A global transition from primarily carbon-based economies toward much heavier reliance on alternative forms of energy is underway as a necessary step to reduce greenhouse gas emissions and curb the most-adverse effects of climate change. Sharply increasing availability of solar, wind, and other forms of renewable or green energy demands consistent access to more raw and processed minerals.\(^1\) Not only is overall global demand for these critical minerals increasing; the mining, processing, and logistics required to bring them to market are unevenly distributed globally.\(^2\) Furthermore, such minerals are not only in high demand to support the energy transition; they also have numerous uses in computing and in national and homeland security.

Some countries that dominate various critical minerals markets, such as the People’s Republic of China and the Russian Federation, have strained or severely diminished diplomatic relationships with the United States and its allies.
and partners. These countries have also demonstrated willingness to leverage their supply chain dominance via economic coercion, which creates implications for national security. Others, such as the Democratic Republic of the Congo, have experienced long-standing political instability, and yet others endure extreme flooding and other climate and weather hazards that can threaten operations. Diversification of the critical minerals supply chains is therefore needed to better maintain continuity of supplies as needs arise.

The United States’ growing need for critical minerals and its considerable reliance on a global supply chain of varying reliability is raising questions about whether, why, how, and when to grow domestic capacity. Analysts from RAND and the Woodrow Wilson Center have conducted extensive research on the topic of critical minerals and motivated organization of an event and subsequent tabletop exercise (TTX) to gather input from domestic stakeholders. One among many complementary options is to look north to Alaska and partner Arctic countries (from Alaska eastward, Canada, Greenland, Iceland, Norway, Sweden, and Finland), as well as developing Arctic and northern infrastructure, industry, and transportation routes.

The Arctic region is rich in resources and could further develop minerals deposits to help meet increased global demand for critical minerals. Yet there are numerous factors to take into consideration to make such propositions successes for varied stakeholders and rights-holders. Existing and future minerals supply chains in Alaska heavily or entirely intersect with Alaska Native land and waters. Considerable up-front investment would be needed to develop new or expand existing infrastructure, but financing options and regulatory processes might not align smoothly with this objective. Public engagement, workforce development, environmental protection, and consequence management are not generally strongly positioned to help manage critical minerals development in the north.

Here, we take a deeper look into issues related to possible future critical minerals development in Alaska through the findings from a TTX cohosted by RAND, the Wilson Center, the University of Alaska, and the U.S. Department of Energy on July 12 and 13, 2023, at the Wilson Center’s offices in Washington, D.C. This paper summarizes the TTX and reports out key findings for policymakers and other stakeholders and rights-holders.

The Arctic—Including Alaska—Could Become an Even More Important Critical Minerals Region

Numerous reports throughout the U.S. government have pinpointed critical minerals as susceptible to disruption and that the United States “must secure reliable and sustainable supplies of critical minerals and metals to ensure resilience across U.S. manufacturing and defense needs, and do so in a manner consistent with America’s labor, environmental, equity and other values.” Domestic sourcing of materials and manufacturing capacity has been the focus of recent U.S. legislation, such as the CHIPS Act of 2022 and the Inflation Reduction Act.

Critical minerals are the focus of numerous supply chain efforts across U.S. agencies and international partners. As a result, these efforts aim to diversify—and
make more resilient—minerals supply chains important to the defense industrial base and broader U.S. economy. They include direct investments, loan guarantees, diplomatic engagement, and tax incentives. To date, these efforts have focused on developing domestic sources of supply (i.e., developing mines and processing projects to increase capability and capacity), such as the use of the Defense Production Act Title III. Efforts to develop supply chains outside the United States are reflected in statutes embedded in the Inflation Reduction Act, which include incentives for automakers to source critical minerals from countries with which the United States has free trade agreements in place. Efforts in the European Union, such as the Critical Raw Materials Act, reflect similar concerns from trading partners also reliant on China for access to critical minerals.

The Arctic region is rich with resources, and, for that reason, Alaska has been one subject of U.S. inquiry for domestic sourcing of critical minerals. USGS maintains information on minerals commodities being produced. Alaska is already a major producer of zinc and has a strong industrial base for lead, silver, sand and gravel, and gemstone production. Table 1 lists more of the minerals present in Alaska (and, in some cases, elsewhere in the Arctic), alongside major applications. Although critical minerals are key for developing renewable energy and associated energy storage systems, there are also several other applications for these important minerals, which further exacerbates demand. Furthermore, in many cases, more geological exploration and study are needed to determine the full variety and extent of minerals in Alaska and elsewhere in the Arctic. For this reason, it is difficult to confirm in the early 2020s whether sufficient amounts of the right types are present to fulfill the diverse array of needs the United States has for these minerals.

Currently, relatively few mines and even fewer processing and refining facilities operate across the Arctic

<table>
<thead>
<tr>
<th>Critical Minerals Resource</th>
<th>Exemplar Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>Lumber preservatives, pesticides, and semiconductors</td>
</tr>
<tr>
<td>Antimony</td>
<td>Flame-proofing compounds, alloys, and batteries</td>
</tr>
<tr>
<td>Bismuth</td>
<td>Medical and atomic research</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Rechargeable batteries and superalloys</td>
</tr>
<tr>
<td>Graphite</td>
<td>Lubricants, batteries, and fuel cells</td>
</tr>
<tr>
<td>Indium</td>
<td>LCD screens</td>
</tr>
<tr>
<td>Platinum-group metals(^a)</td>
<td>Catalytic agents</td>
</tr>
<tr>
<td>Rare earth elements(^b)</td>
<td>Magnets and catalysts</td>
</tr>
<tr>
<td>Tantalum</td>
<td>Electronic components, mostly capacitors</td>
</tr>
<tr>
<td>Tellurium</td>
<td>Steelmaking and solar cells</td>
</tr>
<tr>
<td>Tin</td>
<td>Protective coatings and alloys for steel</td>
</tr>
<tr>
<td>Tungsten</td>
<td>Wear-resistant metals</td>
</tr>
</tbody>
</table>


NOTE: LCD = liquid-crystal display. The degree of accuracy of the resource estimates for each of these minerals varies; given the variability in baseline knowledge and how estimates are calculated, we have elected to leave estimates out of this table.

\(^a\) Platinum-group metals consist of the following minerals commodities: iridium, osmium, palladium, platinum, rhodium, and ruthenium.

\(^b\) Rare earth elements consist of scandium, yttrium, and the lanthanides.
Securing a resilient future for the United States and its northern communities and combating rising global temperatures mean making necessary changes to how energy is produced and used.

region, given challenges that are often amplified there versus elsewhere. Relatively high costs of building the necessary infrastructure to support mining operations and other factors (e.g., the cost of existing logistics, the need for a skilled workforce, concerns about impacts on Alaska Natives and other local communities and ecosystems) have delayed the development of mining projects.

Still, interest is growing in exploring the development of more Arctic resources as global demand for critical minerals rises and as geopolitical and economic pressures necessitate the need for the United States to secure more-robust domestic supplies. Importantly, there is some variability in the reliability of minerals resource estimates, so more geological work and related research need to be undertaken to understand more fully the degree to which Alaska’s minerals could satisfy domestic needs. Stakeholders and rights-holders need to identify requirements for developing Alaska’s critical minerals while offering desirable opportunities to Alaska Natives and other communities and mitigating several potential problems. To do so, they will need to consider a variety of issues, but more clarity on these requirements is needed.

Securing a resilient future for the United States and its northern communities and combating rising global temperatures mean making necessary changes to how energy is produced and used. Critical minerals are exactly that—critical—to every aspect of this important transition. For this reason, the United States relies on critical minerals for its future resilience and security. Securing this future will necessitate wise decisionmaking about where and how the United States shores up its supply chains for these key resources. Alaska and the Arctic offer great promise in this regard if critical minerals can be developed in equitable, environmentally conscious, and financially sound ways.

A TTX is one structured means of gathering information from stakeholders with different experiences and perspectives. In this case, we elected to use a future
scenario–based TTX to encourage discussion in a way that invited participants to leverage their existing areas of expertise while thinking broadly and into the future. The object of the TTX was to identify some priorities for enabling participant-defined desired outcomes and avoiding or mitigating risks associated with critical minerals development in Alaska. The TTX was conducted on July 12, 2023, at the Wilson Center’s Critical Minerals in the Arctic workshop.

The structure of this TTX leveraged ideas from the 360° analytical game style. A 360° analytical game assembles a variety of stakeholders and experts to interactively investigate an issue from different perspectives and approaches. Additionally, we used a future scenario–based approach to set the starting point for the game in 2040 and encouraged discussions to focus on identifying intervention options between the early 2020s and this future.

The scope of TTX discussions included five key focal areas to reflect the themes of the event:

- local community impacts and opportunities
- infrastructure
- finance
- regulatory environment
- supply chains.

Participants were divided into six groups, one for each focal area plus a second group focused on supply chains; a strong contingent of participants had subject-matter expertise in supply chains, and it was deemed to be a particularly broad-ranging topic. Participants represented government organizations, industry, local communities, academia, and think tanks. Participants numbered close to 45 in total, with approximately seven to eight per group, and were dispersed among the groups based on primary area of expertise.

Figure 1 summarizes the different facets of the TTX. The first part of the TTX presented participants with one of two futures in which critical minerals mining projects had been developed in Alaska. The future scenarios were presented in the format of a July 2040 Alaskan newspaper and included social, environmental, international, and political stories related—directly or indirectly—to critical minerals operations and factors that drive critical minerals supply and demand.

Both future scenarios portrayed the assumption of expanded critical minerals production in Alaska. One, however, detailed Alaska as a leading provider of criti-
cal minerals globally. The other imagined Alaska as a supporting supplier of critical minerals, where some resource development has occurred but not enough to make Alaska a central player in global supply chains. These future scenarios did not cover every possible outcome and were constructed as a means of starting participant discussions, rather than constraining them. The research team decided to not look at futures in which Alaska minerals extraction did not expand, or even declined, because the purpose of the TTX was to assess needs to achieve hypothetical futures in which development of critical minerals would be an option. Table 2 summarizes the headlines and group assignments for each future scenario’s newspaper. The mock newspapers are reproduced in Appendix A.

TABLE 2
Details of Two Future Scenarios Utilized for the Tabletop Exercise

<table>
<thead>
<tr>
<th>Future</th>
<th>Title</th>
<th>Groups</th>
<th>Headlines</th>
</tr>
</thead>
</table>
| 1      | Alaska as a major global producer | Communities, Financing, Supply chain | - Alaska’s population continues to increase  
- U.S. creates critical mineral stockpile thanks to Alaska  
- AI detects recontamination of Alaskan rivers  
- New projections confirm climate warming slowdown by 2060  
- Alaska still leads world in mineral research  
- Native communities losing representation  
- Suspected Russian unmanned sea vehicle found in Alaskan waters  
- New innovations in electric vehicle technology |
| 2      | Alaska as a supporting supplier | Infrastructure, Regulatory environment, Supply chain | - Infrastructure crumbling in central Alaska  
- USGS in Alaska continues to discover new mineral reserves  
- Endangered species coming back to Alaska  
- East coast states dominate U.S. economy  
- China launches autonomous supply vehicle to fishing fleets  
- China maintains dominance in critical mineral exports  
- Climate migration could come to Alaska  
- New shipping routes open in the Arctic |

NOTE: AI = artificial intelligence.
After each participant shared one or two ideas around the table, facilitators encouraged participants to seek consensus around two investments or interventions participants determined to be most important and five they determined to be additional, supporting investments or interventions.

even seem inconsistent with the overarching futures being envisioned. Participants were encouraged to voice any issues with the future scenarios, but the research team observed mostly that the future scenarios served their intended purpose, which was to initiate discussion and periodically serve as an anchor to ensure that there was some variability in conversations about the alternative futures.

After they read over the newspapers, participants were given two exercises to help think about risks and opportunities for their particular 2040 future:

- a Mad Libs–style worksheet, for which participants filled in some blanks to reflect what outcomes would be represented in the future (good and bad)
- a strength, weakness, opportunity, and threat analysis, in which participants elaborated on positive strengths and opportunities and negative weaknesses and threats for that future.

After doing each exercise individually, participants discussed their work as a group. Facilitators encouraged discussion on topics related to each group’s particular focus, but participants were not constrained to only these topics.

Participants then considered broadly defined interventions or investments (e.g., policies, physical infrastructure, education campaigns) that could be enacted between the early 2020s and 2040 to realize positive opportunities and discourage or mitigate against risks that had been identified. First, participants developed their own lists of ideas. After each participant shared one or two ideas around the table, facilitators encouraged participants to seek consensus around two investments or interventions participants determined to be most important and five they determined to be additional, supporting investments or interventions. After each breakout group then presented its final results in a ple-
nary session, which were recorded on a worksheet. The worksheets are reproduced in Appendix B.

Findings Suggest That Community Empowerment, Workforce, Infrastructure, and Finance Should be Prioritized

Using the future scenarios as a discussion starting point, participants identified optimistic outcomes and risks to avoid. Priority policy areas for further development reflected measures that might encourage positive change and avoid or mitigate the most-concerning problems that might occur as a result of or in concert with critical minerals development in Alaska.

Several Important Opportunities Were Identified

Across the board, participants found somewhat consistent aspects about which to be optimistic in their respective futures, as illustrated in the word clouds in Figures 2 and 3. Regardless of whether Alaska was portrayed in a leading or supporting role, there was much discussion about how global needs for critical minerals could lead to investments in Alaska’s future related to livelihoods and infrastructure that could then, in turn, promote community growth and stability. Participants repeatedly mentioned that Alaska could face an opportunity to become a national and perhaps global leader in developing the skilled workforce needed. This could be a draw for students to come to Alaska to learn and could become a way of both importing and growing the workforce and talent needed and exporting expertise, which could add to the prestige of the education provided.

The other major theme across group discussions was the hope that technology would bring:

- possibilities for critical minerals research (including the use of space for this purpose)
With the need for energy to provide power for extraction and processing and perhaps even recycling and with the remoteness of locations and lack of connecting infrastructure posing a significant challenge, participants also noted that these sites could become test sites or proving grounds for a myriad of alternative energy options. This was mentioned as an opportunity for the alternative energy industry to look to determine feasibility and cost-effectiveness of everything from space-based solar power to small, modular nuclear reactors.

**Risks and Uncertainties Emerged as Key Policy Issues**

The workshop also supported robust discussions on areas of risk and uncertainty, as illustrated in the word clouds in Figures 4 and 5. The most-common issues identified in future 1, in which Alaska is key in global critical minerals supply chains, centered on the potential for boom-and-bust cycles driven by market durability for commodity pricing at a global scale. Participants were especially concerned about possible effects on Alaska Native and other local communities and on the environment. In particular, participants raised many concerns about the potential for lack of tangible benefit (financially or from building new infrastructure) for communities and the dearth of available mitigations for environmental risks. An area for future interrogation could also be to examine the role that critical minerals might play in the stability of Alaska’s public financing.

Participants reiterated how crucial the required reinvestment into Alaskan communities was for general edu-
cation, trade skills, and stable employment in order to avoid having a workforce that is cyclical and temporary. Additionally, participants balanced their concerns about the present permitting process being too restrictive for this future to be feasible with concerns that even the most stringent of processes had not been able to mitigate the environmental risks and damage from previous minerals extraction efforts.

In contrast, future 2, in which Alaska plays a supporting role in global critical minerals supplies, sparked geopolitical discussions about China’s and Russia’s potential to continue or grow their prominence in many critical minerals commodity markets. This future scenario also spurred substantial discussions about climate change, the centrality of critical minerals for a global energy transition, and needs for resilient infrastructure. Additionally, it raised the concern that, if the invest-
ments in communities, capabilities, and infrastructure had not been made to make Alaska a leader in critical minerals markets, the state and the United States would struggle to play even a supporting role because of the lack of investment in future generations.

Participants also discussed the feasibility or likelihood of going from exploring to full mining extraction. Discussion focused on several examples of locations that had initially seemed promising but were never realized as mines, whether because of the lack of infrastructure to support mining operations and transport extracted material; the lack of local interest in having a mine nearby that could negatively affect a community’s water, wildlife, or land; or even the dearth of actual minerals that early prospecting anticipated to be present.

Developing Critical Minerals Requires a Road Map That Incorporates Several Types of Investments in Coming Decades

Groups touched on many similar issues, each through its respective lens. This lends evidence to the idea that some needed cornerstone investments could facilitate opportunities and mitigate risks as viewed in many stakeholder communities. That is, stakeholders do not necessarily see eye to eye on what the opportunities and risks are, but they might be able to agree on some common issues that need to be addressed. Participant discussions during the solution-identification and prioritization exercises included the following:

- Develop more geological and environmental knowledge to broaden what is known about Alaska minerals deposits and different extractive approaches and their respective environmental and social impacts.
- Meet local community needs for
  - early inclusion in planning, revenue, and, in some cases, project stake ownership
  - required local reinvestment
  - workforce development
  - building of lasting infrastructure that will support the community’s future and account for the eventual closing of the mine and mitigation of any negative effects on the environment and community.
- Stabilize the playing field for the private sector: regulatory standardization and process reform, direct government investment, and financial incentives.
- Encourage participation and collaboration: Provide opportunities for public education and social license development to enhance physical, workforce, and knowledge links within the Arctic (especially across North America and Greenland).

Table 3 summarizes the investment priorities that each group identified.

Findings and Takeaways

Overall, the TTX pointed to potential promise in securing additional critical minerals supplies in Alaska and elsewhere in the Arctic but also cautioned against many common hurdles to development in the state and region and pointed to familiar issues to avoid risks and negative outcomes. The primary opportunities or desired
<table>
<thead>
<tr>
<th>Group</th>
<th>Top Priorities</th>
<th>Additional Priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Future 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Resource discovery incentives</strong> (e.g., expediting the regulatory process, funding for R&amp;D, establishing a clearinghouse for projects, public–private partnerships)</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Public transparency</strong></td>
<td></td>
</tr>
<tr>
<td>Financing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Geological mapping and analysis</strong> of existing geological material</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Market durability policies</strong> (e.g., incentives, insurance assistance, take-or-pay policies)</td>
<td></td>
</tr>
<tr>
<td>Supply chain</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Policies to spur investment</strong> in mining and processing (e.g., loans, grants, public–private partnerships), also acknowledging energy and logistics needs</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Energy, transportation, and communications infrastructure</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Future 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>R&amp;D of sustainable</strong> (i.e., less energy- and logistics-intensive) <strong>extraction and production capabilities</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Transportation</strong> (e.g., ports) and <strong>community</strong> (e.g., utilities) <strong>infrastructure</strong></td>
<td></td>
</tr>
<tr>
<td>Regulatory environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>International standards</strong> for minerals development and production</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Access to financing and government investment</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Table 3—Continued

<table>
<thead>
<tr>
<th>Group</th>
<th>Top Priorities&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Additional Priorities&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
</table>
| Supply chain  | - Policies to reform permitting (i.e., to accelerate processes) that emphasize increasing local capacity and leveraging resident expertise  
                 - Policies for resource-sharing with Alaska Natives | - Workforce training and reskilling (e.g., in mining and metallurgical engineering)  
                 - Transportation infrastructure (e.g., land and pipeline links between Alaska and Canada)  
                 - Energy infrastructure, including renewables  
                 - Internet access  
                 - Opportunities for international engagement on regulatory standards |

<sup>a</sup> Top priorities were those that participants deemed most important. Each top priority required a 25-coin investment during the second half of the TTX.

<sup>b</sup> Additional priorities were those that participants deemed important, but in more of a supporting as opposed to keystone role. Each additional priority required a ten-coin investment during the second half of the TTX.

<sup>c</sup> Social license “refers to the perceptions of local stakeholders that a project, a company, or an industry that operates in a given area or region is socially acceptable or legitimate” (Raufflet et al., “Social License”).

<sup>d</sup> A take-or-pay policy obliges a buyer to either take “delivery of goods from a seller” or pay “a specified penalty.” “Take-or-pay provisions benefit both parties by sharing risk, and they benefit society by facilitating trade and reducing transactions costs” (“Take or Pay: What It Means and How It Works in Contracts”).
outcomes identified included chances for community growth and stability and for workforce development; improved infrastructure, technology, and research; less–environmentally harmful practices; and new markets for alternative energy sources and recycling materials. The primary risk types or negative outcomes that were emphasized included continued boom-and-bust cycles, adverse effects on local and Indigenous communities and the environment, and lack of tangible and sustainable benefits for communities.

Ultimately, each TTX group brought its own perspective to the discussion of the important investments to make for Alaska’s future. Major investments or interventions discussed across groups included the following:

- community engagement: transparency, resource-sharing, investment in communities’ future and sustainability
- infrastructure: transportation, communications, and energy
- policy: permitting, foreign investment, risk mitigation planning, full life-cycle management planning, financing, and market durability
- R&D: sustainable technology, resource and geologic mapping, material processing, and recycling of byproducts or waste.

Having additional dialogue that substantively and tactically focuses on a road map for securing desired outcomes while avoiding hazards and other negative risks will be instrumental for moving forward with legislation, community plans, environmental risk mitigations, and other decisions needed to secure critical minerals supplies for and from Alaska. Toward the end of the event, discussions for the next event centered on future partnerships. In particular, the United States has a promising avenue of increasing cooperation with like-minded Arctic countries. In particular, the United States might leverage its geographically proximal partners Canada and Greenland more in ways that would enable east–west mobility of the workforce, investments in infrastructure, and securing supply chains.

**Appendix A. Tabletop-Exercise Newspaper Futures**

During the TTX, each group of participants was presented with one of two futures in which the production of critical minerals took place in Alaska. Here we present the newspaper futures used during the TTX.

**Newspaper for Future 1**

Figures A.1 and A.2 reproduce the pages of the newspapers we provided participants assigned to future 1.

**Newspaper for Future 2**

Figures A.3 and A.4 reproduce the pages of the newspapers we provided to participants assigned to future 2.
Alaska's mining industry continues to be a driving force for the state, providing jobs and economic growth. The mining sector is also playing a crucial role in the state's sustainability efforts, with companies focusing on pollution control and reduced environmental impact.

The report highlights the potential for increased mineral exploration and development, stating that the state is well-positioned to capitalize on its mineral wealth. It also calls for the development of policies that support sustainable mining practices and the creation of new jobs in the mining sector.

In conclusion, the report presents a comprehensive overview of Alaska's mining industry, emphasizing its importance to the state's economy and future development.
**INFRASTRUCTURE CRUMBLING IN CENTRAL ALASKA**

By JUNE O'MOOSE

FAIRBANKS - Interior Alaska communities are struggling to maintain roads, pipelines, and other important infrastructure due to rising temperatures and weather patterns. Experts warn that solutions are costly and require immediate action.

**USGS IN ALASKA CONTINUES TO DISCOVER NEW MINERAL RESERVES**

By KEN IVE

ANCHORAGE - As part of the federal government’s push to develop not only Alaska’s economy but also national resources, the U.S. Geological Survey (USGS) continues to discover new mineral reserves in Alaska. These are critical minerals necessary for producing batteries, solar panels, and other technologies.

**CHINA MAINTAINS DOMINANCE IN CRITICAL MINERAL EXPORTS**

By AURORA BORALINO

JUNEAU - As the global demand for critical minerals continues to rise, concerns are mounting over China’s continued dominance in the market.

**CLIMATE MIGRATION COULD COME TO ALASKA**

By CORY ACK

ANCHORAGE - Climate migration from coastal communities in the U.S. is expected to increase due to rising sea levels and other factors.

**NEW SHIPPING ROUTES OPEN IN THE ARCTIC**

By EZY ICEBERG

JUNEAU - The rapidly melting Artic ice is opening new shipping routes, which could revolutionize transportation and trade in Alaska and the wider Arctic region.

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**ENDANGERED SPECIES COMING TO ALASKA**

Over the past few years, populations of endangered birds, such as the Steller’s Eider, have been increasing in northern coastal Alaska terms in people's favor.

**China launches autonomous supply vehicle to fishing fleets**

China has launched an autonomous supply vehicle to fish for sustainable resources on the coast of Chile. The launch raised concerns with U.S. officials.

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**FIGURE A.3**
Future 2 Newspaper, Front Page

**FIGURE A.4**
Future 2 Newspaper, Second Page
Appendix B. Tabletop-Exercise Participant Worksheets

Figures B.1 through B.4 reproduce the other materials we gave participants during the TTX.

FIGURE B.1
Breakout Activity 1: Future Scenario–Based Discussion Mad Libs–Style Form

**Critical Minerals Workshop Tabletop Exercise**

**Breakout Activity #1: Scenario-Based Discussion “Mad-Lib”**

This activity is intended as a starting point for group discussion about possible 2040 future positive and negative outcomes. Each person may read the scenario starter represented in the mock newspaper and complete the blanks below.

Based on the news from 2040, our future prospects look
__________________________, primarily due to ______________________
and ____________________.

What gives me hope is that ________________________________,
but I fear that ________________________________.

Having more insight about ________________________________
and ________________________________ would help me better
understand the outcomes implied by the scenario.

---

FIGURE B.2
Strength, Weakness, Opportunity, and Threat Analysis Form

**Critical Minerals Workshop Tabletop Exercise**

“SWOT” Analysis

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>What aspects of the scenario imply U.S. strengths?</td>
<td>What aspects of the scenario imply U.S. weaknesses?</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats and Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are there important opportunities to take advantage of?</td>
<td>Are there important threats and hazards to avoid?</td>
</tr>
</tbody>
</table>
**Critical Minerals Workshop Tabletop Exercise**

**Breakout Activity #3: “100-coin game” brainstorm sheet**

*Please fill in details about investment options below and distribute 0–100 coins among them based on your impression of value proposition for the 2040 future (not implementation difficulty or other factors). Total investments must equal 100 and no use of fractional coins are allowed.*

<table>
<thead>
<tr>
<th>Investment Type</th>
<th>Specific Investment (if known)</th>
<th># coins invested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community &amp; Environment</td>
<td>Engagement:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diplomacy &amp; International Engagement</td>
<td>Resource Access:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tech sharing:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Events:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Standards:</td>
<td></td>
</tr>
<tr>
<td>Economy</td>
<td>Energy transition:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fiscal Policy:</td>
<td></td>
</tr>
<tr>
<td>Material, R&amp;D</td>
<td>Extraction:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Production:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Logistics:</td>
<td></td>
</tr>
<tr>
<td>Policy &amp; Regulatory</td>
<td>Standards:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Responsibilities:</td>
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<tr>
<td>Workforce</td>
<td>Education:</td>
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<tr>
<td></td>
<td>Opportunities:</td>
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<tr>
<td>Other</td>
<td></td>
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</tbody>
</table>

**Critical Minerals Workshop Tabletop Exercise**

**“100-coin game” sub-group brainstorm sheet**

*Please consolidate investment priorities into two categories:*

- 25 coins each to two most important investments
- 10 coins each to five supporting investments

<table>
<thead>
<tr>
<th>Investment 1 (25 coins)</th>
<th>Investment 2 (25 coins)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<tr>
<td>Investment 3 (10 coins)</td>
<td>Investment 4 (10 coins)</td>
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<tr>
<td>Investment 5 (10 coins)</td>
<td>Investment 6 (10 coins)</td>
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<td></td>
<td></td>
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<tr>
<td>Investment 7 (10 coins)</td>
<td>Key investments “just below the cut line”</td>
</tr>
</tbody>
</table>
In this paper, we use the U.S. Geological Survey’s (USGS’s) definition of critical mineral. Other countries might have other methodologies to determine their lists. In addition to source deposits, refining and processing capacity of several critical minerals is concentrated in certain countries, particularly China. In other words, it is not only the raw material that is important but also the refining and processing facilities and the transportation logistics.

Harrell, Rosenberg, and Saravalle, *China’s Use of Coercive Economic Measures*.

White House, *Building Resilient Supply Chains, Revitalizing American Manufacturing, and Fostering Broad-Based Growth*.


This took place as part of a broader, two-day conference on this topic. For more about that conference, see Woodrow Wilson Center, “Critical Minerals in the Arctic.”


Public Law 117-167, an act making appropriations for the legislative branch for the fiscal year ending September 30, 2022, and for other purposes, Division A, CHIPS Act of 2022; Public Law 117-169, an act to provide for reconciliation pursuant to Title II of Senate Concurrent Resolution 14 (commonly known as the Inflation Reduction Act); White House, “CHIPS and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China”; White House, “Inflation Reduction Act Guidebook.”

Public Law 81-774, an act to establish a system of priorities and allocations for materials and facilities, authorize the requisitioning thereof, provide financial assistance for expansion of productive capacity and supply, provide for price and wage stabilization, provide for the settlement of labor disputes, strengthen controls over credit, and, by these measures, facilitate the production of goods and services necessary for the national security, and for other purposes, codified at U.S. Code, Title 50, War and National Defense; Chapter 55, Defense Production. Title III is codified at Subchapter II, Expansion of Productive Capacity and Supply, in that chapter. Also see U.S. Department of Defense, “Defense Production Act Title III Presidential Determination for Critical Materials in Large-Capacity Batteries.”

However, countries with existing free trade agreements with the United States might not have access to every mineral the United States needs to effectively produce onshore manufacturing capabilities like those for battery-electric vehicles. This highlights the need to source more minerals both domestically and abroad.


One limitation of the approach is that we assumed that Alaska would be involved in some way in sourcing critical minerals in the future. No scenario was presented in which Alaska completely shut down critical minerals production or production lessened. This was not an effort to compare Alaska minerals with other U.S. minerals options.

Although a future in which mining does not expand in Alaska is plausible, using that in a scenario would not have met our objective of assessing conditions that could be created to support positive outcomes and mitigate negative risks. We therefore did not include it in this event.

Each group used a total of 100 theoretical coins as a tool to aid discussion and prioritization; each most-important investment was worth 25 coins, and each supporting intervention was worth ten coins. Each participant was given a worksheet to complete during the ideation phase. Each group had to decide how to allocate its members’ 100-coin allotments to the members’ proposed investments or interventions as identified during the ideation period. As shown in Table 3, this resulted in each group identifying seven priorities: two 25-coin choices and five ten-coin choices. There are limitation to the 100-coin approach, but it has utility as a stimulator of conversation and debate.

On effects on communities, see, e.g., Berman, Loeffler, and Schmidt, “Long-Term Benefits to Indigenous Communities of Extractive Industry Partnerships,” and Horowitz et al., “Indigenous Peoples’ Relationships to Large-Scale Mining in Post/Colonial Contexts.”
References


Harrell, Peter, Elizabeth Rosenberg, and Edoardo Saravalle, China’s Use of Coercive Economic Measures, Center for a New American Security, June 2018.


Inflation Reduction Act—See Public Law 117-169.


Public Law 81-774, an act to establish a system of priorities and allocations for materials and facilities, authorize the requisitioning thereof, provide financial assistance for expansion of productive capacity and supply, provide for price and wage stabilization, provide for the settlement of labor disputes, strengthen controls over credit, and, by these measures, facilitate the production of goods and services necessary for the national security, and for other purposes, September 8, 1950.

Public Law 117-167, an act making appropriations for the legislative branch for the fiscal year ending September 30, 2022, and for other purposes, August 9, 2022.

Public Law 117-169, an act to provide for reconciliation pursuant to Title II of Senate Concurrent Resolution 14, August 16, 2022 (Inflation Reduction Act).


U.S. Code, Title 50, War and National Defense; Chapter 55, Defense Production.


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Our colleagues D. Sean Barnett, Charmaine Chui, and Jared Mondschein facilitated the TTX with us. We appreciate their contributions to the success of the exercise. We thank Richard Silberglitt and Cullen S. Hendrix for their review of this document.

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About This Paper
This RAND paper was developed to communicate the results of a tabletop exercise (TTX) conducted as part of a broader event, a workshop called Critical Minerals in the Arctic: Forging the Path Forward. RAND cosponsored the overarching event with the Woodrow Wilson Center, the University of Alaska, and the U.S. Department of Energy’s Arctic Energy Office. The event took place on July 12 and 13, 2023, at the Wilson Center’s offices in Washington, D.C. The TTX, which RAND researchers designed and facilitated, took place on the first day of this event and included the majority of in-person participants who represented government, industry, Alaska Native groups and other local communities, academia, and think tanks. In this paper, we summarize the TTX and report out key findings for policymakers and other stakeholders. The findings should be of interest to policymakers, stakeholders in and rights-holders of Alaska’s natural resources, the mining industry, and those with interest in critical minerals supply chains, the Arctic, policy gaming methodologies, and economic development.

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