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Svalbard in transition: adaptation to cross-scale changes in Longyearbyen

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ABSTRACT



The backdrop for this study is the Norwegian national Svalbard policy, with long-term goals to transition Svalbard into a sustainable future without coal and to maintain Norwegian presence. Tourism, education and research are the three economic pillars. This transition affects the tourism industry, spatial planners, environmental officials, local politicians, port authorities and research community in Longyearbyen. We apply an adaptation framework and a community-based approach to analyse the multiple layers of change identified by key stakeholders: climate change, national policy and increasing tourism. Based on semi-structured interviews with stakeholders in Longyearbyen and document review we analysed the adaptation strategies and measures to address the challenges and opportunities from the economic transition sectors, climate change impacts, national Svalbard policies and increasing tourism activities. Adaptation dilemmas emerge for Longyearbyen: 1) increased tourism is a national goal while strict environmental management restricts its potential tourism operators, and 2) climate change creates hazardous conditions which require the local spatial planners to develop new safe housing areas, but the strict environmental protection limits the action space. A tension is therefore emerging between the national policy context (The Svalbard Treaty, The Svalbard Act, The Environmental Protection Act) which governs development and local adaptation options to address climate change impacts and increasing tourism.

KEYWORDS

Longyearbyen; Svalbard; national policies; economic transition; climate change; adaptation

Complex cross-scale changes: Svalbard and Longyearbyen

The Svalbard Archipelago, with its magnificent nature and relative accessibility (Figure 1), attracts visitors, tourists and researchers from around the world. Climate change, such as increasing ocean temperatures, changing cryosphere conditions including retreating sea ice, and other changes significantly influence the environment.¹ The high Arctic terrestrial and marine fauna and flora and the rich cultural heritage are therefore increasingly vulnerable and in need of protection.² The unique high Arctic environment is an

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¹Meier et al, "Arctic Sea Ice in Transformation". Arctic sea ice, biology and human activities; MOSJ Environmental and Cryosphere Monitoring; Hanssen Bauer et al, "Climate in Svalbard 2100".

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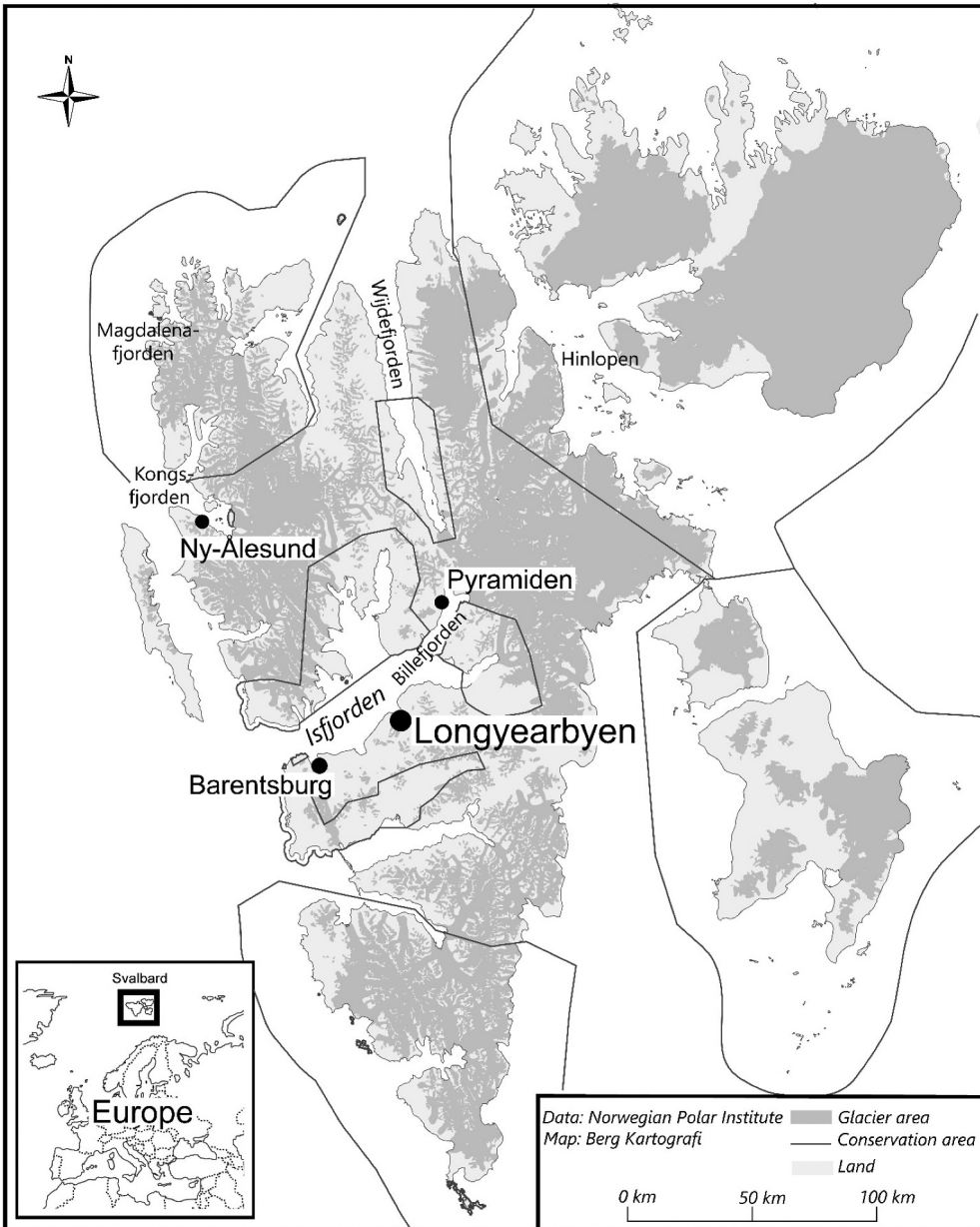


Figure 1. A map of Svalbard.

important key element in discourses about the development of the Svalbard Archipelago. Longyearbyen, the administrative centre on Svalbard and focal point of such discourses, experiences a nationally driven and intended economic transition from coal mining to tourism, research and education (Figure 2). In addition to affecting the environment, climate change has significant impacts on people and human activities on Svalbard. These

²Svalbard Environmental Protection Act 2001 and revisions in 2012. Ministry of Climate and Environment 2001



Figure 2. Longyearbyen Photo Julia Olsen.

changes in many ways permeate the economy, governance and outdoor recreation in Longyearbyen (Figure 3).

Virtually all economic activities, ecological functions and policies evolve around the coastal interface between marine and terrestrial environments. In recent years, Svalbard has experienced major changes in environmental policy, economic and employment structure, and in geo-political significance.³ The Archipelago is at a serious crossroads. Coal mining, the historic backbone of human activities in Svalbard, is no longer an acceptable industrial activity in the context of climate change and is awaiting shutdown (Figure 4).

The Norwegian sovereignty on Svalbard is anchored in the Svalbard Treaty from 1920 (entered into force in 1925, ratified by 44 countries) and forms the legal basis for Norway's ambitious environmental management goals of Svalbard being among the best-managed wilderness areas in the world as duly noted in the Svalbard Environmental Protection Act of 2001.⁴ This is at times at odds with the goal of increased tourism activities in Longyearbyen where the operators sell wilderness as a product in areas with restricted access. An additional management conundrum is found in spatial planning, which in principle follows the domestic land use planning system but deviates in important ways.

³Ministry of Justice 2016, White Paper Svalbard.

⁴Ministry of Climate and Environment. Environmental Protection Act 2001, amended 2012



Figure 3. Photo of Longyearbyen Photo Grete K. Hovelsrud.

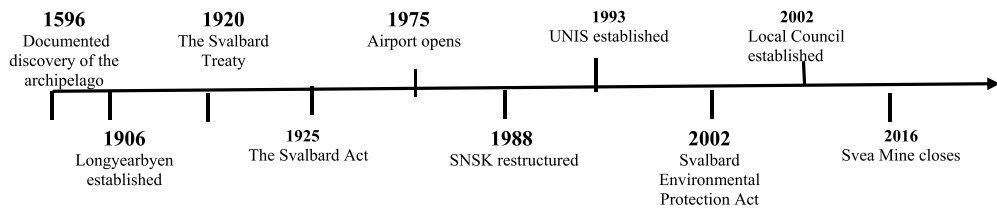


Figure 4. Timeline Transitions on Svalbard.

The backdrop for this study is the Norwegian national Svalbard policy, with long-term goals to transition Svalbard into a sustainable future without coal and to maintain Norwegian presence.⁵

The study is guided by two research questions: What are the cross-scale change processes that affect local business and community development actors in Longyearbyen? What are the opportunities and challenges for local adaptation? Through in-depth interviews and conversations with businesses, public bodies, local community actors and scientists in Longyearbyen, we examine how these actors respond to the current cumulative and cascading impacts of multidimensional change in national policy and local socio-economic and environmental conditions.

⁵Ministry of Justice 2016, White Paper Svalbard

To understand how change affects Longyearbyen we need to understand the key political factors influencing the Archipelago. We outline these before we describe the main characteristics of Longyearbyen. We continue with methods and approach, and an empirically derived analysis of change in Longyearbyen. Finally, we present an analysis of the adaptation strategies to cross-scale changes and concluding remarks about the broader context. In this article, we identify multiple layers of cross-scale changes the community of Longyearbyen contend with and adapt to and analyse the role of national policy in enabling and hindering adaptation. We point to complex interlinkages, only some of which been noted before.

Svalbard policy trends

The policy history of Svalbard has developed along two major lines; the need for geopolitical stability and environmental concern.⁶ The most recent Norwegian Arctic policy,⁷ and the latest white paper on Svalbard⁸ both list the main goals for the Norwegian Arctic: a) a peaceful, predictable and sustainable North, b) holistic and ecosystem-based management, c) international cooperation and justice, and d) a strengthened basis for employment, value creation and well-being. The clear focus on environmental concern has developed over time within the context of larger geopolitical considerations and decades of deliberations.⁹ Currently the main policy emphasis is on economic and environmental change.¹⁰

With basis in the unique governance regime dictated by the Svalbard Treaty of 1920, Norway has sovereign, but not exclusive rights.¹¹ The Norwegian government's strategy has consistently avoided throwing Svalbard into a larger geopolitical game¹² and have maintained a firm position on sovereignty by balancing multiple international interests. The Norwegian policy development can be broadly divided into three phases.¹³ A *laissez-faire* period from 1925 to 1950, where the Norwegian government had few concerns and did little in terms of management actions or specific policy statements. Between 1950 and 1965 the government issued more verbal statements about Norwegian rights and interests, and the period after 1975 is signified by explicit policy and legal efforts to establish a stringent governance regime.¹⁴ During the last four to five decades the environmental governance regime develops as an umbrella framework for land use and resource exploitation in Svalbard. The antecedents to today's legal management framework go back to the Treaty of 1920, where article 2 establishes Norway's rights and responsibilities to ensure conservation of the Archipelago's flora and fauna. A range of environmental measures were institutionalised in the period between 1970s to mid-1990s, mostly addressing single species conservation. A major political change came with the Svalbard Environmental Protection Act in 2001 (revised in 2012), which constitutes an

⁶Kaltenborn et al. 2019 Future environmental policy and governance challenges

⁷Regjeringen 2017, Norway's Arctic Strategy

⁸Ministry of Justice, "White Paper 32 (2015-2016) Svalbard".

⁹Pedersen, "The Constrained Politics of the Svalbard Offshore Area"; "The Dynamics of Svalbard Diplomacy"

¹⁰Kaltenborn et al. "Future environmental policy and governance challenges."

¹¹The Svalbard Treaty 1920, lovdata.no/lov/1920-02-09

¹²E.g. Arlov, *Svalbards historie*. History of Svalbard in Norwegian

¹³Pedersen, "The Dynamics of Svalbard Diplomacy"

¹⁴Østreng, *Det Politiske Svalbard*; Politics and Svalbard, and Arlov, *Svalbards historie*, both in Norwegian

umbrella law for land use management and conservation, stating that in cases of conflict environmental concerns shall trump other land use interests.¹⁵ Several nations, and notably Russia have repeatedly contested the environmental governance regime as an attempt to exclude the commercial rights and interests of other treaty partners, but in practice all treaty members have abode by the law.¹⁶

The nationally driven transition of Svalbard's economy, from coal mining towards tourism, research and education, is a balancing act among economic and environmental priorities.¹⁷ It is also a balancing act in international relations since the implementation of all policy and governance measures must be evaluated against larger geopolitical concerns and reactions. The policies implemented in Svalbard are nested and reflect domestic national interests, while at the same time anticipating potential international reactions from other treaty members and the two dominant arctic geopolitical players, Russia and the United States. Pan-Arctic institutional cooperation and development have to a large extent been the way the Arctic nations have chosen to manage their own interests.¹⁸

At the national level, Svalbard policies have three key dimensions, i. environmental policy and management goals stipulated by the Svalbard Environmental Protection Act, ii. maintaining sovereignty according to the Svalbard Act and iii. transforming Svalbard's economic foundation from coal to tourism, research, and education. The Norwegian Svalbard policy maintains the goal to uphold the Norwegian settlements and preserve the particularly vulnerable and unique environment.¹⁹ The Environmental Policy Act stipulates that environmental concerns shall trump economic interests in case of conflict, while the Svalbard Act stipulates that large areas shall remain unchanged for the purposes of research and monitoring. Svalbard policies cautiously balance national concerns and strategic ambitions, international tolerance,²⁰ and more recently, international policy goals such as the UNFCCC Paris Agreement and the UN Sustainable Development Goals. The newly revised regulation of tourism on Svalbard addresses the protection of nature in the context of the tourism growth.²¹ In addition, the ban on carrying and using heavy fuel oil in protected areas on Svalbard, reflects the strict environmental policy.²²

Longyearbyen: a community in transition

Longyearbyen is the world's northernmost town located at 78°N. The settlement of Longyearbyen was established in 1906 as a 'company town', by the American Arctic Coal Company, which in 1916 was purchased by the Norwegian state-owned coal company *Store Norske Spitsbergen Kulkompani* (SNSK), usually referred to as Store Norske which includes SNSK and its subsidiaries.

¹⁵Ministry of Climate and Environment. Environmental Protection Act 2001, amended 2012

¹⁶Koivurova and Holiencin 2017 Security and Svalbard

¹⁷Ministry of Justice 2016

¹⁸Geopolitics: Pedersen, "The Constrained Politics of the Svalbard Offshore Area"; Young, "Whither the Arctic?"; Østerud and Hønneland, "Geopolitics and International Governance in the Arctic."

¹⁹Ministry of Justice, "White Paper Svalbard."

²⁰Grydehøj et al, "Globalisation and the Arctic."

²¹Ministry of Justice and Public Security, 1991 – Regulation on tourism, field activities and other travel on Svalbard

²²Ministry of Climate and Environment 2014 Regulations of national parks in Svalbard

Store Norske controlled most aspect of the community until the late 1980s and Longyearbyen remained a ‘company town’ until the coal production began to falter.²³ SNSK was restructured in 1988 and is now involved in housing development and other enterprises in Longyearbyen²⁴. The town is the main hub of administration, transportation, research infrastructure, education and businesses on Svalbard (SSB 2016). It has a deep seaport with supportive services and infrastructure, and search and rescue facilities. Longyearbyen Community Council²⁵ was established in 2002 and is a locally elected government with 15 members. The council’s main responsibilities are similar to a Norwegian municipality and include infrastructure, utilities and power, land-use and community planning, education from kindergarten to upper secondary level and child welfare. The Council operates three kindergartens in addition to the 13-grade Longyearbyen School.

In 2018, the registered resident population of Longyearbyen (and Ny Ålesund²⁶) was 2214 (see Table 1).²⁷ Statistics Norway includes individuals as residents when they intend to stay in Svalbard for more than 6 months per year. The Norwegian Immigration Act is not in force on Svalbard, and the Archipelago does not belong to the Schengen area. This means that any resident from a Treaty country may live on Svalbard without a visa, or work or residents permits, provided they have a place to live and are able to support themselves. This is reflected in the large number of nationalities found in Longyearbyen, from roughly 46 countries. The Norwegian populations is large, but declining. This is a concern for the Norwegian government whose goal is to have a stable Norwegian population.

It can be debated whether Longyearbyen can be described as a ‘normal’ local community given the predominantly transient population and Norway’s national policy of maintaining a presence in Svalbard for political and strategic reasons.²⁸ Communities are often described as a social construct and a site for negotiating community sustainability and viability.²⁹ The viability of a community is connected to *inter alia* the physical location, environment and to the dynamic social relations between people, social networks, informal risk-sharing mechanisms, active involvement and leadership.³⁰ Most of the population in Longyearbyen, rotates every 2 to 4 years and the average residence time for the inhabitants is seven years.³¹ The town nevertheless exhibits some of the traits used to characterise a community, such as being geographically bounded, with strong local social relations, place attachment, and shared perceptions of challenges and experience.³² Attachment to place is found to be a strong driving force in addressing community concerns and a strong motivator for living under extreme conditions or at risk,³³ and in Svalbard the level of such attachments may be an indication of how people respond to environmental impacts.³⁴ Despite the transient population in Longyearbyen, community

²³e.g. Arlov, *Svalbards historie*.

²⁴Pedersen, *Longyearbyen dilemma*.

²⁵Longyearbyen Lokalstyre in Norwegian

²⁶SSB includes numbers for Ny-Ålesund in their statistics. The population of Ny-Ålesund is approximately 40 year round residents).

²⁷Statistics Norway Population of Svalbard SSB 2020.

²⁸Ministry of Justice, 2016

²⁹Davidson et al, “Climate risks and vulnerability.”

³⁰Rasmussen, Hovelsrud, Gearheard, “Arctic Human Development Report”; Buikstra et al, “The components of resilience.”

³¹SSB 2016 Statistics Norway. Figures about Svalbard

³²Haugen and Villa, “Local Communities in Norwegian.”

³³Hovelsrud, Karlsson and Olsen et al, “Local Adaptation Strategies.”

engagement is clearly articulated and driven by a shared place attachment, consciousness about the changing environment, networks and voluntarism, and the ability to influence decision-making.³⁵ Longyearbyen's inhabitants, albeit with a great majority of newcomers at any given time, strive for a viable community. Conversely, our study suggests that long-term residents in Longyearbyen find that a transient population comes with challenges. The collective memory of an institution, for example, is easily lost when the turnover of employees is high. It also affects the relationship between different organisations and groups when business and personal relationships must be renewed frequently.

The politically driven transition of Longyearbyen from coal mining to tourism, research and education that began in the late 1980s did not gain speed until this millennium. The shift in economic focus represents a major transformation for Longyearbyen, which in turn requires adaptive responses by local businesses and decision-makers. Figure 5 illustrates changes in type of employment from 2008 until present and shows that employment in the tourism industry is increasing at a higher rate than mining is decreasing.

Figure 6 shows the breakdown of employment in industry groups through the year, and tourism is clearly the highest employer. Svalbard tourism trends show a shift from seasonal to year-round tourism and a change from land-based towards marine-based tourism. There has been a gradual change towards promoting Longyearbyen as a dedicated destination for cruise tourism and not only as a place of transit.³⁶ Such changes have consequences for other businesses than tourism and for the local population. Attention to climate change and to how new and extreme weather conditions and the follow-on changes to the ecosystem affect livelihoods and lives is increasingly included in all aspects of business and human activities, such as tourism.

Methods and approach

This study focuses on local businesses and other local actors involved in public and private community governance and development in Longyearbyen. The authors have extensive experience from Svalbard and Longyearbyen, including a broad network of stakeholders, and an in-depth and broad understanding of the context in which the changes occur. Informal conversations about community and economic development on Svalbard and in Longyearbyen provided us with an even deeper context and understanding of the challenges facing the Archipelago. Because of our in-depth knowledge and engagement, we were able to carefully select who to interview. The data was gathered during two separate visits in 2017 and 2018.

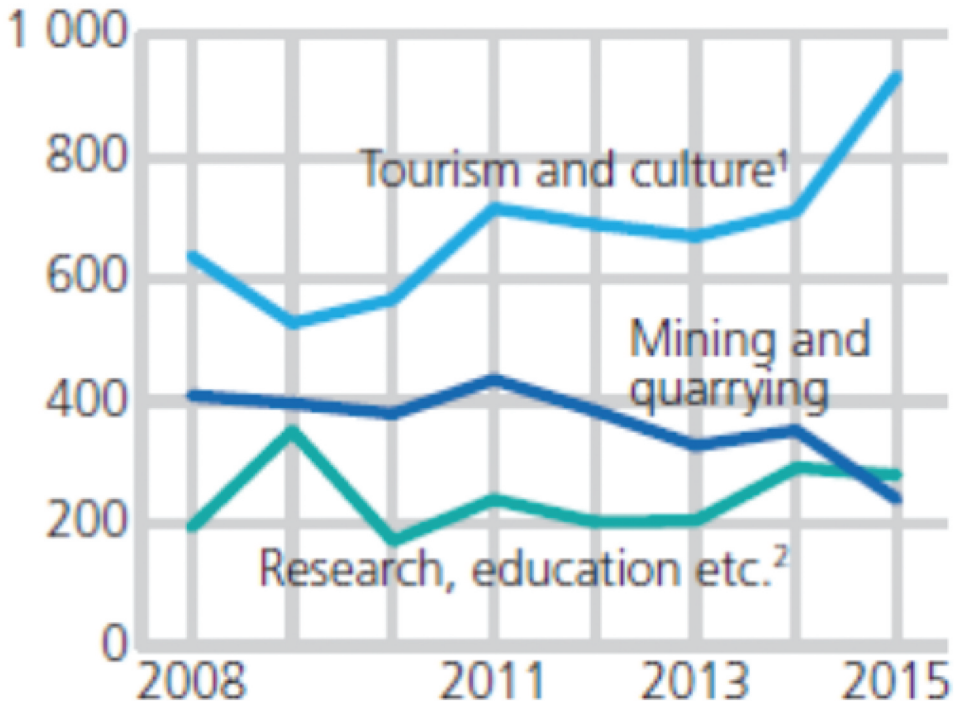
We conducted open-ended semi-structured interviews with 14 informants representing local tourism businesses, cruise associations and networks, public services and local management, and research. All interviewees were selected based on their professional positions and experiences. The purpose of the interviews were three-fold: 1. To identify the most salient change processes and the drivers behind these changes; 2. To identify current and future challenges for Svalbard and Longyearbyen; and 3. To identify current and future adaptation needs to maintain a viable community. The interview guide

³⁴Kaltenborn, "Sense of Place."

³⁵Olsen, Hovelsrud and Kaltenborn, "Increasing Shipping in the Arctic and Local Communities' Engagement"; and Longyearbyen

³⁶Olsen, Hovelsrud and Kaltenborn, «Increasing Shipping in the Arctic and Local Communities' Engagement."

Employment in selected industry groups through the year



¹ Accommodation and food service and cultural activity, entertainment and leisure activities, and business services.

² Professional, scientific and technical services (mainly research) and education.

Source: www.ssb.no/en/sts

Figure 5. Employment in selected industry groups in Longyearbyen and Ny-Ålesund.

addressed social, economic and environmental change, drivers, challenges, opportunities, adaptation strategies and visions for the future. Our interview data are supplemented with a literature review of the core topics of change, development and adaptation in the Arctic.

Adaptation to multiple and interacting factors of change

Our definition of adaptation is commonly used in conjunction with studies of climate change impacts and pertains broadly to adjustments in coupled natural and human systems in response to actual or expected climate stimuli or their effects, which moderate

Employment in industry groups through the year. 2015

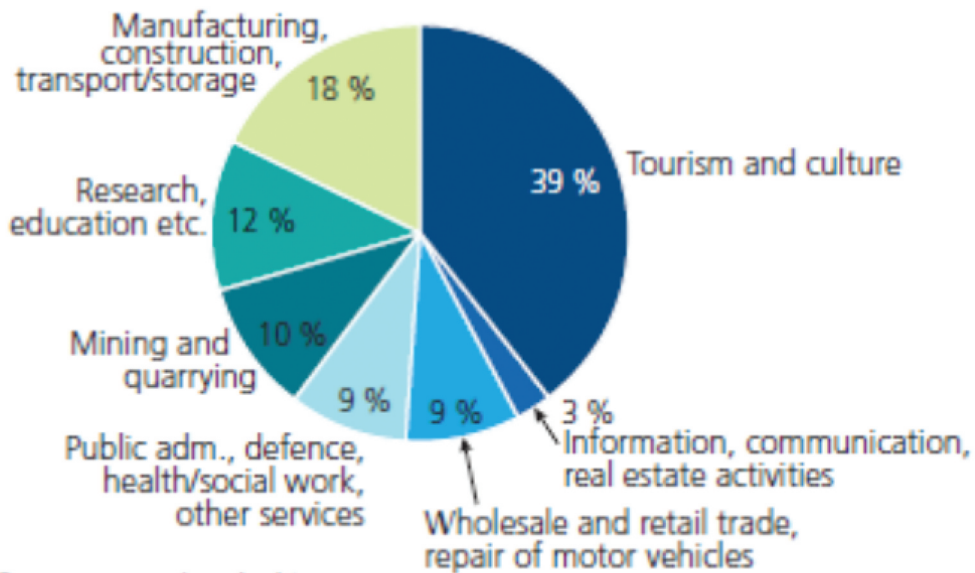


Figure 6. Employment in industry groups 2015.

harm or exploit opportunities.³⁷ During the past two decades the concept of adaptation has developed significantly and is increasingly referred to as a process that takes place along multiple dimensions and in the context of multiple and interacting stressors and cumulative change.³⁸ Adaptation responses, whether reactive or proactive, takes many forms depending on the interactive and multiple effects.³⁹ Studies from Arctic communities show that adaptation processes are shaped by barriers, limits, opportunities and governance and create adaptation strategy options that emerge across scales (institutions such as municipalities and states, sectors such as tourism, fisheries, transport) and actors (businesses, policy makers, government officials, individuals).⁴⁰ Adaptation is also a context-dependent process shaped by the structure of the community, exposure-sensitivities and cumulative change, local capacity to adapt and national guidelines and support.⁴¹ Exposure-sensitivity is understood as the way and degree to which a community is both exposed and sensitive to stresses given changing conditions and situational

³⁷ IPCC AR3 2001 Smit and Pilofosova 2001, Adger et al, «Assessment of Adaptation Practices, Options, Constraints and Capacity.»

³⁸ e.g. AMAP, «Adaptation Actions for a Changing Arctic,» 219–252; Hovelsrud and Smit, *Community Adaptation and Vulnerability in the Arctic Regions*; Schipper and Burton, «Introduction to the Reader»; Leichenko and O'Brien, *Environmental Change and Globalization*.

³⁹ E.g. Smithers and Smit, «Human Adaptation to Climatic Variability and Change.»

⁴⁰ AMAP, «Adaptation Actions for a Changing Arctic – The Barents Region,» 219–252

⁴¹ E.g. Hovelsrud and Smit, *Community Adaptation and Vulnerability in the Arctic Regions*; Smit and Wandel, «Adaptation, Adaptive Capacity and Vulnerability»; Hovelsrud et al, *Community Adaptation and Vulnerability in the Arctic Regions*.

characteristics of place and people.⁴² Some studies from northern Norway find that adaptation processes may be driven by place attachment, social networks and trust, local and experiential knowledge, engaged individuals and perception of risk.⁴³ Other studies of municipalities show that adaptation is driven by engaged officials playing a key role through taking the initiative to join a research project; focusing events (extreme weather events as catalysts for action); observation of climate events elsewhere; and interaction with researchers.⁴⁴ Studies from Longyearbyen illustrate that community engagement is vital to adaptation.⁴⁵ Combined these different drivers of adaptation play a significant role in activating adaptive capacity, which in turn results in adaptation strategies. The capacity of communities to adapt to exposure-sensitivities is shaped by factors and processes such as access to resources and knowledge, economic and livelihood flexibility and opportunities, enabling institutions, governance, infrastructure and connectivity.⁴⁶ Adaptation processes may vary within and between communities, which opens the potential for conflicts over the goal of adaptive actions.

Recent assessments of adaptation studies and research in the Barents Region, where Longyearbyen is located, show that proactive adaptation by local governments to climate change effects such as avalanches, mud slides, sea level rise and thawing permafrost is in practice ahead of national guidelines.⁴⁷ Engineering and new infrastructure may be developed to reduce the effects of thawing permafrost, or the threats of avalanche; other adaptive responses may include new or changed institutional structures, economic mechanisms and innovations.⁴⁸ This means that one response or one-size national adaptation policy does not fit all and that there is a potential for conflict between the goals and concerns of different interests or actors.⁴⁹

Adaptation may also be described as a process through which an actor is able to reflect upon and enact change in the practices and underlying institutions that generate root and proximate causes of risk, frame capacity to adapt and new strategies for climate change adaptation. That adaptation is a response to cumulative and interactive changes in climatic and non-climatic conditions illustrates that it is a highly complex process with multiple strategies⁵⁰.

Change in Longyearbyen

The new Longyearbyen is adapting to a situation where coal mining is gradually being replaced by tourism, research, education. Climate change impacts, development of new economic sectors and wilderness management and increasing tourism activities (in

⁴²Smit et al, "Community Adaptation and Vulnerability in the Arctic," 5.

⁴³Amundsen, "Place Attachment as a Driver of Adaptation in Coastal Communities in Northern Norway"; Hovelsrud et al, "Prepared and Flexible."

⁴⁴Dannevig, Hovelsrud and Husabø focused on adaptation agendas in eight municipalities

⁴⁵Olsen et al, "Longyearbyen and Community Adaptation."

⁴⁶Hovelsrud et al, *Community Adaptation and Vulnerability in the Arctic Regions*; Keskitalo et al, *Adaptation and adaptive capacity*.

⁴⁷AMAP 2017 Adaptation Actions for a Changing Arctic – See in particular Ch. 9 Hovelsrud and Amundsen Leads, and Ch. 10 Nilsson and Hovelsrud, Leads.

⁴⁸AMAP 2017 Adaptation Actions for a Changing Arctic – The Barents Region

⁴⁹E.g. Westskog et al, "How to Make Local Context Matter in National Advice." on national adaptation policy versus municipal needs.

⁵⁰Hovelsrud et al, "Arctic Societies"; on climate change effects on human culture and activities.

Table 1. Population in Longyearbyen and Ny-Ålesund 2002–2019.

Year	2002	2004	2006	2008	2010	2012	2014	2016	2017	2018	2019
Population in Longyearbyen and Ny-Ålesund ^a	1570	1581	1721	1821	2052	2115	2100	2152	2145	2214	2258

^aStatistics Norway report the population for both Longyearbyen and Ny-Ålesund. Ny-Ålesund is an international research community with 43 residents, as of 2015.

Table 2. Consequences of climate change in Longyearbyen.

Impacts of climate change	Challenges and Opportunities	Adaptation measures and needs
Reduced or lack of sea ice, glaciers shrinking	Access Increasing shipping and tourism	Change tourism routes, regulations and products; travel further by ship, shifts in int'l security situation, increase preparedness of tourism vessels
Thawing permafrost, glaciers shrinking, icing conditions	Damage to buildings and infrastructure Transport – navigational challenges	New building codes Maintenance
Avalanches and mud slides	Threatens people and housing; affect psychosocial health and quality of life	Move houses, build protection, zoning restrictions
Wood rot	Cultural heritage and other buildings are deteriorating. climate change accelerates natural change	Protecting cultural heritage
Increased ocean temp	Algae, sea grass and turbid water affects visibility, food security Whales and fish species move north earlier in season	Start cruise season earlier, change land-based tourism activities, potential for increased fisheries
Sea level rise, wave action and less sea ice	Erosion Old graves emerge Coastal cultural heritage at risk	Move buildings to higher ground, restore graves, floating dock,
Floods, surface water Wetter and wilder weather	Limits area for building Less seasonal predictability of weather patterns. Psychological strain on quality of life	Mapping and securing flood areas Increasing need to adjust to and accept adverse weather conditions.

space, time, numbers) are the main factors driving change in Longyearbyen. In [Tables 2, 3 and 4](#) we break down the different drivers of change into empirically defined impacts, challenges and opportunities and adaptation measures or strategies.

Consequences of climate change

The consequences of climate change are real and observable in Longyearbyen, evidenced by the recent avalanches in housing areas, thawing permafrost, retreating sea ice and an ice-free Isfjorden (see [Figure 1](#)) in winter for the first time in the history of the settlement. Climate change is contributing to new threats, such as landslides due to extreme precipitation, and flooding events (see [Table 2](#)). The semi-arid characteristics of the Archipelago are changing with the increasing precipitation. The result is increased unpredictability, likelihood and frequency of avalanches and mud- and rockslides, and erosion along the Longyearbyen River running through town. These changes are exposing some of the cultural heritage sites graves, which are also exposed and sensitive to wood rot because of increased precipitation. The interviewees note changes in wind direction and when combined with heavy snowpack in new areas the threat of avalanches increases. In the past few years Longyearbyen has sadly experienced human fatalities and

destroyed houses from avalanche, and mudslides have changed the landscape in some areas around town. Such events are also increasingly common, beyond the bounds of Longyearbyen, along the recreational routes that locals and tourists use for enjoying the outdoors.

Thawing permafrost destabilises the ground and structural foundations in town and thereby damages the buildings and infrastructure (water pipes, roads). Climate change is causing what can best be described as an emergency response crisis in Longyearbyen and several informants discuss how this is both a major economic issue and a question of safety and preparedness. Power- and water supply increasingly need repairs, the risk of fire is augmented, and erosion and flooding may jeopardise access to buildings. The climate change-related effects such as avalanches threatening homes, thawing permafrost, floods and erosion causing severe damage to roads and other infrastructure, also have consequences for the sense of security and psychosocial health of the residents. Another side effect of experiencing and observing the consequences of climate change is greater awareness about impacts and more focus on environmentally and climate-friendly solutions.

The interviewees highlight the year-round reduction of sea ice and the northward retreat of the ice-edge. They note the unpredictable and therefore dangerous sea-ice conditions and the negative consequences for the habitats of ice-dependent species such as polar bears, ringed seals, and narwhal. More open ocean leads to increased ship access and a longer navigational season both in time and space for cruise ships and other marine tourists, pleasure crafts and supply and fishing vessel.

In combination with strict environmental protection, which limits the action space, the local decision-makers are under pressure to find new safe housing areas, maintain infrastructure, and keep the population safe. Local decision-makers, spatial planners, resource managers and business operators respond with different adaptation measures. For protection against avalanche the local government in Longyearbyen has developed building codes and contingency and maintenance plans, moved houses and implemented zoning restrictions. Other measures include mapping and securing flood exposed areas of the Longyearbyen River, which divides the town in two. Buildings are also moved to higher ground to avoid future damage from sea-level rise and wave action, and a floating dock is in place to ensure safe landing of ships. Managing and planning for Longyearbyen, and the other settlements, reveal several dilemmas with implications for the potential to develop the best adaptation strategies to interlinked and cumulative change, including climate change. A tension is emerging between the policy context (Svalbard Treaty, Svalbard Act, Environmental Protection Act) which governs business development and spatial planning, and the local context.

Sea level rise, wave action and precipitation expose old graves and grave sites. In response, the Governor's Office is developing measures to restore the graves and cultural heritage sites. The operators involved in shipping and marine tourism adapt to the reduced sea ice and shrinking glaciers by extending the cruising season, changing the tourism routes to avoid hazardous conditions, and developing new tourism products. In order to facilitate a higher volume of ships, logistics operators develop proactive measures to improve the harbour infrastructure. Svalbard is a natural hub for shipping along the Northern Sea Route and will likely see a higher volume of ships shifting northward from the Suez Canal. The interviewees note the need for proactive adaptation to

increasing ship traffic. They further note that the lack of regulations for harbour development hampers business development. This creates barriers for potential adaptation measures that could take advantage of an economic opportunity. A potential proactive adaptation measure is to facilitate research and development that can test and study the technical requirements of a new harbour. A less tangible exposure-sensitivity is the wetter and wilder weather that with increased unpredictability reduces the quality of life and increases the psychological strain of Longyearbyen residents. Proactive adaptation includes adjustments in behaviour and an acceptance of the increasingly adverse weather conditions. The weather unpredictability and absence of cold stable winter days are considered a major and new challenge, even though the high Arctic is synonymous with adverse and harsh weather conditions.

National Svalbard policies by two of them: economic transition and wilderness management

The interviewees point to the economic transition and wilderness management as two significant policy dimensions (see Table 3). The economic restructuring from coal mining as key revenue to more service-based activities has weakened the dominance of Store Norske. Simultaneously it has enabled growth in tourism, research and education and resulted in spin off for new supporting businesses. Reduced coal production has an impact on the current energy mix. One of the interviewees states that Longyearbyen in principle is less dependent on locally produced coal than before. One ship load of coal from elsewhere can cover a year-long supply at roughly the same cost as locally produced coal. Economic diversification and splitting up into different businesses and economic services is not merely a business-smart strategy, but simply a survival measure for the Store Norske company.

Some informants focus on the future around how Svalbard policy goals create a nexus of opportunity, uncertainty, and in some cases confusion. Several emphasise that the current Svalbard policies are broad, uncommitting and for the most part politically

Table 3. Impacts of national Svalbard policies on Longyearbyen.

Impacts of Svalbard policies	Challenges and Opportunities	Local Adaptation Measures and Needs
Policy goal of economic diversification in Svalbard opens opportunities for private economic enterprise	Action space for private investments and innovation	More focus on local development and needed technical and economic instruments
Policy goal to increase tourism: increase the acceptance and official support for developing local sustainable tourism businesses	Increased employment, increased visitation in community	New masterplan for tourism. Framework and model for sustainable tourism; identification of carrying capacities, appropriate products and desired tourism segments
Ambitious wilderness management regime: changes the business development, stricter demands on monitoring, activities and reporting	Fewer opportunities for some traditional business activities. Increasing opportunities for innovative, environmentally sensitive tourism	Need for more detailed guidelines, monitoring and analysis of activities and impacts.
Increased profit from logistics and resource exploitation in the Arctic: increase shipping activities and support services	Increasing and diversifying business opportunities	Monitoring of economic, social and environmental impacts

Table 4. Impacts of increasing tourism in Longyearbyen (LYB).

Impacts of increased tourism	Challenges and Opportunities	Adaptation measures and needs
Boom in operators and tourists	Increased employment, increased visitation in LYB, stretching the season potential for conflict between tourists and local population,	New masterplan for tourism. Develop appropriate products and locally desired tourism segments. Guides certification required, Tourism guidelines Facilitate more tourists in town: create designated space and areas and bike and ski tracks; map the paths of local children, reduce impact of tourism on nature, cultural heritage and climate change. Keep hotels open off-season
Diversification in type of tourists	More pressure and opportunity for community and operators; Increasing number of inexperienced operators and tourists; increasing incidents in regulations not being followed	Develop differentiated products (exotic, high-end, tailored); Map volume and type of tourist, activity and areas used; Rank and differentiate between trips and guides; Increase number of days each tourist stays.
Slow cruising close to LYB	Increase spending in town; Saves money for operators' potential for more accidents locally easier access to SAR. Less pressure on the rest of Svalbard	Develop LYB as a tourist town; Place signage in town to guide the tourists, and train hosts to greet them
Safety and environmental concerns	Increased human activities in remote and vulnerable nature. Lack knowledge about impacts on nature. Increased potential for accidents. Capacity to handle large number of tourists Involve tourists in creating awareness of climate change	Be involved in develop SAR capacity Increase awareness among tourists through information and guidelines More field inspectors Environmental tax Develop material that shows the impact on nature and society

mainstream, implying that the current policy scope can both enable and hinder economic development.

Current Svalbard policy indicates a greater acceptance for business development than before. From an economic development point of view the national policy goal of increasing revenue from tourism are clear and positive trends. While some informants point to the lack of defined linkages to business development, others note that there is increasingly more room and acceptance for private enterprise and innovation. Visit Svalbard⁵¹ has developed the Master Plan for Tourism⁵² as an adaptive response to the clear national policy of increasing tourism activities and number of visitors. This is further discussed in the section below.

Protection of biodiversity and cultural heritage has received more attention in recent years and has resulted in changes in both spatial planning and management of protected areas. According to the interviewees, the policy that encourages tourism must be balanced against the strict wilderness management regulations, which limits the use of large parts of Svalbard. This is referred to as a dilemma for businesses. Our impression from the interviews is that the stakeholders perceive the national policy goals as a framework where they can develop adaptive and creative businesses that, given time,

⁵¹Visit Svalbard AS is the official member-based tourism board for Svalbard and Longyearbyen.

⁵²Mimir, "Master Plan for Tourism on Svalbard."

can become socially, economically environmentally sustainable. To ensure profit it will be increasingly important to align with national policy and monitor environmental, economic and social impacts of business development.

The on-going economic transition must be understood both as a means to make Svalbard more economically self-sufficient, hence incurring lower cost to the state, and to flag territorial status and governance without unduly challenging the treaty partners.

Research, tourism and environmentally sound management all belong to the broader 'Svalbard project' – exercising sovereignty through activities that are acceptable within the context of the Treaty.⁵³ Expressed succinctly by one interviewee: 'The Norwegian state is keeping us alive artificially ... Store Norske is an instrument for the state', the ownership report of Store Norske says that one of the reasons the government owns Store Norske is to contribute to maintaining the community of Longyearbyen".

As noted by some interviewees, it remains uncertain what type of community Longyearbyen is and should be in the future. The long-term consequences of the national policy are difficult to predict because of the on-going societal changes. The interviewees clearly point to a need for more focus on local development in response to the economic diversification and demographic change. The transition from a male-dominated company town to a 'normalised' family community has changed the demographic composition of the settlement. An increasing population, with a different demographic signature, challenges the housing situation and local spatial planning. The dire housing situation became even more evident after the recent avalanche damages noted in the section above. There is currently a great shortage of adequate housing facilities, both for families and single persons. Inadequate housing capacity is compounded by the geography and lack of suitable land in the proximity of existing infrastructure, as well as the planning legislation. The latter predominantly favours environmental and cultural heritage concerns over technical housing needs. Several interviewees point out that finding the balance between land use protection and the need for infrastructure development as adaptation to a changing environment can be a delicate issue. Because any actions on behalf of the Norwegians set a precedence where the Russians might claim equal treatment in their settlements in the Archipelago.

Increasing tourism

Longyearbyen has experienced a tourist boom in the past two decades. This increase is due to a growing interest in the Arctic in general and in Svalbard in particular, to national and local facilitation of tourism, and to significant sea ice reduction that allows for easier access. The tourism industry is, therefore, able to offer trips to areas that previously were relatively inaccessible. Because of the favourable sea ice conditions, the cruise ship season commence earlier and extend longer into the autumn. At the same time, on-land tourism increasingly offers year-around attractions, with spectacular Aurora Borealis in the dark winter months as one example. Despite the economic and employment benefits and expected growth potential, more tourists result in overcrowding and increasing pressure

⁵³The Svalbard Treaty from 1920

on the environment and existing infrastructure. Furthermore, the rapid growth in visitors raises concerns that Longyearbyen is becoming a mass tourism destination, which is not a desired goal. Increasingly the question is how to limit the impacts of tourism on the fragile High Arctic environment and on the local community of Longyearbyen. Several interviewees highlight the importance of promoting the Management Area 10 (Isfjorden area – see [Figure 1](#)) as a dedicated destination. This is an area that is regulated for tourism by the national authorities, and it is close to town and search and rescue (SAR) facilities. Another interviewee expresses concern that growth in marine tourism also increases the number of vessels visiting the community, noting that the harbour facilities are at present insufficient for accommodating the increasing demand.

The tourism industry itself is sensitive to the need for developing and adapting the industry in socially and environmentally sustainable directions. However, the sensitivity is variable among companies. Svalbard policies require the tourism industry to balance the development of their products against protecting the environment of the Archipelago. The strict wilderness management policy requires the tourism industry to adapt their products accordingly. The diversity of visitors is increasing from the traditional 'rugged' individuals who wish to experience the wilderness first-hand on their own, to the more urban person who seeks the safe and comfortable adventure on guided trips. Future models for sustainable tourism development will need to deal with this change and increase in products and segments.

The interviewees point to the Visit Svalbard's master plan for tourism for how this is handled locally in Longyearbyen. They emphasise that the master plan is highly attentive to rules and regulations, including internal rules (and sanctions) for local businesses. They further note that the master plan includes a demand for an increasing awareness about the impacts of tourism on the environment, as well as making better use of Longyearbyen proper for tourism activities. That different rules apply to residents and visitors when it comes to travel in the protected areas is a practice which, according to several interviewees, makes little sense from an environmental perspective. The economic opportunities for business and community activities are noted as increasingly circumscribed by the need to take climate change impacts and sustainability requirements into account.

The community responds to increasing tourism in several ways, including designing visitor management strategies and implementing institutional and industrial regulations. An increase in the environmental tax on tourists was suggested by some informants. The tourism operators have adapted by developing networks such as Visit Svalbard, which contains plans, guidance and product development. These efforts are largely supported by a well-established cruise network.

The master plan for tourism includes a focus on developing local areas for tourism. This would entail building stairs to Platåfjellet, the prominent flat mountain top in Longyearbyen, and branding the town as a place to visit rather than being a transit destination. The plan specifies that development is to be attractive to locals and visitors alike. It is of utmost importance to the operators that their adaptation measures to meet increased tourism also show that they care about the town and wish to develop Longyearbyen as a place. Tourism guidelines and increased tourist tax are flagged as necessary measures to meet this development. One of the stakeholders noted that it is

important to avoid conflicts between the tourism industry and the local community. This is exemplified by the project to map the paths (barnetråkket.no) of local children to find out what and who they encounter on their way to school. The new master plan is also better adapted to balance local ship traffic with that of tourist vessels.

In addition, the master plan stipulates developing the coal industry and installations, now more or less historic, as a tourist product. It is important for the operators to avoid situations known from other destinations that are flooded with tourists without control, which may damage nature and create hazardous conditions for the tourists. The tourism industry, therefore, balance adaptation to growth with adaptation to national wilderness management and national policies.

Adaptation to cross-scale changes

The multiple stressors, exposure-sensitives and opportunities that require adaptation in Longyearbyen are summarised in three overarching and interlinked categories: the consequences of climate change, national policies and increasing tourism. The interactions between the different exposure-sensitivities combine and cumulate into intricate processes of change with adaptation challenges and opportunities for Longyearbyen. Seen separately each stressor requires adaptation, but the need for adaptation increases significantly when the cumulative and interacting effects are considered. The unfolding change processes and their underlying drivers found in Longyearbyen illustrates well the cumulative effects of interacting political, environmental and societal conditions. This mirror adaptation to multiple stressors found in studies from other local communities in the Circumpolar Arctic. The Longyearbyen adaptation context aligns with other studies of Arctic community adaptation, in which climate change exacerbates the societal, political, economic and environmental conditions that shape vulnerability and resilience.⁵⁴ Whilst the interviewees, not surprisingly, identify drivers and change processes that are closely linked to their daily occupations, similar directional trends emerge towards broader sustainability and viability issues and caring for Longyearbyen as a community. Broadly stated the goals of adaptation are to secure livelihoods and community. Adaptation to the complexities takes place on the ground by businesses who are interested in making a living, by local policy makers who are concerned with creating a safe and viable community, and by the eclectic and international population who wish to live, explore and thrive in a unique place. What distinguishes local adaptation concerns and efforts in Longyearbyen from other arctic and northern Norwegian communities is the superimposition of the national policy to maintain Norwegian presence in Svalbard. The fact that the economic focus on tourism research and education is a national priority, and not locally driven distinguishes the adaptation context from other arctic communities.

We argue that the national policy goals for Svalbard limit the adaptation options and opportunities for local business and community development, and that climate change exacerbates and pose challenges to the local implementation of the same goals. National policies for Svalbard affect actions that are taken in and about Longyearbyen and may in

⁵⁴E.g. Smit and Hovelsrud 2010; AMAP 2017, 2018 Adaptation Action for a Changing Arctic – Barents Region and Baffin Bay/Davis Strait Region.

fact hinder processes of local adaptation. The complexity for Longyearbyen increases when we consider the multiple pressures from hazardous climate change, national policy, increased interest in the Arctic, increased interest in experiential tourism, a well-articulated wildlife management legislation, and cultural heritage protection. The balancing act of managing the Archipelago through Norwegian sovereignty, legislation and management goals also have international implications and consequences.

Changes can be both enabling and limiting for the potential space to act when Svalbard is developing into a new era without coal mining. We find that there is an iterative, sometimes positive – sometimes negative feed-back between the drivers and the change processes between the three interlinked drivers of change (summarised in [Table 2, 3, 4](#)). These iterative processes in turn create challenges and opportunities, requiring adaptation. This can be illustrated by the climate change-induced reduction in sea ice extent, which opens the Arctic to more marine-based human activities such as marine tourism, an activity which in turn is strengthened by the national policy of increased tourism as one of the economic legs of Svalbard. For Longyearbyen this means adapting to the increased tourism but also to the policy demands for protecting the wilderness.

Longyearbyen is a unique place where it is easy to develop relations between residents and newcomers. The uniqueness is highlighted in national policies as a great opportunity for economic development, but the same uniqueness is also at the heart of the strict wilderness management scheme. This presents a challenge for the local community and business operators, be they local or international. For example, a potential for conflicts or disagreements emerges when national policy and regulations limit the potential for tourism activity in protected areas or near cultural heritage sites. Therefore, challenges to adapting the industry to a new Svalbard may come from the environmental policies designed to protect the nature the tourists are coming to experience. This may not have been thought through by the politicians when they decided to promote tourism as an economic pillar. The highly visible effects of climate change in the region exacerbate the challenges.

A clear adaptation dilemma emerges for Longyearbyen in that the Norwegian government encourages tourism, while the strict wilderness management scheme restricts its potential. Our results indicate that the local businesses are ready to respond to the increased volume of shipping and cruise activities but are dismayed by the lack of open discussions on how to handle the situation. It was stressed during interviews that local businesses are also community actors, with an interest in maintaining a viable town. Another dilemma is raised about the highly transient population of Longyearbyen, which creates opportunities when new ideas and adventurous people arrive, while at the same time the lack of continuity creates challenges. The national policy stipulating that Longyearbyen is not a life cycle community maintains the configuration of the town as transient. Paradoxically the same strict rules that are designed to protect Svalbard, restrict its adaptation potential and development.

Concluding remarks

The national policy goal to transition the economic profile of Svalbard away from coal towards tourism, education and research is partly driven by reduced profitability of coal production, partly to contribute to emission cuts in response to the Paris Agreement's

goal to curb global average temperature increase to 1.5°C, and partly to maintain Norwegian presence. This complex policy and institutional context affect Longyearbyen's ability to adapt. The institutions in Svalbard, pulling at times in different directions serve both as enablers and barriers for adaptation by the tourism industry and local government alike. The rigid rules and regulations for protected areas, cultural heritage and wilderness management, and spatial planning are anchored in the national policy context. Because the Norwegian jurisdiction extends to all settlements on Svalbard, the action space in Longyearbyen is shaped and limited by what the national government wishes to see in the Russian Barentsburg and Pyramiden settlements.

The economic transition in Svalbard is both driven and affected by community adaptive responses. In sum these are linked to 1) the adherence to the Svalbard Treaty; 2) the political decision to maintain Norwegian presence in Svalbard; 3) phasing out coal mining and increasing tourism, research and education; 4) the political will to maintain Longyearbyen as a viable community – akin to Norwegian municipalities; 5) adaptation to multiple stressors: a) to ensure Longyearbyen's safety in the face climate change impacts, and b) to respond to the economic transition. In addition, there are larger issues at play, such as the projected shift in major shipping routes, potentially straight across the north pole,⁵⁵ which may involve Longyearbyen as a major hub. Ultimately, the complex interactions between the local reality of needing to ensure safe conditions as well as aspirations and visions for the future and well-being for the residents, create challenges for developing Longyearbyen sustainably.

It is interesting to observe that while Svalbard, in line with the rest of the Circumpolar Arctic, is experiencing rapid environmental, social and economic change, official Norwegian Svalbard policy emphasises stability, predictability and status quo. We interpret this as a signal of reassurance to the international community that Norway will continue to exercise sovereignty in a responsible manner, rather than a roadmap for addressing inevitable change. The year of 2020 is the 100-year anniversary for the Svalbard Treaty,⁵⁶ an occasion in which international actors such as the EU and/or individual treaty members may challenge Norway's interpretation of certain aspects of the Treaty. Of interest is the Norwegian political position on the jurisdiction over the fisheries protection zone and the continental shelf.⁵⁷

Ultimately, this may develop into an unpredictable power game over significant marine, mineral and hydrocarbon resources. Furthermore, the Arctic is experiencing increasing militarisation as all the circumpolar states are seeking to protect their domestic interests and secure their geo-political position, and the operational environment may influence civilian interests.⁵⁸ How this plays out will clearly affect the community of Longyearbyen and its economic, social and cultural development.

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⁵⁵Smith and Stephenson. "New Trans-Arctic shipping routes navigable by midcentury", projections for navigable trans-Arctic routes

⁵⁶The Svalbard Treaty 1920

⁵⁷Hansen, H.S.B 2016 managing snow crab

⁵⁸Pedersen, "Polar Research and the Secrets of the Arctic,"research and politics

talk to us and share their wealth of knowledge.

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