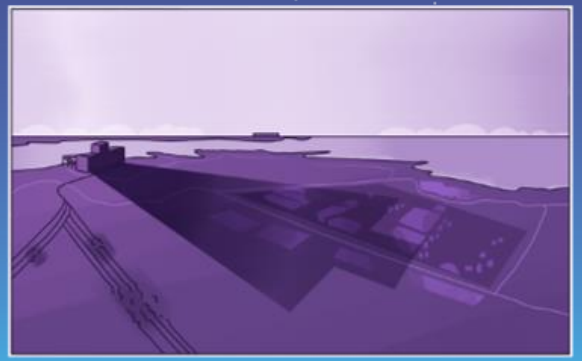
Resource base



Growing hub



Sanctuary



Abandoned land

Artwork by Nickia McIvor

Kirkenes in 2050

INDUSTRIAL TOWN

- Mining and steel production center
- Sydvaranger mine modernization, new port
- Population growth, some Sami displacement
- Dual commercial/military port functions

GLOBAL TRANSPORTATION HUB

- Western terminus of Northern Sea Route
- Railway to Rovaniemi, Euro-Asian trade gateway
- Significant population growth, cosmopolitan community
- Green steel initiatives, research and education

MILITARY OUTPOST

- Climate impacts and geopolitical tensions
- Russia border closure, NATO expansion
- Economic decline, population exodus
- Town center relocation due to environmental damage

INNOVATIVE POLAR RESERVE

- Environmental stewardship and Indigenous rights
- Sami governance influence, eco-innovation startups
- Strict environmental regulations, sustainable tourism
- Slight population decline, tech worker focus

Kirkenes in 2050

Industrial town

Global transportation hub

Innovative polar reserve

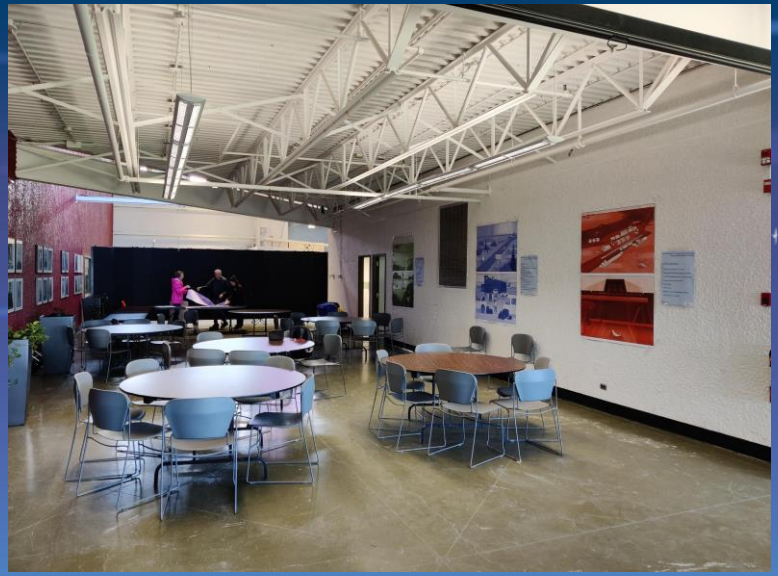
Military outpost

Artwork by Anja Eline Danielsen

Community scenario workshops

Design

- Separate sessions for professionals and general public
- Rotating discussion groups across all scenarios
- Artistic visualizations as discussion prompts
- Anonymous questionnaires for plausibility and implications assessment



Public workshop setting in Churchill, MB, Canada. Photo by Philipp Budka.

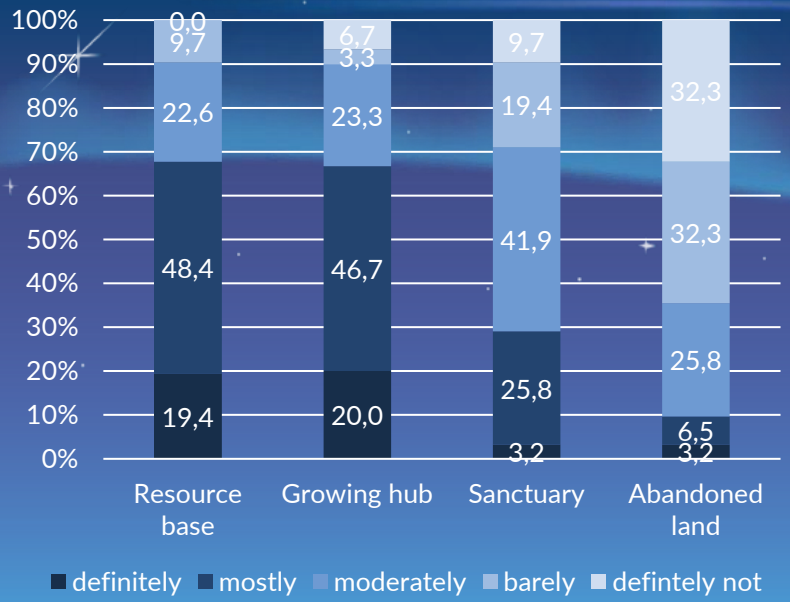
Community scenario workshops

Outcomes

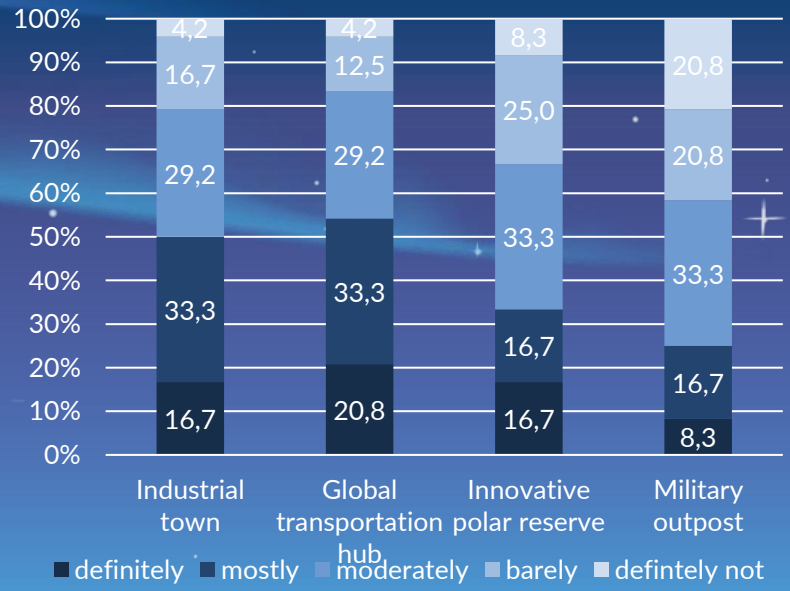
- High engagement: 14-16 participants per workshop
- Shared sense of being "at a crossroads"
- Common concerns: climate impacts, economic sustainability
- Distinct local priorities emerged
- All scenarios perceived as plausible

Are these scenarios possible by 2050?

Churchill (N=31)

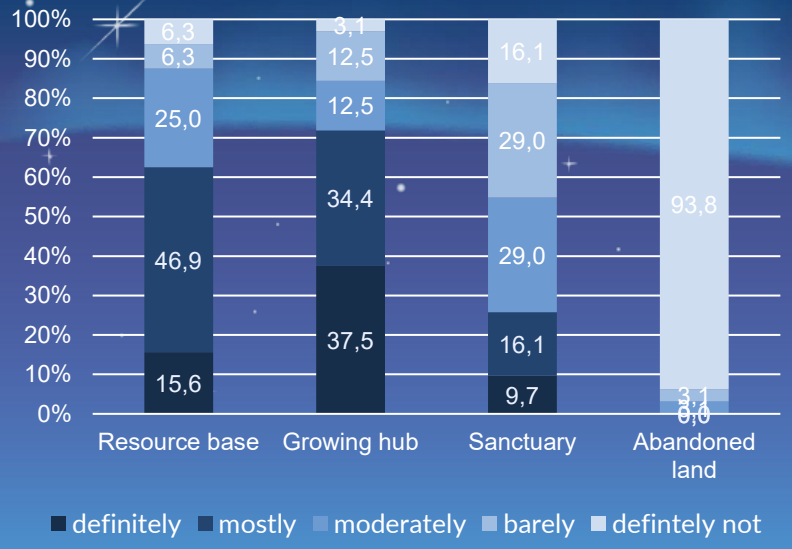


Kirkenes (N=24)

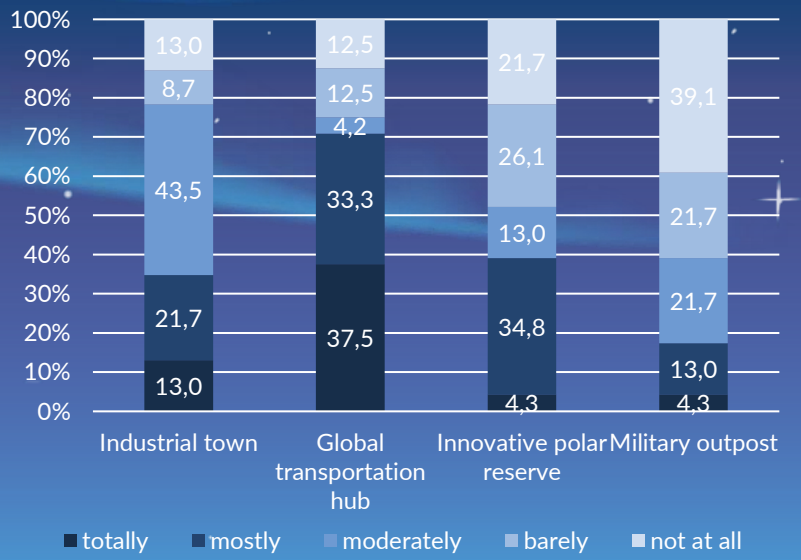


To what extent would your community benefit if these scenarios are realized?

Churchill (N=31,32)

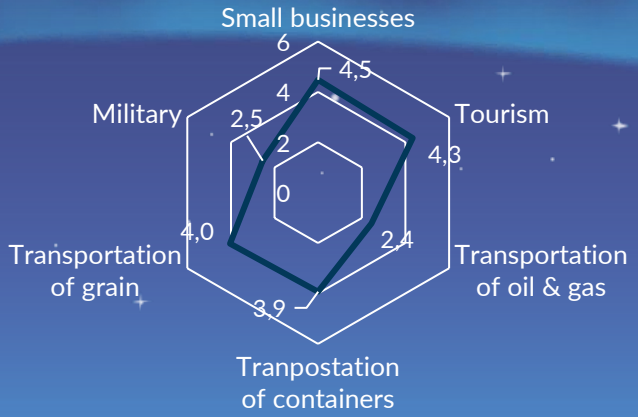


Kirkenes (N=23,24)

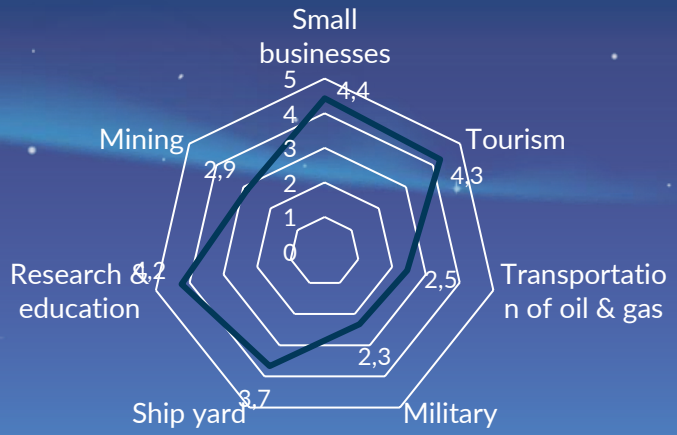


How desirable are the following topics in a future scenario for your community?

Churchill (N=26,27)



Kirkenes (N=20,21,22)

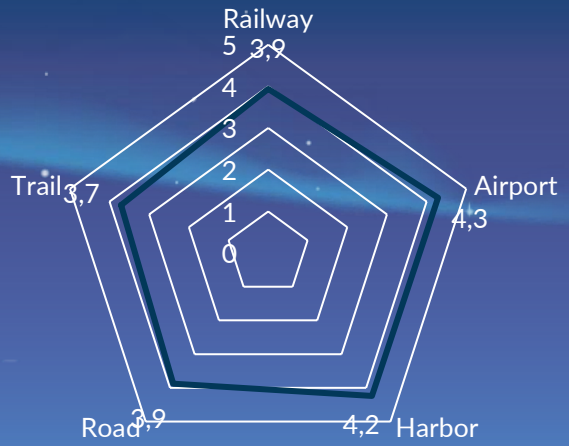


0 – not desirable at all, 5 – very much desirable

How desirable is the following transport infrastructure in a future scenario for your community?

Churchill (N=27)

Kirkenes (N=17)



0 – not desirable at all, 5 – very much desirable

Limitations and lessons learned

Challenges

- Time constraints
- Potential underrepresentation
- Need sustained engagement

Successes

- Local authority involvement
- Artistic visualizations crucial
- Workshop rotation effective

Applications

- Community planning processes
- Infrastructure decisions

Key insights & contributions

Methodological contributions:

- Multi-scale approach balances global trends with local realities
- Artistic visualizations enhance stakeholder engagement
- Ethnographic integration captures nuanced perspectives
- Flexible workshop design accommodates diverse comfort levels

Community insights:

- Communities are acutely aware of potential for significant change
- Both positive and negative scenarios seen as plausible
- Strong desire for meaningful participation in future planning
- Cross-sector dialogue fostered by workshop format

Policy & planning implications

For circumpolar infrastructure planning:

- Need for place-specific, adaptive planning approaches
- Importance of infrastructure resilience to climate change
- Balance between economic development and environmental protection
- Essential role of Indigenous and local community participation

For research & practice:

- Scenarios as tools for community dialogue, not just prediction
- Value of sustained engagement beyond one-off consultations
- Integration of multiple knowledge systems and scales
- Art as bridge between technical analysis and public understanding

Future research directions

Methodological development:

- Longitudinal studies tracking scenario influence on community decisions
- Cross-cultural adaptation of scenario methods & enhanced integration of Indigenous knowledge systems
- Interactive and immersive visualization techniques

Empirical extensions:

- Application to additional circumpolar communities and comparative analysis
- Sectoral extension beyond transport infrastructure
- Integration with climate impact modeling

Conclusions

Our multi-scale scenario approach demonstrates:

✓ Effective integration of global trends with local knowledge

✓ Strong community appetite for forward-looking dialogue

✓ Value of artistic visualization in technical discussions

✓ Potential for scenarios to foster inclusive planning processes

As circumpolar communities navigate rapid change, participatory scenario approaches can play a central role in fostering informed, inclusive, and forward-looking decision-making.

Thank you!

Questions and Discussion

Contact: strelkon@iiasa.ac.at

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