INTRODUCTION

Measuring Urban Sustainability in Arctic Conditions

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Cities have taken on a new significance since the beginning of the twenty-first century, with more than half the global population now living in urban centers. Although cities make up only 3 percent of the world's landmass, the United Nations estimates that in 2018 urban populations accounted for 55 percent of the global population, with that number constantly rising (United Nations Department of Economic and Social Affairs Population Division 2019). The growth of the world's cities has led to growing concerns about urban sustainability and invigorated efforts to define and measure this concept (Science for Environment Policy 2015). Most prominently, the United Nations' seventeen Sustainable Development Goals (SDGs) adopted in 2015 includes SDG 11, "Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable," which focuses specifically on cities and communities.

Despite its remote location, the Arctic has long participated in the global urbanization trend. A majority of the Arctic population resides in urban environments; the region has seen urban growth in resource-rich areas even as the populations in other parts of the Arctic shrink (Dybbroe 2008; Heleniak 2010, 2013; Howe 2009). As Carrie Schaffner's chapter in this volume shows, expanding cities provide housing, jobs, and education for human populations (Glaeser 2011), but also impart negative effects such as pollution, encroachment on open land, and contributions to impacts on the surrounding natural environment far beyond the settlement limits (McKinney 2008). The

Arctic region is particularly sensitive since average temperatures there have risen much more quickly than the global rate over the past fifty years (Arctic Monitoring and Assessment Programme 2017). The changing climate has spurred an interest in measuring the state of the Arctic urban centers, those centers' efforts to promote sustainability, and the efficacy of such efforts. It is imperative to properly assess the extent of the challenges these cities face and the effectiveness of the policies they implement in response to the challenges in order to estimate their ability to survive into the future.

The purpose of this chapter is to introduce a method for measuring the sustainability of Arctic cities. Originally, the project team sought to develop its own Arctic Urban Sustainability Index that would best fit Arctic conditions. The effort was based on the thinking that the Arctic is sufficiently different from the rest of the globe that it deserves its own index. That task proved difficult to execute, however: The assembled multidisciplinary, multinational team had difficulty agreeing on which indicators should be included in the index and how to condense this list down to a top ten that would most effectively inform policymakers. At the same time, a review of the project by National Science Foundation (NSF) auditors suggested that the best way to move forward was simply to apply the international standard for urban sustainability developed by the International Organization for Standardization (ISO)—ISO 37120. The ISO is a nongovernmental international organization linking 164 national bodies that has published nearly 23,000 standards, covering a range of products, services, and systems.

ISO 37120, described in more detail below, is intended to apply to all cities on the planet. It seeks to be an international set of indicators designed to measure and promote sustainability while creating a uniform standard that makes it possible to compare experiences across cities. Use of this standard allows our project to test how well it applies in the extreme conditions of the Far North, and identifies areas where the standard falls short, for example in addressing issues such as remoteness and permafrost. Another benefit of working with ISO 37120 as opposed to a specific Arctic index is that it integrates our work and the Arctic cities into a global conversation in which all cities are measured by the same standard. To the extent that Arctic cities are different from other cities, comparing them across similar measures makes it possible to gauge the level of difference.

This chapter proceeds as follows: First, we define urban sustainability. Then we briefly trace the history of urban sustainability indicators. Building on this discussion, we discuss the creation of ISO 37120 and then examine how it can be applied to Arctic cities. After examining issues of data collection, we then place ISO 37120 in the context of other sets of indicators that have been drawn up to apply to Arctic circumstances. Finally, we provide a roadmap for the book. Although this volume cannot comprehensively test ISO 37120 in Arctic conditions, it provides an in-depth examination of some of the indicators in the context of a variety of case study cities.

Defining Urban Sustainability

Our definition of a sustainable city draws on the foundational statements that stress the use of resources in a way that does not impinge on the living standards of future generations (World Commission on Environment and Development 1987). Sustainability is holistic and highlights the many integrative links among its constitutive components (Dale 2012; Matson, Clark, and Andersson 2016). In the case of ISO 37120 these components range across nineteen categories, from economic vitality to wastewater management. Concerns that previous work did not take full account of the world's complexity and the level of interactions among its systems have led universities to encourage increased multidisciplinary studies from their faculty (Brown, Deletic, and Wong 2015), caused funding agencies like NSF to support research on nexus issues that exist at the interfaces of several systems (e.g., the food-energy-water nexus), and encouraged the National Academy of Sciences to study ways to promote team science (Cooke and Hilton 2015).

Sustainability indicators are collections of specific measurable characteristics of society and nature that measure the various components of social, economic, and environmental quality (Reed, Fraser, and Dougill 2006). They are distinguishable from simple environmental, economic, or social indicators by the way they are integrated and developed with input from multiple stakeholders (Maclaren 1996). Most importantly, the sustainability indicators should not give a snapshot of current conditions, as other indicators do, but instead should provide a sense of whether a city is using its resources in a manner that will allow it to continue to develop into the future.

Despite the considerable work addressing sustainable cities, there are "no mature models of urban sustainability" available today whether in the Arctic or the rest of the planet (Gardner 2016: 3). Even though ISO 37120 lays out a clear set of indicators, there is little agreement about what components are necessary for a sustainable city and the necessary relationship among these components. In fact, "a sustainable Riyadh will look and operate differently from a sustainable Reykjavik," given the entirely different contexts in which they are located (Gardner 2016: 3).

Previous attempts to develop indexes and ranking systems of all sorts have often run into trouble. According to one recent survey of the field, they are "often incoherently defined, anchored in confused and untested theories, measured idiosyncratically, and subject to manipulation by both the raters and the rated, leading to unintended, unwanted consequences" (Snyder and Cooley 2015: 179). Moreover, it is important to take into account ethical considerations in determining what is counted and who is doing the counting, thereby seeking to remember and articulate what is left out (Stone 2018). In a practical sense, indicators are typically a simple way to measure a complex situation and are most effective in starting a conversation rather than in producing a comprehensive assessment (Mair et al. 2018). Despite these clear limitations, we think it useful to set a baseline, measure progress, and identify best practices in the pursuit of urban sustainability in Arctic conditions.

Brief History of Urban Sustainability Indicators

Given the holistic and future-oriented approach that sustainability requires, how is it possible to measure sustainability in quantitative terms? The Rio Earth Summit of 1992 began to address the lack of assessment capacity by publishing Agenda 21, which included a call (in chapter 40), for the development of sustainability indicators (United Nations Conference on Environment & Development [UNCED] 1992). Since the Agenda 21 call in 1992, hundreds of indexes have appeared, ranging widely in scope and scale (Parris and Kates 2003). Twenty years later, the 2012 Rio+20 Earth Summit stressed practical measures for achieving sustainability through the building of green economies and green development pathways in developed and developing countries alike. The idea was to ensure robust economic performance in the developed and developing worlds while also taking into account environmental and social concerns.

The Conference of Parties (COP) meeting in Paris, called COP21 or the 2015 Paris Climate Conference, was even more focused on the actual implementation of policies, with each member country submitting individual plans on how to promote country-level sustainability goals. The seventeen UN SDGs, adopted in 2015 with a target of 2030 provide a comprehensive set of guideposts, addressing issues ranging from poverty to the state of the oceans. While the UN identified seventeen discrete SDGs, the enterprise stresses the interconnectedness of the goals and the need to work on them simultaneously. SDG 11 of this ambitious development plan addresses communities and cities, calling for improvements in environmental stewardship, the building of more-inclusive societies, and long-term planning to continue economic growth without adversely affecting the planet or disadvantaged peoples. SDG 11 seeks to take a more integrated approach than previous efforts by focusing on universal access to adequate, safe, and affordable housing; public transportation; participatory and integrated planning and management, especially with regard to inclusion, resource efficiency, mitigation and adaptation to climate change, and resilience to disasters; protection of cultural and natural heritage; reduction of deaths due to disasters; reduction of adverse environmental impacts from air pollution and solid waste; access to green public spaces; positive economic, social, and environmental links between urban, peri-urban, and rural areas; and the offer of support to developing countries in creating green buildings with the use of local materials to reduce environmental impact.

Creating ISO 37120

Although the SDGs are more noticeable, the ISO 37120 is the first international standard on city metrics and it is more comprehensive in its scope of analyzing urban sustainability. ISO published the first version in 2014 (ISO 2014) and a revised version in the summer of 2018. ISO 37120 is based on the broadly used Global City Indicators Facility project, which included more than 255 cities across eighty-two countries. The World Bank set up this project in 2007 and it is now housed at the University of Toronto, which hosts an on-line database seeking to make the data for the participating cities available (World Council on City Data n.d.).

ISO 37120 2014 included 115 indicators organized into twenty themes (ISO 2014). Of the 115 indicators, 31 were considered to be core, and to require reporting from all participating cities. The other indicators were considered to be supplementary, and to require reporting when available. The core indicators each fulfill the following conditions: They are reportable annually, comparable, relevant to public policymaking, cost effective to collect, understandable, and not overly complex. The revised 2018 version of the ISO 37120 included

Table 0.1. | *ISO 37120 core, supporting, and profile indicators*

Theme	Core indicators	Supporting indicators	Profile indicators
Economy	1	7	3
Education	4	2	0
Energy	5	2	2
Environment and climate change	3	6	0
Finance	2	2	2
Governance	1	3	0
Health	4	2	0
Housing	2	2	6
Population and Social Conditions	1	2	6
Recreation	0	2	0
Safety	5	5	0
Solid Waste	5	5	0
Sport and Culture	1	2	0
Telecommunications	0	2	0
Transportation	2	5	2
Urban/Local Agriculture and Food Security	1	3	0
Urban Planning	1	3	3
Waste water	3	1	0
Water	4	3	0
Total	*45*	*59*	*24*

128 indicators of which 45 were core indicators, for nineteen domains of sustainability—economy; education; energy; environment and climate change; finance; governance; health; housing; population and social conditions; recreation; safety; solid waste; sport and culture; telecommunication; transportation; urban/local agriculture and food security; urban planning; wastewater; and water (ISO 2018). Table 0.1 summarizes the key components of the standard. In addition to the forty-five core indicators, there are fifty-nine supporting indicators and twenty-four profile indicators. The ISO requires cities to collect data on the core indicators to participate in the measurement process, recommends collecting the supporting indicators, and suggests collecting the profile indicators as background information. The number of core indicators ranges from zero to five for the nineteen topics.

Applying ISO 37120 to Arctic Cities

As noted in the preface, we have not been able to collect all the data required to fully measure the approximately fifty Arctic cities described in chapter 1 that make up the heart of this project. Instead, the chapters in this book seek to test out a few of the indicators on a variety of case study cities.

By applying ISO 37120 to some of the most extreme situations on the planet we can stress test the list of indicators included in it and determine whether these indicators are in fact the best available for measuring urban sustainability and if they make sense in Arctic conditions. If they do not give us good data about the Arctic cities, perhaps the standard is not effective for other cities either. Our conclusions on the application of ISO 37120 to Arctic cities will generate new voices in the broader international conversation about how best to measure urban sustainability. Of course, it might eventually turn out that cities are not all alike, so that some components of the ISO index are more universal than others (Smith 2019). Beyond the Arctic/non-Arctic distinction, there may be strong differences between developed and less-developed cities, tropical and temperate cities, and coastal and inland cities. Our findings will fit into the broader context of this discussion.

Naturally, we do not plan to accept ISO 37120 uncritically and many of the chapters in this book provide extensions to the ISO. This introductory chapter provides a brief introduction to ISO 37120, and the book's Conclusion ties together the numerous themes raised by each of the specific chapters. The chapters in this book examine how well a select group of indicators work for a variety of case study cities.

Data Collection

A central concern in measuring the indicators is data collection. The authors of ISO 37120 specifically sought to define core variables that are reportable annually, comparable, relevant to public policymaking, cost effective to collect, understandable, and not overly complex. Currently, there are no widely accepted standards among city governments identifying which data they should collect. City governments around the world gather different data; even when data is collected on similar topics, such as housing, the numbers often are not comparable across countries. The Arctic region spans eight countries whose cities have different methods and schedules for collecting information on their economies, societies, and environments. The diversity, both within cities and across the circumpolar north, is extenuated by the variability in social, political, and economic systems within the Arctic.

Even when the data is available, questions remain about what it is actually telling us. For example, if we have a number measuring a specific aspect of sustainability for a city, does that number tell us about the entire city? In other words, will an indicator hold true across the entire urban area, or is it specific to a single neighborhood or to several subregions within the city? In theory, an indicator must be able to represent an entire urban area, but cities are inherently patchy and diverse (Grove et al. 2015). The result is that, even when we have a number for a city, it might not tell us much about the level of variety across the city in the dimension it is measuring.

Europe boasts the most urban sustainability indicators of any region in the world, and these indexes often focus on different aspects of sustainability. The richness of these indexes results largely from the resources of the Eurostat data collection agency. This institution provides standardized data collection methods, taking in the same measures across many countries. This centralized data center has made it easy to design and test the functionality of many different indexes, and provides historical data with which to validate the accuracy of measures. Unfortunately, Arctic cities do not have a similar system in place that is well developed enough to serve our purposes. The Arctic Council publishes papers using this type of internationally standardized data, but it does not always publish the data that the research was based on. On 28 March 2016 NSF created the Arctic Data Center (http://arcticdata.io/), and we hope eventually to publish the data generated by this project there.

Existing Arctic Indicators

Before diving into our analysis of urban sustainability in Arctic cities using ISO 37120, we here briefly describe previous efforts to measure the sustainability of Arctic cities. To date, Arctic researchers have started developing indicators, but they have not yet focused specifically on urban sustainability. Arctic indicators first emphasized social and environmental concerns and were associated with the need of Arctic communities and policymakers to resolve the complex problems associated with climate change. But the process of developing useful indicators is still in early stages of development. A recent survey of Arctic sustainability research called for sustainability indicators that better link social and ecological processes (Petrov et al. 2015: 9). Additionally, there is a need for greater knowledge about urban areas in the Arctic since the existing "sustainability literature pays negligible attention to urban areas and urban-rural relationships" (Petrov et al. 2015: 11). A key task for the proposed Agenda 2025 is the design of sustainability indicators and monitoring systems (Petrov et al. 2015).

One of the most prominent efforts to develop a set of indicators for the Far North so far has been the Arctic Social Indicators (ASI) project. This effort began in 2006 in response to the publication of the *Arctic Human Development Report,* the first social sciences/humanities report commissioned by the Arctic Council. That report declared, "The SDWG [Sustainable Development Working Group] should organize a workshop to devise a small number of indicators to be used in monitoring or tracking changes in human development in the Arctic over time" (Einarsson et al. 2004: 11). As a result, for the first time Arctic scholars sought systematic ways to measure "social, economic and cultural trajectories of change" (J. Larsen, Schweitzer, and Petrov 2014). They were particularly concerned that life in the Arctic was different from life elsewhere, and therefore sought to add new categories to existing indexes such as the United Nations Human Development Index, including fate control (see chapter 6 of this volume), cultural integrity, and contact with nature (Einarsson et al. 2004: 11). The first Arctic Social Indicators report, published in 2010, included six general domains to measure:

1. Health and Population
2. Material Well-Being
3. Education
4. Cultural Well-Being
5. Contact with Nature
6. Fate Control

The report went on to develop seven indicators within these six domains:

1. Infant Mortality (Domain: Health/Population)
2. Net-migration (Domains: Health and Population; Material Well-Being)
3. Consumption/harvest of local foods (Domains: Contact with Nature; Material Well-being)
4. Per capita household income (Domain: Material Well-being)
5. Ratio of students successfully completing postsecondary education (Domain: Education)
6. Language retention (Domain: Cultural Well-Being)
7. Fate Control Index (Domain: Fate Control)

(J. N. Larsen, Schweitzer, and Fondahl 2010: 153–54)

Criteria for including these particular indicators included "data availability, data affordability, ease of measurement, robustness, scalability and inclusiveness" (J. Larsen et al. 2014: 33).

On the basis of the Arctic Social Indicators, the team commissioned a series of case studies to test the usefulness of the indicators. As the final report, published in 2014, points out, the indicators were focused on Indigenous peoples living in the Arctic and have less to tell us about non-Indigenous people living there. "Although ASI-I insists that the ASI framework must apply to both Indigenous and non-Indigenous Arctic residents, the nature of the data and indicators themselves in the Cultural Vitality, Contact with Nature, and Fate Control domains allow measuring wellbeing of Indigenous people and often precludes us from considering other groups. This is a major limitation in many case studies presented in the current report" (J. Larsen et al. 2014: 46).

Another limitation was that "significant data challenges and incompatible units of measurement across national and administrative borders prohibit the application of ASI indicators to all regions of the Arctic" (J. Larsen et al. 2014: 47). In particular,

> Our original ambition had been to produce extensive sets of comparable data featuring ASI indicators for each of the six ASI domains. However, this task soon proved impossible given the current state of data quality and lack of data availability both at the panarctic level and at different geographical scales. It became clear that we had to limit our analysis to selected regions and, furthermore, that our set of indicators could not be compared between regions in any meaningful way given existing differences in data protocols in addition to other data issues. Furthermore, all five regional case studies required our teams to deviate to varying degrees from the technical definitions of individual ASI indicators. It was necessary to make adjustments to tailor the analysis to meet the regional availability of data and, hence, to settle for the best possible proxies or in some cases substitute with secondbest alternative indicators—though without compromising the validity of the analysis. (J. Larsen et al. 2014: 278)

Overall, the Russian case study, which focused on the region of Sakha (Yakutia), proved to the be the least-data-rich region. In this region, as in others, one could often pick the indicator that best told the story one wanted to tell about the region. For example, if you wanted to highlight a positive trend, you could emphasize that infant mortality rates were falling, but if you took a more pessimistic view, you could stress that suicide rates increased after the collapse of the

Soviet Union. Governments are also likely to try to manipulate indicators in an effort to convince domestic and international audiences that they are performing well (Cooley 2015: 5; Libman and Obydenkova 2016; Zaloznaya and Hagan 2012). Such findings point toward the need to collect several indicators for each domain to develop a complete and nuanced picture of the situation.

Another set of indicators came from Andrey Petrov's project on the Inuvialuit, a group of Indigenous people in the Arctic, as part of the Canadian project called Resources and Sustainable Development in the Arctic. This dataset includes information on population, education, culture, the labor force, well-being, income, government, and housing.

Roadmap for the Book

This book is divided into four parts. Part I introduces what we mean by urban sustainability and how to measure it. The Introduction describes ISO 37120 as the tool we will use to measure sustainability and chapter 1 lays out what we mean by Arctic cities. Part II includes chapters that test out various urban sustainability indicators in Arctic conditions to see how well they work. Part III discusses a variety of dimensions that are missing from the current international standard and suggests ways to provide a more comprehensive understanding of urban sustainability in Arctic conditions. Finally, the Conclusion pulls together the various strands of what we have learned and provides a comprehensive analysis of what an Arctic Urban Sustainability Index might look like, showing where ISO 37120 succeeds and where it falls short. The discussion below briefly lays out the arguments from each of the chapters.

Part I: Urban Sustainability in the Arctic

Chapter 1. "Arctic Cities," by Carrie Schaffner, George Washington University

This chapter explains how we define Arctic cities and lists the nearly fifty cities that meet our criteria. The chapter then explains how Arctic cities are different from other cities in the rest of the world. Most notably, their environment limits access, makes energy expensive, requires intensive attention to infrastructure, reduces the availability of labor, mandates reliance on vulnerable food supply chains, and threatens the maintenance of a strong community culture. Key drivers for development in the Arctic are the development of indigenous societies, resource extraction, and protecting national security. Finally, the chapter explains that, despite the harsh conditions, people remain in the Arctic, among other reasons in order to develop their place-based capital and benefit from subsidies. This overview of Arctic cities provides the context in which we proceed to test out some of the ISO indicators in various case study cities.

Part II: Testing Indicators of Arctic Urban Sustainability

Chapter 2. "Shrinking Cities, Growing Cities: A Comparative Analysis of Vorkuta and Salekhard," by Nadezhda Zamyatina, Moscow State University; and Luis Suter, Nikolay Shiklomanov, and Dmitry Streletskiy, George Washington University

The authors apply several of the ISO indicators to two Russian cities: Vorkuta, a declining coal-producing city, and Salekhard, a booming natural gas regional capital. Vorkuta reached the peak of its productivity in the 1950s and 1960s and has been shrinking along with Russia's coal industry ever since. Salekhard is now developing as global demand for natural gas grows. This case study of two cities helps refine our understanding of how ISO 37120 works in Arctic conditions by focusing attention on the determinative indicators of transportation links to southern cities and diversification of the economy into export-oriented resource extraction, provision of administrative services, and locally oriented economic development. The chapter also stresses urban design and attachment to place. The authors argue that the ISO set of indicators would better apply to the Arctic by taking into account the remoteness and inaccessibility of Arctic cities, their frequent reliance on a single factory, the way the cities are laid out, and the emotional links people feel toward their cities due to the social capital they have developed over time.

Chapter 3. "Norilsk: Measuring Sustainability in Population Size and Well-Being," by Marlene Laruelle, George Washington University

As the largest city built on permafrost, one of the most polluted in the world, and a destination for a range of diverse emigrants, Norilsk puts a heavy burden on its social network. This chapter examines a wide range of ISO indicators in the context of Norilsk. It finds that the index provides a useful overview of the state of the city. However, the indicators fall short because they do not measure the effort stakeholders make in trying to improve their sustainability performance, the emotional attachments based on a sense of place, the social fabric of the city and its residents, the remoteness of the city locations and transportation accessibility, and the cost of goods in the city in relation to local salaries. Additionally, the ISO measures do not provide an overall sense of the dynamics in the city.

Chapter 4. "Yakutsk: Culture for Sustainability," by Vera Kuklina with Natalia Shishigina, V. B. Sochava Institute of Geography of Siberian Branch of Russian Academy of Sciences

This chapter applies the culture components of ISO 37120 to Yakutsk. The chapter develops four indicators for culture: cultural institutions, cultural diversity, cultural economy, and contact with nature. The analysis shows how each of these elements functions in the city context. Counting cultural institutions is an easy way to compare cities, but the numbers hide much of the richness of cultural life in Yakutsk. The cultural diversity section addresses the questions of ethnic and rural identities, linguistic and religious landscapes, and institutions in the urban context. Cultural economy includes economic activities that use culture as a resource. Finally, contact with nature examines how Indigenous peoples bring their practices into the city. Ultimately, the chapter shows that the quantitative indicators can be useful in providing an introduction to the city and in launching a discussion of culture, but that qualitative studies must complement the indicators to provide a more comprehensive understanding of how culture can contribute to sustainability.

Chapter 5. "Assessing Energy Security in Nome and Lavrentiya: How Breaking Down Energy and Governance Silos Makes a Difference," by Katherine Weingartner, George Washington University; and Evgenii Antonov and Alexey Maslakov, Moscow State University

This chapter examines how two small, geographically similar cities near the Bering Sea, one in the United States and one in Russia, ensure their energy security by investigating the ISO 37120 parameters for energy and governance. The primary focus is on how the different governance structures of the two cities impact energy resilience. Both city structures are remote from higher-standing regional and federal governments, but Nome has more autonomy than Lavrentiya in devising local solutions. The chapter concludes ISO 37120 would be more effective in addressing energy governance issues if it included a way to measure the availability of financing for renewable energy projects at the municipal level.

Part III. Extending the International Standard for Measuring Urban Sustainability

Chapter 6. "Fate Control and Sustainability in Arctic Cities: Recasting Fate Control Indicators for Arctic Urban Communities," by Andrey N. Petrov, University of Northern Iowa

This chapter examines in detail the concept of fate control, defined here as the ability to guide one's own destiny by making choices and transforming those choices into actions and outcomes. The chapter develops a method to measure each city's capacity to make choices and the resources it has to implement them. The chapter contributes to the theoretical dimension of the discussion by extending the international standard for measuring urban sustainability by adding a measure of the ability of communities and individuals to govern themselves. Petrov applies the Fate Control Index to twelve Arctic cities, demonstrating what this tool can tell us and illuminating the road forward for future applications.

Chapter 7. "What Do ISO Indicators Tell Us About Corporate Social Responsibility and Sustainability in Cities of the Yamal-Nenets Autonomous Okrug, Russia?," by Stephanie Hitztaler and Veli-Pekka Tynkkynen, University of Helsinki

This chapter uses several ISO 37120 indicators to measure the contribution of corporate social responsibility to the cities of the natural-gas-producing Yamal-Nenets Autonomous Okrug. Some of the indicators show the benefits of such programs, especially in the area of building new sports facilities. But despite this improvement in the sustainability ranking as measured by this indicator, the ongoing fossil fuel extraction and Gazprom's overall impact on the area reduce the city's sustainability. In this sense, ISO indicators can be cherry picked in ways that are deceptive in terms of a corporation's overall impact on urban sustainability.

Chapter 8. "Planning for Sustainability: The Russian Case," by Alexander Sergunin, Saint Petersburg State University

Sergunin's chapter points out that ISO 37120 does not pay sufficient attention to the planning process. He provides an overview of how the urban planning process works in the comparative context of several Russia Arctic cities—Arkhangelsk, Murmansk, Monchegorsk, Nickel, Norilsk, Salekhard, Severodvinsk, and Vorkuta. He examines how these cities implement the concept of sustainable development; which governmental and societal institutions are involved and the degree to which they are open to public input; which aspects—economic, environmental, or social—are prioritized; and whether the policies are short-term efforts or are conducive to the sustainable socioeconomic and environmental development of the northern urban areas that actually improves the human condition. The analysis finds that the planning offices are typically understaffed and lack the resources for the comprehensive work to which they aspire, not all the plans emphasize the role of civil society input, the level of concern about environmental issues varies with the level of pollution in the cities, and despite some clear successes, there is a long way to go toward increasing transparency and involving public participation in the overall process.

Chapter 9. "Transport Connectivity and Adapting to Climate Change in the Russian Arctic: The Case of Sakha Republic (Yakutia)," by Aleksandra Durova, Massachusetts Institute of Technology

ISO 37120 does not pay much attention to connectivity between cities, a key problem in the Arctic. Durova's chapter addresses this issue in detail. Existing transport connectivity gaps in combination with climate change impacts make communities vulnerable to connectivity disruption risks. The livelihoods of communities in this context are largely affected by government policies in the Arctic and adaptation actions in the transport sector across various scales. This chapter examines the nature of adaptation actions in the transport sector of the Sakha Republic (Yakutia). Findings of the study demonstrate that adaptation planning remains in its infancy. When adopted, adaptation measures are shaped by a combination of stressors, including safety and emergency risks, as well as efforts to make money from climate change rather than simply addressing its deleterious impacts. Adaptation actions responding to urgent needs may reduce sensitivity and exposure to climate change risks, but do not address the root causes of vulnerabilities. Adaptations driven by potential opportunities can increase resilience of the transport system, but also both run the risk of becoming dysfunctional and increase the potential of negative implications in the long term.

Chapter 10. "Sustaining Sustainability in Whitehorse, Yukon, Canada," by James Powell, University of Alaska Southeast

Sustainability planning has little value unless the strategies prepared are actually implemented. ISO 37120 pays little attention to this issue. Whitehorse is a leader in implementation, drawing on funds from Canada's national gas tax. Key to successful plan implementation is identifying priority indicators and issuing regular reports to determine to what degree they were actually implemented. The Whitehorse program's key components include a strategic sustainability plan initiated by citizens and the city government and institutionalized with a joint Planning and Sustainability Services Office, a comprehensive list of sustainability indicators that reach across all programs, and a website for sustainability with dashboards for each indicator. Whitehorse's ability to meet many of its benchmarks makes it a good model for other Arctic cities.

Conclusion. "Next Steps for Arctic Urban Sustainability," by Robert W. Orttung, George Washington University

The conclusion ties together the major findings of the case study analyses and links them back to the theoretical introductory chapter. It then lays out the directions for future research. A key shortcoming of ISO 37120 is that it lacks a theory of sustainability that defines the drivers of sustainability. Other shortcomings include a lack of forward-looking dynamics and a failure to explain how the various components of sustainability work together. The standard does not always make sense in Arctic contexts because it does not take into account permafrost, the isolation of many northern cities, the lack of economic diversity, and the importance of Indigenous cultures. Future research will develop a comprehensive dataset that brings together measures for the 128 indicators across the nearly fifty cities with populations over twelve thousand people.

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