KEN COATES & CARIN HOLROYD

Northern Sweden and Economic Development

ABSTRACT Governments around the Circumpolar world are attempting to ensure the long-term viability of northern economies, generally by supporting the natural resource economy and seeking opportunities to promote "new economy" commercial development. The challenge is formidable, in large measure because few Arctic or sub-Arctic regions have the research capability, highly skilled personnel, venture capital, accessible markets and entrepreneurial drive necessary to compete in the global science and technology-based economy. Communities in Norrbotten County in Sweden have made significant efforts to develop contemporary economic opportunities. This essay considers efforts made by a series of northern centres—Arjeplog, Kiruna, Luleå, Skellefteå and Haparanda—to build jobs and businesses beyond traditional northern economic activities, demonstrating that creative and determined northern regions can compete successfully in the age of rapid technological transformation.

KEYWORDS Norrbotten, innovation, regional economic development, winter economies, resource development, IKEA, Sami, Circumpolar, tourism

In January 2017, Ingvar Kamprad, the Swedish founder of mega-store IKEA, passed away. He left a large estate, estimated at 362 billion Swedish kronor (US$46 billion), divided equally between his four children and a remarkable allocation of some US$23 billion for business development in Norrland (northern Sweden) ("Half of Ikea ..." 2018). While the details and uses of the bequest remain undetermined, the donation of such a large sum of personal money to regional economic development is unprecedented. The confidence expressed in the far north by one of the world's greatest entrepreneurs is a testament to the region's ability to sell its future prospects to outsiders and suggests that the magnetic properties of the North remain intact.

Kamprad's money will be extremely helpful. The Circumpolar North faces increasing demands for change in the early twenty-first century. For generations, the economies of the northern reaches of Canada, Alaska, Scandinavia and Russia rested on the development of natural resources, a slowly expanding tourism industry, and large government

JOURNAL OF NORTHERN STUDIES VOL. 15 • NO. 1 • 2021, pp. 7–24

expenditures in the development of the social welfare state. More recently, the foundations of northern life have been altered by rapid technological changes, the digital revolution, transitions in the natural resource economy, the emergence of city-states as the drivers of the modern economy, and the re-empowerment of Indigenous rights (Coates & Holroyd [eds.] 2020*a*).

Among the northern regions, the Swedish north has been among the most stable and prosperous, vying with northern Norway for Circumpolar leadership in sustained economic prosperity. The tech-driven city of Luleå is among the most successful and innovative communities in the Far North, vying with Tromsø, Norway, and Oulu, Finland, for tech-driven business development (Nilsen 2016; Regional Development ..., n.d.). Kiruna, the famed mining city, is reformatting itself as a twenty-first century science centre. Skellefteå, a medium-sized town seeking to redefine itself, is poised to become the most prominent manufacturing centre in the North. At the same time, the Indigenous cultural tourism centre of Jokkmokk celebrates and commercializes Sami resilience. Northern Sweden's economic well-being rests, importantly, on continuing national investments in infrastructure, education and economic promotion, combined with supports for investment and free markets (Sanandaji 2015).

This paper examines the approaches taken by various northern Sweden communities and their efforts to adapt to changing economic opportunities in the Circumpolar world. There has been a broad scholarly and policy effort to understand both the realities of regional economic development and, more specifically, adaptations to the imperatives of the tech-driven realities of the twenty-first century (Doloreux 2004; Asheim & Coenen 2005; Asheim & Gertler 2005; Larsen & Fondahl 2015). Governments and communities in the Circumpolar world have devoted a substantial amount of effort and money to expand economic activity in the region. The results across the Far North have been uneven, at best, with little stability and prosperity expanding outside of Scandinavia (Coates & Holroyd 2020*b*; Larsen & Petrov 2020; Larsen & Fondahl 2015). *The Arctic Human Development Report* of 2015 provided an apt description of the two main economic elements in the Circumpolar World:

> The Arctic economy, like all regional economies, serves two different markets. A wide range of resource products including diamonds, iron, gold, zinc, oil and natural gas, fish, and timber is produced for an international market. A local market likewise exists to provide goods and services to the residents of local regions throughout the North. This local economy includes a significant public sector that provides income, jobs, and services to local residents. In some parts of the North, the local economy includes a traditional sector that provides for local consumption through fishing, hunting, herding, and gathering. The strength of the connections between these two parts of the local economy varies across the North.
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> The local and international economies often behave like two separate economies, occupying the same space, but with little in common. This difference exists, for example, in the structure of production. While the international economy supports modern large scale, capital-intensive production, local production often takes place in small groups, which mix modern and traditional methods of production. The two economies also have contrasting economic geographies. The international economy is concentrated while historic settlements in the local economy are small and scattered. These contrasts are less likely for those industries that have historical local roots in a region or those which may serve both local and international markets, like fishing and herding. (Huskey, Mäenpää & Pelyasov 2015: 154–155)

Huskey *et al.* described the Circumpolar economy as having three elements: the formal economy based on large-scale resource development, the informal economy founded on traditional and small-scale economic activity and government transfers. The 2015 *Arctic Human Development Report* paid little attention to the emergence of an Arctic innovation-centred economy, which has become increasingly important in recent years (Hall 2020). This divided economic reality, compounded by the striking economic differences between the various Arctic nations, makes the examination of Sweden's experience with the development of new economic foundations in the North particularly important. First, however, it is worthwhile to remember the history of economic development in the north.

The History of Economic Development in the Circumpolar World

Northern regions hold an unusual place in the economic transformation of their nations. They have, for the most part, been managed as "internal colonies" of the nation state, a source of natural resources and economic opportunity, dominated by southern capitals and politicians but not an integral part of the country (Coates 1985; Coates & Morrison 1992; Haycox 2020; Wood 2011; Forsyth 1994). All the Circumpolar regions long sustained Indigenous harvesting economies, based on hunting, trapping, fishing, gathering and, in Scandinavia and Russia, reindeer herding. There was oil, gas and mineral wealth in North America spotlighted by the Klondike Gold Rush in Yukon, echo gold mining booms in Alaska, the discovery of oil at Point Barrow on Alaska's northern tip, the wealthy Red Dog mine in western Alaska, oil and gas and diamonds in the Northwest Territories, iron ore and other minerals in Nunavut, oil potential off Greenland, uranium in northern Saskatchewan, the massive oil sands and shale gas deposits of northern Alberta, rare earth minerals in northern Ontario, nickel in northern Labrador, and exceptional hydroelectric capacity in northern Manitoba and northern Quebec.

Northern Europe is, in general, more prosperous than the North American North; the region does not have the extreme poverty of many of the Indigenous communities in northern Canada and Alaska, the major infrastructure problems facing remote, fly-in settlements, and the inequalities between northern residents and the fly-in workers brought in to operate the mines and most construction projects. This is, outside of Russia, substantially due to the strong and consistent presence of big government, major commitments to regional infrastructure (including the Internet), and strong social welfare benefits for all citizens. In northern Scandinavia, the massive hydro-carbon resources off Norway's coast propelled it to a future of endowed prosperity. Northern Sweden and Northern Finland have Canadian style resource economies, based on closely connected small-scale agriculture with forestry, mining and hydroelectric development. Russia, with the massive natural resource potential of Siberia available, has rediscovered its northern mission, tied largely to President Putin's reassertion of its military prowess and the desire to dominate resource markets, especially in China and East Asia (Rotnem 2018; Josephson 2016; Conley & Rohloff 2015). The result has been the rapid development of Siberia, including mobile nuclear plants, the growth in northern population and infrastructure, and a major expansion of resource development. The effort is foundering now on the heels of the collapse of global oil and gas prices, but Russia's aggressive investments in the Arctic stands in stark contrast to the go-slow strategies in much of the rest of the Circumpolar world.

Northern economic development has been, at least notionally, a national government priority across the Circumpolar world. These efforts over the decades have had a variety of imperatives: solidifying national sovereignty in the Far North, gaining access to valuable resources, raising the standard of living for regional residents, particularly Indigenous peoples, and expanding the reach of the country into the northern regions. In Alaska, the Government of the United States expanded the Alaska Railway in the 1920s, but it was the arrival of the US armed forces in larger numbers during and after the Second World War that sparked a major expansion of the territorial economy. Indeed, the military has played a foundational role in northern economic well-being across much of the Circumpolar world, particularly during the massive investments during the Cold War. The Canadian government made few efforts in the North until the Roads to Resources program of the Progressive Conservative government of John G. Diefenbaker (Isard 2010). This Canadian effort focused on infrastructure development but fell far short of expectations. In northern Scandinavia, efforts to integrate northern regions into the national economy included road and rail construction, electrification, the construction of new universities and colleges in the 1960s and 1970s and the rapid modernization of towns and cities. Much of this growth and government investment rested on the rapid expansion in northern resource development after the Second World War, an era of explosive international expansion in mining, the forest industry, oil and gas development and the exploitation of hydroelectric capacity (Coates & Powell 1989).

The combination of the post-war resource boom and the expansion of government commitments established the foundation for the modern North. Since that time, all of the northern regions and their national governments have made concerted efforts to build economic opportunity in Circumpolar areas. The program details vary, from infrastructure plans (like the proposed railway through northern Finland), investments in innovation strategies (focused on Tromsø, Luleå, Umeå and Oulu), coordinated tourism promotion (focusing largely on winter and wilderness tourism), the promotion of entrepreneurship (with limited to mixed results), and Indigenous economic empowerment (with the strongest results coming in the Canadian North and Alaska).

Perhaps the greatest challenge rests with the fact that the global economy shifted faster than the economic adaptation in northern regions. Beginning in earnest in the 1990s, the foundations of the global order changed. The advent of the technology-based economy, driven by the evolution of the Internet and the emergence of digital systems, have transformed the "old" industries and resource development generally, reducing employment while sustaining productivity (Mitra 2019). This, in turn, re-enforced the dominance of major universities, research institutes and larger urban centres. The rapid growth of northern regions in the 1950s and 1970s slowed (save for a few locations, like Tromsø, Norway) as automation and technological innovation improved production processes and reduced employment. Most northern regions stagnated, except for exceptional developments like Rovaniemi's conversion of Santa Claus into a major tourism industry, even as government efforts escalated (Pretes 1995; Rusko, Merenheimo & Haanpää 2013: 37).

The new economic reality, with little to do with the specific circumstances in the North, prioritized knowledge work, technological innovation, and digital media. The new formulation pushed expectations about the role of the North to the side, save in occasional and cyclical interest in major resource developments. Being informally marginalized did not sit well with northerners, particularly those in the larger centres. In the main cities, including Anchorage, Fairbanks, Whitehorse, Tromsø, Bodø, Luleå, and

Rovaniemi, local authorities adopted a "new economy" focus, building on local post-secondary institutions, national grants, and extensive government-business engagements. Government agencies, at the national, regional and local levels, demonstrated considerable belief in the technology-based economy, hoping that new companies would be launched, capitalizing on the imperatives of globalization and the "work anywhere" dream of the digital age. The returns came slowly and inconsistently, largely because the imperatives of access to venture capital, large numbers of highly qualified personnel, excellent research facilities, and local production capabilities left the advantages clearly with the larger metropolitan centres. Individual entrepreneurs and businesses are flourishing but the long-desired emergence of an Arctic innovation eco-system has not materialized.

In the "new" North, governments and community organizations seek to improve opportunities for Indigenous peoples, create more stable economies, adjust for declines in employment and activity in the natural resource sector, and search for an ongoing role for northern districts in the technology-driven order. Economic stability remains elusive, reflected in 2020 fluctuations in global commodity demand and prices that have harmed oil and gas developments, supported the mining industry and traumatized Arctic and sub-Arctic tourism. Building a commercial presence for Indigenous people and communities has been aided by a global surge in Indigenous-led entrepreneurship, although progress remains mixed. To date, technology has been more disruptive than beneficial, reducing employment in resource development, eliminating many jobs in the service sector and promising further disruptions in the near future.

The last quarter century has not seen the emergence of a new model for Circumpolar economic development, other than the long-standing dependence of periodic resource developments (vulnerable to global market demand and prices) and more regular infusions of government funding. As a result, most Circumpolar districts (although not northern Sweden) remain economically stagnant, if not declining, with continued outmigration of young people, growing retail competition from e-commerce providers that is undermining small town businesses, challenges attracting and retaining professional and scientific staff, difficulties securing risk capital, and limited ability to ramp up promising companies to medium-sized and large-sized firms. As one northern economic developer, Robert Granström, observed:

> The transition to 21st century economic realities was possible in Sweden thanks to the national economic system supporting urban growth. Still today, the net export figures in Sweden indicate that Sweden's wealth is coming from minerals, forestry and hydropower. We have been spending the net income on infrastructure and fancy buildings in the city. (Granström & Lestander 2019)

The Circumpolar world, particularly in Russia, northern Canada and Alaska, has not yet made a strong or consistent transition to current economic realities. To the degree that the knowledge economy—what some authors call the "Fourth Industrial Revolution" (Schwab 2017)—is fundamental to contemporary prosperity and continuing competitiveness, the North is not well-prepared for long-term success. The North's efforts continue, in the face of uneven results, bolstered by the faith and commitment of community leaders and the desire to set northern districts on a more positive and promising trajectory. But, to be clear, the challenge is formidable, the results uncertain, and the costs of failure highly significant. It is in this context that our research, which previously has included many studies across the Circumpolar world, was drawn to northern Sweden.

Northern Sweden

Norrbotten County, the northern quarter of Sweden, straddles the Arctic Circle. Despite its size, under three percent of Sweden's 10.2 million people live in the county. Of the 275,000 people in the region, almost one-third, 77,000, live in the city of Luleå. The rest are scattered in smaller communities throughout the 150,000 square kilometres. In the past, the natural resources of northern Sweden (hydroelectricity, timber and minerals) contributed significantly to Sweden's nation-wide industrialization and maintained a high level of regional prosperity throughout the twentieth century. Over the past forty years and most specifically the last two decades, many Norrbotten communities have tried to build on their natural resource base and attract or develop new sectors of their economies.

In the fall of 2019, the authors made an extended research trip through northern Sweden, meeting community economic development officers and business leaders, and visiting commercial establishments. We focused on selected communities and sectors, exploring the diversity of regional adaptations to twenty-first century economic conditions. In each sub-region, leaders spoke of the economic transitions underway in the region, tied to the large decline of employment in the forest industry (largely due to the advanced mechanization of sawmills, pulp mills and paper mills), uncertainty and renewal in the mining sector, and growing national and international interest in northern tourism. They described, too, the movement of regional young people to major centres in the South, the difficulty of holding the attention of national governments, the uneven impact of technological change, and the cycles of economic opportunity in the region, conditions echoed by advocates for regional development throughout the Circumpolar world. Through these case studies, this paper explores a variety of economic strategies—manufacturing, retail, the marketing of winter, space research—in Norrbotten and describes the broad, loosely connected development in the region.

Arjeplog—Winter Car Testing

The Arjeplog region, a scenic area in northern Sweden just south of the Arctic Circle, consists of a main town of the same name with approximately one thousand citizens along with six Sami villages and numerous tiny communities, collectively home to another 1,800 people spread out over many square kilometres of mountains and lakes. "There are more snowmobiles than women in Arjeplog," stated one city official. The regional economy was, for years, built around a sawmill and the Boliden silver mine, both now closed. The Boliden operation had a major impact on the region, opening numerous small mines around Västerbotten County (the county south of Norrbotten) and transforming the small farm economy in the process. Soon after the mine closed in 1996, the Argentis Business Council (three-quarters owned by local companies and the rest by the municipality) was formed to devise economic development strategies for the region. Today, Argentis' five staff help local businesses, including everyone from Sami reindeer herders to store or restaurant owners, build economic opportunities.

Tourism has been a major employer in the region for decades. As Sami reindeer herding can run into conflicts with tourism, snowmobilers in particular, and the forest industry, the city of Arjeplog has regular meetings with Sami representatives to work out issues. Two national government agencies, the Swedish Agency for Economic and Regional Growth and the Swedish National Road Administration, have offices in Arjeplog (Sölvell 2016). Nonetheless, Arjeplog has long been determined to create economic and

employment opportunities in the region and thereby encourage its young people to return once they have completed their education.

In 1972, three engineers from Teldix, a German aircraft electronics company, which had recently developed an automotive anti-skid braking system, came to Arjeplog looking for a place to winter test cars and car components. They met with two local entrepreneurs, David Sundström and Per-Axel Andersson, who maintained an airline landing strip on a local lake. The two parties reached an agreement that the Germans could use the runway for car testing. After a few years, Sundström and Andersson began to focus on the car testing sector and started a company they eventually called the Icemakers.

Arjeplog is well suited for car testing in winter conditions. The region has more than 8,000 lakes; winters are cold and snowy. The Icemakers bought snow clearing machines, built storage facilities and learned how to create excellent ice testing conditions. Demand for car testing services in Arjeplog continued to grow. In the 1980s other companies, Colmis and Cartest, entered the sector. Additional service companies set up in nearby communities. Porsche, Mercedes, and BMW along with a range of component companies arrived to run tests in the area. They were soon followed by other European and Asian companies. One of the early—and remaining challenges—was providing accommodations for the influx of drivers and engineers. As there were nowhere near enough hotel rooms for the number of people who were coming to town, local folks rented out rooms in their houses, earning them additional income.

By 2020, Arjeplog was the winter car testing capital of the world. The northern Sweden test region (Arjeplog, Arvidsjaur, Jokkmokk, Älvsbyn, Kiruna and Piteå) is home to one-third of the global market for vehicle and component (brakes, drive train, tire) testing (Granström & Lestander 2019). The second largest market share is held by Finland, which has one-sixth of the market. Other places where winter car testing occurs include northern Ontario, Canada; Hokkaido, Japan; near the Mongolian border in China; in New Zealand (mainly tires as it is expensive to transport cars so far away) and in Greenland. There are now thirty different testing facilities in the Swedish winter test region. The area has so many bodies of water that each company conduct its confidential tests on its own lake. European, Asian, and North American auto companies, subcontractors and component producers now test in Arjeplog. Four to five thousand cars are tested annually, worth approximately US$100 million. Almost all of the car testing service companies are family run and make approximately US$1 to 2 million in annual profit. The larger companies produce value in excess of US$2 million; the largest company produces a financial return of US$27 million.

Cars and components are tested for functionality in cold climates. Service companies provide a wide range of services that include tracks on ice and land, cold chambers, garages, administrative buildings, gas stations and work rooms (Sölvell 2016). Car testing service companies hire personnel ranging from cleaners to engineers. Employment usually runs only for the test season, November to April, which is about six months of the year. In 2002, the Swedish Proving Ground Association (SPGA) was formed as a not-for-profit association of Swedish automotive testing service providers. The SPGA and its member companies develop industry guidelines and practices. In recent years, there has been a strong focus on security, safety and infrastructure issues and a coordinated effort to expand the sector.

Starting in the 2010s, tourism spin-offs connected to vehicle testing were launched. Former rally car drivers and drivers who wanted to test or improve their driving skills can pay to use the ice driving tracks. Event companies offer passenger rides, driver experienc-

es, and ice driving training for professional rally and racing car drivers. This has proved to be very popular and lucrative. One company, Arctic Falls, has two indoor year-round winter testing facilities with a variety of different track layouts on snow, asphalt and ice. Companies have also begun to promote summer ground testing. In 2018, four of the vehicle test companies and the Luleå University of Technology launched the Snow Academy project. The Snow Academy's focus is to build on extensive knowledge of snow amassed by the car and tire testing companies and develop methods for measuring snow quality (Evans 2018). The SPGA, the test service companies, and the Argentis Business Council are continually thinking about future testing possibilities, and the role they can play in supporting a sustainable society.

Car testing has inverted the Arjeplog economy. Where previously activity spiked in the summer forest and tourist season, the winter months now dominate the economy. Hundreds of outside professionals fill the hotels through the season (several of the larger facilities close through the non-winter season) and there are more foreign visitors than locals in Arjeplog during the winter. Tourism is the largest summer economy, although the testing industry continues its efforts to expand their activities through this time.

Kiruna—From World Class Mining to the Commercialization of Space

Developments 400 hundred kilometers to the north of Arjeplog illustrate the region's effort to continue to capitalize on natural resources while planning for a different economic future. Kiruna, a city of 23,000 people north of the Arctic Circle, is the site of the world's largest and highest quality iron ore mine. Mining began at the Kiruna mine site in 1898; over one billion tonnes of ore have been mined since then. The iron extracted to date, however, represents only about one-third of the 4.0 kilometre long, 1.5 kilometre deep ore body ("Kiruna Iron Ore Mine, Sweden," n.d.). While a great deal of ore remains, the miners have dug so far underground near to the city that a widening crack in the earth is threatening the city's safety and, in the longer-term, its existence.

Faced with the combination of a gathering crisis and a still-rich ore body, in 2004, the company that owns the mine (Luossavaara-Kiirunavaara AB or LKAB) decided to move the city about four kilometres away to allow mining to continue. The city relocation is an enormous undertaking and could cost about US$1 billion. The town centre should be re-established by 2022 while the rest of the relocation could take until 2040 (Michael 2018; Anzilotti 2018). LKAB is investing in the future in other ways. In conjunction with SSAB (a highly specialized steel producer) and Vattenfall (a large European energy producer), LKAB has invested in research on the carbon-free production of steel. A new technology called HYBRIT would allow for the production of steel using hydrogen and fossil-free electricity, expanding demand for locally produced iron ore ("SSAB in brief," n.d.).

The region is not content to live off the profitability of one of the world's most successful mines, which has produced a high wage, stable and strong community. Kiruna and the surrounding area of Swedish Lapland have also built up a tourism sector. There are direct flights in the winter from London, Tokyo and Shanghai. Visitors primarily come to see the northern lights in the winter. North of Kiruna is the small town of Abisko and, nearby, Abisko National Park. The area is famous for the King's Trail (Kungsleden), Sweden's most famous hiking trail. Aurora Sky Station, which opened in 2007, offers visitors a unique northern lights viewing experience, complete with a chair lift

ride and a gourmet dinner. The Aurora Sky Station has turned Abisko into a year-round tourist destination. Prior to its opening, Abisko's visitor services businesses closed down between November and February.

Over the past decade, many visitors come for the opportunity to stay at the Icehotel in Jukkasjärvi, not far from Kiruna. The main part of the hotel is newly built each fall out of blocks of ice harvested from the nearby Torne River the previous March. Construction of the 35 rooms takes two months, with work completed by mid-December. Artists from around the world submit designs for the room decorations. Selected artists spend two weeks carving their designs for the rooms. Next-door is the Icehotel 365 which has twenty ice rooms inside a wooden external structure. The rooms are kept at -5 degrees and are open year-round. Icehotel 365 also hosts the Icebar; all glasses and goblets are made of ice. Warm rooms are also available. Most guests like to spend just one night in a cold room but stay longer to partake in the various activities on offer: dog sledding, ice sculpting, snowmobiling in winter and fishing, river rafting and hiking in the summer. The Kiruna Ice Hotel has a highly regarded restaurant, which focuses on Sami and Swedish culture and specialities. The hotel has 50-year-round employees, increasing to 180 employees in the winter (Kiruna Ice Hotel 2019). The hotel is fully booked for most of the year, providing a substantial and sustained boost to the regional economy.

More significantly, Kiruna is also the site of a significant and growing space industry, which started in 1957 when the Institute of Space Physics began its world leading research into the aurora borealis (Bergström-Roos 2019). Seven years later the Esrange Space Center, a scientific research station and rocket range, was built by the European Space Research Organization, later the European Space Agency. The first sounding rocket was launched from Esrange in 1966 and over 150 rockets supporting atmospheric and ionospheric research were launched between 1966 and 1972 when the Swedish Space Corporation took over Esrange. Esrange's activities have since expanded to include larger rockets reaching higher altitudes, high altitude balloons and satellite tracking. A few kilometres from Esrange is a European Space Agency's satellite station. Also in Kiruna is the EISCAT (European Incoherent Scatter) Scientific Association's radar antenna site, which opened in 1981. The site enables research on the upper atmosphere and the ionosphere and different phenomena such as space weather, space debris and the aurora. And at the Kiruna airport is Arena Arctica, an aircraft hangar and atmospheric research facility.

Students have been carrying out doctoral work in space physics at the Swedish Institute of Space Physics (IRF) in Kiruna for decades. Over the past twenty years, the Swedish government has tried to build on the space research cluster that exists in Kiruna and expand the educational programs in space and related areas. In 2001, the Graduate School of Space Technology was launched by the IRF and the Luleå University of Technology. The Kiruna Space and Environment Campus (KRM) opened in 2003. It was initially managed by a consortium of the IRF, the Luleå University of Technology (LTU) and Umeå University. Today it is managed by LTU, now considered Sweden's space university, which offers summer and undergraduate courses as well as master's and PhD programmes to domestic and international students. A Space High School opened in Kiruna in 2000. It recruits its 30 highly talented and motivated students from all over Sweden (Sandahl & Norberg 2003; Sandahl & Wikström 2005: 35–40).

In 2014, LTU, established in 1971 and now with more than 19,000 students, began building on its already strong position in space technology research and education to take a lead in encouraging business and research opportunities within the space sector.

With the support of two consecutive European Union funded projects and several partners, LTU launched a space program for innovation and growth that encouraged university, industry and regional collaboration. Since 2014, Kiruna has strengthened its plan for the space industry and improved collaborations among the various actors. The EU funding was designed to promote regional growth and support small and medium sized enterprises (Bergström-Roos *et al*. 2019). The first EU project, RIT first phase 2015–2018 (both projects are referred to as RIT, which is a Swedish abbreviation for "space for innovation and growth"), had three main components: the establishment of a Centre of Excellence for space technology in Kiruna, the implementation of joint research and development space projects, and the initiation of an innovation ecosystem for the space business.

The Centre of Excellence in Space Technology, managed by LTU, was established at the Space Campus in 2018. Designed as a space for collaboration and ideas, the Centre regularly conducts pilot projects, networking with external partners, interdisciplinary research, knowledge gathering about the needs of the space industry and the competencies of regional small and medium sized enterprises. For the second work project of joint industry-academia research projects, eight PhD students supervised by LTU faculty with industry co-supervisors were enrolled and should complete their research projects, which are all related to space industry needs, in 2020. Products and services with the potential for commercialization have been identified (Luleå University of Technology, n.d.). Lastly, the development of an Innovation Ecosystem for the Space Business began by identifying the various businesses in the region connected to the space industry and then creating opportunities for them to cooperate and develop commercialisable products and services (Bergström-Roos *et al.* 2019). The second EU project, RIT phase two (2019–2021), builds on the projects in phase one with the aim of creating an innovation system that would help the space industry grow by focussing on collaboration, research and cluster development. There were two additional work projects in this phase: the establishment of a commercial testbed for space and the development of an aerospace cluster.

Kiruna's space commercial cluster remain a work in progress, undertaken at a time of continuing prosperity based on the local mine and northern tourism. The space industry capitalizes on the unique characteristics of Kiruna—northern location and clear skies—and is allowing the exploration of a business sector that may become very successful in the years ahead. Kiruna has, over the past quarter century, understood the importance of building for the next economy while being sustained by the prosperity of its iron mine. It has, likewise, supported a strong, unionized, working-class community noted for its adaptability to emerging technologies while exploring effective means of building an additional professional and science-based economy focused on the economic potential of space.

Skellefteå—From the Forest Industry and Mining to Gaming and Batteries

While manufacturing has not been prominent in northern economic development outside of Russia, one of the most dramatic investments in recent decades is currently underway in northern Sweden. Northvolt, a new Swedish battery developer and manufacturer committed to developing the world's greenest battery, announced in October 2017 that its gigafactory Northvolt Ett would be built in Skellefteå.

Skellefteå, just a few kilometres south of Norrbotten County, was once the largest city in northern Sweden. When universities opened in Umeå and Luleå in 1965 and 1971

respectively, people shifted to those cities. Skellefteå has a long history of mining, particularly of gold, earning it the nickname "Gold Town." The mining company Boliden AB currently mines lead, gold, copper, silver and zinc and is the largest local employer with 3,000 staff members. The company's numerous mining operations had a sizeable impact on the local economy, sparking the development of the industrial elevator manufacturer Alimak Hek, for example, which currently has close to 300 employees in the community. In this region, Boliden had numerous small mines in contrast to its two very large mines, which dominated the economic landscape, in Norrbotten County.

The community's professional development benefited, as well, from the presence of Rönnskärsverken, a base metal smelter opened in 1928 to serve Boliden, in nearby Skelleftehamn (the company has expanded in recent years to recycle electronic waste). Over the past decade, Skellefteå made concerted efforts to diversify its economy and to lessen its reliance on resource development. By promoting Skellefteå's important advantages (including its location close to the Baltic Sea, a skilled and loyal workforce, less expensive housing than major cities and therefore lower salaries for workers) Skellefteå tried to attract big data companies, and call centres (Palm 2019). The community developed advanced skills at bringing new firms into the region.

The city established the Arctic Game Lab, building on the fact that the LTU's campus in Skellefteå offers gaming and graphic design programs. Graduates, however have had to relocate to find work. The city put together a strategy to encourage graduates to stay. It ran gaming events and encouraged companies to establish in Skellefteå. The city created an incubator to help start-ups and gave scholarships to recent graduates to fund work on their own games. The effort has been successful; in 2020, there were 40 gaming start-ups with 170 employees in Skellefteå.

The city has additional advantages over other small northern communities, particularly the fact that it owns the local port, airport and Skellefteå Kraft, the regional diversified energy company (hydro, nuclear and wind). The availability of power, land and lithium and the high level of business and community engagement with the city were among the reasons that Northvolt selected Skellefteå for its new battery factory. In 2017, after an international competition that attracted 40 serious community applicants, Northvolt confirmed that it is building a massive 3.8 billion Euro electric battery factory on 200 hectares of land near Skellefteå. The first phase of the plant should open in 2023 and will be producing lithium ion batteries for electric cars and for other industrial uses. The company's slogan is "Let's Recharge the World."

The scale of the city's victory in the Northvolt competition was truly impressive. The community's economic development unit spent years on the multi-stage competition, mobilizing the local business community and citizenry in a comprehensive campaign to secure one of the most significant manufacturing competitions in a generation. The announcement that the plant would be coming to Skellefteå touched off a massive celebration in the city. The plant, despite being built in a small city, will be the fifth largest manufacturing operation in Sweden. It will be the largest lithium ion battery factory in Europe, producing on an economy of scale that will halve the current cost of batteries (Engström 2020). Five production lines for different size batteries are planned. Northvolt already has contracts for production to 2028, including producing materials to be assembled at the Volkswagen factory in Germany. Northvolt investors include Scania (a Swedish owned manufacturer of commercial vehicles), BMW, Volkswagen and IKEA.

The plant will have 3,000 employees, including the recycling plant ReVolt, which will be built on site. Suppliers will employ another 1,000 people. Skellefteå is expecting

the creation of 10,000–12,000 new jobs with dozens of subsidiary businesses and services. This will mean that about 25,000 people could be moving to Skellefteå (Hedqvist 2018). Local unemployment is currently low so the factory and suppliers will need to attract hundreds of additional managers, researchers and line staff. The city will help the companies attract workers both from other parts of Sweden and from abroad, primarily Asia. The community will also build the needed housing and infrastructure. Skellefteå Kraft Energy will provide the energy, which the factory will need in the construction and subsequent operations.

The economic impact will be dramatic. Over 10 billion Swedish kronor (SEK) will be invested in renewable power (SwedishCleanTech, n.d.). Piteå, a small city north of Skellefteå in Norrbotten, could eventually have the largest land-based wind farm in Europe if the project starts operations in 2022 (Renewables Now 2020). An additional 10 billion SEK will be invested in regional housing. Private sector investment of approximately 35 billion SEK is anticipated along with additional infrastructure investments, including 5 billion SEK in the development of a railway connecting Umeå, Sweden, and the Finnish border. More than anything, the fact that a comparatively isolated small town could attract one of the most important and largest new factory installations in the western world, speaks volumes about the resilience of the sub-Arctic and Arctic people and businesses.

The Innovative North

These examples—Arjeplog, Kiruna, and Skellefteå—are not the only illustrations of northern Sweden's creative positioning and repositioning and of northern responsiveness to economic transitions in general. Numerous communities and businesses have understood the economic value of being northern, particularly in terms of outdoor activities, aurora viewing and Sami culture. Southern and international interest in these activities has been growing steadily in recent years, providing a seasonal boost to the regional economy. In other cases, communities are capitalizing on and commercializing long-established activities. Jokkmokk, a long-time centre for Sami culture and commerce, has built on this heritage to create a strong, largely Sweden-focused tourism industry. Each February, Jokkmokk hosts a Sami Winter Market, continuing a 400-year old tradition. The week-long festival of Sami culture and handicrafts attracts some 40,000–50,000 people per year, a massive "invasion" of the small northern community of some 3,000 people. Jokkmokk also has an excellent museum displaying Sami artifacts and information on Sami life and history.

Some of the most innovative, non-technological advances can be seen in a small city on the Sweden-Finland border. Haparanda is a small town located on the very north end of the Swedish coastline adjacent to Tornio, Finland. Over the years, the community's economy focused on cross-border trade with Finland, with the region's businesses creating strong ties across the boundary. This trade evolved over time according to the state of Finland–Sweden relations and the relative strengths of the national economies. The town has seen its population decline since 2012 primarily, the city's statistics show, because women who go away to school do not seem to return (men do) and, probably connected, fewer babies are being born each year. Haparanda's mayor wants to create reasons for people to stay (Tornberg 2019). In 2015, 700 refugees came to Haparanda temporarily; 150 stayed. Haparanda's main economic areas are the forest industry, food production (reindeer, fish, berries) and tourism. Visitors come to explore the Haparanda archipelago

and neighbouring islands. The Polar Explorer Icebreaker offers three-hour cruises in the frozen Bothnian Sea. Guests can walk on the frozen sea or even take a swim in a flotation survival suit. These tours, which take place between December and March, are very popular especially with visitors from Asia. In 2019, there were 20,000 bookings.

In the early 2000s, the then-mayor of Haparanda approached Ingvar Kamprad, the founder of Sweden's iconic furniture store, about building an IKEA in Haparanda. Although the municipality of Haparanda only has 10,000 people, the location put the IKEA within reach of the population of Luleå and other smaller Swedish communities and significantly also of Tornio, Kemi, Oulu and Rovaniemi in Finland and, with a lengthy drive, even of western Russia. Mr Kamprad must have been convinced as the northernmost IKEA store in the world opened in November 2006 in a purpose-built commercial mall on the Haparanda side of the Haparanda-Tornio border. The store has 250 employees (full and part time) and attracts a million visitors a year. The Haparanda IKEA was so popular that it expanded within its first year of operation (in which it attracted two million visitors), the fastest such expansion for IKEA in Sweden. Tourists, conferences and new stores followed the IKEA into Haparanda. While overall the IKEA has had a positive economic impact on Haparanda there have been downsides, including the hollowing out of the city centre. While IKEA itself does not really compete with local shops, many of the stores that followed IKEA have been taking business away from long-established shops.

The largest city in Norrbotten, Luleå (population 78,000) has also emerged as among the most technologically-advanced in the Circumpolar world (competitive with Oulu, Finland, bolstered by the communications company Nokia, and Tromsø, Norway). Luleå decided to use its cold climate as a positive attribute, realizing that its reliable and long winters provided a real opportunity in the management of digital information. Server farms, which host thousands of servers and serve as the backbone of the Internet-based economy, require a great deal of energy and give off a great deal of heat. In a cold climate, fans can pull in outside air and cool the warm servers inexpensively.

Facebook saw the advantages of Luleå, which included substantial tax exemptions on electricity that made Sweden cost-competitive with Norway, and opened its first server farm there in 2013 (Wong 2017). As *Time*'s Lisa Eadicicco described it:

> The site is comprised of two colossal buildings, each about the size of 17 ice hockey rinks, full of gear that makes it possible for billions of people around the world to upload status updates, photos, and videos each day. (Eadicicco 2016)

The company says that its Luleå server farm uses 40 per cent less power than its other facilities (Eadicicco 2016). Facebook has announced plans to open a third enormous (93,000 square metres) server farm in the community in 2021 (Dawn-Hiscox 2018). Along with cold weather, Luleå also has the advantage of abundant and inexpensive hydroelectricity and high quality staff trained at LTU. Some local analysts urge the city not to be complacent, pointing out that other cold places have similar attributes. The server farms have brought hundreds of highly skilled and well-paid professionals into the city; Facebook's data centre had 150 employees (Harding 2018), while also supporting the development of a start-up culture based on data management and data mining. Consider this assessment of Luleå's economic revitalization tied to the Facebook server farms:

> Facebook's Luleå site, the company's first data centre outside of the USA, contributed 9bn SEK ($992m) of full economic impact. It created 4,500 full-time jobs over 10 years (direct, indirect, and induced impacts), including 1,450 direct impact jobs (yet

> it is not clear how many remain employed inside the facility). According to BCG, in 2012 Facebook contributed 1.5% to the region's economy. (Webster 2020)

Luleå has positioned itself as a crucial partner in the European and global Internet economy, supporting the city's transition from a traditional forest industry and industrial based economy to an essential element in the "new economy" of the twenty-first century (Boston Consulting Group 2014).

Conclusion

Governments and economists struggle to quantify what is variously called the "new economy" or the "innovation economy." New technologies have had a powerful influence on the resource sector, sustaining or expanding productivity and output. It is difficult to determine if the resulting economic activity fits into the "new" or the "old" economy category. Advances in technology-enabled retail and online booking for tourist attractions likewise straddle this increasingly artificial divide. Northvolt, the largest new Circumpolar industrial development outside of Russia, is clearly focused on fueling the technology-based economy and is celebrated as a major northern innovation, but it is, at root, a classic manufacturing investment, drawing on the North's ready availability of minerals and hydroelectric power. The focus, clearly, should be on economic transitions rather than ill-defined notions of innovation or the "new economy." Regions and economies adapt. They are doing so in the twenty-first century and they did so previously.

Northern Sweden's economic transition continues, as it has over the long industrial history of the region. The long-standing natural resource economy remains in place and, particularly in Kiruna, continues to make major contributions to regional prosperity. Forest industry activities, mining and hydroelectric power generation remain prominent elements in terms of employment, business activity and general economic success. Major infrastructure investments are still being made in these areas, including a planned railway from Umeå to Haparanda, a rail line through northern Finland to the Arctic Ocean (connected to China's massive and controversial Belt and Road initiative), and upgrades on existing roads, electrical and Internet systems (Huang 2016; Hilmola, Henttu & Panova 2018; Weissmann & Rappe 2017).

It is well understood in Norrbotten, at the community and regional level, that the old resource-based order will not provide a secure foundation for the long-term. A concerted effort is being made to expand the tourism sector, through the inclusion of Indigenous/Sami attractions and the international promotion of winter travel and activities. The winter effort is part of a broader campaign to capitalize on the region's northern location, which includes expanding on earlier investments in space research and commercializing space-based enterprises. The creativity of the northern Sweden tourist industry is matched by the region's commitment to international outreach. Asian and European travellers have supplemented the area's long-standing appeal to southern Swedes. But Norrbotten has also made major commitments to the emerging technological economy. Luleå has emerged as an international testbed for sub-Arctic tech development, just as Kiruna's space industry endeavours to solidify a high-tech sector in the long-standing mining town. If the Skellefteå battery factory and related developments continue along its intended path, the city will compete with Luleå as northern Sweden's high-technology centre.

Economic revitalization in northern Sweden reveals the importance of a series of key elements: understanding and capitalizing on the unique and special characteristics of the sub-Arctic, embracing winter as a crucial part of the seasonal cycle, utilizing the nat-

ural endowments of the region, including hydroelectric power, repurposing and building upon existing infrastructure (most of it initially developed for the natural resource economy), engaging with and including Indigenous peoples as appropriate and possible, being alert to the monetary scale and speed of investment in the modern high technology economy, building cross-border connections (with Finland and Norway in the case of Norrbotten) to facilitate regional cooperation, being audacious and persistent with vision for community and regional transformation, and unleashing the entrepreneurial energies of regional residents, particularly those loyal to the region and determined to create employment opportunities to keep young people in the North.

Norrbotten is not the only revitalizing part of the Circumpolar world. Russia is using the decades-old Moscow-driven large-scale development model to open vast expanses of Siberia. The Government of Yukon has invested significantly, with small gains, in a Whitehorse-based innovation economy; developments in the Northwest Territories and Nunavut are embryonic, focused on the activities of a handful of north-focused entrepreneurs and a continuing reliance on mining. Alaska is doubling down on a now-wounded energy-based economy and several major mines but has made improvements to regional infrastructure. The vast and resource-rich provincial North in Canada has not yet made substantial Norrbotten-type transformations and, like Alaska, still counts on the renewal of the resource economy to maintain prosperity and opportunity in the region. Northern Norway retains a high level of well-being, tied to continued income from the Arctic oil and gas sector (Godzimirski 2014; Ihlen 2009; Listhaug 2005) and sustained government investments. Tromsø's economic development relies heavily on the University of Tromsø, the Arctic University of Norway; the most successful achievements rest with "blue innovation" and the enhancement of Norway's ocean-focused economy.

Northern Sweden's economic well-being is not assured, and, with current economic and political uncertainties, it is not possible to provide accurate forecasts on downstream developments. Northern communities have stepped forward in creative and, to date, successful ways that build on existing strengths and exploit new opportunities. The most compelling message, one that is largely obscured to southern observers and politicians, is that the North needed not be confined to the traditional and limited sub-Arctic economy. In northern Sweden, as elsewhere, the key lies in communities and regional leaders who believe strongly in the region and are committed to developing its long-term potential. Should the current approaches to northern Sweden's development hold in the decades ahead, the region has the potential to be the leader of the Circumpolar world's innovation efforts and a model for community-driven adaptations to twenty-first century realities.

Northern Sweden is not alone in making impressive adaptations to an evolving global economy. Oulu and Rovaniemi in Finland, Tromsø, Bodø and Hammerfest in Norway, and Reykjavík, Iceland, have similarly capitalized on the unpredictable mix of changing global demand, technological innovations, entrepreneurship and government stimulus. Alaska, Greenland and the Canadian North, in contrast, are strongly wedded to the traditional northern resource economy (although Whitehorse, Yukon, is making a concerted effort to promote technology-based business). Northern Sweden demonstrates the kind of adaptation, innovation, collaboration and regional commitment necessary to remain competitive in a rapidly changing and unpredictable global economy. The economic approach that evolved in Northern Sweden is more of a guide than a model for other Circumpolar and sub-Arctic regions, demonstrating the vital interplay of local governments and businesses, international investors, and global consumers. There are few, if any, re-

gions in the Circumpolar world that would not be pleased to replicate the economic performance of Luleå, Haparanda, Skellefteå, Kiruna, Arjeplog and other communities in Northern Sweden.

NOTES

[1] We made a preliminary orientation trip through the region in 2011. Ken Coates has visited Luleå, Kiruna and Umeå on numerous occasions over the past 25 years and has worked extensively with faculty members and university administrators from the region. Carin Holroyd has visited Sweden and northern Scandinavia at several times, including a regional orientation trip through much of northern Sweden in 2011.

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AUTHORS

Dr. *Ken Coates* is Canada Research Chair in Regional Innovation, Johnson-Shoyama Graduate School of Public Policy, University of Saskatchewan, Canada. His research focuses on technological and commercial innovation in the Circumpolar world and on the socio-economic challenges facing Indigenous communities.

ken.coates@usask.ca

Dr. *Carin Holroyd* is Professor of Political Studies, University of Saskatchewan. Her Arctic research has focused on Asian economic interests in the Circumpolar world. Coates and Holroyd are the editors of *The Palgrave Handbook of Circumpolar Policies and Politics* (2020).

carin.holroyd@usask.ca