CONGRESSIONAL PROGRAM
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# Energy Security & the New Energy Economy:

## Overcoming Challenges and Bottlenecks

Oslo & Bergen, Norway
August 26-September 1, 2023

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# AGENDA

## SATURDAY, AUGUST 26:

U.S. participants depart the U.S. throughout the day.

## SUNDAY, AUGUST 27:

U.S. participants arrive in Oslo, Norway from mid-morning to mid afternoon.

***Transport from Oslo airport to conference hotel***

**7 – 9 PM**: **Working Dinner**
Seating is arranged to expose participants to a diverse range of views and provide the opportunity for a meaningful exchange of ideas. Scholars and lawmakers are rotated daily. Discussions will focus on United States energy policy broadly, and in particular, the ways in which lawmakers play a role in enhancing energy security while advancing decarbonization solutions in parallel, and how these dual imperatives might be complimentary.

## MONDAY, AUGUST 28:

**6:45 – 8 AM: Private breakfast is available**

**8 – 9 AM: Breakfast Conversation with Julio Friedmann,** *Chief Scientist and Chief Carbon Wrangler, Carbon Direct*

Dr. Julio Friedmann is an internationally recognized expert on carbon management. His work concerns how to reduce and remove carbon dioxide from the air and oceans through investment, science, and business. Dr. Friedmann will outline the topic of carbon management for the conference participants, contextualize the planned site visits, facilitate dialogues about the role of carbon management in climate change policy, and address associated policy questions.

**9 – 9:15 AM: Introduction and Framework of the Conference**
This conference is organized into roundtable conversations, working lunches, site visits, and pre-dinner remarks. This segment will highlight how the conference will be conducted, how those with questions will be recognized, and how responses will be timed to allow for as much engagement as possible.

**Speaker:**
**Charlie Dent,** *Vice President, Aspen Institute; Executive Director, Congressional Program*

**9:15 – 11 AM: Roundtable Discussion**
***Building Cleaner and Faster: Making the Permitting System Work for 21st Century Energy Needs***
Achieving net-zero emissions by 2050 is ecologically essential, technologically feasible, economically achievable, but procedurally impossible. How can Congress reimagine the permitting system to reinforce security and environmental imperatives?

**Speakers:**
**Jim Connaughton,** *CEO, Nautilus Data Technologies; Former Chair of the White House Council on Environmental Quality*
**Katie McGinty,** *Vice President & Chief Sustainability, Government & Regulatory Affairs Officer, Johnson Controls; Former Chair of the White House Council on Environmental Quality*

**11 – 11:15 AM**: **Break**

**11:15 AM – 1:15 PM: Roundtable Discussion**:
***A Critical Minerals Policy for the United States***
Critical minerals like cobalt, lithium, nickel, and copper (among others) have emerged as key enabling resources for the clean energy transition, but the difficulty of securely accessing these raw materials will be a barrier in the decades to come. These minerals are essential building blocks of wind turbines, electric car batteries, and other clean energy infrastructure, and therefore a steady supply to the West is crucial to meet climate goals. Sustainably and ethically sourcing the minerals necessary to fight climate change raises a host of challenges related to geopolitical competition, domestic mining and processing, and technological innovation. This session will explore these roadblocks and highlight what actions Congress could take to secure the critical minerals supply necessary for the U.S. new energy economy to thrive.

**Speakers:**
**Frank Fannon**, *Managing Director, Fannon Global Advisors; former Assistant Secretary of State for Energy Resources*
**Jonathan Pershing**, *Program Director, Environment, Hewlett Foundation; Former U.S. State Department Special Envoy for Climate; former Special Envoy for Climate Change, U.S. Department of State*

**1:15 – 2:15 PM: Working Lunch**
During lunch, Members will discuss how permitting challenges and minerals scarcity might be examples of "bottlenecks" preventing progress on advancing the dual imperatives of energy security and addressing climate change. Using these examples as a starting point, members will consider the role that the policy process plays in addressing bottlenecks, and how technological and economic factors could be brought to bear alongside the policy process.

**2:15 – 4 PM: Individual Discussions**
Members of Congress and experts meet individually to discuss the U.S. critical minerals policy. Scholars and experts available to meet individually with Members are Frank Fannon, Jonathan Pershing, Julio Friedmann, Jason Bordoff, Robin Millican, Rich Powell, Sonia Aggarwal, and Maureen Hinman.

**4:20 PM: Group boards buses and is transported to the residence of the U.S. Ambassador to Norway to clear security protocols to enter residence**

**4:40 PM: Bus arrives at the residence and group, all with passports in hand, clear through security in 20 minutes**

**5 – 6:30 PM: Meeting and Standing Light Dinner with the U.S. Ambassador to Norway, Marc Nathanson and Jane Nathanson**
The discussion will focus on issues of interest to members of Congress.

**6:30 – 7 PM: Group boards buses and returns to hotel**

## TUESDAY, AUGUST 29:

**7-8:20 AM: Breakfast**

**8:30 - 9:45 AM: Roundtable Discussion:**
***Norwegian Energy Leadership: How It Informs America's Energy Transition***
Norway is successfully transitioning into green energy, while continuing to generate traditional energy sources. The country is also far advanced in managing carbon. The Ministers of Petroleum & Energy and Trade & Industry will share their experiences.

**Speakers:**
**Bjelland Eriksen**, *State Secretary Andreas, the Ministry of Petroleum and Energy of Norway*
**Jan Christian Vestre,** *Minister of Trade and Industry of Norway*

**9:45 – 9:55 AM: Break**

**9:55 – 11 AM: Roundtable Discussion**
***Geopolitics of Energy: Reinforcing Allies' Energy Independence***

In many NATO member countries, the Russian invasion of Ukraine and the subsequent chaos in world energy markets thrust into the forefront of public consciousness the risks posed by energy supply chains that are vulnerable to disruptions in geopolitical equilibrium. This session will address in what ways the United States might be positioned to reinforce allies' energy security and deprive adversaries of opportunities to use energy flows as an instrumentality of pressure.

**Speaker:**
**Jason Bordoff,** *Founding Director, Center on Global Energy Policy; Professor of Professional Practice, Columbia SIPA; Co-Founding Dean, Columbia Climate School*

**11 – 11:45: Working Lunch**
Discussion continues between members of Congress and scholars, focusing on the transatlantic energy relationship between the United States and its allies, including Norway. Members will consider how recent global events have changed some of the fundamental assumptions that have underpinned the energy system, and the ways in which newly reinvigorated transatlantic ties present policy opportunities for addressing the dual imperatives of energy security and addressing climate change.

**11:45 AM – Noon: Group boards buses and departs at noon for Brevik, Norway**

**Noon – 2:15 PM: Travel to Heidelberg Materials Sement Norge – Brevik Carbon Capture and Storage (CCS)**

**2:30 – 3:30 PM: Educational Site Visit**
**Heidelberg Materials Sement Norge – Brevik Carbon Capture and Storage**
Cement production is a major contributor to global greenhouse gas emissions, both from the release of carbon dioxide contained in limestone (one of the key ingredients of cement) and the energy needed to heat the limestone during the cement manufacturing process. We will visit an innovative cement manufacturing facility, the first industrial-scale carbon capture and storage (CCS) project at a cement production facility. The Northern Lights facility, which we will visit later in the week, is the ultimate destination for this captured carbon.

**3:45 – 5:45 PM: Group returns to Oslo**

**6 – 7 PM: Electric Ferry – New Energy Efficient Mode of Water Transport**
Critical to success in the energy transition will be the electrification of the transpiration sector, including short-haul maritime vessels like ferries. The world's first electric ferry was put into operation in Norway in 2015 with the manufacturer projecting emissions to be cut by 95 percent and costs by 80 percent compared to a fuel-powered ferry. Today, Norway has about 80 electric commuter ferries in operation and built and operates the first high-speed ferry, a multi-stop commuter route, which reduces emissions in the region the equivalent of taking 60 buses off the road. Participants will ride an electric ferry to dinner with commentary by a local expert.

**7 – 9 PM: Working Dinner**
Seating is arranged to expose participants to a diverse range of views and provide the opportunity for a meaningful exchange of ideas. Scholars and lawmakers are rotated daily. Members today have seen examples of electrification and carbon management, which are two of many essential tools that will be necessary for the new energy economy of the future. What other ways do conference attendees view as essential for the new energy economy? How might new approaches enhance energy security in the process?

## WEDNESDAY, AUGUST 30: *(Overnight in Bergen)*

**7 – 8:30: Breakfast Available**

**8:30 – 10:15 AM: Roundtable Discussion**
***U.S. Leadership in Clean Energy Innovation***

The United States has emerged as a leader in clean energy innovation, pioneering cutting edge technologies that will help define the energy system of the future. Adding to the momentum is recently enacted, robustly bipartisan legislation which has made unprecedented investments in clean energy demonstration and development, world class universities that train the next generation of scientists and engineers, and the United States National Laboratories which have embraced a clean energy innovation agenda. This session will seek to address what it will take for the United States to maintain and expand on its status as a world leader in clean energy innovation.

**Speakers:**
**Robin Millican,** *Senior Director, Breakthrough Energy*
**Rich Powell,** *CEO, ClearPath*

**10:15 – 10:45 AM: Break and check out of hotel**

**10:45 – 11:45 AM: Working Lunch**
Discussion continues between members of Congress and scholars on clean energy innovation. Members will discuss how the United States can (continue to) lead global energy innovation, positioning the United States as a key engine of new opportunities in the energy transition and the energy economy of the future. In what ways can energy innovation enhance the national security of the United States?

**Noon: Bus departs for Oslo airport to fly to Bergen**

**1 – 2 PM: Clear Oslo airport security and prepare to board flight**

**2:50 PM: SAS Flight 269G departs Oslo**

**3:40 PM: SAS Flight 269G Arrives in Bergen**

**3:40 – 5 PM: Group exits airport and boards buses for transport to hotel**

**5 – 6 PM: Group is transported to Bergen hotel and completes hotel check-in**

**8 – 10 PM: Working Dinner**
Seating is arranged to expose participants to a diverse range of views and provide the opportunity for a meaningful exchange of ideas. Scholars and lawmakers are rotated daily. Discussions will focus on how policymakers might navigate the emergent tension between the need for global cooperation to combat climate change and increasingly pressing global power competition. In what ways does this tension influence American energy security and climate change imperatives?

## THURSDAY, AUGUST 31: *(Overnight in Bergen)*

**6:30 – 8:34 AM: Breakfast Available**

**9 – 10:30 AM: Roundtable Discussion**
***A New Era of Global Competition: Trade, Climate Cooperation, and National Security***
The United States' trade agenda is undergoing a period of historic upheaval. Globalization seems to now be disfavored relative to new "America First" strategies (exemplified in particular by the array of recently passed historic subsidies for domestic clean energy investment). Abroad, some believe the relevance of the World Trade Organization continues to decline, and European allies have announced a "border carbon adjustment mechanism." All the while, multilateral, bilateral, and regional

trading regimes are emerging as the new trade world order. In what ways is the United States well positioned to leverage trade opportunities to reinforce energy security and climate change imperatives? How might policymakers balance conflicting energy imperatives that favor global competition, but also simultaneously necessitate cooperation?

**Speakers:**
**Sonia Aggarwal,** *CEO, Energy Innovation; former Special Assistant to President Biden for Climate Policy, Innovation, and Deployment*
**Maureen Hinman,** *Co-Founder and Chairman of Silverado Policy Accelerator*

**10:30 – 10:45 AM: Break**

**10:45 AM – 12:15 PM: Policy Reflections for Members of Congress**
***All attendees can remain in the meeting room, however, this session is only for Members of Congress to discuss ideas and policies.***
This time is set aside for members of Congress to reflect on what they have learned during the conference and discuss their views on implications for U.S. policy. Members of Congress have seen and learned a lot this week. Drawing on the full range of conversations and site visits throughout the week, members will seek to identify for each other the most promising takeaways for the United States policy process, with a special focus on opportunities for bipartisan cooperation and agreement enhancing United States energy security while addressing climate change. This is a members-only conversation.

**12:15 – 1 PM: Working Lunch**

**1:15 – 2:30 PM: Group boards buses and travels to Northern Lights company**

**2:45 – 4:45 PM: Educational Site Visit**
**Northern Lights (an open-source carbon management facility)**

We will visit the world's first open-source carbon dioxide transport and storage infrastructure, which delivers carbon storage as a service. The goal of this service is to help emitters stop emissions that cannot be avoided in other ways from reaching the atmosphere and to provide a safe and permanent storage option for $CO_2$ that is removed from the air. Carbon dioxide is received in liquid form transported by ship, offloaded into a terminal (which we will tour), and then eventually injected through undersea pipelines into permanent geologic undersea storage.

**5 – 6 PM: Group boards buses and returns to hotel**

**7:30 – 9 PM: Working Dinner**
Seating is arranged to expose participants to a diverse range of views and provide the opportunity for a meaningful exchange of ideas. Scholars and lawmakers are rotated daily. Discussions will focus on the specific role that carbon management might play in addressing climate change. Carbon management is thought by some to distract from other important climate change agendas, while others maintain that carbon management is a necessary and indispensable tool when deployed alongside a full-spectrum approach to addressing climate change. How might member views on carbon management influence the federal policy process?

## FRIDAY, SEPTEMBER 1:

**Breakfast available at 6:30 AM**

**Participants depart the hotel for the airport at various times from early morning to early afternoon to return to the U.S.**

# CONFERENCE PARTICIPANTS

## MEMBERS OF CONGRESS AND THEIR SPOUSES:

**Rep. Kelly Armstrong** and Kjersti Armstrong

**Rep. Earl Blumenauer**

**Rep. Julia Brownley**

**Rep. Sean Casten**

**Rep. Kathy Castor** and Bill Lewis

**Rep. Michael Guest** and Haley Guest

**Rep. John Joyce**

**Rep. Tom Kean** and Rhonda Kean

**Rep. Rick Larsen** and Tiia Karlén

**Rep. Marc Veasey**

**Rep. Debbie Lesko** and Joseph Lesko

**Sen. Lisa Murkowski** and Verne Martell

**Rep. Gary Palmer** and Ann Palmer

**Rep. Scott Peters** and Lynn Gorguze

**Rep. Chellie Pingree**

**Rep. Deborah Ross** and Steve Wrinn

**Rep. David Rouzer**

**Rep. John Sarbanes** and Dina Sarbanes

**Rep. Brad Schneider** and Julia Schneider

**Rep. Kim Schrier**

**Sen. Peter Welch** and Margaret Cheney

## SCHOLARS AND EXPERTS:

| | |
|---|---|
| **Jason Bordoff** | *Founding Director, Center on Global Energy Policy, Columbia University, SIPA; Co-Founding Dean, Columbia Climate School* |
| **Jim Connaughton** | *Chairperson, Nautilus Data Technologies; Former Chair of the White House Council on Environmental Quality* |
| **Andreas Bjelland Eriksen** | *State Secretary, Ministry of Petroleum and Energy of Norway* |
| **Frank Fannon** | *Managing Director, Fannon Global Advisors* |
| **Julio Friedmann** | *Chief Scientist and Chief Carbon Wrangler, Carbon Direct* |
| **Maureen Hinman** | *Chair and Co-founder, Silverado Policy Accelerator* |
| **Timothy Mason** | *Assistant Director for Energy and Mitigation Policy, Energy and Environment Program, Aspen Institute* |
| **Katie McGinty** | *Vice President and Chief Sustainability and External Affairs Officer, Johnson Controls; Former Chair of the White House Council on Environmental Quality* |
| **Jan Christian Vestre** | *Minister of Trade and Industry of Norway* |

## FOUNDATION REPRESENTATIVES:

| | |
|---|---|
| **Sonia Aggarwal** | *CEO, Energy Innovation; former Special Assistant to President Biden for Climate Policy, Innovation, and Deployment* |
| **Robin Millican** | *Senior Director, U.S. Policy and Advocacy, Breakthrough Energy* |
| **Jonathan Pershing** | *Director, Environment Program, Hewlett Foundation; former Special Envoy for Climate Change, U.S. Department of State* |
| **Rich Powell** | *CEO, ClearPath* |
| **Rip Rapson** | *President and CEO, The Kresge Foundation* |

| | |
|---|---|
| **Dan Schory** | *Chief of Staff for Infrastructure, Arnold Ventures* |

## ASPEN INSTITUTE CONGRESSIONAL PROGRAM:

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|---|---|
| **Charlie Dent** | *Executive Director, Congressional Program and Vice President, Aspen Institute* |
| **Tyler Denton** | *Deputy Director* |
| **Carrie Rowell** | *Conference Director* |
| **Jennifer Harthan** | *Senior Associate, Congressional Engagement* |
| **Ketevan Chincharadze** | *Policy Advisor* |

# CONFERENCE SUMMARY

**Timothy Mason**
*Assistant Director for Energy and Mitigation Policy, Energy and Environment Program, Aspen Institute*

**Ketevan Chincharadze**
*Policy Advisor, Congressional Program, Aspen Institute*

## Introduction:

Between August 26 - September 1, 2023, the Aspen Institute Congressional Program gathered 21 bipartisan, bicameral members of Congress in Norway to discuss *Energy Security and the New Energy Economy: Overcoming Challenges and Bottlenecks*. The conference that took place in Oslo and Bergen, featured expert-led dynamic discussion sessions, meetings with Norwegian ministers, and educational site visits.

More than fifteen U.S. experts talked about making the U.S. permitting system more efficient, obtaining critical minerals for green energy technology development while enhancing national security, ensuring U.S. leadership in clean energy innovation, and leveraging trade to reinforce national security and U.S. global competitiveness. Norwegian ministers expounded on the ways Norway accelerates energy transition in an effort to fully decarbonize by 2030. The site visits to a Heidelberg Materials cement facility employing carbon capture and Northern Lights that complemented the conference sessions helped members witness the Norwegian innovation in the making – the production of carbon-free cement and carbon capture and its permanent storage underground.

This report highlights the key conference takeaways and policy ideas that came forth amid the conference sessions.

## Preliminary Remarks on the Site Visits and Their Connection to Energy Security and Climate Change

Recognizing the crucial role of scientific advancement and innovation for energy security and transition, an American scientist and internationally recognized expert kicked off the conference with a discussion on the role of carbon management in climate change policy. He suggested that, in some instances like industrial production, carbon

capture is often the most impactful and cost-effective way to remove significant quantities of carbon – four to seven billion tons annually – when employed as part of comprehensive plans to meet climate goals.

Carbon management is the subject of some controversy, especially amongst those who are concerned about the continued use of fossil fuels throughout the 21st century. Some view carbon management as presenting an excuse or "band-aid" that might unnecessarily prolong the life of fossil fuel assets, thereby slowing the urgency of the overall clean energy transition. However, carbon management has a much wider applicability than fossil energy production, and hosts a particular potential value in the field of industrial decarbonization. Therefore, even if concerns about carbon management and fossil fuel are well-founded, there is still a great need to push forward on developing carbon management technology and capacity both in the United States and around the world.

Geologic sequestration offers a permanent and effective solution to ensure that captured carbon is effectively managed. There are ongoing efforts to build this capacity in the United States, and Norway is at the vanguard of these efforts.

One of the key enabling factors furthering Norway's success in carbon management is public policy that creates favorable conditions for the expansion of this industry. In particular, government subsidies and the presence of a carbon price help to bring the financial calculus into balance in a way that might not be possible without these supports. As the industry benefits from technological innovations and economies of scale, the cost of carbon management is anticipated to come down sufficiently, creating favorable conditions for its continuation even with less government support. The United States can learn from Norway's experience to craft public policy consistent with energy and climate objectives.

## Building Cleaner, Faster: Making the Permitting System Work for 21st Century Energy Needs

The United States aims to have net zero emissions by 2050 and a net-zero energy sector by 2035. Two former senior government officials, however, argued that this ambitious goal is "ecologically essential, technologically feasible, economically achievable, but procedurally impossible." To move towards this climate goal, the U.S. needs to reform its permitting system and boost investments in infrastructure. They, made four recommendations to revamp the permitting system and streamline the process:

1. **Immediate approvals**: Congress should establish criteria to identify pre-qualified locations for decarbonization projects, such as former military bases, and the nature of projects that can be approved almost immediately.
2. **Accelerated approvals**: For decarbonization projects that might harm the local environment, Congress should create a two-step process: (1) categorize climate-friendly projects and (2) speed up the environmental review and permits for any specific local issues in those projects.
3. **Accelerated adjudications**: Once a project is approved, any adjudications for decarbonization projects must include a final decision timeline of well under one year to ensure that protracted litigation does not undermine project viability.
4. **State and local conformity**: To get federal funding and tax incentives for infrastructure or climate projects, states and localities must follow the same fast approval and decision-making process.

An expert highlighted the difference between the permitting regime, which largely involves permission to *start* building a project, and the compliance regime, which entails the project's ongoing legal obligation to abide by laws and regulations. The permitting regime mostly predates the compliance regime and thus in many ways does not consider the basic fact that projects must comply with an array of laws (environmental and otherwise) even after a permit is received. In this regard, the expert asserts that the compliance regime is more than sufficient in most cases to safeguard legal imperatives intended to protect the public and the environment. Therefore, the permitting regime can safely be streamlined and optimized to approve important projects without yearslong delays.

To emphasize the significance of permitting, an expert highlighted the success of the 2007 gas bill because of special permitting provisions; in contrast, one member recalled the unfortunate failure of the California high-speed rail project, partially due to permitting issues.

During the roundtable discussion, one member brought up public mistrust of the government when it comes to site identification. It is a challenge, he argued, to account for or remedy the historical trauma inflicted during the previous large scale infrastructure undertakings when the needs of local communities were often under attended to, sometimes in egregious ways. The experts recommended working closely with local communities and educating them on the benefits of potential projects to build trust. They also put forth the idea of requiring community support for projects as a prerequisite for moving forward. To encourage progress, federal incentives could be introduced to reward those embracing these changes.

There was discussion about differentiating between a so-called "objector's veto" versus meaningful community engagement. When objectors are seeking to exercise a veto through litigation, failing to fix the complete permitting process in a comprehensive way effectively translates to fixing none of it.

Many communities in the United States seek investments in their areas that will generate more affordable, cleaner energy and create jobs. But unless the permitting process becomes faster and more efficient, the U.S. will fall behind its climate goals.

## A Critical Minerals Policy for the U.S.

Critical minerals are essential for building green technology, and the U.S. heavily relies on foreign sources for these minerals. As one expert highlighted, 40% of copper, 60% of nickel, and 70% of cobalt are imported because the U.S. does not produce enough domestically despite its capacity to do so. At the same time, the U.S. recycles only 50% of its gold, 60% of its nickel, and 30% of its cobalt. The experts encouraged members to think about strategies to increase domestic mining and improve recycling of raw materials while simultaneously leveraging diplomacy to find new supply sources to counter Chinese dominance in the industry.

While the U.S. grapples with building its own sustainable market to ensure a reliable supply chain, China continues to advance its long-term vision to dominate the industry, which gives China a unique advantage. The way that Chinese companies mine and process minerals often does not abide by environmental standards that the West considers important.

For example, Indonesia, which is the world's largest nickel producer, is a major mining site for Chinese companies who often do not handle the process in an environmentally friendly manner. For instance, Chinese miners do not have a solution to the waste aggravated by Indonesia's wet climate, and they instead dump it straight into the ocean despite known ramifications. China controls almost all sales of nickel mined in Indonesia among many other countries in the developing world.

Because of its dominance, China has the unique ability to manipulate pricing by, among other methods, flooding the market with materials that can weaken domestic mining projects and threaten meaningful competition in the market.

Experts agreed that a complete decoupling, which has become a buzzword, is unrealistic given the interdependence of the U.S. and Chinese markets. It would create more challenges for the global economy than opportunities, which is why, experts argued,

looking for new markets is a better policy option for the U.S. As one member put it, "Either the U.S. develops a new one [supply chain] or it will be Chinese."

One expert recommended a "North American solution." He suggested that U.S. companies should benefit from federal incentives to mine minerals in the U.S., Canada, or other countries on the continent for different minerals. A member highlighted the high labor costs in the United States and other potential partner countries like Australia that will make mining and subsequent green energy technology production more expensive. Another member underpinned the significance of public-private partnerships in the U.S. regarding three major areas: minerals, traders, and offtakers,[1] to advance the development of a secure minerals supply chain. An expert also mentioned the potentially pivotal roles that could be played by the U.S. International Development Finance Corporation, or the Export-Import Bank.

There is a gap in conceptualizing the pros and cons and crafting a holistic minerals strategy collaboratively. Despite the seemingly high cost of American labor, mining in economically disadvantaged communities often results in limited local benefits, with extracted materials shipped elsewhere. Therefore, as a member recommended, the approach should shift towards presenting a "comprehensive package" to communities rather than making mining purely extractive.

An expert emphasized that the U.S. needs to develop a long-term vision and consider current and future demands on critical minerals. He also distinguished the security of critical minerals and that of fossil fuels; disruptions in oil and gas supply have an immediate impact, they argued, whereas low amounts of critical minerals halt the production of new technologies while the existing ones, like solar panels, continue to function. Thus, they encouraged members to think in terms of both fossil and green energy when it comes to energy security – the conversation that was further continued during the next conference session on power competition.

## Geopolitics of Energy: Reinforcing Allies' Energy Independence

A major theme in contemporary global energy policy is renewed attention to energy security, following a collective amnesia which developed after the shale revolution, but now in major focus after the Russian invasion of Ukraine.

An expert argued that Europe is paying twice more for gas than it did before the war, calling for the need for diversification of energy sources. They emphasized that "there is no energy transition without energy security."

[1] An offtake agreement is an agreement between the buyer (off-taker) and the seller to trade goods prior to their production

The specter of petrostates weaponizing oil has haunted politicians since the '70s. Yet this expert maintained that "energy independence is a myth." Even while the U.S. is a net exporter, the country is still dependent on global prices. The expert, therefore, asserted that demand reduction is key to security; simultaneously maintaining and reinforcing interconnected global energy markets is also key to energy security.

The oil industry is interdependent, and despite the U.S. being a net exporter, it relies on global prices. Energy security, this expert suggested, comes from "both using less and exporting less," which will only become possible if the U.S. invests in green, renewable energy sources.

Nevertheless, the shift towards clean energy introduces new risks that necessitate careful policy consideration. The oil supply should not be curtailed before demand naturally diminishes; but the demand for oil in the U.S. has been rising. Reserves and stockpiles should only be tapped during actual crises and should not be used as tools for price management. At the same time, the expert emphasized that affordability of energy – green or not – is the key. The U.S. government should make sure that energy transition does not become a financial burden to consumers.

## A New Era of Global Competition, Trade, Climate Cooperation, and National Security

The conversations on the geopolitics of energy further continued through the lens of the economy and national security. One expert highlighted that reliance on fossil fuels for energy can lead to significant disruptions if the supply is cut off. Clean energy sources provide a more stable energy supply, ensuring energy security. Similarly, clean industrial materials allow for the continued use of existing infrastructure and resources, even during supply disruptions. Besides, they argued, clean energy sources become increasingly cost-effective over time and form a stable economic system, resilient against price shocks. However, the lack of materials supply may undermine these advantages.

The expert noted that the demand for materials like steel, cement, and plastics will continue to increase substantially. Thus, the U.S. government's priority should be to secure the supply chain and maintain a competitive edge. They recommended considering trade policies such as a border carbon adjustment to encourage clean manufacturing practices and create a trading club for minerals with high labor and environmental standards. These measures can help ensure that clean materials production remains competitive and environmentally responsible on a global scale.

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U.S. competitiveness is also crucial in the semiconductor industry, particularly to counter Chinese competition, another expert suggested. While the CHIPS and Science Act – which provides $52.7 billion for American semiconductor research, development, manufacturing, and workforce development – is a step forward, China's significant investments in chip manufacturing highlight the need for continued innovation and support.

This expert talked about the importance of trade tools to support the United States' ambition in the clean tech market, which is estimated to be worth $100 trillion by 2050. They argued that the current trade policies lack coherence and do not align with the rapid nature of the global economy. They identified several fundamental trade challenges.

The existing trade system lacks effective tools to deal with countries that engage in unfair trade practices, including market-distorting industrial policies, forced technology transfer, and intellectual property theft, primarily by China. Such practices erode the benefits of the trade system for the United States. Businesses also thrive in predictable regulatory environments. Timely punishment of such trade cheaters is essential to prevent the permanent destruction of industries due to unfair competition.

The United States has significant market access through Free Trade Agreements (FTAs), amounting to $9.8 trillion. In comparison, the European Union (EU) holds $17 trillion, while Mexico has $54 trillion. The U.S. has fallen behind because it does not negotiate with allies as actively as some other countries like China, which is gaining an advantage.

The expert suggested that the U.S. should continue negotiating new FTAs and renewable energy deals to encourage potential partners to become climate-friendly in exchange for conducting business with the U.S. The European Carbon Border Adjustment Mechanism (CBAM), which entails calculating emissions associated with the production of various goods and deciding on the appropriate tariffs, which can be used as a framework, especially in developing countries. Experts also recommended revisiting the North American Free Trade Agreement (NAFTA) and the United States-Mexico-Canada Agreement (USMCA) and encouraged members to pay closer attention to Latin America, where Chinese influence has been becoming more prominent.

During the discussion, one member raised a concern about intellectual property (IP) theft, especially when it comes to artificial intelligence (AI), which enables Chinese companies to recreate some of America’s tech innovations. Experts and members agreed that Congress needs to take a proactive role in securing U.S. intellectual property.

Given Chinese technological advancement, the U.S. needs a coherent industrial policy going forward. The government needs to leverage trade policy and encourage private investments in key innovation sectors, such as green energy technology, chip manufacturing, biological technology, etc.

## U.S. Leadership in Clean Energy Innovation

Experts and members dedicated an entire session to boosting U.S. leadership in energy innovation and the ways to achieve it. One expert outlined three compelling reasons to prioritize innovation in the energy sector. First, innovation is essential for tackling the climate crisis, given the staggering global emissions of 58 gigatons of greenhouse gasses annually. Eliminating these emissions while maintaining living standards and enabling developing countries to prosper is a challenge. Second, clean energy innovation serves as an energy security strategy, vital for ensuring a reliable energy supply. Third, innovation is central to sustaining economic growth and productivity. A Boston Consulting Group study projected the clean energy technology market to reach $100 trillion by 2050, presenting a significant opportunity for the United States private sector. It is also important to have a strategy of innovation deployment, because "where the U.S. invests and what it prioritizes matters."

This expert also identified challenges across various sectors. They argued that in the power sector, transitioning to 100% clean energy while expanding the grid to facilitate electrification is a problem because of the lack of a combination of renewable energy sources and old-generation technologies like nuclear and hydro. The industrial sector needs to generate high-temperature industrial heat from green sources and cut down emissions. Regular batteries cannot store enough energy to meet the needs of long-distance and heavy-duty transportation. However, advanced biofuels and electrofuels might be able to help address this problem. Heat pumps are essential for buildings, but they have challenges in extreme cold climates. Agriculture can become more climate-friendly by managing soil carbon, altering cattle farming methods, promoting afforestation, and introducing innovative fertilizers. Investing in research and development, providing tax benefits for private companies, and developing infrastructure like pipelines and clean grids are crucial for facilitating such innovations, the expert noted. The Department of Energy (DoE) needs to revamp its strategy, tailor its programs to sector-specific needs, and ensure a stable funding system.

Another expert shared practical perspectives on putting these concepts into action, emphasizing the significant changes brought about by the shale gas revolution in the United States. This revolution had far-reaching effects on American energy, industry, and emissions. It turned the U.S. into a net exporter and the world's leading exporter of

liquefied natural gas (LNG), leading to emissions reductions in the power sector while keeping energy costs affordable. This transformation was made possible through a collaboration between the government, private industry, and Congress. Investments in technologies such as horizontal drilling and underground imaging played a crucial role in this achievement.

To replicate this success, the expert argued for demonstrating technologies domestically with federal incentives, removing regulatory barriers, and subsequently exporting these innovations globally. The example of nuclear technology export to countries like the UAE demonstrated the potential for international collaboration and trade deals. South Koreans are successful and efficient in building nuclear reactors, which is another area where the U.S. and South Korea could partner.

During the discussion,  many experts agreed that it is more efficient to have a performance-based energy policy, as opposed to a technology-based one. Instead of favoring specific technologies or solutions, regulations, and standards should focus on setting desired performance outcomes or targets from various technologies. One member pointed out that in 2007, the U.S. implemented a performance-based lighting efficiency standard that aimed at a 70% increase in efficiency over ten years. This standard was successfully achieved and led to a 7% reduction in the nation's electricity costs. Similar success can be replicated if the energy policy becomes predominantly performance-based.

Members highlighted the importance of workforce development, indicating the need for investment in education programs to raise generations of creative scientists. One member argued that the UAE guarantees around 100 thousand work visas for people with advanced graduate degrees, while the U.S. mostly sends international students back home after graduation. Another member recommended subsidizing university degrees in priority areas like nuclear and green energy technology and keeping trained professionals in the U.S.

## Norwegian Energy Leadership: How It Informs America's Energy Transition

Norway is rapidly transitioning to green energy, while also using traditional fossil energy to strengthen its economy. Members met with two senior Norwegian government officials to learn more about the country's successful approach that enables innovation and the economy to thrive and draw parallels with the policy opportunities in the United States.

During the discussion, both officials highlighted Norway's proactive stance in various areas of sustainability. They emphasized initiatives such as green industrial development, critical minerals, and battery strategies that the government has been developing and actively pursuing. The country aims to achieve net zero emissions transportation and ban oil-based cars by 2030: Tesla is already one of the best-selling vehicles, all new ferries are electric, and even some new electric airplanes that are under construction will soon be launched. The officials reminded the members that Norway is a major supplier of cobalt and nickel to the U.S. and expressed their eagerness to strengthen the partnership for critical minerals with the United States.

Members learned about Norway's unique approach to energy management and innovation. Many energy companies in the country are owned by municipalities, fostering efficiency and community involvement. They expedited the permitting process, while ensuring that community engagement remains a top priority. The Norwegian government recognized the country's great potential in carbon capture and storage (CCS) technology and supported private companies through the Longship program to develop full-scale carbon capture and storage projects.

Members visited Northern Lights, a facility that has developed the first-ever open-source CO2 transport and storage infrastructure network, offering companies across Europe the opportunity to store their CO2 safely and permanently underground. The first phase of the project will be operational in 2024 with a storage capacity of up to 1.5 million tonnes of CO2 per year.

The group also visited Heidelberg Materials' Brevik CCS facility, the world's first CO2-capture facility at a cement plant. It is Heidelberg Materials' most advanced project within CCS, which will be in operation by 2024. Both projects are supported by the government's Longship program, underpinning Norway's vision to reduce emissions by CCS.

Ministers also highlighted that Norway is a prominent oil and gas producer and exporter, although these resources are not predominantly consumed domestically; they get exported mostly to Europe, which has been instrumental to Europe's energy security during the war in Ukraine and the subsequent energy crisis. Members had a chance to visit Equinor's Kollsnes processing plant in Øygarden, which is the largest of its kind in Europe. The plant plays a key role in the transport and processing of gas and condensate[2] /light oil to European allies to the south.

During the discussion, one member suggested the Norwegian government might be disincentivized to help European countries transition to green energy, since oil exports

[2] oil that condenses into liquid after being freed from high pressure wells

are a large portion of its economy. Another member, however, clarified that Norway reinvests the profit generated by fossil fuel exports in green technology innovation. The country can only become fully green with significant investments in research and development, and to finance various initiatives, it needs a sustained income that, at least presently, comes from oil exports.

## Conclusion

The United States has an ambitious climate agenda that requires more persistent efforts from the government. The conference sessions emphasized that the country needs to develop a new supply chain of critical minerals for green technology, increase investments in energy innovation, revamp the permitting process, leverage trade agreements, establish new partnerships, and work closely with the private sector to accelerate the deployment of renewable technologies, which can enhance energy diversification and security. Members came up with specific policy ideas to boost America's global competitiveness in the energy sector that are featured in the policy memorandum below.

## POLICY ACTION MEMORANDUM FOR MEMBERS OF CONGRESS[3]

- The U.S. permitting system is a major challenge to accelerating the deployment of new energy assets, including clean technologies. The U.S. government should consider the four-fold policy strategy ((1) immediate approvals, (2) accelerated approvals, (3) accelerated adjudications, and (4) state and local conformity)[4] to meet the country's ambitious climate goal of achieving net zero emissions by 2050.

- Critical minerals are essential for developing next generation technologies, including clean energy and electrification assets. Currently China dominates the market with prominent supply chains in developing economies. The U.S. should develop alternative supply chains to reduce dependency on Chinese-mined minerals and ensure the critical minerals security.

- The U.S. imports around 40% of copper, 60% of nickel, and 70% of cobalt, because the country does not produce enough domestically despite its capacity to do so. At the same time, the U.S. recycles only 50% of its gold, 60% of its nickel, and 30% of its cobalt. The U.S. government needs to boost domestic mining and recycling to ensure critical minerals supply. This might be achieved through incentives like tax credits.

- The U.S. should leverage free trade agreements (FTAs) to boost its competitiveness in an array of industries including clean energy technologies. The U.S. should negotiate FTAs with more countries to avoid falling behind other allies or competitors.

- Climate technology innovation is essential for tackling emissions, ensuring a reliable energy supply, and sustaining economic growth and productivity. The U.S. needs to increase investments in research and development, potentially by providing tax benefits for private companies, and develop infrastructure like pipelines and clean grids to facilitate such innovations. The Department of Energy (DoE) needs to tailor its programs to sector-specific needs and ensure a stable funding system.

- Domestic mining of critical minerals should not be purely extractive. This disincentivizes local workers and offers limited economic opportunities to communities, implicating an array of political, justice, and equity concerns. The government should incentivize mining activities that pursue comprehensive strategies that offer mining communities thoughtful

[3] *The Aspen Institute Congressional Program is a neutral convener and does not advocate any specific policies. This document is a summary of potential solutions presented by members of Congress and experts during the conference discussion sessions.*
[4] See the rapporteurs' summary for more details

and meaningful benefits and reclamation initiatives.

- Energy policy should be performance-based, not technology based. This means that instead of favoring specific technologies or solutions, regulations, and standards should focus on setting desired performance outcomes or targets from various technologies.

# SCHOLARS' ESSAYS

## Breaking China's Stranglehold over the Energy Transition

**Frank Fannon**

*Managing Director, Fannon Global Advisors*

The fundamental laws of supply and demand hold true to the extent that markets are free, transparent, and competitive. This is not the case with critical minerals. And China – which controls 50 to 90 percent of the clean energy supply chain – likes it that way.

The United States should lead the retaking of the commanding heights of the new energy economy. To do so, America should readjust its thinking, reassess its allies and institutions, and reinvent economic statecraft. Free nations know that they should increase mineral investment beyond China's control. But to succeed, they should establish guards to prevent China from using its market power to undercut and bankrupt mining investment at home and abroad.

A clean energy transition requires increasing reliance on non-coal metals and minerals, like lithium for batteries, copper for transmission lines, or rare earth elements for motor magnets. The global base metal mining market is valued at $551 billion. By contrast, the global oil industry generates $2 to $4 trillion per year depending on prices. According to the World Bank, the mining industry should increase production more than 500% by 2050 to achieve clean energy and climate change targets. McKinsey estimates that copper and nickel alone would require capital expenditures of $250 billion to $350 billion by 2030 to meet demand.

Given this vast structural supply deficit and government policies supercharging demand, one would assume that we are in a great minerals exploration race. However, this is not the case. S&P Market Intelligence found that mining companies spent a meager $13 billion on exploration activities in 2022. The global oil and gas firms spent nearly $500 billion on capex development even though government policies are curbing demand for their product.

The Chinese Communist Party's (CCP) strategy included government-sponsored theft of American intellectual property, debt-trap diplomacy to secure critical metals, the shirking of human rights and environmental conventions, and building mega-factories

at home for global export. It worked. China controls more than 80 percent of all stages of the solar industry and 75 percent of electric vehicle battery capacity.

The CCP has repeatedly weaponized its control of critical minerals against free nations. In 2010, China banned the export of rare earth elements over a fishing dispute with Japan skyrocketing prices. In 2019, Party Leader Xi sent a fearful West a message by publicly touring a rare earth plant in protest over U.S. trade relations creating market turmoil. Yet, China's real strength is not its ability to restrict supplies and increase prices, but its consistent practice to dump product and crash the market.

China can use its position as the world's clean energy swing producer to undermine a western company's economic thesis and survival. Securing financing to develop a mining project has always been challenging but is even more pronounced when return on investment is premised on the value of a commodity subject to CCP manipulation.

While Beijing banned rare earths in 2010, in 2015 China dumped rare earths on to the market forcing America's only mine into bankruptcy. In March 2023, Beijing signaled that it would take greater control of cobalt supplies, and coincidentally miner Jervois announced that it would suspend construction of America's only cobalt project that same month. China has also stepped up to control prices where it is reliant on imports. Unhappy with business-to-business contracts, the CCP formed the China Minerals Resources Group, a new state agency to buy iron ore for the country's 20 steel producers.

The United States has raised global awareness of the China challenge and advanced policies to spur development of a secure clean energy supply chain. The Inflation Reduction Act (IRA), for example, provides $370 billion in taxpayer subsidies to incentivize domestic mining, processing, and clean tech manufacturing. Yet, for America to retake clean energy and security leadership, it should establish clear boundaries and prohibit U.S. taxpayer incentives ending up in the hands of Chinese firms. These prohibitions should apply whether the firms are operating abroad or in collaboration with companies at home. Failure to do so explicitly would unjustly reward and enrich the CCP's exploitative practices and undermine U.S. competitiveness.

The U.S. should apply a more nuanced test in considering alliances. Free Trade Agreements alone are insufficient determinants in this new era of economic realpolitik. European Commission President Ursula von der Leyen would like the EU to qualify for IRA subsidies even though several European EV factories are owned by Chinese companies. Meanwhile, German Chancellor Scholz led Volkswagen and other CEOs to meet with Party Leader Xi in Beijing. Increasing dependence on a strategic threat weakens free nations' shared security.

America should work to strengthen traditional alliances; however, we must also be pragmatic in our economic statecraft. U.S. and European officials have discussed creating a critical minerals "buyer's club," but to be credible, club membership should be dependent on a more rigorous test than just geography.

The United States has launched meaningful programs to increase its domestic clean energy capacities and encourage the diversification of mineral supply chains away from China. Yet, capital formation has not met the scale of climate goals or national security needs. America should take actions to improve investor confidence and rebalance the critical minerals market playing field. We can act boldly and create meaningful competition or act rhetorically and entrench Chinese control for generations.

# The Age of Energy Insecurity:
# How the Fight for Resources Is Upending Geopolitics[5]

**Jason Bordoff[6] and Meghan L. O'Sullivan**



As recently as 18 months ago, many policymakers, academics, and pundits in the United States and Europe were waxing lyrical about the geopolitical benefits of the coming transition to cleaner, greener energy. They understood that the move away from a carbon-intensive energy system that relied on fossil fuels was going to be difficult for some countries. But on the whole, the conventional wisdom held that the shift to new sources of energy would not only aid the fight against climate change but also put an end to the troublesome geopolitics of the old energy order.

Such hopes, however, were based on an illusion. The transition to clean energy was bound to be chaotic in practice, producing new conflicts and risks in the short term. By the fall of 2021, amid an energy crisis in Europe, skyrocketing natural gas prices, and rising oil prices, even the most optimistic evangelist of the new energy order had realized that the transition would be rocky at best. Any remaining romanticism evaporated when Russia invaded Ukraine in February 2022. The war revealed not only the brutal character of Russian President Vladimir Putin's regime and the dangers of an excessive energy dependence on aggressive autocracies but also the risks posed by a jagged, largely uncoordinated scramble to develop new energy sources and to wean the world off old, entrenched ones.

One result of this turmoil has been the revival of a term that had come to seem anachronistic during the past two decades of booming energy supplies and utopian visions of a green future: energy security. To many Americans, that phrase is redolent of the 1970s, conjuring images of boxy sedans and wood-paneled station wagons lined up for miles, waiting to fill their tanks with gasoline at sky-high prices thanks to the Arab oil embargo of 1973 and the Iranian Revolution of 1979. But energy security is hardly a thing of the past: it will be crucial to the future.

Energy security has historically been defined as the availability of sufficient supplies at affordable prices. But that simple definition no longer captures reality; the risks the world now faces are both more numerous and more complicated than in earlier eras. To

[5] This essay was originally published by *Foreign Affairs' May/June* 2023 issue, Volume 102, Number 3
[6] Jason Bordoff is the Founding Director, Center on Global Energy Policy, Columbia University, SIPA; Co-Founding Dean, Columbia Climate School

handle these new challenges, policymakers should redefine the concept of energy security and develop new means of ensuring it. Four broad principles should guide this process: diversification, resilience, integration, and transparency. Although these principles are familiar, the traditional methods of applying them will prove insufficient in this new era; policymakers will need new tools.

There is no reason to despair just yet. After all, the oil crisis of the 1970s sparked a great deal of innovation, including the development of today's wind and solar technologies, greater efficiency in vehicles, and new government and multilateral institutions to make and coordinate energy policy. The policies and technologies that now seem old and outdated were once shiny and new. Today's crisis may likewise lead to novel ideas and techniques, as long as policymakers fully grasp the new realities they face.

## The Future Arrived Early

The events of the past year and a half have dramatically revealed the many ways in which the energy transition and geopolitics are entangled. Dynamics that were once seen as theoretical or hypothetical are now concrete and evident to even the casual observer.

First, the past 18 months have highlighted the "feast before famine" dynamic facing traditional producers of oil and gas, whose power and influence will increase before it wanes. In 2021, for example, Russia and other oil and gas producers had a banner year in terms of revenue as extreme weather and the world's emergence from pandemic slowdowns boosted demand for natural gas. Such shocks had outsize impacts in a market with a meager cushion. In previous years, poor returns, uncertainty about future demand for energy, and pressure to divest from fossil fuels all contributed to diminished investment in oil and gas, resulting in inadequate supplies. Russia took advantage of these tight energy markets by draining its European gas storage sites and slashing spot gas sales even as it met long-term contractual commitments. Average natural gas prices tripled from the first half to the second half of 2021. Combined with rising oil prices, these developments granted Russia a feast of annual revenues that were 50 percent higher for oil and gas than the Kremlin had expected.

The past year and a half also demonstrated that some oil and gas producers were still prepared to use their energy prowess to ruthlessly advance their political and geostrategic objectives; hopes that the world had moved beyond such behavior were dashed with the brutal Russian invasion of Ukraine in February 2022. In the months that followed, Russia gradually cut its pipeline gas deliveries to Europe by more than three-quarters, triggering a crisis that led European governments to spend a staggering

800 billion euros shielding companies and households from higher energy costs. The world's dependence on Russia for energy initially weakened the global response to the invasion: for many months, Russian oil flows were exempt from European sanctions. To this day, the EU has not sanctioned Russian gas sales; indeed, its members continue to import significant volumes of Russian liquefied natural gas. Tight energy markets allowed Russian oil and gas revenues to soar and gave Moscow a potential means of dividing a newly united Europe.

By last year, the mismatch between declining supplies and rising demand had already tightened the oil market. Prices leaped even further, to a 14-year-high, on market fears that the delivery of millions of barrels per day of Russian oil would be disrupted even as demand surged. At the beginning of the war in Ukraine, the International Energy Agency (IEA) predicted that Russian production would decline by three million barrels per day. Fears of supply shocks drove up oil prices and boosted both the income and the geopolitical heft of major oil producers, particularly Saudi Arabia. The United States had thought its days of begging Saudi Arabia to increase oil output had passed. But in the face of high prices, old patterns reasserted themselves, as Washington pleaded— mostly in vain—for more output from Saudi Arabia, the only country with any meaningful spare oil production capacity.

The tremors of the last 18 months also illustrate how the geopolitical environment can affect the pace and scope of the transition to clean energy. Before the Russian invasion of Ukraine, European countries and the United States were committed to transforming their economies to achieve net-zero carbon emissions in the coming decades. The brutality of Russia's actions and the knowledge that those actions were funded by fossil fuel receipts reinforced the determination among many in Europe and the United States to move away from oil, gas, and coal. In Washington, one result was landmark climate legislation in the form of the Inflation Reduction Act. Europe also expedited its green plans, notwithstanding some small near-term increases in coal use.

Many American officials worry, however, that a more accelerated energy transition will necessarily involve greater dependence on China, given its dominance of clean energy supply chains. U.S. Senator Joe Manchin, a Democrat from West Virginia, warned that he did not want to have to wait in line to buy car batteries from China the way he waited in line in the 1970s to buy gasoline made with oil from the Middle East. Such fears led Congress to create incentives for the domestic production, refining, and processing of critical minerals now centralized in China. Rather than praising Washington for finally passing meaningful climate change legislation, however, much of the world resented these moves as acts of U.S. protectionism, stirring talk of climate-provoked trade wars.

Finally, the energy crisis of the last 18 months has widened the rift between rich and poor countries. Many countries in the developing world became more strident in objecting to pressure to diversify away from fossil fuels, noting the rise in food and energy costs emanating from a European war. Developing countries have also denounced what they perceived as the hypocrisy inherent in how the developed world has responded to the crisis: after years of citing climate change as a reason to avoid funding natural gas infrastructure in lower-income countries, for example, European countries were suddenly racing to secure new supplies for themselves and building new infrastructure to accept them. Making matters worse, as Europe bid up the price of gas, demand for coal spiked in Asia and drove prices to record levels, leaving developing and emerging-market countries, such as Pakistan and Bangladesh, struggling to afford energy in any form. These tensions were on full display at the UN climate conference in Egypt in November 2022. Biden arrived to take a victory lap over the passage of a historic domestic climate law but found that poorer countries were unimpressed. Instead, they asked why the United States was not doing more to finance climate-change adaptation and clean energy outside its borders and demanded that their richer counterparts compensate them for the damage that climate change has already caused to their cities, agriculture, and ecosystems.

The energy crisis may have eased in recent months, but it is still far too early for complacency. The vast majority of Europe's reduction in gas demand last year arose from unusually warm weather and the idling of industrial production, as opposed to intentional conservation that can be sustained. Moreover, Europe may not be able to rely on much, if any, Russian gas to refill its storage facilities over the coming year. The flow of piped Russian gas into Europe throughout 2022, albeit in shrinking volumes, has now halted and seems unlikely to resume; the Russian liquefied natural gas still flowing to Europe could come under pressure and be curtailed in the months ahead.

Meanwhile, with growing risks to Russian oil output, global demand is expected to rise nearly twice as much as supply in 2023, according to the IEA. Washington's primary tool for cushioning supply disruptions, the U.S. Strategic Petroleum Reserve, is vastly diminished. If prices begin to soar again, Western countries will have few options but to turn once more to Saudi Arabia and to the United Arab Emirates, which also has some spare capacity. Ironically, by the time the UAE hosts the next major UN climate conference, at the end of 2023, the world may well also be turning to Abu Dhabi not just for climate leadership but for more oil.

Driving the new energy insecurity are three main factors: the return of great-power rivalry in an increasingly multipolar and fragmented international system, the efforts of many countries to diversify their supply chains, and the realities of climate change.

Russia's invasion of Ukraine and its broader confrontation with the West offer a striking example of how the ambitions of a single leader can create energy insecurity for broad swaths of the world's population, and the war serves as a reminder that great-power politics never really went away. The U.S.-Chinese contest, however, may ultimately prove more consequential. The intensifying desire of the United States and China to not rely too much on each other is remaking supply chains and reinvigorating industrial policy to a degree not seen in decades. Even with redoubled efforts to produce more clean energy at home, the United States and others will still depend on China for critical minerals and other clean energy components and technologies for years to come, creating vulnerabilities to Chinese-induced shocks. For instance, in recent months, China has suggested that it may restrict the export of solar energy technologies, materials, and know-how as a response to restrictions that Washington imposed last year on the export of high-end semiconductors and machinery to China. If Beijing were to follow through on this threat or curtail the export of critical minerals or advanced batteries to major economies (just as it cut off rare earth supplies to Japan in the early 2010s), large segments of the clean energy economy could suffer setbacks.

Traditional energy heavyweights are also recalibrating their positions in response to the changing geopolitical landscape in ways that increase energy security risks. Saudi Arabia, for instance, now sees its global stance differently than it did in the decades that followed the famous "oil for security" bargain struck by U.S. President Franklin Roosevelt and Saudi King Abdulaziz ibn Saud on Valentine's Day in 1945. Riyadh is now far less concerned with accommodating Washington's requests, overt or implied, to supply oil markets in ways consistent with U.S. interests. In the face of a perceived or real decrease in U.S. strategic commitment to the Middle East, Riyadh has concluded it must tend to other relationships—especially its links to China, the single largest customer for its oil. The kingdom's acceptance of China as a guaran- tor of the recent Iranian-Saudi rapprochement bolsters Beijing's role in the region and its global status. Relations with Moscow have also become particularly important to Saudi Arabia. Regardless of the invasion of Ukraine, the Saudi government believes that Russia remains an essential economic partner and collaborator in managing oil-market volatility. It will therefore be extremely reluctant to take positions that pit the Saudi leadership against Putin.

The new energy insecurity is also shaped by forceful moves many countries have made to domesticate and diversify their supply chains since the invasion of Ukraine and the global pandemic. Such moves are understandable, and even wise, given the now evident risks of excessive dependence on certain countries, notably China, in this new geopolitical era. Yet an interconnected global energy system remains the cornerstone of energy security; markets are still the most efficient way to allocate supplies. Increased self-sufficiency may give countries an increased sense of resilience but could also make

them vulnerable; an interconnected global market can ease disruptions caused by extreme weather or political instability. More segmented energy markets will inevitably have fewer options to tap in such circumstances. The U.S. Inflation Reduction Act and Europe's Green Deal industrial plan are intended to accelerate the drive to net-zero emissions, and they reduce energy insecurity in some ways by curbing dependence on globally traded hydrocarbons exposed to geopolitical risks.

Yet they also increase insecurity, since promoting domestic industries runs the risk of stoking protectionism and fragmentation, both of which can make economies less energy secure.

Finally, climate change will be a major threat to energy security in the coming decades, posing risks to infrastructure old and new. Warmer waters and more severe droughts will make it harder to cool power plants, transport fuels, and rely on hydropower. In 2022, California lost half its hydroelectric output because of drought, and Brazil was nearly forced to ration electricity after losing much of its hydropower. These kinds of events will become more common as the world decarbonizes because an energy system less reliant on hydrocarbons will depend more heavily on electricity; the cheapest way to decarbonize sectors such as transportation and heating will be to use electricity instead of gasoline engines or natural gas boilers. The IEA estimates that if the world is to reach the goal of net-zero carbon emissions by 2050, 50 percent of global energy consumption will need to be met by electricity, up from only 20 percent today. And nearly all that electricity will need to be produced from zero-carbon sources, up from only 38 percent today.

Climate change will place much of the infrastructure for this electricity generation, transmission, and distribution at greater risk, since fragile grids and overhead wires are often more vulnerable to extreme weather, wildfires, and other climate-related risks. Climate change can also have a negative impact on renewable sources of electricity, with the UN Intergovernmental Panel on Climate Change projecting that by 2100, average global wind speeds could fall by 10 percent as climate change reduces the differences in atmospheric temperatures that generate wind.

## Diversification Dilemmas

One solution to these problems is to diversify supply. Diversification remains as central to energy security as it was in 1913, when Winston Churchill, then the first lord of the Admiralty, declared that "in variety, and in variety alone" would the United Kingdom find a solution to vulnerabilities created by his decision to shift the British navy from a reliance on Newcastle coal to less secure sources of oil from Persia.

*Aspen Institute Congressional Program*

In the long run, the clean energy transition will lead to improved energy security in many cases by diversifying fuel sources and suppliers. For example, transportation, most of which currently runs on oil, will be less vulnerable to fuel supply disruptions in a world where roughly two-thirds of vehicles are electrified, since electricity can be generated from multiple energy sources. And because most electricity is produced close to where it is consumed, a more electrified world will also be less subject to import disruptions caused by disputes among countries.

Yet as the transition progresses and consumers diversify away from fossil fuels, new vulnerabilities and threats to energy security will arise. Even as oil use wanes, geopolitical risks may increase as global production becomes further concentrated in countries that can produce at low cost and with low emissions, many of which are in the Persian Gulf. In the IEA scenario in which the world reaches net-zero carbon emissions by 2050, the share of global oil supply from OPEC producers rises from around one-third today to roughly one-half. The oil giant BP anticipates an even greater global dependence on these producers, estimating that by 2050, they will account for close to
two-thirds of global oil supply. In the long run, that will be a large share of a tiny pie, but for decades, oil demand will remain very high and consequential even if annual demand is falling.

U.S. policymakers may well ask themselves how comfortable they would feel if global oil production were to be even more heavily concentrated in OPEC countries than it is today. Faced with that outcome, they might consider a number of options, such as extending the increasingly popular concept of “friend shoring” to oil by more actively supporting production at home and in countries such as Norway and Canada, which are perceived as less risky than, say, Iran, Libya, and Venezuela. Some officials might even advocate penalizing less friendly oil sources through import taxes or even sanctions.

Taking such measures to subvert the market and bolster oil production in preferred locations would carry significant risks, however. It would undermine the benefits that come from the ability to reroute oil supplies in case of disruption. It would also risk backlash and retaliation from major global oil producers in OPEC, which can send prices higher by restricting output. Subsidizing domestic supply would also run counter to efforts to encourage consumers to move away from fossil fuels. A better approach would be to embrace global markets but boost defenses against inevitable shocks and volatility with larger, not smaller, strategic oil reserves.

Meanwhile, diversifying the inputs of clean energy will be even more difficult than doing so for fossil fuels. The sources of the requisite technology and components, notably the critical minerals needed for batteries and solar panels, are even more heavily

concentrated than oil. The world's largest supplier of lithium (Australia) accounts for around 50 percent of global supply, and the leading suppliers of cobalt (the Democratic Republic of the Congo) and rare earths (China) each account for around 70 percent of those resources. In contrast, the world's largest producers of crude oil—the United States, Saudi Arabia, and Russia—each account for just 10 to 15 percent of global supply. The processing and refining of these minerals are even more concentrated, with China currently performing around 60 to 90 percent of it. Meanwhile, Chinese companies manufacture more than three-quarters of electric vehicle batteries and a similar proportion of the so-called wafers and cells used in solar energy technology.

U.S. policymakers have recently awakened to these vulnerabilities and the fact that they will become more acute as the transition progresses. The Inflation Reduction Act encourages the production of critical minerals in the United States and elsewhere by providing tax credits and loan guarantees for domestic producers, among other measures. The Biden administration recently signed agreements with Congo and Zambia that are intended to increase U.S. imports of their clean-energy minerals. And the U.S. International Development Finance Corporation (DFC) has pursued debt transactions to support the development of solar cell manufacturing outside China. But to get more of the minerals it needs from more of the countries it prefers, Washington will need to strike many more bilateral and multilateral trade agreements and sharpen instruments such as the U.S. Export-Import Bank, which can fund overseas mining operations in friendly countries such as Indonesia. For its part, the U.S. Congress should increase the DFC's authority and expand its ability to make investments.

Another area that badly needs more diversification is enriched uranium, which will become more important as the use of nuclear power increases globally to meet low-carbon electricity needs. Russia's role as a dominant supplier of nuclear fuel services to many countries, including the United States, is a source of great discomfort and vulnerability, given the current geopolitical realities. Boosting uranium production, conversion, and enrichment in the United States and among its West- ern allies and substantially ramping up their fabrication of the fuel assemblies for Russian-made reactors will be critical to maintaining the existing nuclear fleet and keeping decarbonization goals within reach.

## Building Resilience

A secure energy system must be able to withstand and bounce back quickly from unexpected shocks and disruptions. At the most fundamental level, reliable energy infrastructure is the key to that sort of resilience. Governments and private companies

have long worked to protect energy infrastructure from dangers of all kinds, from terrorist attacks to hurricanes. As the transition proceeds, they will need to step up such efforts. Moreover, as the clean energy economy becomes more digitized and electrified, it will be exposed to a growing threat of cyberattacks. Private companies and governments will need to coordinate and cooperate to deter and respond to threats such as the 2015 cyberattack that took out large swaths of the grid in western Ukraine.

Resilience also requires flexibility, which in the energy sector is measured by the ability of every part of a system to cope with losses in other parts. Because renewable sources such as solar power and wind are highly variable, the energy they generate needs to be either stored or backed up by other sources, with delivery systems making minute-by-minute adjustments. That is already a difficult task, and it will become even harder in a grid with more intermittent sources of energy and more variable electricity demand. According to the IEA, the global power system's need for flexibility—measured as the amount the rest of the system needs to adjust to handle changes in demand and in solar and wind output—will more than quadruple by 2050 if all countries fulfill their climate pledges. Today, plants that run on coal or gas perform most of these adjustments. But as the transition progresses, the number of such plants—and thus their ability to serve as backstops—will progressively diminish.

To counteract that dynamic, U.S. policymakers should take steps to make sure that the increasing share of renewable energy on the grid is matched by adequate balancing resources and storage capacity. Doing so will require structures such as so-called capacity markets, which pay generators to be available to meet peak demand even if they are idle much of the time. Such mechanisms can help ensure that companies whose resources are needed only infrequently nevertheless stay in business and support a reliable electricity supply even as their utilization rate falls as the grid decarbonizes.

Officials can also make use of new tools to manage demand for energy without massively inconveniencing consumers or creating political headaches. For instance, digital technology can help consumers shift energy-intensive activities to low-demand times of the day (such as running dishwashers and clothes dryers overnight) or prompt them to save energy by lowering thermostats in unoccupied rooms. Artificial intelligence will also play a growing role—for example, by reducing the amount of time that energy systems are down for maintenance, by forecasting demand, and by improving storage. Such tools would have come in handy in December 2022, when grid operators in Texas badly underestimated how much electricity customers would need and the state barely avoided widespread blackouts. Finally, officials should avoid the early retirement of fossil-fired electricity sources that can balance the grid and ensure reliability before alternatives are fully capable of providing the necessary level of service.

A resilient system must also be able to weather unexpected shocks and supply disruptions. For decades, policymakers have relied heavily on two types of buffers: the spare capacity of oil-producing countries (especially Saudi Arabia) and strategic stockpiles, which members of the IEA are required to hold as part of an agreement forged after the Arab oil embargo in the 1970s. These historical buffers will still matter as the transition unfolds—even more so if, as seems likely today, declines in energy supply and investment are not synchronized with declines in demand, leading to less slack in the system to handle unexpected shocks and more volatility. Moreover, it is clear that Riyadh has become far less willing to dip into its spare capacity whenever Washington demands it. As coal generation declines in a decarbonizing economy, there will be less opportunity for power generators to toggle between natural gas and coal, as many do now. This new reality could result in more volatility in natural gas prices. And recent turmoil in the refining sector that contributed to skyrocketing gasoline and diesel prices in the United States was a reminder that limited refining investment can bite consumers before vehicle electrification causes fuel use to drop sharply. For those reasons, other strategic stocks of all kinds will become more important—not just those that hold oil but also ones that hold natural gas and oil products such as diesel fuel and gasoline.

The United States will also need strategic stockpiles of the building blocks of clean energy, working with its allies to amass critical minerals such as lithium, graphite, rare earths, and nickel. Such coordination would be enhanced if the IEA had a hand in negotiating agreements, assessing which countries are best positioned to contribute to which stockpiles, and regularly monitoring whether the composition of stockpiles fits current needs. The IEA has played this role admirably for oil and oil products and could do so again with critical minerals if its members chose to expand its mandate.

## Integration As Insurance

A desire for greater security has spurred the decades-long quest for ‘energy independence’ in the United States and elsewhere. And because of the shale revolution, the United States has become energy self-sufficient in net terms. Nevertheless, the country continues to be vulnerable to geopolitical risks because in a global market, supply shocks anywhere affect prices everywhere. Proponents of the transition to a net-zero carbon system have long heralded the greater insulation from geopolitics that would likely result from the end of the fossil-fuel era. But at least for the next few decades, energy security will be advanced not through more autonomy but through more integration—just as it always has been.

Interconnected and well-functioning energy markets increase energy security by allowing supply and demand to respond to price signals so the entire system can better handle unexpected shocks. In 2005, when Hurricanes Katrina and Rita disrupted much of the U.S. Gulf Coast's vast production and refining operations, energy companies were able to avert fuel shortages by quickly importing supplies from the global market. Similarly, after the Fukushima nuclear disaster in 2011, Japan was able to temporarily shut down its nuclear power sector because it could import other sources of fuel from the global market.

But maintaining and cultivating interdependence in today's environment is more difficult than at any time in recent memory, as countries around the world are embracing industrial policies that involve increased state intervention in markets. Although those efforts can deliver benefits, such as minimizing markets' vulnerability to the whims of geopolitical adversaries, many policymakers want to go further, promoting such policies as a means to boost domestic jobs and build political coalitions in support of stronger action on the environment. Indeed, although climate diplomacy has been premised for years on the assumption that progress depends on transnational cooperation, some efforts to advance climate action paradoxically risk undermining cooperation by fueling the forces of fragmentation and protectionism.

The case for energy integration has suffered as a result of Europe's urgent need to decouple from Russian energy during the war in Ukraine. Nevertheless, although shocks may be felt more broadly in an integrated system, they are also felt less intensely. Integration is a form of insurance that spreads the risk of energy supply disruptions among many parties. And even if more autonomy were preferable to more integration, it would not be possible to expand clean energy at the scale and speed needed if each country sought to produce and consume only within its own borders. According to the IEA, the value of global trade in critical minerals will need to triple to achieve net-zero emissions by 2050. Global trade in low-carbon fuels such as hydrogen and ammonia will also need to grow exponentially. For the United States, energy security will require fewer trade barriers and more trade agreements with allies, as well as with other countries that meet certain environmental standards. Washington should also eliminate tariffs on goods and technologies related to clean energy and help finalize the Environmental Goods Agreement, which would reduce tariffs on goods that benefit the environment to lower their costs and increase their trade.

## What You Don't Know Can Hurt You

One of the reasons that the United States, Canada, Japan, and several European countries created the IEA in 1974 was that a lack of accurate, reliable data on prices and supplies had made it hard for governments to craft policies and respond to crises. The lesson was clear: good data allows markets to function, prevents panic, and deters the speculation that exacerbates price spikes, volatility, and shortages. Over the decades, IEA data, along with data assembled by the International Energy Forum, has underpinned decision-making about production levels and guided actions such as coordinated releases of stockpiled oil.

A clean energy economy will need the same kind of transparency. Inadequate data in nascent markets, such as those for green ammonia and hydrogen, can cause supply disruptions, a lack of liquidity, and poor availability of spot price assessments, all leading to pronounced price fluctuations. The energy transition will also depend heavily on the market for critical minerals, such as nickel. But investors were reminded of how market opacity can trigger extreme volatility when the price of nickel on the London Metal Exchange almost quadrupled over just two days in early 2022, owing to massive short-selling caused in part by a lack of price transparency.

Currently, some private companies have good information on prices, but no single entity gathers broad industrywide data and makes it publicly available. The IEA is the clear candidate to fill that role. Ideally, the agency would ask governments to share consumption and production data on minerals and make informed inferences about inventory levels. Such data sharing would be especially important to ensure compliance if governments agreed to create strategic stockpiles, as they do with oil. For such a system to work, however, the IEA would have to bring in countries that are not members of the organization but produce or consume significant amounts of those minerals, which in turn would require a new legal framework for the agency. Meanwhile, to help prevent market manipulation and speculation, national regulators such as the U.S. Commodity Futures Trading Commission should require greater transparency in the pricing and trading of commodities.

## Security and the Climate

The importance of energy security never diminished; it had simply been taken for granted in a world of abundance and integrated, well-functioning global energy markets. Policymakers now have the opportunity to look at energy security and climate security afresh, to accord appropriate weight to both, and to appreciate that neither can be achieved in the absence of the other.

*Aspen Institute Congressional Program*

This effort requires recognizing that energy security is not a static concept but one that has evolved a great deal since the crises of the 1970s. Policymakers must grasp the new risks to energy security and modernize their toolkits to combat them. Doing so is not a distraction from addressing climate change but central to it; without this shift, energy crises might derail the drive to net-zero emissions. In the not-so-distant past, officials and experts thought that excessive fears about energy security might hinder the fight for the climate. Today, the opposite is true: as the transition to a net-zero world proceeds, the bigger danger to the climate will be insufficient attention to energy security.

# U.S. Leadership in Clean Energy Innovation

**Rich Powell**

*CEO, ClearPath*

The United States is experiencing many of the same challenges as its global partners, including economic inflation, high fuel and electricity prices, increasing carbon dioxide emissions and global supply chain chaos. Yet, addressing how to solve this crisis has created a narrative of false choices in Washington and globally. There have been debates on renewables versus fossil fuels, economy versus environment, and 100% global emissions reductions versus inaction in the United States, which has clouded the path forward. No nation, government, or business will achieve their climate goals while maintaining economic vitality unless policymakers eliminate these false choices and leverage all energy resources on the table.

There are three major components of the global deployment of clean energy technologies to address global energy challenges:

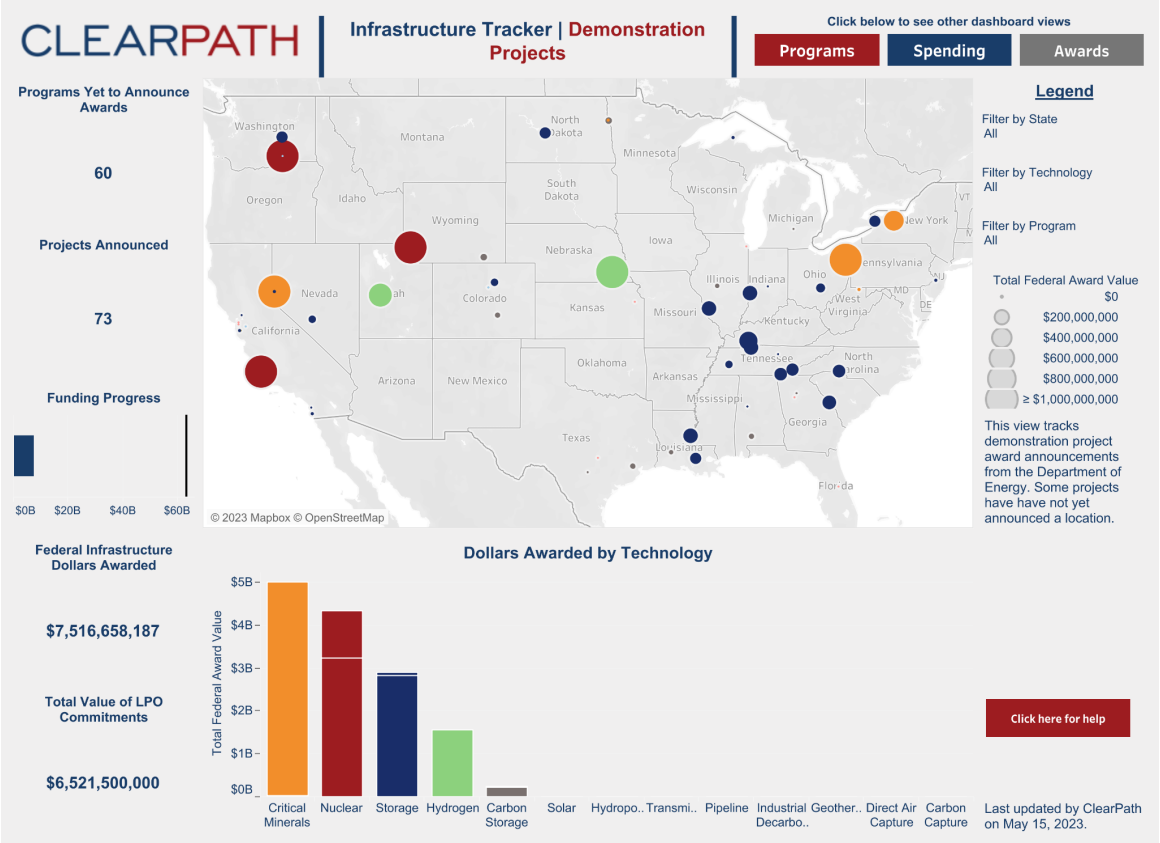
1. Successfully innovating and demonstrating technologies in the U.S. in partnership with the U.S. Department of Energy (DOE);
2. Removing regulatory roadblocks to build enough quickly to bring down costs; and
3. Collaborating with international financial institutions and development finance institutions to ensure clean reliability in the developing world

## Innovate, Demonstrate, and Deploy

Large-scale energy innovation often needs to bring together private and public investments to scale up deployment and bring down costs. This model worked for solar, wind, natural gas, and other clean energy technologies. Fortunately, the past few years has yielded targeted federal energy innovation policy that, if implemented right, could help bring resource production back to America. The successful implementation of the bipartisan Energy Act of 2020, the bipartisan Infrastructure Investment and Jobs Act (IIJA), the bipartisan Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act, and federal tax incentives is critical to ensuring that U.S. companies can demonstrate and deploy their technologies and be able to compete on the world stage.

To assist with accountability and oversight, ClearPath has developed an interactive dashboard to follow progress across the major demonstration programs led by the DOE

from the initial program development stages all the way through to final award selections.[7] To date, DOE has announced 73 separate awards totaling $7.5 billion across programs funded by the IIJA, with additional demonstration programs set to announce awards before the end of the year.




One area where we have seen a particular uptick in demand due to the recently enacted federal programs is carbon capture. Recent legislation infused nearly $12 billion into the carbon management supply chain along with significant tax incentives, which has resulted in a 550 percent increase in demand for carbon storage permits from our federal regulators in the past year alone.[8,9] In 2021, in an effort to provide more storage options for innovative capture management companies, Congress directed the Bureau of Ocean Energy Management to initiate the rule-making process to develop regulations to

[7] https://clearpath.org/clearpath-infrastructure-tracker/
[8] https://www.mayerbrown.com/en/perspectives-events/publications/2022/06/carbon-capture-utilization-and-storage-class-vi-wells-and-us-state-primacy
[9] https://www.epa.gov/uic/class-vi-wells-permitted-epa

take advantage of the U.S.' over 360 gigaton worth of offshore pore space.[10,11,12] Although the U.S. does not currently have a legal framework in place that allows for permanent offshore sequestration like Norway, a regulation is in the works and expected to be released soon. It is clear that the U.S. shares Norway's ambitions to get emissions stored safely underground. The combination of the U.S. tax credits and vast storage capabilities close to the nation's Gulf Coast industrial activities make it an ideal place to develop one of the world's lowest-cost carbon capture and storage that will allow projects to develop at scale.

Outside of Norway and the U.S., carbon capture, utilization, and storage (CCUS) is on the rise globally. There are 35 projects in operation worldwide and over 250 million metric tons of CO2/yr of capture capacity currently in development by 2030.[13] 40 percent of the capacity in development over that timeline is in the U.S., which is currently the global leader on CCUS technology. While the over 100 million metric tons of capacity announced in the U.S. is significant, it is only scratching the surface of this country's potential. A recent report from the DOE estimates that getting CCUS technologies on track for climate targets in the U.S. would require capacity to capture 400 to 1,800 million tons of CO2 per year by 2050.[14] This level of development would represent $100 billion of investment by 2030 and $600 billion by 2050.

On a global level, reaching net-zero by 2050 likely requires at least 4-7 gigatons of CO2 captured per year, meaning that we currently only have one-half of one percent of the CCUS capacity needed today.[15] CCUS technologies allow us to mitigate emissions and also support American jobs. Right now, the U.S. truly has the lead on other countries through a combination of engineering expertise, technical leadership, and recently enacted public policy like the enhancements to the 45Q carbon capture utilization and storage tax credit and the DOE's Carbon Capture Demonstration Projects Program. Going forward, the U.S. needs to parlay this leadership edge into the potential to export our expertise – alongside our LNG – to support the development of carbon capture technologies in other countries.

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[10] https://www.boem.gov/sites/default/files/documents/about-boem/regulations-guidance/BOEM-5th-International-Conference.pdf
[11] https://gov.alaska.gov/wp-content/uploads/FINAL-Carbon-Management-Bill-Package-FAQs_1.26.2023.pdf
[12] https://www.boem.gov/sites/default/files/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/Energy_Economics/External_Studies/OCS%20Sequestration%20Report.pdf
[13] https://www.iea.org/reports/carbon-capture-utilisation-and-storage-2
[14] https://www.energy.gov/lpo/articles/doe-releases-fourth-pathways-commercial-liftoff-report-carbon-management
[15] https://www.iea.org/reports/ccus-in-clean-energy-transitions/ccus-in-the-transition-to-net-zero-emissions

## Overcoming Regulatory Roadblocks

Achieving net-zero emissions by 2050 is ecologically essential, technologically feasible, economically achievable, but procedurally impossible. There are many ways to accelerate U.S. leadership in clean energy innovation. The single largest mover for private sector investment is regulatory certainty. Developers can only build new energy infrastructure as fast as federal, state, and local governments can permit them, but it simply is not fast enough. It can now take six years to permit carbon dioxide storage locations needed to store billions of tons captured from industrial sites, 16 years to permit an offshore wind farm in Massachusetts, and up to 15 years for a new transmission line from Wyoming to Utah.[16,17,18]

Data from the Council on Environmental Quality (CEQ) shows that on average it takes agencies 4.5 years to issue a Record of Decision for an Environmental Impact Statement (EIS). However, the average belies the real challenge.[19] In reality, 10 percent of projects took 10 years or more to reach a Record of Decision from the initial Notice of Intent. The projects most likely to be held up in permitting purgatory are those that have the potential to offer the greatest benefits. Unnecessary regulatory hurdles that slow down the deployment of innovative technology and necessary infrastructure threaten the United States' ability to significantly reduce our emissions and provide low-cost options to the rest of the world on an ambitious timescale.

The U.S.  needs to build clean energy projects faster to meet emissions reduction targets by 2050. The current regulatory environment causes unnecessary delays that make clean energy projects more expensive, distract regulatory resources from where they are most needed, and impede deployment of billions of federal dollars for clean energy demonstration projects. Queue delays and backlogs have escalated, making it more difficult to deploy all forms of clean energy. In 2022, it took five years for a project to advance through the queue, compared to three years in 2015 and under two years in 2008.[20] The permitting measures in the Fiscal Responsibility Act was a positive, constructive, significant step towards a wider conversation, but much remains to be done. To reach net-zero emissions, for example, the U.S. will  need to permit roughly 1,000 major projects every year through 2050. Today, the country  only permits dozens at this scale. The public wants more energy infrastructure of all kinds to make the grid

[16] https://www.reuters.com/business/energy/top-us-oil-states-vie-carbon-capture-oversight-speed-up-permits-2022-01-26/
[17] https://www.nytimes.com/2017/12/19/us/offshore-cape-wind-farm.html
[18] https://cowboystatedaily.com/2023/04/20/after-15-years-of-permitting-transwest-wind-transmission-project-is-still-5-years-from-going-live/
[19] https://trumpwhitehouse.archives.gov/wp-content/uploads/2020/01/20200612CEQ_EIS_Length_Report_Update.pdf
[20] https://emp.lbl.gov/sites/default/files/queued_up_2022_04-06-2023.pdf

cleaner, more resilient, and more affordable, but they also want new buildings to be safe and responsible. The U.S.  needs a balanced approach. A broad coalition of energy policymakers and developers – the Cleaner Faster — has aligned around four big reform principles:

1. Automatic approvals for clean energy in key zones;
2. Accelerated timelines for all permitting;
3. Fast adjudication of suits that arise;
4. Big incentives for states to streamline their permitting in line.[21]

## Exporting U.S. Clean Innovation – the Opportunity for American Nuclear Industry

An increase in demand for carbon-free, dispatchable electricity has coincided with unprecedented momentum within the U.S. nuclear industry. The International Energy Agency (IEA) modeled that in order to reach net-zero by 2050, the world needs to double the amount of today's nuclear energy capacity, or the equivalent of roughly 25 new 1,000-megawatt reactors per year by 2030 with accelerated growth beyond that.[22] From a climate perspective, some estimates suggest that deployment of the next generation of advanced nuclear reactors could unlock the equivalent of up to 1,500 million metric tons per year of global emissions reduction potential by 2050.[23] The calls for climate action on the global stage have never been louder, and the effects of the Russian invasion of Ukraine on international energy markets are lasting, which makes the expansion of reliable, secure, and affordable nuclear power more important than ever.

Currently, there are 15 designs in the application or pre-application process with the U.S. Nuclear Regulatory Commission (NRC). Some of these projects include the NuScale Carbon Free Power Project in Idaho; the TerraPower Natrium demonstration in Wyoming; the X-energy-Dow Chemical high temperature gas reactor in Texas; the GE Hitachi small modular reactor in Tennessee; and GE Hitachi's unprecedented global deployment consortium with the Tennessee Valley Authority, Canada's Ontario Power Generation, and Poland's Synthos Green Energy. These designs are being planned for deployment across North America and overseas.

At least eight U.S.-based companies have publicly announced international partnerships to explore deployment in more than 10 countries. For instance, GE Hitachi's BWRX-300 design for small modular reactors (SMRs) has been gaining traction in Poland with a

[21] https://www.aspeninstitute.org/publications/building-cleaner-faster-report/
[22] https://www.iea.org/reports/world-energy-outlook-2022
[23] https://www.iea.org/reports/nuclear-power-and-secure-energy-transitions

recent agreement on technical collaboration for development and deployment in the country.[24] Similarly, NuScale Power recently inked a contract with Romania for the first phase for deployment of what would be that country's first SMR.[25] Another U.S. SMR startup, Last Energy, recently announced power purchase agreements for nearly 3 dozen units of its power plants with industrial partners in the United Kingdom and Poland, representing $19 billion in electricity sales.[26]

Every international sale of a nuclear reactor – whether from the U.S. or a competitor – comes with both economic and geostrategic considerations for the countries involved. Entering into these partnerships can lock in a relationship between the entities involved for up to 80 to 100 years over the lifecycle of the project; from construction through decommissioning. This involves technology partnerships across engineering, design, construction, fueling, operations and maintenance. A network of U.S. nuclear projects abroad can promote our high-standards industrial and safety practices in other countries, while serving as an important dimension of America's technological and climate leadership around the world.

## Conclusion

The choice should be clear: producing American clean resources here at home and exporting them abroad creates jobs, promotes innovation, increases energy security, and leads to reduced global emissions. Targeted federal policy should empower American entrepreneurs, accelerate American innovation, and foster private sector investment into American industries.

[24] https://www.ge.com/news/reports/smrs-deploy-ge-hitachi-signs-four-party-agreement-to-bring-small-modular-reactors-online
[25] https://www.nuscalepower.com/en/news/press-releases/2023/nuscale-and-ropower-announce-signing-of-the-contract-for-phase-1-engineering-and-design-work
[26] https://www.ans.org/news/article-4868/last-energy-sets-up-microreactor-deals-for-poland-and-the-uk

# A New Era of Global Competition:
# Trade, Climate, and Investing in America

**Sonia Aggarwal**

*CEO, Energy Innovation; former Special Assistant to President Biden for Climate Policy, Innovation, and Deployment*

## The Security Backdrop

Energy can be a potent weapon. Fuel exports to some countries finance Russia's war, and in others, Russia withholds fuel as a form of aggression. Europe has cut its fuel purchases from Russia to retaliate economically, leaving the bloc chasing other sources of fuel to reduce energy price spikes that make life harder for families across the continent. All of this stirs political unrest stretching far beyond the direct conflict.

This is nothing new. The United States has been enmeshed with the Middle East and its oil riches for more than fifty years, creating energy, economic, and security vulnerabilities with grave consequences for American families. Global oil prices are in large part controlled by a small number of nations that do not have the U.S. interests at heart, and when these volatile prices rise, the U.S. faces serious economic and social consequences. Worse, American dependence on oil has funded terrorism, including the groups behind 9/11, bombing in Yemen, attacks in Syria and Israel, and so many more tragedies. The U.S. has funded both sides of the War on Terror.

Coal, oil, and natural gas can extract this economic toll because fossil fuels have powered economic growth for the last century, dramatically expanding human capabilities and productivity. Picture one 500-horsepower car, then picture 500 horses. That is what is on call at the press of the gas pedal. If the U.S. economy was powered by burning matches, it would require striking 125 quadrillion every year (a quadrillion is a thousand trillion). That is every individual in America burning through 12 matches every second forever. The energy and industrial systems humans built around fossil fuels enabled incredible societal advances in mere decades – the blink of an eye in human evolution.

Fossil fuels have been a force multiplier. They are stored in select regions of the world, ready for drilling or digging, at a steep cost for global security. Burning these fuels also costs us dearly in other ways – kids with asthma, crops drying up and dying, megastorms that wipe away entire towns, Florida families watching their nest egg vanish as the home they own becomes uninsurable, and on and on.

This is a heady record of benefits and drawbacks of fossil fuels, forcing painful trade-offs. Fortunately, the U.S. can now avoid those painful economic and security

drawbacks with clean energy. Rapid technology cost declines and smart policy have provided proven options to power economic growth, and the U.S. is in the opening days of a domestic clean energy economic boom that is onshoring manufacturing and creating new high-paying jobs across the U.S.

## The Path Forward

A great geopolitical reshuffling is underway, thanks in part to the fact that solar and wind are now the cheapest power sources on Earth, electric cars are ending pain at the pump, heat pumps and hydrogen electrolyzers are having a moment, and factory owners are seeking new ways to get ahead. All this cuts the need for fossil fuels. The switch will not flip overnight, but the economic fundamentals have arrived, as has the imperative to act on climate.

The sun shines and the wind blows the world over, and it is possible to manufacture and deploy clean energy almost anywhere. Of course, raw materials—including common ones and some rare ones—are required to build clean energy, but the extraction required for a zero-emission global economy is about 1/535$^{th}$ the scale needed for today's fossil fuel heavy economy.[27] Globally, we mined seven million tons of minerals for clean energy in 2020 and that annual extraction rate would need to increase to about 28 million tons over the next 15 years for a zero-emissions world.[28] Compare that to the 15,000 million tons of fossil fuels we currently extract every year. We cannot ignore the mineral requirements for a zero emissions global economy, and they will indeed be important. But we must not lose sight of the fact that the clean energy economy entails far less extraction and far fewer geopolitical dependencies as fossil fuels.

The binding constraint on near-term availability of most of these materials is less about where they are located—many are common throughout Earth's crust—and more about who has the industrial capability to process them. Consider: China extracts just five percent of the world's nickel but refines and processes 35 percent of global demand, extracts 13 percent of lithium but processes 58 percent, and extracts 1.5 percent of cobalt but processes 65 percent.[29] The point is: China is investing in the capability to process the minerals needed for the future, even if they are importing much of the raw material. The U.S. could absolutely make more of these investments, which would pay dividends for our security and global positioning.

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[27] Thomas, M. (2023, March 29). *A Fossil Fuel Economy Requires 535x More Mining Than a Clean Energy Economy.* Distilled. https://www.distilled.earth/p/a-fossil-fuel-economy-requires-535x

[28] IEA. (2021). *The Role of Critical Minerals in Clean Energy Transitions.* IEA, Paris. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions, License: CC BY 4.0

[29] Venditti, B. (2022, January 20). *Visualizing China's Dominance in Clean Energy Metals.* Visual Capitalist Elements. https://elements.visualcapitalist.com/visualizing-chinas-dominance-in-clean-energy-metals/

A natural worry arises: We cannot trade dependence on Putin for dependence on Xi. Chinese policymakers are making strategic investments in manufacturing clean energy equipment. One of every four vehicles sold in China last year was electric. China is the largest exporter of electric cars in the world, and earlier this year, China became the largest exporter of cars in general[30] – overtaking Japan after beating out Germany for the number two slot last year. China manufactures more than 60 percent of the world's heat pumps,[31] most of which are exported. America cannot afford to fall behind.

The nations that win in this geopolitical reshuffling will be the ones that invest in innovation and manufacturing, the ones that cultivate export markets for clean energy equipment. They will be the ones that provide a high standard of living for their citizens with dramatically-lower pollution. They will help the U.S. shake the many security vulnerabilities generated by financing groups that hate America. And they will be the nations that pass proactive policy to get ahead of these clear global trends. This is not partisan, it is practical – it is where the world is going.

## The Way to Win

Congress has an incredible recent record – the bipartisan American Innovation and Manufacturing Act, bipartisan Energy Act of 2020, bipartisan Infrastructure Investment and Jobs Act, bipartisan Chips and Science Act, and Inflation Reduction Act. These laws demonstrate a deep apprehension of global trends and make incredible progress to point the American nation in the right direction – every week citizens see a new headline about global corporations investing in America.

But it is hard to overstate the scale of change underway worldwide. Winning in the great geopolitical reshuffling requires additional steps.

Additional strategic investments in American innovation and manufacturing can build upon that recent legislation and position the U.S. to lead the new global economy. The U.S. can build a resilient global supply chain for clean energy equipment – which the world will demand in head-spinning quantities over the coming decades.

Recent laws have provided a much-needed boost for key technologies like clean hydrogen. The Infrastructure Investment and Jobs Act[32] and the Inflation Reduction Act[33] give America many of the tools it needs to compete globally in producing clean

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[30] Hoskins, P. (2023, May 19). *China overtakes Japan as world's top car exporter*. BBC. https://www.bbc.com/news/business-65643064

[31] CLASP. (2022). *Heat Pumps' Contribution to Carbon Neutrality* [White paper]. CLASP. https://www.clasp.ngo/wp-content/uploads/2022/11/Summary-of-Heat-Pump-White-Paper-2022.pdf

[32] *Regional clean hydrogen hubs.* U.S. DOE Office of Clean Energy Demonstrations. https://www.energy.gov/oced/regional-clean-hydrogen-hubs

[33] *Financial Incentives for Hydrogen and Fuel Cell Projects.* U.S. DOE Office of Energy Efficiency & Renewable Energy. https://www.energy.gov/eere/fuelcells/financial-incentives-hydrogen-and-fuel-cell-projects

fertilizer and sustainable aviation fuel using clean hydrogen. Additional investment in manufacturing electrolyzers – the technology that produces that clean hydrogen—would onshore the end-to-end clean hydrogen supply chain.

But this  risks falling behind in other sectors. Take steel, for example, where the widely held impression that Chinese steel is low-quality and high-pollution masks impressive manufacturing progress. In 2019, HBIS began building the world's first large-scale facility to make primary steel with hydrogen, using an Italian technology. That facility is running today, producing 1.2 million tons of primary steel each year.[34] Baosteel has now finished building its own 400 foot tall steel-making furnace in Guangdong, and by the end of this year, it will be pumping out another million tons of hydrogen-based primary steel.[35] The volume of steel from those two facilities alone equals about 10 percent of the primary steel made in the U.S. annually right now.[36]

Our close allies are also making progress. The world's largest steelmaker, ArcelorMittal, will upgrade a Spanish facility to be zero carbon, using about $500 million in public funds to make recycled steel.[37] Meanwhile in Germany, Salzgitter AG is building a zero-carbon primary steel facility with about $1 billion in public support alongside the company's own $1 billion investment.[38] Beyond steel, Rio Tinto and Alcoa are investing $1.1 billion in a zero-carbon aluminum facility in Canada, with about $220 million in government support.[39] But here is a red flag: The new aluminum factory in Canada uses a technology developed by an American company who was unable to find sufficient public support for demonstration in our country.

Where are America's headlines for first-of-a-kind zero carbon industrial facilities? The Inflation Reduction Act provides a down payment, but it is not enough to bring production to scale. Beyond steel and aluminum, electrofuels, zero-carbon industrial

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[34] https://www.hbisco.com/site/en/groupnewssub/info/2023/17019.html

[35] https://www.energiron.com/energiron-largest-hydrogen-based-dri-facility-in-china-for-baosteel-zhanjiang/

[36] Primary steel is a subset of total steelmaking, and refers to making new steel from iron rather than recycling steel. Much of the steel we make in the U.S. is recycled, but insufficient availability of scrap steel globally means primary steel will be required into the future. The U.S. currently makes approximately 23.5 million tons of primary steel each year.

[37] Collins, L. (2021, July 20). *World's first large-scale zero-carbon steel plant will require €500m of public money.* Recharge. https://www.rechargenews.com/energy-transition/world-s-first-large-scale-zero-carbon-steel-plant-will-require-500m-of-public-money/2-1-1042649

[38] Salzgitter AG. (2023, May 24). *SALCOS® milestone reached - Salzgitter AG awards contract for direct reduction plant* [Press release]. https://www.salzgitter-ag.com/en/newsroom/press-releases/details/salcos-milestone-reached-salzgitter-ag-awards-contract-for-direct-reduction-plant-20791.html

[39] Government of Canada. (2023, June 12). *Canada deepening its collaboration with global leader Rio Tinto to produce the world's greenest aluminum* [Press release]. https://www.canada.ca/en/innovation-science-economic-development/news/2023/06/canada-deepening-its-collaboration-with-global-leader-rio-tinto-to-produce-the-worlds-greenest-aluminum.html

chemicals, and zero-carbon cement will be needed at scale in a zero-carbon economy. All are worthy of further work with our allies to build resilient supply chains.

Then, of course, there is manufacturing the clean energy equipment itself – like power generation, batteries, transformers, electric vehicles, and heat pumps. Since passage of the Inflation Reduction Act, private companies have announced more than $70 billion in investment to manufacture more solar, wind, batteries, and electric vehicles in the U.S.,[40] including a new solar facility to be built in Oklahoma – which will be the largest economic development project in the state's history.[41]

America will also net geostrategic and economic returns from additional investment in mining and processing critical minerals, whose demand is on the rise. Even though the rate of extraction to support a zero-carbon global economy will be multiple orders of magnitude smaller than today's rate of extraction, it will be composed of different stuff. The U.S. has incredible lithium reserves, but lacks infrastructure to extract and process it at scale. Similar opportunities exist for other key minerals. Careful and proactive management of permitting and siting challenges related to new extraction projects here in the U.S. will be essential. And simultaneous investment in mineral refining and processing capabilities will pay off.

Policy that supports American manufacturing of strategically important products creates high-quality job opportunities, but it also accomplishes something else profound. A thriving manufacturing base provides the basis for world-leading innovation. Consider this: China manufactures lithium-based batteries at an incredible scale. Now, Chinese researchers and companies are innovating in sodium-based chemistries that have long befuddled researchers elsewhere. Chinese researchers can walk across the street from their university to labs run by the world's largest chemical manufacturers, and then stroll over to a nearby battery manufacturing line.[42] These are the historically American benefits of maintaining a lively manufacturing base in critical areas.

Surgical trade mechanisms will also be essential. A carefully managed trade relationship with China – not a trade war, to be quite clear – is the proper medicine. The strategy is not about foreclosing trading options or setting ever-increasing tariffs, but about collaborating with allies on import standards. The Europeans are advancing a "carbon

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[40] Conness, J. (2023). *IRA+CHIPS Investments*. https://www.jackconness.com/ira-chips-investments

[41] Oklahoma State Government. (2023, May 22). *Governor Stitt Welcomes Largest Economic Development Project in State History* [Press release]. https://oklahoma.gov/governor/newsroom/newsroom/2023/may2023/governor-stitt-welcomes-largest-economic-development-project-in-.html#:~:text=Governor%20Stitt%20Welcomes%20Largest%20Economic%20Development%20Project%20in%20State%20History,-PRINT&text=Today%2C%20Governor%20Kevin%20Stitt%20welcomed,and%20panel%20factory%20in%20Oklahoma.

[42] Bradsher, K. (2023, April 12). *Why China Could Dominate the Next Big Advance in Batteries.* The New York Times. https://www.nytimes.com/2023/04/12/business/china-sodium-batteries.html?smid=tw-share

border adjustment mechanism,"[43] to protect their domestic industries. This means that goods imported into the European Union will be subject to a tariff based on their carbon intensity. The U.S. could enact a similar policy, in partnership with our European partners, to show China and others that these are the rules of engagement on international trade in the modern era – climate standards and labor standards should be the basic price of admission to our markets.

Climate trading clubs can also help. The Global Arrangement on Sustainable Steel and Aluminum Trade[44] is intended to protect our workers and avoid the worst impacts of climate change, while facilitating trade that meets basic standards in these sectors. Similar climate and labor clubs could be created for additional global commodities, including critical minerals. If designed and implemented well, this stimulates a race to the top, making important commodities available at low-cost while protecting America's workers and managing to avoid cooking the planet.

Unfortunately, America has abdicated leadership in some technological realms, but the country has the opportunity—and a great head-start thanks to recent legislation—to regain it for the strategic industries of the future. Much more is needed to meet the moment and position America to win:

1. Ensure that current policies—notably the Inflation Reduction Act—that support zero-carbon electricity, transportation, buildings, and industry remain in place, maintaining the certainty needed for investors in multi-year projects.
2. Work with trading partners to adopt policies guaranteeing industrial products imported to the U.S. meet emissions and labor standards, such as a carbon border adjustment mechanism and a trading club for critical minerals. Cultivate export markets for domestically manufactured clean energy equipment.
3. Dramatically increase policy support for modern, zero-carbon industrial facilities; for domestic manufacturing of clean energy equipment beyond those boosted by the Inflation Reduction Act; and for mining and processing of the minerals needed to support global demand for all this equipment.

The world's energy and industrial systems are changing. Fast. The imperative to reach zero emissions in the next 25 years to avoid disastrous climate change impacts suggests the pace and scale of change will further accelerate. Proactive policy will double down on investments in manufacturing the zero carbon products the world is just beginning to demand.

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[43] European Commission. (n.d.). *Carbon Border Adjustment Mechanism.* https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

[44] The White House. (2021, October 31). *FACT SHEET: The United States and European Union To Negotiate World's First Carbon-Based Sectoral Arrangement on Steel and Aluminum Trade.* https://www.whitehouse.gov/briefing-room/statements-releases/2021/10/31/fact-sheet-the-united-states-and-european-union-to-negotiate-worlds-first-carbon-based-sectoral-arrangement-on-steel-and-aluminum-trade/

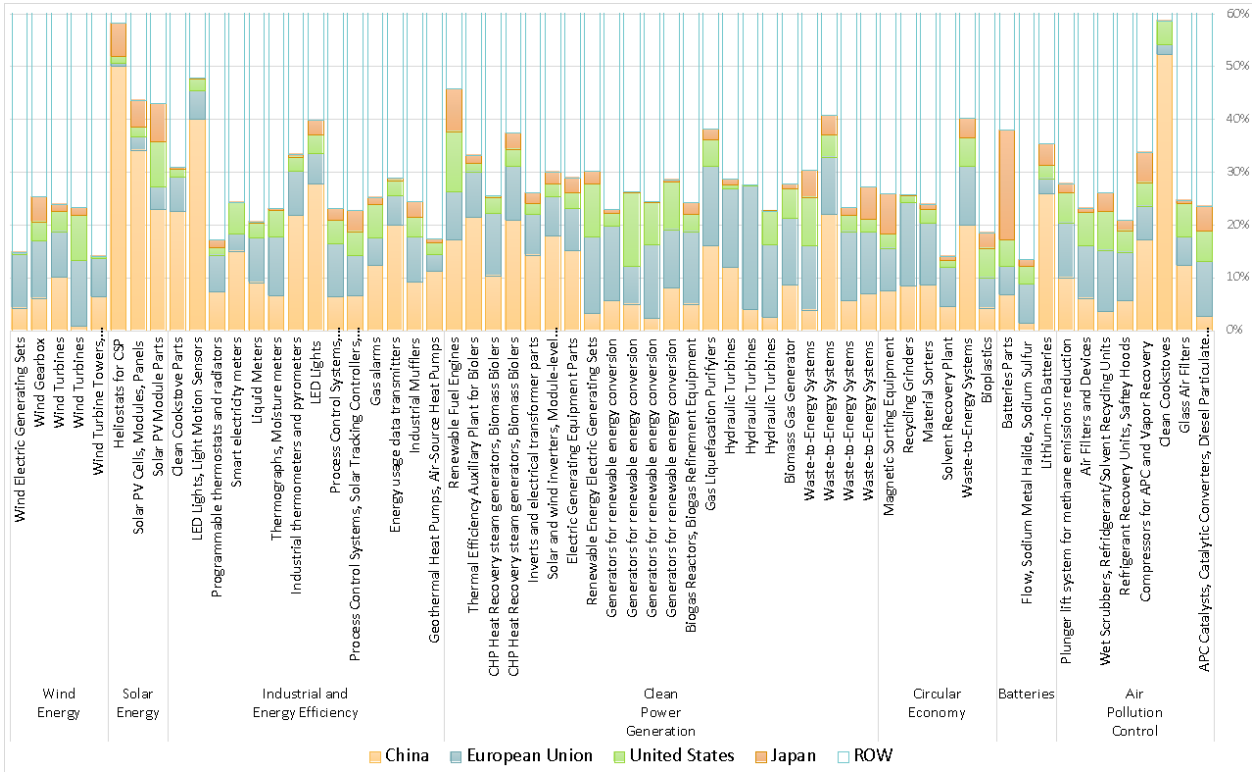
# Net Zero Trade Policies for U.S. National Security

**Maureen Hinman**
*Chair and Co-founder, Silverado Policy Accelerator*

**The Race to Capture the New Energy Economy and Set the Rules of the Game in the New Global Economy Has Already Begun…**

The global net zero energy transition is charging forward amidst compounding pressures from twenty-first century great power competition, global economic realignment, and in the wake of several systemic stress tests, a crisis of confidence in the ability of existing laws and institutions to equitably govern the global economy and protect domestic stakeholders. Since energy is core to all economic activity, the national models that win the clean energy race will also win the rights to define the new global energy and economic system and policy framework. Therefore, winning the technological and global market race to net zero is essential for the United States to achieve its energy, economic, national, and climate security goals. To lead in the 21st century the United States needs to craft a new set of domestic policies and global trade rules.

**Figure 1. Leading World Cleantech Exporters, Percent World Exports, 2019**



**…but the U.S. is Late Off the Starting Block**

The United States is woefully behind in developing the tools necessary to defend and advance American interests in the clean energy race. Despite recent investments in innovation and manufacturing facilitated through the Inflation Reduction Act (IRA), competitors and adversaries, especially China, dominate global exports of cleantech – in some cases (e.g., solar) by orders of magnitude that make it that much more challenging to close the gap (see Figure 1). This outcome is attributable to the insufficiency of existing U.S. and international laws and policies governing trade to maintain a level playing field for U.S. investments in cleantech manufacturing. Even where tools do exist, they are often subject to Administrative discretion (E.G. Section 301) and correspondingly contemporaneous political pressures. The present policy framework undermines U.S. cleantech investments and ingenuity in three fundamental ways:

***First, the carrots and sticks within existing trade rules were designed for market economies and democracies.*** Both domestic and international trade law and policies are artifacts of the global economy and partners engaged at the time of their negotiation. Core trade principles, such as transparency, fairness, and reciprocity, were codified in 1994 in the Marrakesh Agreement establishing the World Trade Organization (WTO), before the advent of market accelerators like the digital economy and modern logistics, and the introduction of large non-market, authoritarian partners into the system. The purpose of the world trade system is to create a rules-based framework that facilitates commerce by rewarding fair competition and encouraging partners to minimize and resolve disputes amicably. The system achieves this through the interaction between market economics and democratic norms. The rationale is that within market economies both businesses and consumers will feel the price pressure of unfair practices and will apply pressure in turn to their elected governments to resolve the issue swiftly. Notably, the General Agreement on Tariffs and Trade (GATT), the predecessor to the WTO, did not include any non-market economies as original drafting parties, and as these countries looked to join the WTO, they agreed through their accession process to move more towards market economy principles.

As such, the system did not anticipate the long-term retention of significant centrally planned, authoritarian economies. Since the rules rely on pain points that occur when governments are accountable to stakeholders, non-market, authoritarian economies can successfully navigate around these pressures and can deliberately contravene rules and norms to gain market and political advantage. The introduction of China into the system has played out accordingly with China, as part of their national development strategy,[45] undermining the mechanics of the world trade system through the intentional

[45] Findings of the Investigation Into China's Acts, Policies, and Practices Related to Technology. Transfer, Intellectual Property, and Innovation Under Section 301 of the Trade Act of 1974. March 22, 2018 https://ustr.gov/sites/default/files/Section%20301%20FINAL.PDF

contravention of rules and norms ranging from market-distorting industrial policy to rampant IP theft and forced technology transfer. This form of systemic rent-seeking has enabled China to gain competitive advantages that would be impossible for an economy of its scope to achieve in an environment of fair competition. Furthermore, systemic rent-seeking has eroded the benefits of the trade system for high-compliance countries like the United States and undermined faith in the efficacy of trade rules to deliver on their economic and social remit.

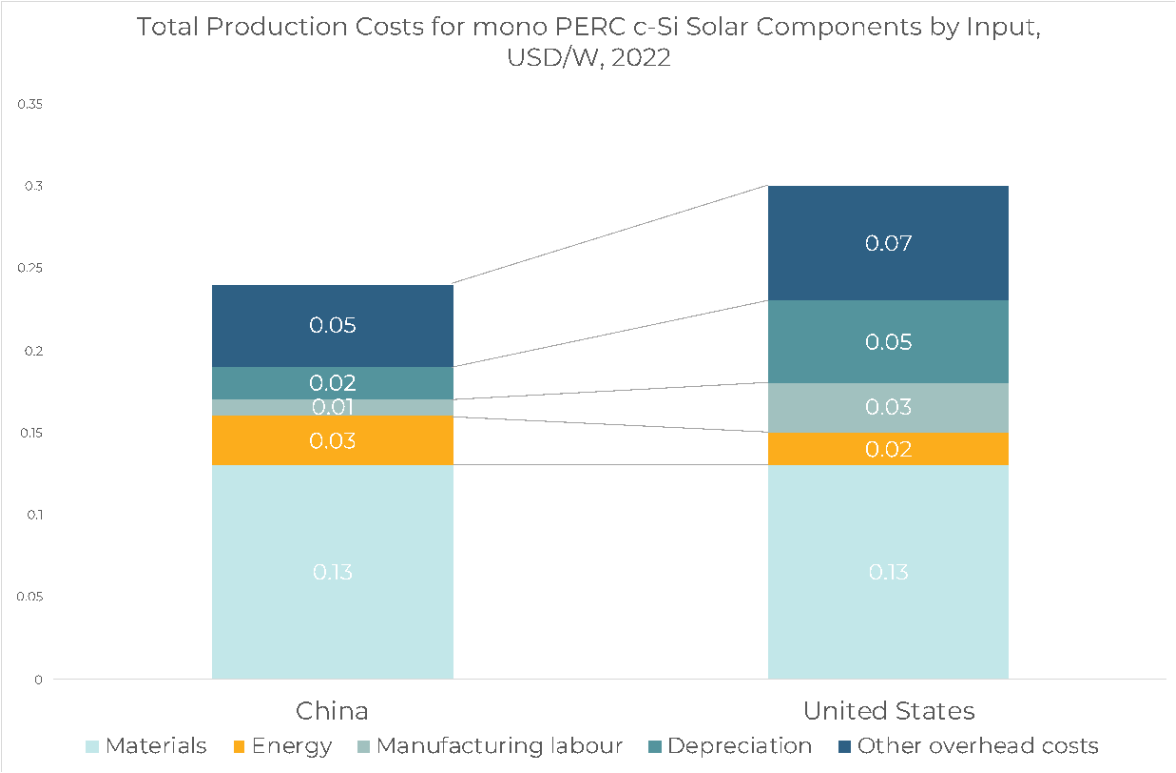
***Second, existing trade rules were designed for economies with similar environmental and labor protections.*** A corollary problem to a system designed for democracies and market economies is that when trade rules were negotiated, international governance of environmental and labor matters was considered outside the lane of trade agreements and squarely within the purview of Multilateral Environmental Agreements (MEAs) and Multilateral Labor Agreements (MLAs). This approach meant that environmental and labor concerns were addressed through the lens of the sovereign right to regulate and make decisions appropriate for the protection of natural resources (i.e. rather than include specific commitments on labor and environment, GATT Article 20 allows members to take trade restrictive measures that would otherwise be prohibited but which may be permissible under an Article 20 exception, such as that the measure is "related to the conservation of exhaustible natural resources"). The rationale at the time in support of this approach held that there was a large overlap in membership between the WTO, MEAs, and MLAs, such that in states where rule of law reigned, a level playing field in terms of labor and environmental rules would persist. The architects of the system did not believe that a partner among the (mostly) democratic parties could persist with harming its citizens and trade partners by intentionally underperforming on labor or environment to gain market advantage without domestic and international repercussions.

Again, China's entrance into the system has invalidated this assumption, with rent-seeking also arriving in the form of intentional and systemic underperformance on environmental and labor standards despite possessing the technical capacity to achieve high levels of protection. Evidence that China intentionally reduces inspection rates and enforcement stringency for the operation of air pollution control equipment in coal fired power plants to avoid the additional energy costs associated with operation, particularly among State Owned Enterprises (SOEs)[46] is widespread. Despite China's status as a major global exporter of air pollution control equipment, it gains market advantage by avoiding the additional energy costs of operating air scrubbers and other environmental equipment in its own market. Similarly, China's notoriously weak labor protections and

[46] Karplus VJ, Wu M. Dynamic responses of $SO_2$ pollution to China's environmental inspections. Proc Natl Acad Sci U S A. 2023 Apr 25;120(17):e2214262120. doi: 10.1073/pnas.2214262120. Epub 2023 Apr 17. PMID: 37068224; PMCID: PMC10151602.

forced labor practices[47] provide downward pressure on wages globally and in cleantech supply chains in particular.

**Figure 2. Resulting Manufacturing Costs**




Source: Special Report on Solar PV Global Supply Chains, International Energy Agency, 2022.

Figure 3 demonstrates these effects in the solar manufacturing space. China's labor costs are a third of U.S. costs. Its deceptively higher energy costs are owed to record high coal prices in 2022 and the high penetration of coal compared to gas in the United States, providing China with even more incentive to compensate for fuel price differences through avoiding parasitic losses on energy by hitting the 'off' switch on air pollution control equipment. As a point of reference, for coal power plants in the United States, parasitic losses, including those to operate air pollution control equipment and other environmental infrastructure such as water treatment systems, account for around 30% of the difference between gross and net power generation.[48]

China can maintain these practices, because without democratic and market-based institutions to counteract bad governance in conjunction with the established sovereign

[47] Section 307 and Imports Produced by Forced Labor. Congressional Research Service. July 26, 2022. https://crsreports.congress.gov/product/pdf/IF/IF11360
[48] Electricity Data Browser, U.S. Energy Information Administration, 2022.

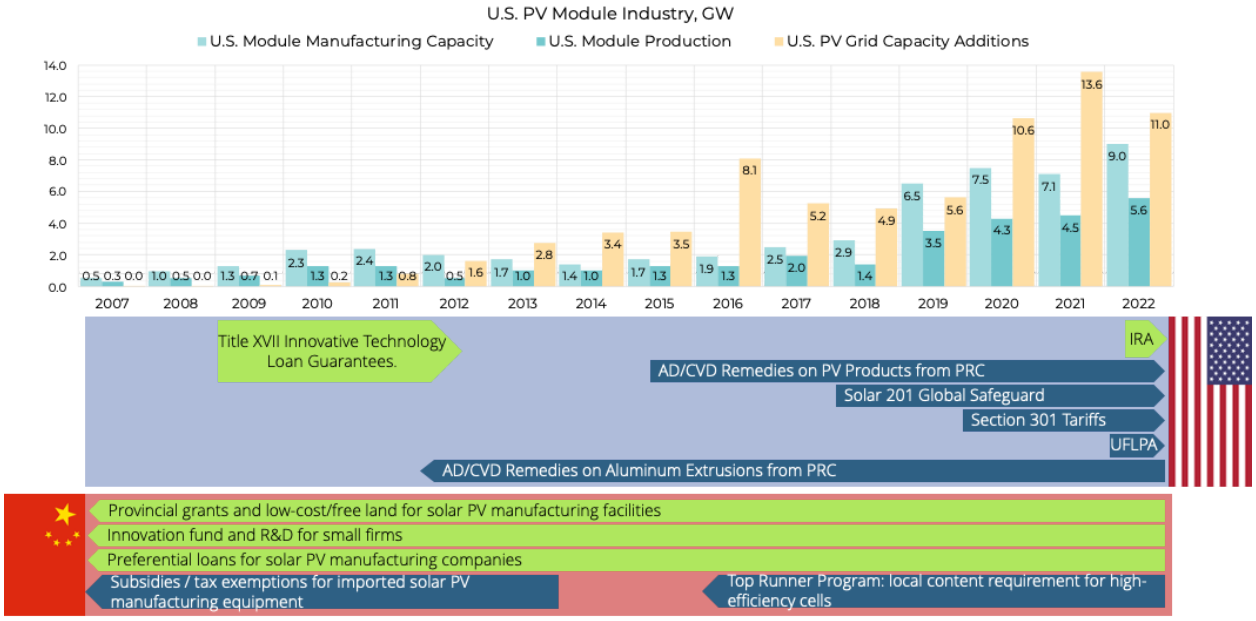
right to regulate articulated in international trade law, there is no meaningful redress to operating a pollution haven or labor pit. China's jarring opacity creates further challenges to enforcement and international oversight. MEAs and MLAs are similarly inert, with few having meaningful sanctions regimes to punish treaty violations. As a result of the failure to frame rules in terms of national capacity meet standards China continues to strategically underperform where the United States remains bound by the rule of law. In short, China has weaponized the U.S. own good rules against the U.S.

***Third, an inability to consistently play offense and defense on behalf of domestic energy investments and strategic interests.***

As unfortunate as China's market manipulations and rule breaking has been, the United States should also contend with China's consistent and ongoing industrial support policies contrasted against sporadic U.S. investments in industrial development and lumbering, politically driven, incoherent, and sometimes even counterproductive domestic trade policies. A prime example of the incoherence between innovation investments and U.S. trade policies can be observed in the solar manufacturing industry between 2009 and 2018 (see figure 2). In the wake of a multibillion-dollar investment in the solar industry via Title XVII Innovative Technology Loan Guarantees between 2009 and 2011, solar module manufacturing capacity rose in the United States roughly 2.4 GW, followed by abrupt declines in solar module production and capacity, despite growing domestic demand for solar modules in the years that followed. In 2015, the Commerce Department found that China had subsidized its producers, driving a subsequent 60 percent decline in module prices.[49] Additional headwinds to solar manufacturing were created by Anti-Dumping and Countervailing duties placed on aluminum extrusions, an essential component to solar panels, in 2011. By the beginning of 2017 when USTR initiated its Section 201 safeguard investigation, U.S. manufacturing capacity had sunk 30 percent to just 1.7 GW.

[49] Section 201 Cases: Imported Large Residential Washing Machines and Imported Solar Cells and Modules. USTR Fact Sheet. Accessed July 15, 2023. https://ustr.gov/sites/default/files/files/Press/fs/201%20Cases%20Fact%20Sheet.pdf

**Figure 2. Timeline of Select U.S. and China Domestic and Trade Policies Impacting Solar Manufacturing**




Source: Silverado analysis, NREL Renewable Energy Data Book (2008-12), EIA Generator Database, and IEA Special Report on Solar Supply Chains, 2022.

The shift to a net zero energy system is a technology supremacy game. Much like the race to 5G the prevailing leader will have the privilege of establishing a baked-in infrastructure model and associated policy framework that will last generations. The solar case highlights a lack of both offensive and defensive tools to win the clean technology race as well as an incoherence between policies. In particular, the insufficiency of trade remedies in the rapidly moving global economy, the lack of net economic benefits tests to short-circuit counterproductive trade remedies, and a lack of consistency in financial support to industry compared to the U.S.'s chief geopolitical and economic competitor.

The United States should shift towards strategic trade policies that both prioritize strategic sectors and underscore our democratic and social values. This shift will require more dynamic and agile trade rules and relationships as technology matrices evolve. Such rules will require an objective economic benefits test and limits to Administrative discretion, so that authoritarian partners cannot 'wait out' a U.S. Administration. Adapting trade policies to meet this generational challenge will require a new set of trade policies and practices that can achieve the following:

1. **Level the playing field on climate, environment, and labor arbitrage through policy instruments that apply rules based on trade partners' technical capacity.** The United States can short circuit pollution havens and

labor pits, requiring production methods comparable in effectiveness to domestic rules and standards, with outlets for developing countries based on their technical ability to implement those methods. Options include:

- **Levy Carbon Border Adjustment (CBA) and border pollution fees:** Levy fees at the U.S. border to level the playing field for clean production practices adopted by U.S. producers. Define a new hierarchy of trade partners that addresses capacity of partners to implement environmental controls before they receive developing country Special and Differential Treatment (SDT) under any new border adjustment regime. Raise the bar globally by providing SDT recipients with the option to zero-out their fees if they make commensurate national investments in climate and environmental infrastructure using U.S. technologies.
- **Expand the definition of illegal subsidies to explicitly address labor and environmental arbitrage:** Treat systemic underperformance on environmental measures (including structural excess capacity) and below-market labor practices as an illegal, actionable subsidy and apply countervailing duties.

2. **Establish trade policies that are coherent with domestic manufacturing, energy, climate, and national security goals.** Create policy coherence for sectors of domestic innovation investment and those of national security importance. Options include:
    - **Modify trade remedy laws allowing for the suspension of certain trade remedies for strategic sectors:** Through the application a 'net economic benefit to the United States' test the U.S. could selectively suspend trade remedies (i.e., temporarily remove or reduce duties) for critical components to sectors that have received U.S. taxpayer innovation funding or have been identified as in the national security interest of the United States (e.g., the solar/aluminum extrusion example above).
    - **Provide scope for 'rapid response' mechanisms:** Expand the use of safeguard and Section 301 policies to address market manipulations such as IP theft, below market loan programming, and environmental arbitrage. Trigger policies through surveillance and a set of objective measures rather than simply Administrative discretion to ensure 'rapid response' is not tied to political winds.
    - **Establish a 'reciprocity' policy for structural offenders:** China routinely enacts market access barriers to fair U.S. participation in its market while enjoying free and fair access to ours. USTR outlines these barriers every year in the National Trade Estimate Report. The U.S. could establish a 'reciprocity' policy for structural, repeat offenders that allows the U.S. to impose far stricter requirements on those countries'

investments in the United States, including for example, an expansion of CFIUS reviews to environmental and cleantech sectors.

3. **Establish a critical supply chain for cleantech and enhance and expand the template for high-standard trade relationships.** Create a template among trusted partners for market-driven, high standard trade rules that reward efficiency, ingenuity, and environmental performance underpinned by democratic values and a common view on how to treat external partners that intentionally flout rules. Features should include:
    - **Preferential Market access for Environmental Goods and Services:** Expand environmental markets among friends and allies by liberalizing trade in environmental goods and services. Establish a mutual recognition regime for professional licensing in areas like environmental and civil engineering, chemistry, and consulting services.
    - **Harmonize or establish equivalence between technical regulations and standards impacting the energy and environmental industries:** Reduce technical barriers to trade in the energy and environmental industries and other critical sectors, such as recycling and sustainable mining, by harmonizing or establishing grounds for equivalence and extending the presumption of conformity among partners. Enable improved efficiency in permitting and licensure through regulatory data sharing and coordination.
    - **Share surveillance and enforcement responsibility for non-member violations:** Share surveillance of third parties market manipulations and require coordinated enforcement responses among parties to prevent third parties from 'playing' members against one another. Allow for rapid response mechanisms for labor and environmental violations both within and outside the agreement. Make use or purchase of products developed with stolen intellectual property from members sanctionable within the pact.

# RECOMMENDED READINGS

## A Critical Minerals Strategy for the United States:
### The Role of Congress in Scaling Domestic Supply and De-Risking Supply Chains[50]

The Aspen Institute, Energy & Environment Program

Spring, 2023

*The Aspen Institute's Energy & Environment Program convened a task force of experts over the last year and a half to focus on an immediate policy priority: securing a responsible and resilient critical mineral supply chain for the United States. This report is motivated by the roundtable discussions between task force members. It includes objectives, a strategic approach, findings, and recommendations for U.S. policy on critical minerals. The report is directed specifically toward the United States Congress. A full list of signatories can be found at the end of the document.*

### Executive Summary

The United States currently faces a rapidly shifting global environment that increasingly places strategic importance on responsible and resilient access to critical minerals. These minerals—which are essential inputs to a wide range of applications ranging from clean energy technologies to advanced defense systems—will continue to increase in importance over the coming decades. Global competition over these resources due to the rapidly accelerating energy transition, fragmentation of international supply chains, and rising geopolitical tensions with adversaries is of key importance to the climate, economic, and national security interests of the United States in the 21st century.

There is an urgent need for policymakers to define a coordinated critical minerals strategy for the United States. A U.S. critical minerals strategy must set out to achieve two objectives. First, it must seek to responsibly increase domestic and global production and processing of critical minerals at the scale and timeline needed to limit global temperature increases. Second, it must aim to secure responsible and resilient critical mineral supply chains that minimize vulnerability to external risks.

[50] See the publication here:
https://www.aspeninstitute.org/publications/a-critical-minerals-strategy-united-states-energy/

As Congress formulates a comprehensive U.S. critical minerals strategy, it should bear in mind key insights that emerged from a task force of experts convened by the Aspen Institute throughout 2022 and 2023. In particular, Congress should take note that:

1) There is a clear role for targeted policy intervention to address current and potential causes of failure in critical mineral markets.

2) Environmental and social issues are an essential component of the critical minerals puzzle. A failure to balance efforts to streamline supply with these considerations will not only result in harm and injustice to local communities, but will also jeopardize supply growth as projects are subject to legal challenges and mining companies lose their social license to operate.

3) The United States cannot solve the critical minerals challenge on its own. Regardless of the reforms taken, the United States will be unable to fully reach self-sufficiency for critical mineral mining and processing in the time frame available.

4) Policymakers should view with nuance the extent to which China's dominance of critical mineral processing currently represents a source of geopolitical leverage. While China is a major refiner of minerals like copper and nickel, its processing capacity provides it with more limited geopolitical leverage in those supply chains than is often perceived. China's dominance of rare earth elements, by contrast, provides it with a more pronounced degree of leverage. The influence that China derives must be assessed mineral by mineral, based on factors such as China's status as a net exporter, American diversity of imports, and the availability of substitutes.

These insights are among those that have led the Task Force of the Aspen Institute to make a series of 11 recommendations to the U.S. Congress. Three clusters of recommendations are particularly of note:

First, Congress must take steps to help close what is anticipated to be a yawning gap between domestic supply and demand. Most importantly, Congress must make it easier to extract and process critical minerals domestically by legislating a place-based approach to critical mineral permitting and by setting timelines on project adjudication. At the same time, Congress needs to encourage measures to reduce the demand for critical minerals, such as investing more in technology for substitution and recycling.

Second, Congress needs to take a leadership role in clarifying and enforcing the rights of indigenous communities affected by mining. It should clarify and endorse the concept of Free, Prior, and Informed

Consent and see that it is adhered to. The Task Force recommends clarifying that Free, Prior, and Informed Consent—in the sense of consent being a requirement for progress—applies to Tribal Nations directly impacted by critical mineral development; best efforts to achieve consent should also be sought from Tribal Nations which can only claim to be affected indirectly by such development. In both cases, consultations are essential. In addition, Congress should facilitate the ability of Tribal Nations to obtain equity in the form of an ownership stake in critical mineral projects.

The Task Force's recommendations—around permitting reform, Free Prior and Informed Consent, and Tribal Nation project equity—will help boost U.S. critical mineral supply in a manner that is economically, environmentally, and socially responsible and innovative. Even still, the United States will be unable to bring new projects online as quickly as is needed to meet future needs or completely eliminate dependence on China for refining and processing supply chains.

The Task Force therefore offers a third set of actions around sourcing critical minerals responsibly from overseas. Rather than embracing Buy America provisions, the Task Force recommends working with allies, partners, and others around the world to agree upon a common set of clearly defined environmental, social, and governance standards for the production and processing of critical minerals. Resource-rich countries are seeking investment in higher-value segments of the supply chain rather than upstream, extractive segments alone. The United States and other likeminded countries, including the EU, UK, Canada, Japan, and South Korea, among others, can increase and coordinate concessional finance to those countries across various stages of mineral value chains.

In addition, **Congress should facilitate bilateral and multilateral frameworks that increase critical mineral supply chain coordination, as well as the negotiation and passage of bilateral and multilateral trade agreements among countries that meet mutually agreed upon standards.** Such efforts should establish a framework to enhance cooperation with a broad range of other countries around the world—including in South America, Africa, South Asia, and elsewhere—at the speed and scale necessary to secure U.S. economic and national security interests and buffer reliance on Chinese supply chains.

The dynamism of the global landscape and of critical mineral markets will require U.S. policymakers to continuously re-evaluate the challenges the country faces and the policy prescriptions that it requires. The content of this report, including the objectives, strategic approach, findings, and recommendations, lay out a principled, bipartisan roadmap for Congress to continue building on recent momentum and place the United States in a strong position to pursue the energy transition, build economic opportunity, and strengthen national security.

## **Letter from the Co-Chairs** – June 2023

The global transition to clean energy is at a crossroads. Cost declines across a range of low-emissions technologies have driven a surge of clean energy growth in recent years. But the scale of deployment necessary to bring the global energy system to net zero will require even faster growth, placing new burdens upon supply chains.

The availability of critical minerals such as lithium, cobalt, copper, nickel, and others will be a key determining factor for whether it is possible to scale up clean energy at a pace commensurate with the climate crisis. Demand for these materials, which are needed to manufacture a range of clean energy technologies, is set to escalate dramatically as the energy transition gains momentum. Global supply chains are not yet ready to accommodate this surge of demand.

Policymakers have begun to wake up to this impending bottleneck. In the past year, the United States Government has announced strategic initiatives to shore up the country's supply of critical minerals, including announcing convening a Minerals Security Partnership and using the Defense Production Act to accelerate domestic mining and processing. Key provisions in the Energy Act of 2020, the Bipartisan Infrastructure Law (BIL), the CHIPS and Science Act, and the Inflation Reduction Act were also aimed at boosting domestic mining, refining, and processing capabilities. But as demand continues to grow, the United States still lacks a comprehensive critical minerals strategy.

Without a plan, the United States faces serious risks to its economy and national security, not to mention an accelerated clean energy transition. Chronic material shortages may inflame tensions with allies and adversaries abroad, as governments vie for dominance over supply chains. And high prices for such materials risk choking off the growth of American clean energy. A coherent strategy is needed to address these risks, and to do so in a way that advances equity, environmental conservation, and indigenous sovereignty.

This report seeks to fill that gap. In three separate sessions over the course of a year, policymakers, Indigenous leaders, investors, subject matter experts, civil society leaders, and industry leaders weighed in on the key considerations and policy actions they believed should be included in such a strategy. What follows are both the findings of the Task Force and the recommendations these discussions yielded.

We direct this report toward Congress intentionally because it has an important and yet unrealized role in advancing a critical mineral strategy for the United States. The recommendations in this report are focused on the most immediate area for action; they

do not constitute every action that Congress, or even the U.S. government, should take in the coming years. Like other components of a national strategy to help the country meet the opportunities and challenges of the energy transition, these issues will demand continuous assessment and action in the years to come as many of the uncertainties described in this report clarify.

Nevertheless, we believe these recommendations are important components of a United States critical minerals policy. Happily, they are not simply our own ideas, but reflect the insights and wisdom of a large, diverse, and bipartisan groups of experts. They would, if adopted, contribute significantly to the growth of a robust, secure, resilient, and just supply chain, itself a vital ingredient of a successful energy transition.

We are grateful for the work of many people who were instrumental in bringing this report to fruition. We appreciate the time and expertise of all the members of the task force, who engaged constructively and were the source of the many ideas contained in this report. We are also immensely indebted to two people—R.J. Johnston and Cina Vazir—who wielded the pen, not only capturing conversations and accurately translating them into crisp language, but also bringing their own deep expertise to the issues at hand. Without R.J. and Cina, there would be no report. Lilly Lee also provided invaluable research assistance. Finally, we owe our gratitude to Tim Mason and Greg Gershuny and the whole team at the Aspen Institute for conceptualizing this Task Force and providing it support throughout its existence.

**Professor Meghan L. O'Sullivan**
*Incoming Director, Belfer Center for Science and International Affairs*
*Jeane Kirkpatrick Professor of the Practice of International Affairs, Harvard University Kennedy School*

**Professor Jason Bordoff**
*Founding Director, Center on Global Energy Policy*
*Professor of Professional Practice, Columbia University School of International and Public Affairs*

## Introduction

Critical minerals require urgent attention from policymakers. These minerals range from the lithium used in lithium-ion batteries to the rare earth elements used in advanced defense systems. They are required throughout the U.S. economy and are an essential foundation for American economic prosperity and national security. But critical mineral supply chains currently face exceptional challenges due to increasing demand and fragile supply. In 2022, the U.S. Government designated 50 minerals as "critical" based on their importance to U.S. economic and national security interests, and their vulnerability to supply chain disruption.[1]

Critical minerals will play an increasingly pivotal role in the global economy over the coming decades. As the world transitions to a new energy mix, it will require clean energy technologies that are extremely mineral-intensive. Demand for minerals is projected to rise at unprecedented rates and could generate supply shortfalls that will slow, or potentially even derail, global efforts to reach net-zero targets.[2] Despite this impending supply gap, efforts to scale supply must take into account environmental and social considerations, particularly given the mining industry's troubled historical performance on these issues.

The supply-demand dynamics of critical minerals are further complicated by the vulnerability of critical mineral supply chains. Supply chains are highly geographically concentrated, exposing American climate, economic, and national security interests to potentially traumatic disruptions. Vulnerabilities not only apply to disruptions in mine production, but also to the processing of critical minerals. Most global processing capacity is heavily concentrated in China, which has in the past shown strategic intent to wield its market power as a geopolitical and economic tool.

The Aspen Institute's Energy & Environment Program convened a task force of experts in 2022 to help policymakers address these challenges. This task force represented the wide range of domains and expertise needed to shape the success of U.S. critical minerals policy. Participants included the following:

- Former U.S. Congress members
- Investors
- National security and geopolitics experts
- International and multilateral organizations
- Environmental non-governmental organizations
- Academics and scientists
- Innovators and technologists
- The manufacturing industry
- The mining industry

- Indigenous and tribal leaders

Over the course of three days of roundtable sessions dispersed over the calendar year, these individuals focused on defining the critical minerals challenge, designing a strategic approach, and providing actionable recommendations to the U.S. Congress. Participants are in strong alignment that reaching our goals regarding critical minerals will require both domestic and foreign policy responses. Without action on both fronts, U.S. policy will fail to fully overcome the challenges and grasp the opportunities at hand.

## Objectives

Based on the important role of critical minerals for climate, economic, and national security interests, and on the challenges facing these supply chains, Congress should focus on achieving two key objectives:

1) Responsibly increase domestic and global production and processing of critical minerals at the scale and timeline needed to limit global temperature increases (to 1.5°C above pre-industrial levels).

2) Secure responsible and resilient critical mineral supply chains that minimize vulnerability to external risks.

Achieving these two objectives will reduce the risks that the insufficient and fragile supply of critical minerals pose to U.S. climate, economic, and national security interests. But risk reduction is only one part of the picture. A bold, coordinated, and swift strategy to achieve these objectives can also develop new sources of American power, both at home and abroad.

## Strategic Approach

The signatories of this report are in unanimous consensus that the U.S. Congress must pursue a bold, coordinated, and swift strategic approach toward critical minerals.

Over the last few decades, U.S. policy on critical minerals has generally suffered from insufficient urgency, reach, and harmonization. Meanwhile, competitors such as China have acted aggressively, leaving the United States in what is now a challenging and vulnerable position. Recent legislation such as the Inflation Reduction Act and the Infrastructure Investment and Jobs Act, while not perfect nor comprehensive, are now beginning to make a meaningful impact. But these pieces of legislation are only the first steps in a longer journey. More action is required.

U.S. strategy must be bold if it is to overcome the scale of the challenge, intense competition from China, and vital threats to American climate, economic, and national security interests. It must also be coordinated given the cross-cutting nature of critical minerals, which touch various arenas such as technology, environmental justice, indigenous reconciliation, energy, trade, and geopolitics. And U.S. strategy must be swift for America to gain an advantage in a quickly changing global supply and demand landscape, including in the manufacturing of the clean energy technologies that will dominate the next decades.

In addition to these principles, U.S. strategy must be grounded in the realization that critical minerals are both a domestic and foreign policy challenge.

Domestic initiative will certainly be essential, ranging from permitting reform to strong social and environmental standards. These initiatives can help the United States contribute to limiting global critical mineral shortfalls and reducing exposure to supply chain risks. However, critical minerals are also an international challenge. The United States will not achieve the scale of critical mineral supply needed to reach global 1.5°C goals on its own. Current projections show that more than 300 new mines will need to be built globally by 2035 to meet estimated mineral demand from electric vehicles alone.[3]

Demand growth provides the United States with an imperative to work simultaneously to increase domestic and international production. Work in these two arenas needs to occur together. The United States will not likely develop the ability to independently meet its own consumption of all critical minerals anytime soon. Experience in energy security shows that although commodity independence can be an alluring goal, it imposes hidden costs and inefficiencies, is often unrealistic, and forfeits geopolitical advantages. Domestic and foreign policy responses are not in tension but should be harmonized. And the U.S. should strive toward broader supply chain resilience, not independence.

**The signatories of this report have therefore determined that U.S. policymakers should pursue a two-pronged strategy to develop the foundations for more resilient supply chains at home and maximize connections with strategic exporting and importing countries abroad.**

This strategy will seize on existing American comparative advantages—ranging from the country's unique capacity for innovation to its deep alliance system—while also developing new sources of power. It will be founded on areas of existing bipartisan consensus and will achieve specific objectives while furthering the U.S.'s wider social, environmental, economic, diplomatic, and national security agenda.

The following two sections lay out key recommendations for the U.S. Congress to consider and hopefully embrace to meet its role in ensuring a robust U.S. approach to an emerging strategic challenge and opportunity. These recommendations focus on immediate priorities rather than offer a comprehensive assessment of the need for Congressional action. As the landscape further clarifies, Congress will need to re-evaluate the need for further actions.

## Findings:

### Finding #1: Demand for critical minerals is forecast to surge over the next two decades as the world rapidly manufactures and deploys clean energy technologies.

Many clean energy technologies require substantial quantities of minerals. An electric vehicle, for example, requires six times more minerals than a conventional vehicle. Electric vehicles, alongside battery storage and electricity networks, are projected to be a major source of demand growth for various critical minerals, including cobalt, copper, lithium, and nickel. The development and deployment of other technologies, such as wind and solar, will significantly boost demand for minerals like rare earth elements and tellurium.

The forecast increases in demand from clean energy technologies, layered onto more stable existing demand trends, imply steep growth in total demand for many critical minerals. Consulting firm McKinsey estimates that lithium production, for example, will need to increase by more than 700 percent from 2020-2030 for the world to achieve its 1.5°C climate goals.[4] Cobalt, neodymium, and nickel are estimated to require around 100 percent increases in supply over the same timeline.[5] Rapid demand growth also applies to high-volume markets. S&P Global projects that copper demand will almost double from 2021 to 2035, with annual demand expected to rise by an extraordinary 24 million metric tons.[6]

In the cases listed above, demand growth exceeds the rate at which supply grew from 2010-2020 by a factor ranging from about one-half to six.[7] The percent of demand growth is largest for smaller markets such as lithium and tellurium and relatively smaller, but still very significant in terms of the total tons of material, for larger markets such as copper. Production of many minerals will need to grow much faster than it has in recent history. While high prices will lead to investment in new supply, the average time for a mine to come online is more than 16 years, according to the International Energy Agency (IEA), meaning that it will take time for markets to respond to price incentives.[8] Additionally, multiple sources of risk and uncertainty are leading mining

companies to retain a cautious approach, directing cashflows to share buybacks and dividends rather than capital expenditure.[9]

Various projections show that supply deficits may be on the horizon. Consulting firm Ernst & Young, for example, projects copper will face a shortage of 4.7 million tons by 2030 based on the existing pipeline of projects.[10] Meanwhile, Benchmark Minerals Intelligence expects that by 2030 there will be a 12.5 percent lithium deficit.[11] Studies from a variety of other sources—including the IEA, McKinsey, and S&P—similarly show that the current level of committed global mine production for minerals such as cobalt, copper, lithium, and nickel is insufficient to achieve the goals of the Paris Agreement.[12]

**Finding #2: Looming critical mineral shortfalls, caused by a projected gap between rapid demand and slower supply, present a substantial challenge to U.S. economic and climate interests.**

Temporary supply imbalances have already demonstrated an ability to increase price volatility, disrupt markets, and challenge the business models of actors throughout the clean energy supply chain. A 10 percent increase in the price of nickel translates to a 1.2 percent increase in the cost of manufacturing a NMC 811 battery cell.[13] A similar increase in lithium and cobalt prices translates to a 0.8 and 0.4 increase, respectively, in the cost of manufacturing a battery cell. The impact of high critical mineral prices was seen in 2022, when the average global price of lithium-ion batteries increased 7 percent from the previous year.[14] This increase represented the first time battery prices increased in more than a decade and reversed a long-time trend of substantially falling prices. Rising battery prices are meaningful given that battery cells represent 30-40 percent of electric vehicle production costs.[15]

Long-lasting supply shortfalls could have even more significant implications. Despite their notable impact on battery prices, the high mineral prices of 2022 resulted in relatively mild economic damage since most battery manufacturers had existing supply contracts with fixed prices. [16] For various minerals, but specifically for lithium, new long-term contracts will have prices linked to market prices, meaning volatility will be more impactful. While many critical mineral prices eased in 2023, the looming long-term mineral supply shortfalls, in contrast, could be larger and more sustained, threatening to cause the prices of clean energy technologies to rise more dramatically and remain higher for longer. [17] For example, the International Monetary Fund (IMF) finds that lithium, cobalt, nickel, and copper prices could reach historical peaks for a prolonged period under net-zero scenarios.[18] Supply shortfalls could thus limit the total quantity of clean energy technology that will be built.

The negative effects of critical mineral shortfalls will not only be felt in clean energy markets. Supply-demand imbalances can also reverberate throughout the entire American economy given the ubiquity of minerals across all sectors of economic activity. Copper, for example, is used across a variety of industries including construction, electronics, transportation, and manufacturing of machinery.[19] High-grade nickel, as another example, is not only used in batteries, but is also a key ingredient of stainless steel. Tight copper and nickel markets could lead to higher prices for numerous products and constrain output in both the clean energy sector and other seemingly unrelated sectors. The sectors in which output will be most affected will depend on the elasticity of suppliers but will span beyond just that of clean energy.

Supply-demand projections are inherently uncertain. While there is consensus that critical mineral shortfalls will harm U.S. interests, there are varying opinions on the likelihood and potential severity of supply shortfalls. A central consideration is whether markets will sufficiently adjust to meet demand. The Aspen Institute's task force highlighted five key factors that could cause markets, both domestically and internationally, to function inefficiently and lead to suboptimal outcomes for the United States and its allies. These factors are outlined in Findings #3-7 and are clear areas of consideration for future policy.

**Finding #3: Efforts to scale critical mineral production will generate, and already have generated, legitimate and serious environmental and social concerns.**

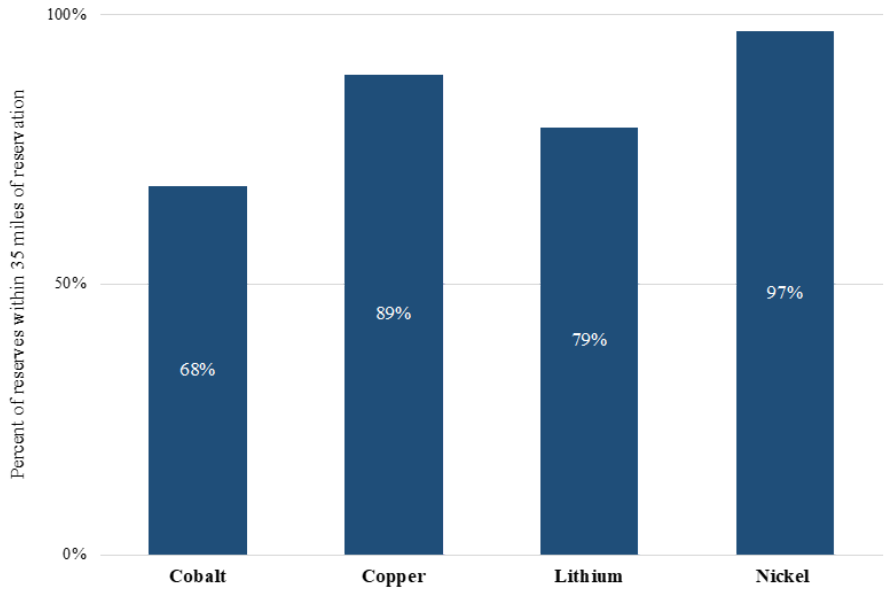
The mining and processing of critical minerals generate considerable environmental risks due to toxic waste, water usage, and impacts on biodiversity. Toxic waste is one of the largest environmental concerns. When mismanaged, this waste can harm local populations and biological habitats. The 2015 Gold King Mine disaster in Colorado, in which three million gallons of toxic waste were released into the Animas River, provides a recent example of the environmental risks posed by mining waste.[20] The 2019 Brumadinho disaster in Brazil is another example. In that case, the collapse of a tailings dam—where toxic waste is stored—not only caused environmental damage, but also killed 270 people.[21] The mining industry's high rate of water usage is another growing concern. Numerous mining projects have been blocked in recent years due to their high water consumption in what are already water-stressed regions. These projects range from lithium mines in Chile to copper mines in Arizona. Operation of mines and processing facilities can also have damaging impacts on biodiversity, especially in cases where there are complex risks to local ecosystems.[22]

The environmental risks of mining create a tension between efforts to increase critical mineral production to meet global climate goals and valid concerns about protecting local environments. They also create a barrier to scaling critical mineral production.

Communities and regulators, from Peru to Malaysia, have recently taken actions to shutdown mines and processing facilities for environmental reasons.[23] If efforts to quickly increase mineral production fail to account for environmental concerns, they could lead to more environmental disasters. These disasters, in turn, would further harm the reputation of the mining industry at a crucial moment, resulting in less political support, lower levels of approval for new projects, more community protests, higher perceptions of risk, and reduced access to capital.

On the social front, the mining industry has a long history of failing to respect community interests, including not consulting locals, breaking agreements, destroying sacred sites, and forcing displacements. This has created mistrust within many communities, particularly indigenous communities that have been disproportionately affected. Uranium mines, for example, have left a devastating impact on the Navajo Nation.[24] Moreover, mining projects have frequently failed to provide sufficient economic opportunities for local citizens. In the United States, many minerals are located near Native American Reservations, underscoring the particularly pressing need to engage in more effective dialogue with Tribal Nations. Without a social license to operate, mines will struggle to receive permits, raise capital, and bring minerals to market, and the United States will not realize its full potential for domestic production.

Figure 1: Percent of U.S. Critical Mineral Reserves Within 35 Miles of Native American Reservations, 2021 (Source: MSCI)




**Finding #4: Political risk in various producing countries creates barriers for diversified investment and challenges for responsibly scaling production.**

Governments in countries with strategic critical mineral reserves, such as the Democratic Republic of Congo and Zimbabwe struggle with a history of corruption, mismanagement, and economic instability that disincentivize diversified global investment. While these countries have an important role to play in global efforts to increase critical mineral production, their high level of political risk is a barrier to the rapid deployment of capital that is needed to quickly build new mines. As a result, countries with substantial governance risks may fail to achieve their full production potential. Many Western companies are often unsure how and whether to invest in countries with high political risk, whereas Chinese companies are more willing to incur such risk given the strong political backing of the Chinese state. As discussed later, this dynamic makes it more difficult to build diversified supply chains.

Downstream manufacturers also face difficulties in sourcing minerals that may be tied to unethical labor practices. In the Democratic Republic of Congo, for example, an estimated 10-20 percent of cobalt comes from artisanal mines, many of which are connected to child labor, precarious working conditions, and environmental malpractice.[25] The international community remains undecided on how to address the tension between scaling supply of critical minerals and reducing human rights abuses. While there may be potential levers to affect positive change on both the demand and supply side—such as traceability initiatives and formalization of artisanal mining—these levers have thus far not been commonly agreed upon nor exercised at scale.[26]

**Finding #5: Long project lead times create a situation of inelastic supply in the face of uncertain, volatile demand. In the United States, permitting is a particularly significant barrier to scaling critical mineral production.**

According to the IEA, mining projects took an estimated global average of more than 16 years to move from discovery to production from 2010-2019.[27] It took the mines included in the dataset about 12 years move through exploration and feasibility studies, and four to five years to complete construction. Various technical, financial, and regulatory steps contribute to the time it takes for a mine to reach production. Lead times also vary substantially by country and mineral. The IEA reported that the average lead time for lithium mines in Australia was only four years, while the lead time for lithium mines in South America was seven years. Copper mines, meanwhile, had a global average lead time of 17 years. Overall, the average lead time of more than 16 years is alarming when juxtaposed with projected critical mineral supply deficits in 2030 (seven years from now) and even larger projected deficits in 2040 (17 years from now).

The long global lead times in the mining industry are caused by a host of variables including technical difficulties, access to capital, and permitting processes. These factors constrain the ability of markets to respond to price signals. Slowly moving supply,

amidst rapid, volatile, and uncertain demand, creates a much larger possibility of future mineral shortfalls. Reducing lead times is an important area of concern for policy, given the positive impact that shorter lead times could have on calibrating supply and demand, and on facilitating critical mineral production on the timeline needed to meet global climate goals. Although the major barriers to reducing lead times vary by country and mineral, permitting is one of the most significant roadblocks to scaling up production in the United States.

In an in-depth 2015 study on mine permitting in the United States, SNL Metals and Mining concluded that "of all the developed nations, unexpected and often unnecessary delays in obtaining mining permits afflict the U.S. most severely."[28] According to the study, it takes an average of seven to ten years for a mine in the United States to receive all the permits required to begin operations.[29] Permitting comparisons across countries are somewhat problematic given differences in the environmental and social challenges of each country and the way of measuring timelines. Nevertheless, the permitting process in the United States—along with many other OECD countries—and post-permitting legal disputes are a notable contributor to project risk and longer lead times.

Some argue that the U.S. permitting process is more efficient than commonly assumed, pointing to a 2016 study by the Government Accountability Office (GAO) which found that it took the Bureau of Land Management and the Forest Service an average of two years to approve hardrock mining plans from 2010 to 2014.[30] However, approval from the two agencies is just one part of a larger puzzle, which can include mining permits and authorizations needed from more than 30 different federal, state, and local programs.[31] The 2016 GAO study also does not seem to fully consider delays from litigation, which can lengthen mineral production timelines by a number of years. The various permitting hurdles beyond approvals from two federal agencies help illustrate the complexity of the U.S. system and the roadblocks mining projects face to begin production.

There are three ways that unpredictable and inefficient permitting can prove a headwind for U.S. efforts to scale production of critical minerals. First, delays can drastically cut a mine's expected value before it even begins production and lead a project to become financially unviable.[32] Second, permitting uncertainty can lead to lower levels of total investment in U.S. mining projects due to the higher level of perceived risk. And third, permitting delays can lengthen the time it takes for projects that do eventually receive permits to begin production. These three constraints have meaningful implications for the U.S.'s prospects of rapidly scaling critical mineral production to meet increases in demand and climate objectives. American policymakers face the challenge of making permitting more efficient, predictable, and transparent while minimizing important social and environmental tradeoffs. A failure to do so could

result in investments moving toward foreign countries that have less permitting risk, thus undermining U.S. efforts to use domestic production as a means of bolstering supply chain resilience.

### Finding #6: Substantial uncertainty over future critical mineral demand increases the potential for future supply shortfalls.

Changes in technology and policy can drastically affect mineral demand. The IEA projects that the growth in *demand from clean energy technologies* for minerals such as cobalt and graphite could range from six to 30 times based on the direction of battery chemistry evolution.[33] The wide range of these projections is significant given that clean energy technologies are estimated to be a major source of demand growth for cobalt and graphite. For example, clean energy technologies could make up 69 percent of total cobalt demand by 2040 under the IEA's Sustainable Development Scenario.[34] Cobalt producers, as well as those of many other critical minerals, are struggling to plan for huge levels of demand variance that hinge on unpredictable, and often rapid, technological changes. The IEA estimates that a slow shift to batteries with high nickel content could lead cobalt demand to increase by a factor of slightly more than 30 between 2020 and 2040, compared to projections estimating that cobalt demand will increase by a factor of 21 under the IEA's base case Sustainable Development Scenario.

Policy uncertainty also plays a crucial role. According to the IEA, the main source of demand variance for critical minerals is uncertainty over the climate incentives and implementation policies of governments.[35] Total lithium demand in 2040, for example, differs by more than a factor of three between the IEA's Stated Policies Scenario—which describes current government policies— and its Sustainable Development Scenario—which models a "well below 2.0°C" pathway.[36] While producers are largely basing their demand forecasts on current government policies, new climate pledges and policies could quickly change demand for critical minerals. Changes in both demand and supply can also be rapidly induced by geopolitical forces. The mining industry will likely struggle to react to these changes and to provide elastic supply given the long lead time of the industry. This heightens the risk of possible future shortfalls.

### Finding #7: A lack of reliable data and sufficient transparency make it difficult for markets to align supply and demand, and increase the risk of volatility, thereby limiting investment in supply growth.

Many critical mineral markets lack reliable data and transparency, particularly in comparison to other commodities such as oil and gas. This opacity complicates the ability of consumers and producers to assess supply-demand balances, plan for potential risks, and interpret price signals. These dynamics were recently evident in 2022 when

the London Metals Exchange suspended nickel trading after short selling caused prices to increase more than 250 percent over two days. They were also present when lithium carbonate spot prices in China increased twelvefold from 2020 to 2022, before declining by more than half in the first few months of 2023.[37] Supply shortfalls are likely when reliable supply and demand data is unavailable, future changes in demand are rapid and unpredictable, and supply is inelastic in the near term.

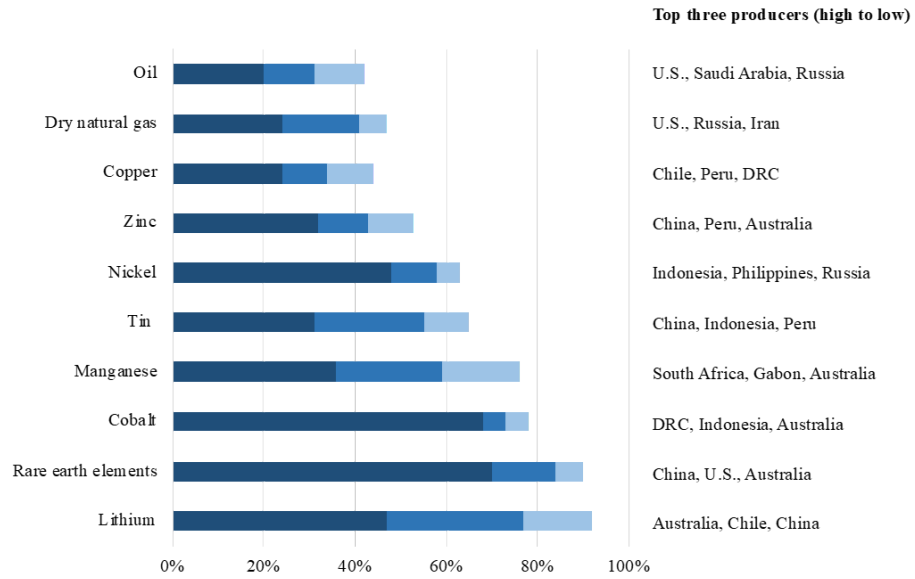
Despite current projections, sustained critical mineral shortfalls may not materialize for every critical mineral given uncertainty around the pace of the transition and technological innovation. Global experience has shown that markets have a powerful ability to respond to price incentives. Commodities such as lithium have also displayed more elastic supply than commonly thought.[38] But environmental, social, and governance challenges, long lead times (particularly due to permitting in the United States), demand uncertainty, and a lack of market transparency heighten the risk that critical mineral markets will not function efficiently moving forward. The implications could be severe given the nature of minerals as an increasingly important foundation for American climate, economic, and national security.

**Finding #8: The upstream supply of many critical minerals is extremely geographically concentrated and vulnerable to supply chain disruptions.**

The United States currently imports most of its critical minerals. As of 2022, the United States imported more than half of its consumption of more than 51 different minerals.[39] For 15 of these minerals, the United States relied on imports for 100 percent of its consumption.[40]

High import reliance is problematic given the concentration of critical mineral supply chains. As shown in the figure below, global production of critical minerals is even more concentrated than that of oil and gas. In many cases, the top three critical mineral producers control more than 50 percent of global production. Some supply chains are dominated by a single supplier. The Democratic Republic of Congo, for example, produced 68 percent of global cobalt in 2022.

Figure 2: Market Share of Top Three Producers (Oil and Dry Natural Gas in 2021, Minerals in 2022) (Sources: USGS and EIA)




The concentrated production of critical minerals places supply chains at severe risk of disruption from unintentional supply shocks, which could result from events such as political instability or natural disasters, and intentional supply shocks, which could result from production cuts or export restrictions. These risks are increasingly likely as the world moves away from globalization and into an era in which trade wars, nationalizations, and geopolitics promise to feature more prominently. Early signs of disruption are already taking place. In Latin America, Argentina, Bolivia, and Chile have reportedly considered forming a lithium cartel.[41] Although the effects and likelihood of a cartel are uncertain, a lithium cartel could threaten to limit lithium production, both from lower levels of private investment and efforts to control output. Peru, the countries' neighbor, has shown it could also generate major supply disruptions as its copper production remains threatened by political instability.[42] More generally, rising resource nationalism in Latin America, amid a shift to more populist politics, is generating concerns about future critical mineral supply. Similar sentiments are also being expressed in other important producing regions, such as Africa.[43] In Asia, Myanmar recently imposed a ban on all tin exports, while Indonesia has banned exports of nickel concentrate.[44]

China's acquisitions of overseas mining assets add another variable to existing challenges in critical mineral markets. As of 2020, for example, 15 of the 19 largest cobalt producing mines in the Democratic Republic of Congo were fully or partially

financed by Chinese companies.[45] The DRC may be an extreme example, as China does not hold such dominant control of mining in most other countries. Nevertheless, Chinese investments in overseas mining assets, like its "going out" strategy with oil and gas, have increased over the last decades. They will continue to grow as China's demand for minerals mounts and the energy transition accelerates. To support these endeavors, the Chinese government has often provided Chinese companies with large credit lines, allowing them to claim ownership of strategic mining assets throughout Africa, Asia, and South America.

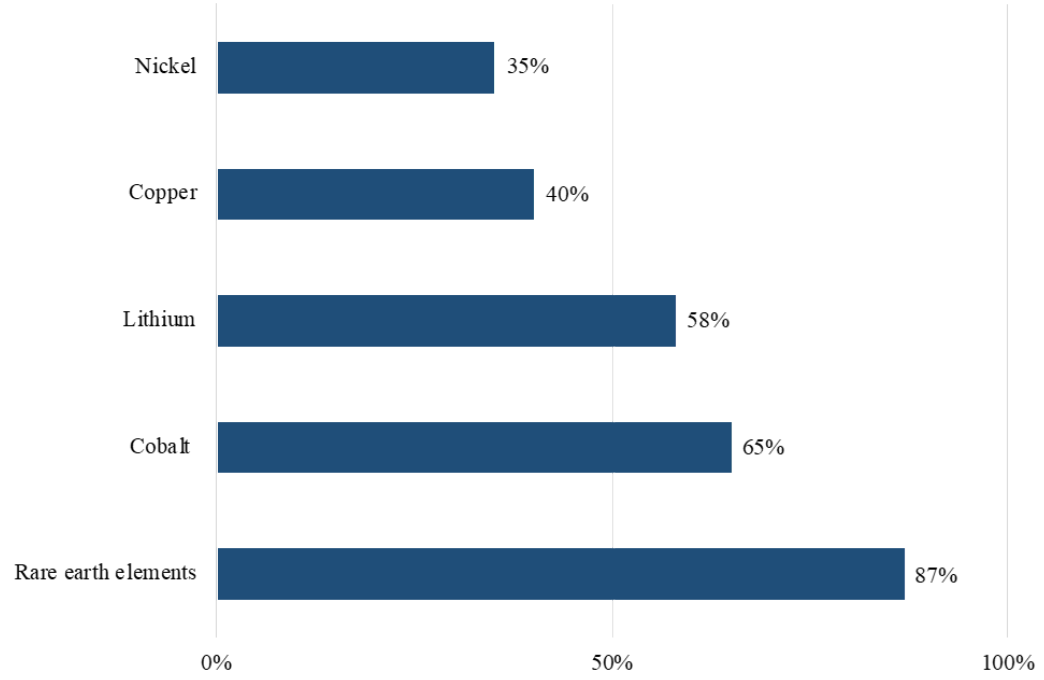
While Chinese investments are positive for boosting global supply, they could also distort trade flows in ways that are difficult to track. Since many of the Chinese mining companies operating abroad are state-backed, they could potentially opt to supply resources to China in the case of a global shortage, even if higher prices are offered elsewhere. This is different than how a normal market with independent companies and traders would function. These dynamics are particularly important given the growing trend of vertical integration in critical mineral markets. Various downstream manufacturers are increasingly interested in locking up supply through offtake agreements or through direct ownership stakes in upstream production. This behavior is not only seen in Chinese firms but is also a model being pursued by American companies such as General Motors and Tesla. As companies pursue vertical integration and fixed offtake, ownership of overseas assets will become increasingly important in determining a country's ability to obtain the supply—and stable prices—of minerals that are needed for the domestic production of clean energy technologies. China's role in overseas investments also has diplomatic implications for the United States, as it has provided China with a means of strengthening its relationship with and increasing its leverage over various countries in the Global South.[46]

Mineral production is further concentrated at a corporate level, with companies like Glencore producing nearly one-fifth of global cobalt, and four companies responsible for nearly 60 percent of global lithium production.[47]

### Finding #9: Global processing capacity for critical minerals is also geographically concentrated, creating risks to U.S. and global supply.

Processing of critical minerals, which converts raw material into usable components in manufactured technologies, is a central bottleneck to developing more resilient supply chains. More than half of the processing of minerals used in lithium-ion batteries, such as cobalt, lithium, and nickel, is concentrated in three or fewer countries. For certain minerals, such as rare earth elements, China holds an effective monopoly on global processing.

Figure 3: China's Market Share in Total Processing of Selected Minerals, 2019 (Source: IEA)




China's dominant role in critical mineral processing is the result of decades of targeted industrial policy which has significantly subsidized domestic industry, invested heavily in R&D, and focused on workforce development. These policies coincided with decades of globalization and the gradual offshoring of the U.S. mining and processing industry, in addition to downstream manufacturing industries. As for talent, U.S. enrollments in mining engineering degrees began to dramatically decline beginning in the 1980s due to the offshoring of jobs and decreased funding for academic programs.[48] The United States then closed the U.S. Bureau of Mines—an important agency for research and development, and for information collection and dissemination—in 1996.[49] During this same period, China invested heavily in building its technical capacity and human capital. In 2020, the graduating class of the China University of Mining and Technology was larger than the total number of all mining engineering graduates in the United States.[50]

China's advantages in processing have been further reinforced by its cost competitiveness historically derived from lower environmental, safety, and labor standards. As global trade flows moved to lowest cost points of production, China gained market power due its favorable policy and regulatory environment that provided key inputs, high subsidies, and low costs.

**Finding #10: China's dominance of rare earth elements extends across the full value chain, creating risks and vulnerabilities distinct from those of many other critical mineral supply chains.**

Rare earth elements present a distinct challenge to the United States. China produces approximately 70 percent of global mined production of rare earth elements. Even more importantly, China currently controls an estimated 89 percent of separation, 90 percent of metallization, and 92 percent of magnet production in the rare earth element supply chain; it also accounts for over 70 percent of U.S. imports of rare earth oxides, chlorides, metals, and permanent magnets.[51] This dominance takes on additional significance since the United States relies on imports for all of its refined rare earth elements.[52] Unlike with other minerals, China derives leverage from rare earth elements due to its status as a dominant net exporter and an overwhelming source of U.S. imports.

China is aware of its leverage and the government has signaled strategic intent to wield rare earth elements as an economic and geopolitical tool, as it did when it restricted exports of rare earth elements to Japan in 2010 following a diplomatic dispute.[53] Since 2009, China has led the world in the number of export restrictions on minerals, increasing its export restrictions by a factor of nine.[54] China also passed an export-control law in 2020 that established a broad mandate to restrict exports if in China's national security and public policy interests.[55] Some experts, such as William Reinsch of CSIS and Gary Hufbauer of the Peterson Institute, have speculated that recent actions could signal China's consideration of restricting exports to the United States.[56] Other reports suggest that China has drafted plans to use its rare earth elements as a trade weapon against the United States and is considering banning the sale of rare earth refining technology to the United States.[57] Reports from Chinese national media, point to Xi Jinping's visit, along with his lead trade negotiator, to a rare earths facility during the height of the 2019 trade war as suggestive of China's willingness to use rare earth elements as a source of leverage in trade disputes.[58]

Economic interdependence is not inherently bad nor is China guaranteed to wield rare earths as a geopolitical weapon. But the case of rare earth elements provides three important takeaways. First, China's share of processing provides more leverage for some minerals than it does for others, largely depending on China's level of exports and imports. Second, China has at least signaled that it is *considering* use of its processing dominance as a form of geopolitical leverage. Third, the benefits of less reliance on China may be particularly worthwhile for certain minerals. An interagency group led by the Department of Defense in 2021 found that although the United States consumes only $613 million in rare earth elements, that consumption unlocks an estimated $496 *billion* in U.S. economic activity, demonstrating outsized economic vulnerabilities.[59]

**Finding #11: China's dominance of midstream supply chains for battery metals affords it a real advantage, but the extent to which that dominance creates energy security risks and geopolitical leverage is often exaggerated.**

Contrary to common perception, China's control of critical mineral processing does not automatically generate unilateral geopolitical leverage in critical mineral supply chains. For example, despite holding a large share of global processing for copper and nickel, China is currently a net importer of refined copper and nickel.[60] China's dominance of cobalt and lithium processing also does not seem to constitute a major geopolitical threat to those supply chains. China represents a major share of global demand for refined cobalt and lithium and exports very small quantities of these materials to the United States; rather, Chinese cobalt and lithium are used domestically in value added sectors such as battery cell manufacturing and eventually appear in the United States embedded in end products.[61]

China's control of global processing of these minerals *could develop into an area of more pronounced leverage,* especially as the United States seeks to localize manufacturing of key technologies in the short term. China's existing dominance and competitive advantages in processing may make it economically challenging for certain midstream operations—such as lithium or nickel processing—to gain market share and scale in the United States. Even if the United States increases its capacity to mine critical minerals and manufacture clean energy technologies, American supply chains will remain vulnerable if there are not significant increases in mineral processing capacity. In fact, increasing mining and manufacturing without increasing processing will heighten American reliance on Chinese processing and strengthen China's ability to use processing as a means of geopolitical and economic leverage.

Critical minerals are ultimately different in nature than other commodities such as oil and gas. While a shock in energy has immediate impacts on everyday citizens, minerals are inputs to manufactured products, offering more time for adjustment and less tangible impact on most citizens. If there were a disruption in mineral exports, intentionally motivated by geopolitics or unintentionally by a natural disaster or other event, there would be supply chain bottlenecks, delivery delays, and higher costs for new clean energy products, such as solar panels and EVs, but the ability to keep the lights and heat on or drive existing EVs would not be affected. Many minerals may also prove more substitutable than a commodity like oil historically has, even if such substitutes can be inferior in technical characteristics, as is the case for sodium as a substitute for lithium and aluminum as a substitute for copper. Over time, manufacturing and processing can be done anywhere, unlike oil and gas production which depend on geological fortune.

Nevertheless, critical mineral supply shocks can still significantly impact the profitability of value-adding activities such as the manufacturing of clean energy technologies and related industries, like the auto industry. And, as observed above, critical mineral supply chains are more concentrated than those for oil and gas, so may suffer from even more pronounced supply chain risks. The U.S. 100-day Supply Chain Review in 2021 found that there were 37 different mineral markets where more than half of global production comes from a single non-American source.[62]

While mineral disruptions may not have the same effects as those of energy, they will certainly restrict global efforts to meet climate goals. They can also hamper the economic security, and in some cases national security, of many nations, including the United States. As has historically been the case with other commodities, there is definite value in ensuring that both global and American supply chains are less vulnerable and more resilient.

**Finding #12: The United States will not be able to attain self-sufficiency in critical mineral production, let alone supply all global demand, anytime in the near future.**

The United States is heavily reliant on imports to meet its domestic demand of most critical minerals. In 2022, U.S. mined production of battery metals such as cobalt, manganese, and nickel satisfied only 10 percent, 8 percent, and 0 percent, respectively, of domestic consumption.[63] While recycling helped bridge the gap for cobalt and nickel, the United States still relied on imports for 76 percent of its cobalt consumption and 56 percent of nickel consumption. The United States currently imports 100 percent of the manganese that it consumes domestically. Although efforts to build domestic mines are accelerating, many of these projects will only make a small contribution to fulfilling total U.S. demand. For example, Jervois's new cobalt mine in Idaho has been touted as a breakthrough for the United States but is projected to meet only 10 percent of annual U.S. demand.[64] As discussed earlier, the United States will not be able to build new mines quickly, given permitting timelines, local objections, and other challenges to project development. And with minerals such as manganese, the United States faces the additional challenge of not having produced for more than a half century and lacking reserves, with existing resources thought to have low grades and high extraction costs.[65] The United States currently relies on imports for more than half of its consumption of 51 different minerals.[66] Attempting to scale mined production to meet existing, not to mention rapid growth in, U.S. demand for all critical minerals will be costly and timely.

Even if the United States were to produce all the minerals it consumed, that would come at a cost, as the gains of trade would be lost and domestic resources more costly to produce. Moreover, as is true for oil and other commodities, if the United States would

remain integrated into a global market, the price of domestic commodities would still be vulnerable to threats from global supply shortfalls. There are many benefits to being part of an integrated global market, as interconnected and well-functioning energy markets increase energy security by allowing supply and demand to respond to price signals so the entire system can better handle unexpected shocks. At the same time, interconnectedness means global critical mineral shortfalls could impact U.S. mineral prices, which would harm American downstream manufacturers. Global critical mineral shortfalls, as discussed throughout this report, would also harm U.S. interests by impeding the pace of the energy transition. Recent analysis shows that it will take unprecedented action for all global democracies to jointly produce enough critical minerals to meet their combined demand based on stated 2030 climate goals.[67] It is obvious that the United States will not be able to supply enough critical minerals to meet the global demand of all democracies, let alone the entire global market. Given the magnitude of projected growth in critical mineral demand and realities of integrated commodity markets, it is neither feasible nor desirable to have as a policy objective "independence" or "self-sufficiency" in critical minerals.

**Finding #13: Current U.S. efforts to diversify its sources of supply and encourage global production are too geographically narrow.**

The United States has recently attempted to diversify upstream production through legislation such as the Inflation Reduction Act and new structures such as the Minerals Security Partnership. Although these initiatives have generated some positive movement, they have been overwhelmingly focused on an exclusive group of countries. Tax credits under the Inflation Reduction Act are offered to countries with which the United States has a free trade agreement, and members of the Minerals Security Partnership are primarily advanced economies, most of which are net importers of critical minerals. These initiatives exclude an important "middle group" of suppliers.

Middle group countries—those that are neither U.S. free trade partners nor U.S. adversaries—do and will continue to play a strategic role in critical mineral markets. Over 60 percent of global cobalt, manganese, and nickel production, for example, comes from middle group suppliers. In many cases, these suppliers are not included in U.S. initiatives, leaving them with little option but to turn to China for investment. As outlined earlier, this has been the case in countries like the Democratic Republic of Congo, which produced 68 percent of global cobalt in 2022 but has a cobalt sector largely dominated by Chinese investment. The same has occurred in Indonesia, which produced 48 percent of global nickel in 2022.[68] That same year, Indonesia's nickel-rich islands of Halmahera and Sulawesi received $3.4 bn in investment, of which 94 percent came from China and less than one percent from the United States.[69] Argentina's lithium sector is beginning to present a similar story.[70] Three different countries and commodities, but all share the similarity of being strategic producers that

are not engaged as free trade partners in the Inflation Reduction Act nor as core members of the Minerals Security Partnership. The United States has shown a pragmatic approach to IRA implementation by making countries that have recently conducted mineral-specific "trade agreements" with the United States eligible for IRA compliance, although political hurdles may constrain some of these efforts to expand eligibility.

Figure 4: Global Critical Mineral Production and Reserves by Type of U.S. Relationship, 2021 (Source: USGS)

**Global critical mineral production by type of US-relationship (2021, %)**

| ***Production (2021, %)*** | **Lithium** | **Nickel** | **Cobalt** | **Manganese** | **Copper** | **Graphite** |
|---|---|---|---|---|---|---|
| **Total USMCA** | 0 | 5 | 3 | 1 | 12 | 1 |
| **Total FTA** | 81 | 6 | 5 | 17 | 41 | 0 |
| **Total FTA-suggested** | 1 | 14 | 3 | 0 | 2 | 0 |
| **Total Non-FTA** | 9 | 48 | 75 | 74 | 19 | 17 |
| **Total Concern** | 14 | 14 | 8 | 7 | 12 | 86 |
| **Total (rounded)** | 105 | 87 | 93 | 98 | 87 | 104 |

**Global critical mineral reserves by type of US-relationship (2021, %)**

| ***Reserves (2021, %)*** | **Lithium** | **Nickel** | **Cobalt** | **Manganese** | **Copper** | **Graphite** |
|---|---|---|---|---|---|---|
| **Total USMCA** | 3 | 2 | 4 | 0 | 13 | 1 |
| **Total FTA** | 68 | 22 | 19 | 18 | 42 | 0 |
| **Total FTA-suggested** | 0 | 5 | 3 | 0 | 4 | 0 |
| **Total Non-FTA** | 11 | 39 | 56 | 78 | 11 | 77 |
| **Total Concern** | 7 | 11 | 11 | 4 | 10 | 23 |
| **Total (rounded)** | 90 | 79 | 93 | 99 | 79 | 102 |

***Notes***

*1) These numbers are based on USGS statistics. Percentage errors are due to rounding by USGS of production totals or the omission of 'rest of world' estimates.*

*2) Countries of concern include China, Russia, Iran, North Korea, and Cuba. FTA countries include Australia, Bahrain, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Israel, Jordan, Korea, Morocco, Nicaragua, Oman, Panama, Peru, and Singapore. FTA-suggested countries include EU countries and the Philippines.*

## Recommendations

### Recommendation #1: Congress should streamline permitting by utilizing a place-based approach and setting strict timelines on adjudication.

The slow pace of permitting prevents the United States from positioning itself as a key hub for responsible mining that it has both the physical resources and the high environmental and social standards to be. Addressing this challenge requires balancing two truths. First, a long and unpredictable permitting process can threaten the financial viability of existing projects and lead to lower levels of future investment, which will slow production and the ability to address climate challenges. Second, the dangers of mining present a compelling need to safeguard an impeccable level of environmental and social standards. In fact, a permitting process that fails to respect these standards could result in damage that substantially turns public support against the mining industry and undermines the initial climate, economic, and national security goals of streamlined permitting.

American environmental and social standards have greatly improved over the last decades. This provides the United States—and its key, like-minded trading partners—with an advantage as it evaluates options for permitting reform. Not only are strong standards in place prior to project approval, but adherence to these performance standards is strictly monitored when a project begins construction. Civil and criminal penalties are imposed on those who violate existing standards. When thinking through permitting reform, Congress must distinguish the approval process from substantive performance standards. Streamlining the former does not imply making any changes to the latter.

Congress should follow two steps in pursuing permitting reform. These steps are partially based on the ideas laid out more fully in the Aspen Institute's 2021 Building Cleaner Faster Report.[71]

First, Congress should pursue a place-based approach to streamline permitting for mines and processing facilities located in specific areas. Such an approach would entail establishing a presumption of project approval for any operation located on brownfield sites that have already been cleared for redevelopment and greenfield zones that have been previously designated and agreed upon by relevant parties (e.g., Bureau of Land Management (BLM) and Tribal Nations on public land). In these cases, Congress should require the lead permitting agency (such as BLM or the United States Forest Service (USFS)) to approve or reject the application within a 90-day period. These locations have already been pre-assessed, reducing the need for a lengthy permitting process unless there is a particularly unique risk posed by the nature of the new project. New

projects approved in this manner will still be subject to the full suite of performance standards and resulting civil and criminal penalties for noncompliance.

Second, Congress should set strict timelines on the adjudication process for critical mineral permits. Protracted litigation can be a major risk and source of delay during permitting. Congress has precedent for establishing firm adjudication timelines on projects of national importance. Examples include the establishment of an aggressive 100-day time limit for administrative resolution of contract award disputes with the Government Accountability Office related to defense and other vital government services, and similarly limited timelines for any appeal and the grounds for review of the administrative decision. Congress also expressly created a streamlined 30-day process for all transactions reviewed by the Committee on Foreign Investment in the United States to avoid the impact of delayed approval on U.S. businesses.[72]

Although mining is much more complex, a similar time-limited approach could be applied to critical mineral projects given the scale of production that is needed over the next two decades to meet U.S. climate objectives and contribute to the domestic production of key technologies. More specifically, Congress should restrict adjudicative review to clear and obvious errors in the assessment of harmful impacts or interpretation of existing standards. A specific scope and timeline for the review process will prevent the possibility of long delays and improve efficiency. It will also maintain environmental and social considerations by ensuring that all potential harms and relevant standards have been properly assessed.

As Congress tackles permitting reform, it can additionally investigate opportunities to streamline permitting by incorporating more mining projects into coverage under Title 41 of Fixing America's Surface Transportation Act (FAST-41). FAST-41 sets strict permitting timelines and improves permitting transparency. Coverage of FAST-41 was recently granted to a $1.7 billion zinc and manganese mining and processing operation in Tucson, Arizona.[73] It was the first critical mineral project accepted for coverage under FAST-41 and may set an important precedent for coverage of similar projects in the future.

### Recommendation #2: Congress should clarify and endorse the concept of Free, Prior, and Informed Consent, making clear that it should be received from Tribal Nations directly impacted by critical minerals development.

As described in the findings above, many of the delays in developing U.S. critical mineral deposits stem from permitting delays. Such delays are often the product of the opposition of local and indigenous groups to the projects, and occur against the backdrop of a painful history of such groups with the mining industry.

In 2007, 143 countries voted for the UN General Assembly to adopt the UN Declaration on the Rights of Indigenous People (UNDRIP). The United States was opposed to the declaration at the time, in part due to opposition to the concept of "Free, Prior, and Informed Consent (FPIC)," which suggested to many that indigenous groups hold a veto over the development of projects affecting their interests. In 2011, however, the United States revised its position and, a decade later in 2021, ratified UNDRIP, yet called the declaration's provisions "aspirational" rather than legally binding.

This sequence of events has left lingering uncertainty about what Free, Prior, and Informed Consent means in the U.S. context. While many stakeholders in the mining industry rhetorically embrace the idea of consultation with parties to be affected by projects, there is less support and consensus around the idea of consent and whether it should constitute a veto. Further, there is no shared sense of what is required versus what is desirable around FPIC, leading to drawn out timelines, often involving extensive court battles. This ambiguity meets neither the interest of mining companies seeking to move ahead, nor indigenous groups seeking protection, nor indigenous groups wishing to benefit from such developments.

For these reasons, Congress should clarify which communities can expect to be afforded Free, Prior, and Informed Consent and what that consent means. One possibility the Task Force found attractive is for Congress to distinguish between tribal communities immediately adjacent to mining projects and those who live further away but may still have environmental or cultural concerns. For the first group, FPIC would be a binding concept in the sense that a project could not proceed over the objection of a direct affected Tribal Nation; for the second group, FPIC would be encouraged, but full consent of these Tribal Nations would not necessarily be required for the project to move forward. In both cases, the process of consultation would be required, augmented by clearer standards and guidelines from Congress on the timelines and scope for the consultation process.

Some may initially find this position as too definitive and discouraging of private investment in much-needed areas to produce much-needed resources. However, it was the sense of the Task Force that more was to be gained by a clearer, sharper definition and application of FPIC than lost. Even without holding a legally recognized veto, indigenous groups have been able at times to manifest their opposition to particular projects and effectively prevent project approval for decades.

A clearer understanding of what it means to withhold consent, as well as who possesses the ability do so, will expedite the process. It would likely reduce rather than increase uncertainty over critical minerals project development timelines by removing the prospect for long regulatory and legal battles over projects in communities that are opposed to development. FPIC would also provide strong incentives for industry to both

target investment in communities that support project development and to engage early on with these communities on both sharing of benefits and mitigation of environmental impact. In contrast, a poorly designed or overly broad FPIC process is likely to lead to major project delays while potentially undermining the ability of tribal communities that favor development to move forward.

**Recommendation #3: Congress should endorse and further facilitate the ability of Tribal Nations to obtain equity in critical mineral projects.**

Congress should ensure that Tribal Nations that do wish to engage in project ownership have access to the required financial and technical assistance. Enabling Tribal Nations to become full project partners could be an important step in increasing their leverage, knowledge, and power, creating a more just system of shared economic opportunity, reducing the possibility of future litigation, and building the trust between the private sector and local communities that will be required to sustain an increase in the domestic production of critical minerals required to meet at least a portion of future American needs.

Currently, companies commonly ensure that local communities benefit from critical minerals development by paying local taxes and supporting local jobs and procurement. While important, Congress can help ensure that Tribal Nations are more meaningfully invested in these projects by providing concessional financing and loan guarantees to Tribal Nations that are interested in obtaining equity in critical mineral projects.

Congress should provide Tribal Nations with concessionary finance and loan guarantees to acquire equity at rates that are attractive and fair to existing equity owners. A *Tribal Energy Loan Guarantee Program* already exists to provide loan guarantees to support tribal investment in energy-related projects, including those in mining. It is well funded, with an increase in authorities to $20bn through the Inflation Reduction Act, and with an additional $75 million provided to carry out the program.[74] Yet unlocking these funds will require Congress to provide clearer guidelines about its use. Ongoing concerns regarding "double dipping"[51] and other bureaucratic hurdles have meant that the program has not yet funded a single energy project on Native American reservations.[75] Alternative arrangements for equity involvement may also be structured with the mining company as creditor, paying for the initial shares, and with the indigenous group's repayments drawn out of dividends.

[51] Double dipping" refers to the prohibition in the budget reconciliation law against using loan guarantee funds for projects that already received other federal support. Critics argue that the DOE's interpretation of the law is unduly harsh and limits the program in ways that contradict the intent of Congress.

**CANADA'S EXAMPLE.** Canada offers useful examples of indigenous equity agreements. Multiple indigenous groups in Canada have obtained equity in local projects, particularly in those involving petroleum and renewable energy. The growing popularity of these arrangements—which are structured differently for each project—show that the private sector and indigenous communities are beginning to view co-ownership as a potential win-win scenario. The First Nation's Major Projects Coalition in Canada is a coalition of 27 aboriginal groups that have joined together to invest in high-value projects. Moreover, in Canada, equity has been granted as a recognition of historical claims. Despite these successes, access to affordable capital has often proven a major roadblock for Canadian indigenous groups seeking to acquire equity.

Congress should also ensure that Tribal Nations have access to technical assistance to manage the complexity, risks, and high transaction costs of equity negotiations. Congress could either mandate that technical assistance be offered through the Department of the Interior or offer grants for Tribal Nations to hire independent consultants. Given that many critical minerals are near, but not specifically on, Native American Reservations, Congress should offer the benefits listed above to indigenous communities that are deemed to be directly affected by critical mineral projects.

The Task Force was divided about whether Congress should impose a royalty fee for mines operating on federal land.[52] Some argued that royalties are a barrier to investment in critical minerals development at a time when more investment is urgently needed to increase supply. Others argued that a mechanism to impose and redistribute royalties could provide local communities with a risk-free flow of shared economic benefits, which could compensate communities for the risks that they face and better align incentives between mining companies and local citizens, ultimately making increases in production more sustainable.

Congress should further study the merits and risks of a limited royalty fee on all hardrock mines located on federal land used for the purpose of redistribution to local communities affected by mining activity. The exact structure of such royalties—including whether they are levied on revenue, profit, or some other

[52] The absence of a royalty framework for mining on public domain land stands out given that the federal government earns royalties on extraction of other commodities on federal lands including for oil, gas, and coal. Hardrock mines on public domain land are excluded from royalty payment due to the 1872 Mining Law, which has now turned more than 150 years old and has limited relevance to the contemporary context of critical minerals. However, it should be pointed out that several states collect royalties from mining on public land. Furthermore, Congress has updated the 1872 Mining Law over past decades but has so far not opted to introduce royalties.

metric—would need to be assessed carefully to ensure a steady flow of funding while not placing an undue burden on mining companies. The same principles should be applied to the rate of the royalty. Ideas can also be taken from local and state royalty structures for mines outside of federal land and from international models. Congress should assess the merits of royalties relative to other approaches to shared benefits discussed above, including equity-based participation for local communities affected by mining.

Regardless of its eventual decision on royalties, Congress should also provide the Federal Bureau of Land Management and the United States Geological Survey with the relevant funding and mandate to collect data on all mines located on federal land. Federal agencies are not currently collecting sufficient data on the activity of hardrock mines that are located on public domain land since these mines do not pay royalties. Improved data collection will require more funding and a specific mandate.

**Recommendation #4: Congress should continue to increase funding for the National Defense Stockpile, enabling it to effectively fulfill its mandate for defense and security.**

The National Defense Stockpile (NDS) is an essential tool to help the United States withstand shocks to critical mineral supply chains, reduce overdependencies on foreign countries, and ensure the ability to maintain production in defense, industrial, and essential civilian sectors.[76] An early version of the stockpile was first formed shortly before World War II to help the United States acquire and store raw materials in the face of a looming war effort.[77] The NDS was guided by the idea that stockpiles improve supply chain resilience and decrease vulnerabilities. These principles were powerful during the interwar era and various instances of geopolitical uncertainty.

Today, the NDS remains as crucial as ever. The increasing importance of critical minerals and the fragile state of supply chains presents an imperative to maintain a robust national stockpile. But now is the right time to reassess and reform the NDS, given how the energy transition is posing a new set of challenges, including the possible, if bounded, ability of U.S. adversaries to use dominance in critical mineral supply chains for geopolitical reasons.

The United States government has already acknowledged the need to expand the use of the NDS. The Departments of Energy, Defense, and State have signed a memorandum of agreement that paves the way for stockpiling for a larger purpose, specifically to support the transition to clean energy[78]. This stockpiling can further give a public procurement angle to ESG-compliant mineral production by establishing standards around operations that qualify for public procurement.

For the new NDS to be effective, two efforts must be part of this reform. First, there will need to be a detailed study (outside the scope of this task force) to determine which type of critical materials to stockpile. While the decision may be simple for some minerals, it will be difficult for others. Minerals such as lithium have a variety of specialized final forms, many of which are highly specific and difficult to store and transport. In such cases, the NDS could generally seek to have the largest stockpiles for the form of material that is least logistically complex and can most easily be converted into a wide range of different final forms. Similar logic explains why the Strategic Petroleum Reserve is based around crude oil, rather than refined oil products. For minerals, storing concentrate or semi-refined material will be most effective if domestic processing capacity is increased. Many of these materials are useless on their own and must be processed, underscoring the importance of domestic processing. Holding sizeable stockpiles of concentrate or semi-refined material can help support the growth of the mineral processing industry in the United States by guaranteeing processing facilities feedstock in the case of a supply chain emergency—such as dramatic cuts in access to imports of concentrate—that would otherwise leave these facilities vulnerable to financial collapse.

In addition, rebuilding the NDS as a pillar of U.S. critical minerals policy will require sustained fiscal support. Even when just considering its more traditional mandate, the NDS is currently severely underfunded. Annual funding for the NDS decreased from $42 billion in 1952 to less than $1 billion in 2021, in adjusted dollar terms.[79] According to the United States 100-day supply chain review, “from FY2003 to FY2018, Congress diverted 89.8 percent of the proceeds from NDS program activities” to other programs.[80] Congress has recently decided to reverse course, authorizing $1 billion for the NDS in the 2023 National Defense Authorization Act.[81] It must continue to increase funding for the NDS over the coming years. Congress should ensure that this funding is sufficient for the NDS to provide an effective buffer for defense and security in the case of a national emergency.

Congress should avoid the impulse to alter the fundamental nature of the NDS. The NDS should not be used as an economic stockpile that aims to control market prices. Rather, efforts to rebuild the NDS should continue to focus on the NDS’s role as a provider of supply chain resilience. This mandate means that the NDS will not cover all U.S. civilian needs, nor smooth commodity prices. But a rejuvenated and refinanced NDS will first and foremost provide a crucial buffer against supply chain disruptions for defense needs. With sufficient funding, the NDS could also provide initial protection against extreme supply chain disruptions that could cause levels of instability that are significant enough to impose long-term harm on American climate and economic interests. Congress should seek to provide the NDS with the adequate financial resources to potentially provide defense, industrial, and essential civilian sectors with

strategic raw materials; allow time for markets to reposition in the case of supply emergencies; and offer protection against foreign adversaries' ability to use critical minerals as geopolitical leverage against the United States.

**Recommendation #5: Congress should expand funding for R&D and undertake regulatory reform to promote substitution of alternatives, demand reduction, and recycling of critical minerals.**

Substitution of alternatives, demand reduction, and recycling can help build multiple pathways for low-carbon technologies, reduce the need for mining, encourage the more efficient use of critical minerals, and decrease the potential for supply chain disruptions.

In the market for batteries, the development of alternatives looks promising. For example, Lithium Iron Phosphate (LFP) batteries reduce the need for the nickel, cobalt, and manganese used in Nickel Manganese Cobalt (NMC) batteries. Sodium-ion batteries are another alternative and reduce the need for lithium, although demand for battery-related minerals, particularly lithium, will remain strong in the near term. Technologies such as sodium-ion batteries are still nascent and present a variety of tradeoffs on range and vehicle size, but are promising alternatives in the long term, and for grid storage, specifically if supported by policy incentives [82] The same applies to other technologies, such as iron nitride magnets, which could potentially substitute for rare earth elements that are used in magnets.

There are a number of reasons why policies may be needed to support the development of such alternatives. Adoption and full commercialization of such new technologies can fail or take longer than expected due to various reasons. Many technologies may face cost differentials that hinder adoption. In some cases, the private sector may not fully internalize the positive externalities of new technologies. For example, a battery that requires less minerals will offer benefits to society by reducing the need for mining. But this may not always be a primary consideration for auto companies, which may be more focused on variables such as product cost and performance. A good example is LFP batteries, which do not require nickel, manganese, or cobalt. These batteries were developed in the United States but abandoned because they had a lower energy density than other batteries. China further developed the technology to achieve 85 percent of energy density of NMC 811 batteries, while holding a grip on patents until the end of 2022, by which time a significant portion of electric vehicle batteries in China were LFP, compared to around 5 percent in the United States.[83]

Recycling can also play an increasing role in reducing the need for future mining as a larger number of mineral-intensive products reach the end of their life cycle. For every recycled battery, or for every new battery that relies to some extent to recycled components, the need for critical minerals is reduced. Increasing the contribution of

recycling in the supply chain also reduces the negative environmental impacts associated with critical mineral mining and supports climate objectives. Recycling can also improve supply chain resiliency for advanced economies—such as the United States—which are large consumers of minerals embedded in end products. The IEA projects that by 2040 recycled quantities of copper, cobalt, nickel, and lithium from spent batteries could meet 10 percent of global demand for those four minerals.[84] In fact, recycling currently accounts for a significant portion of United States cobalt and nickel consumption.[85] United States recycling rates of other minerals, such as lithium and rare earth elements, however, are extremely low. It is essential to lay the groundwork for a national battery recycling program now, so that it is available at the necessary scale as the stock of end-of-life electric vehicles and depleted batteries grows over the next decade.

Congress can address barriers to developing alternative technologies and to recycling by increasing funding for research and development related to demand reduction, substitution, and recycling and/or to mandate specific requirements, such as battery recycling, as well as funding start-ups and de-risking emerging technologies through programs such as the DOE Loan Program Office. Yet, when it comes to recycling, simply creating incentives and funding is not enough. Congress and regulatory agencies such as the Environmental Protection Agency should, through targeted regulations, also encourage development of recycling infrastructure; this can be done by ensuring spent batteries are framed and categorized as a valuable recyclable product and resource in the regulatory framework, rather than categorized as a waste or hazardous waste. Further, Congress should ensure that the regulatory and permitting entitlement framework is set up in a way that accelerates the development of recycling infrastructure.

These are important avenues for policy and Congress should evaluate the effectiveness of scaling recycling vis a vis substitution and demand incentives. Continuing to increase funding for research and development of technologies that reduce critical mineral dependencies is crucial. Development of these technologies often rely on government early- and mid-stage support. In some cases, more funding for research and development or more federal requirements on issues such as recycling may prove far more effective and practical than demand incentives. In other cases, demand incentives may be a productive compliment to other existing initiatives.

**Recommendation #6: Congress should implement a grant program for accredited mining programs in the United States and should earmark a certain proportion of funds for recruitment initiatives.**

The U.S. workforce faces challenges that could significantly constrain efforts to increase critical mineral mining, processing, substitution, and recycling. More than half of the

current United States mining workforce—equating to about 221,000 workers—are expected to retire by 2029.[86] Meanwhile, the United States only conferred 327 mining and mineral engineering graduates in 2020, with the number of mining programs in the United States in large decline since the 1980s.[87]

Over the longer term, supply-demand dynamics will play a role in helping recalibrate labor markets. However, the rapid scale of projected mining growth, intense competition for talent, and students' lack of knowledge about mining indicate a need for Congressional support.

Congress should design a grant system for accredited United States mining programs, ensuring that a certain proportion of new funds are earmarked for recruitment initiatives. Mining currently struggles with a variety of recruitment-related issues, including a negative perception of mining and students' lack of exposure to the industry. In fact, research indicates that students' lack of knowledge about mining may be one of the main drivers of low enrollment in mining degrees.[88]

Congress can build on existing legislation, such as the Mining Schools Act of 2022 that requires the Secretary of Energy to provide technology grants to strengthen domestic mining educations through a newly established Mining Professional Development Advisory Board as well as via the mine safety, health training, and education funding managed by the Mine Safety and Health Administration of the Department of Labor.[89]

Where possible, Congress can also seek to offer grants to multidisciplinary initiatives. These initiatives can seize on the fact that developments in robotics, automation, big data, and cloud computing are changing the landscape of mining. For the United States to build a competitive mining industry, it must focus not only on training mining and chemical engineers, but also on attracting technologists, data scientists, and mathematicians. Supporting interdisciplinary initiatives will allow the United States to leverage the strengths of its existing workforce and position itself to become a leader in the future of critical minerals.

New initiatives to train qualified mining talent will not reap rewards overnight but will be essential for building a competitive American mining sector over the next decades. Strengthening the United States workforce will help develop the necessary talent to power domestic supply chains and support the Biden Administration's Just Transition agenda.

### Recommendation #7: Congress should resist reliance on Buy America provisions when crafting legislation related to critical minerals and seek to develop alternative international agreements to meet domestic needs.

Congress has recently increased its use of Buy American provisions as a means of building support for legislation, supply chain resilience, and the U.S. manufacturing base. While these objectives are understandable and important, Congress should look for other ways to achieve them apart from requiring that manufacturers and others buy American inputs only. Buy America provisions can distort investment and lead to supply shortfalls in critical mineral supply chains. These provisions also risk alienating key U.S. allies and triggering similar responses from other countries, leading to a race to the bottom where countries compete to offer the highest subsidies.

This cautionary note is particularly important given that, as explained earlier in this report, under no feasible circumstance will the United States meet all its needs for critical minerals exclusively through domestic production. The United States will need to draw on the resources and developments of other countries to meet its future demand. For this reason, the United States should focus on developing an alternative approach to Buy America that builds relationships with reliable countries to help them develop their resources and provide those resources to global markets.

The below recommendations build on one other to create standards, frameworks of support, and relationships that would collectively build this system. Ideally, the efforts described below would be pursued in a multilateral context. However, in the interest of speed, or due to other reasons, bilateral agreements might be developed simultaneously, with an eye to creating umbrella frameworks in the future.

In seeking to build these arrangements, the United States can build on existing dialogues and agreements, such as the Minerals Security Partnership, ongoing 30D negotiations with the EU and Japan, the Americas Partnership for Economic Prosperity, and the Indo-Pacific Economic Framework for Prosperity. It can do so by leveraging financing tools and encouraging member countries to offer similar mechanisms, thereby pooling resources and maximizing impact. As they take form, agreements should seek to include an expansive group of strategic exporting and importing countries. They should also have an open architecture, allowing countries to join over time. Multilateral agreements should seek wide membership rather than exclusivity.

### Recommendation #8: Congress should work with federal agencies and international allies to establish clear standards for foreign mining projects that qualify for support.

The United States and its partners should engage in a "race to the top" to create supply chains and markets with new standards around climate, human rights, transparency, biodiversity, and indigenous rights. As discussed in subsequent recommendations, these standards can be the basis for greater financial support and trade benefits. In this way, the United States can develop reliable trading partners for critical minerals, while

having greater confidence that the environmental and social aspects of these projects are managed responsibly.

Congress can play an important role by working with federal agencies and international partners to define the required environmental and social standards for mining projects that qualify for support and benefits. Environmental, social, and governance (ESG) standards should reflect existing American values and legislation while leaving space for input from partner countries. They should embody the existing Minerals Security Partnership Principles for Responsible Minerals Supply Chains, which is explicit about not endorsing a single ESG accreditation framework but requiring internationally recognized ESG standards.

In working with others to develop such standards, Congress has a range of useful precedent from which to draw. First, Congress can refer to its new domestic standards and lean on existing work by the Department of Labor Mine Safety and Health Administration, which sets labor standards for mine operations in Title 30 of the Code of Federal Regulations, and that of the Environment Protection Agency, which establishes environmental standards for mineral mining and processing (last updated in 1979).[90]

Congress can also rely on international frameworks such as the Extractives Industry Transparency Initiative (EITI), the Global Industry Standards on Tailings Management (GISTM), and the Initiative for Responsible Mining Assurance (IRMA) for important reference points. These frameworks reflect a variety of reforms and innovations the mining industry is using to reposition from an “extractive” sector to an “enabling” sector that supports the low carbon transition with more sustainable industrial practices and reimagined, stronger partnerships with local communities.

In terms of sustainable mining, several areas of innovation and industry best practices stand out. These include the adoption of net zero Scope I emissions for critical minerals mining operations, through the incorporation of electrification, hydrogen, biofuels, and CCUS. Industry standards are also emerging around biodiversity protection through growing industry commitment to net positive land impact. This policy means that mining companies commit to setting aside a greater amount of land for long-term conservation than the amount of surface that is disrupted by the mining development and operations. Also embedded in biodiversity protection and land protection are stronger reclamation standards for new projects and a more fulsome effort on reclaiming historic, abandoned mine sites.

Among the emerging global standards for sustainable mining, perhaps none will be more vital than the adaptation of the strictest industry standards around managing tailings waste from mine operations. Tailings waste poses risks of both potentially

disastrous large volume breaches and floods, as well as slow leaching of toxic materials. The emerging standards should require, wherever possible, the usage of clean dry stack tailings to replace legacy approaches of tailings ponds and slurries. The principles of the Toward Sustainable Mining (TSM) protocol provide sound language for consideration. Efforts to more responsibly manage tailings will be enhanced by emerging brownfield business models around the secondary processing of minerals that might otherwise end up in tailings deposits, but could in many cases be extracted for economic value.

Congress and partner countries should offer support to countries that wish to meet these standards (for their own benefit or in order to qualify for the types of assistance that follows). The ultimate goal of such efforts is to be inclusive, rather than exclusive, and some countries will need assistance in meeting the agreed upon standards. While many developing economies react negatively to Western conditions around governance standards, strategic exporters are extremely interested in determining how to retain more economic value. This is true in countries ranging from Chile to the Democratic Republic of Congo. The United States should recognize this opportunity and provide technical assistance to exporters to standardize, design, and implement regulatory and legal frameworks to capture more value, either directly or through partnerships with technical assistance providers such as the World Bank and the Intergovernmental Forum on Mining, Minerals, Metals, and Sustainable Development. As discussed below, these initiatives will be most impactful if paired with hard financing for project development or market access for products.

**Recommendation #9: Congress should increase funding for the Development Finance Corporation and provide it with an expanded authority, and priority, to invest in critical mineral projects abroad that meet—or can, with U.S. support, meet—the above standards.**

The United States and its allies must develop a coordinated package of policy tools to partner more effectively with strategic exporters of critical minerals. Many strategic exporters are developing economies with limited access to mineral expertise, intellectual property, and finance. This presents a gap for the United States and its allies to step into as important partners. However, a lack of sufficient action in the last two decades has forced many countries to rely overwhelmingly on Chinese investment. More active engagement by the United States and its allies will help boost global production and diversify supply chains.

Congress should provide the Development Finance Corporation (DFC) with an expanded authority to invest in critical mineral supply chain projects, including midstream diversification in mineral-rich countries. The DFC does not currently have substantial participation in mining projects and will need increased funding to invest more heavily in critical minerals. Since 2003, U.S. development finance has only

supported a handful of mining projects, including most relevantly US$ 25 million in debt financing in 2020 for expanding the production of Brazilian cobalt and nickel mining and US$ 30 million in equity investments again for Brazilian cobalt and nickel production for green energy transition use cases.

In order for the DFC to meet this new mandate, Congress will need to provide it additional funding; the DFC's current budget for all activities is FY 2023 is $7.7 billion, which is insufficient given the scale of the critical minerals supply gap and the multiple calls on the DFC for other areas of economic involvement beyond mining.[91] The need for more finance is particularly true given the high capital requirements of critical mineral operations. Even with a blended finance model, meaningful investments in critical minerals will impose significant financial demands on the DFC. The DFC will also need increased funding to hire and compensate new staff with relevant mining expertise. Congress should increase the DFC's funding to overcome these challenges.

In addition to increasing the DFC's funding, Congress should provide it with an explicit mandate to prioritize investment in critical minerals, including mining, processing, and recycling operations. Investments should primarily focus on countries that are U.S. partners and have signed up to and verifiably met the standards mentioned above. In cases where there is sufficient confidence, the DFC can offer its range of financial products, including debt financing, equity investments, and political risk insurance. Given that, resource-rich countries are seeking investment in higher-value segments of the supply chain rather than upstream, extractive segments alone, the United States and other likeminded countries, including the EU, UK, Canada, Japan, and South Korea, among others, can increase and coordinate concessional finance to those countries. As discussed below, the United States, in particular, can increase access to certain IRA incentives to enhance supply-chain coordination.

Ideally, these DFC products can be offered in tandem with parallel financial support from other partner countries. Pooled financing mechanisms will provide a robust package of support to qualified projects. This will strengthen the incentives of net exporters to partner with the United States, will help diversify sources of investment, and will allow for increased, and more responsible, critical mineral production.

Where possible, the DFC and the parallel development organizations of partner countries can also invest in infrastructure adjacent to critical mineral operations. For example, investments in roads and electricity can provide important public goods to civilians while also de-risking nearby critical mineral operations. Selected projects could also qualify for follow-on agreements with EXIM, MCC, and USAID, further bolstering partnerships between the United States and strategic exporting countries. As alluded to earlier, the goal of such projects should not be to exchange minerals for infrastructure. Rather, the United States must approach projects through a lens of partnership, offering

assistance that will allow countries to successfully manage their critical minerals, while also helping meet international climate and supply chain objectives.

**Recommendation #10: Congress should facilitate bilateral and multilateral frameworks that increase critical-mineral supply-chain coordination and support the negotiation and passage of bilateral and multilateral trade agreements among countries that meet the standards recommended above.**

Given the inability of the United States to meet its own domestic needs for critical minerals, it is in America's interest that countries with which the United States has predictable political relations develop their critical minerals for global markets and for purchase by American companies and the U.S. government.

The United States can pursue these arrangements through new partnerships and existing bilateral and multilateral frameworks like US-EU Trade and Technology Council and Indo-Pacific Economic Framework.

Bilateral trade arrangements between the United States and countries that sign up and adhere to the standards listed earlier can be the first step in spurring even greater investment and production. These agreements can reduce tariffs and expand market access in other ways. Even better than bilateral approaches are multilateral ones that promote investment and supply-chain coordination among the developed and developing countries while protecting against unfair competition from countries which derive advantages from poor labor, social, and environmental practices. Ideally, these would take the form of multilateral trade agreements, although other frameworks are also possible.

These initiatives will require strong regulations around traceability given the complex nature of markets and the traders within them. Congress should study innovative contemporary traceability initiatives, alongside United States experiences tracing conflict minerals, oil, and natural gas.

**Recommendation #11: Congress should help establish and fund a structure to improve demand projections and increase price transparency.**

When the IEA was formed in 1974, it was created to address a variety of challenges that were facing oil markets. One of the IEA's key functions was to ensure improved visibility of global prices and supplies. At the time, oil markets were suffering from a lack of transparency, leading to an increased probability of price volatility and supply shortfalls. Over the years, the IEA has demonstrated its ability to serve other important functions, such as coordinating international stockpiles to promote energy security.

Today, many of the challenges that plagued oil in the 1970s and incentivized the creation of the IEA are now affecting critical minerals in a similar, if not more pronounced, fashion. First, the sheer number of critical minerals makes markets difficult to fully track. However, an even larger problem is the opacity and small size of many of these markets. The recent volatility in lithium prices, meanwhile, shows that volatility comes not only from insufficient price transparency, but also from insufficient data on total market supply and demand. As mentioned earlier, demand uncertainty is one of the main barriers confronting critical mineral producers. Insufficient data on current and future global supply further complicates the picture.

The IEA could be the best place to take on this challenge, but it may fall outside the purview of Congress to coordinate changes within the IEA or facilitate the construction of a new international organization. In the meantime, Congress can still ensure progress by creating and funding a structure like the Energy Information Administration (EIA) but dedicated specifically to critical minerals. Such as structure could be housed within the United States Geological Survey (USGS) or could be created independently. The former is likely preferable given USGS's existing access to data, institutional experience, and expertise.

This new domestic structure should focus on similar tasks as the EIA, such as conducting short- and long-term domestic and international mineral projections, building various scenarios, assessing potential risks, and conducting detailed analyses. This agency could be complimentary, rather than duplicative, of current USGS initiatives. For example, it could focus on providing additional transparency in international markets. Like the EIA, it could also specialize in assuring that public sector consumers have access to timely, reliable, and customized information to guide policy decisions. Congress could grant this new structure with a mandate to collaborate closely with similar information agencies in other countries, working together to form joint analyses. This new structure should have a specific task of sharing its domestic and international forecasts with the public to promote more clarity around future demand.

## Signatories

**Co-Chairs:**

Meghan L. O'Sullivan**,** *Incoming Director, Belfer Center for Science and International Affairs and Jeane Kirkpatrick Professor of the Practice of International Affairs, Harvard University Kennedy School*

Jason Bordoff**,** *Founding Director, Center on Global Energy Policy and Professor of Professional Practice, Columbia University School of International and Public Affairs*

**Participants:**

Adina Adler, *Deputy Executive Director Silverado Policy Accelerator*

John Bailey, *Partner Yorktown Partners LLC*

Rahim Bapoo, *Managing Director BMO Capital Markets*

Morgan Bazilian, *Professor Colorado School of Mines*

Andy Blackburn, *CEO Niron Magnetics*

Juan Carlos Jobet Eluchans, *Distinguished Visiting Fellow Columbia University Center on Global Energy Policy*

Ana Cabral-Gardner, *Managing Partner and Co-founder A10 Investimentos*

Amrita Dasgupta, *Energy Analyst International Energy Agency*

Stephen D'Esposito, *President and Chief Executive Officer RESOLVE*

Rohitesh Dhawan, *President and Chief Executive Officer International Council on Mining and Metals*

Jeff Donahue, *Natural Resources Industry Executive and Investor*

Roderick Eggert*, Professor; Viola Vestal Coulter Foundation Chair In Mineral Economics; Deputy Director Of Critical Materials Institute Colorado School of Mines*

Jonathan Elkind, *Senior Research Scholar Center on Global Energy Policy*

Jeffrey F. Kupfer, *Adjunct Professor Carnegie Mellon University*

Alex Fitzsimmons, *Head of Government Affairs Sila Nanotechnologies Inc*

Greg Gershuny, *Executive Director, Energy & Environment Program The Aspen Institute*

Heidi Heitkamp, *Former United States Senator*

Maureen Hinman, *Chairman and Cofounder, Silverado Policy Accelerator*

Robert Johnston, *Senior Research Scholar Columbia University Center on Global Energy Policy*

Melanie Kenderdine, *Principal, Energy Futures Initiative*

Tae-Yoon Kim, *Energy Analyst, International Energy Agency*

Niamh King, *Director, Aspen Strategy Group and the Aspen Security Forum*

Daniele La Porta, *Global Head of Sustainability and ESG, Gerald*

Tamara Lundgren, *Chairman, President and Chief Executive Officer Schnitzer Steel Industries, Inc.*

Brian Menell *Chairman & CEO, TechMet Ltd.*

Timothy Mister, *Head of Credit and Royalties, Appian Capital Advisory*

Tom Moerenhout, *Adjunct Associate Professor of International and Public Affairs; Adjunct Associate Research Scholar of International and Public Affairs, Columbia University*

Guilherme Oliveira, *Scientific Director, Vale Institute of Technology*
*Rich Powell, Chief Executive Officer, ClearPath*
David Sandalow, *Inaugural Fellow, Columbia University Center on Global Energy Policy*
Sridhar Seetharaman, *Vice Dean for Research and Innovation, Fulton Schools of Engineering, Arizona State University*

Yang Shao-Horn, *JR East Professor of Engineering, Massachusetts Institute of Technology*
Dan Steingart Stanley-Thompson, *Professor of Chemical Metallurgy in the Department of Earth and Environmental Engineering and Professor of Chemical Engineering, Columbia University*
Greg Walden, *Former Member of Congress and Former Chairman, Energy and Commerce Committee*
Alan West, *Samuel Ruben-Peter G. Viele Professor of Electrochemistry and Professor of Earth and Environmental Engineering, Columbia University*
Abby Wulf, *Vice President and Director, Center for Critical Minerals Strategy Securing America's Future Energy*

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# Building Cleaner, Faster[53]

Final Report[54]

The Aspen Institute, Energy & Environment Program

Spring 2021

On March 31, President Biden announced "The American Jobs Plan" as part of his Build Back Better agenda to accomplish two important missions: (1) decarbonizing the nation's economy to address the challenges of climate change and the energy transition; and (2) growing jobs and the economy while simultaneously making the nation's infrastructure more resilient. The White House announcement focused on fiscal, policy, and regulatory goals. This paper solves for the critical missing link: the need to address the challenges of delay, uncertainty, and cost of our current environmental review and permitting system that threatens the build out of decarbonization infrastructure. As described below, there is a well established precedent for both Congress and the Executive Branch introducing regulatory tools for streamlining the approval process for environmental projects that will bring net benefits and otherwise comply with strict requirements.

Anticipating the Administration's bold proposals for urgent economy-wide action on climate change, the Aspen Institute Energy & Environment Program convened a group of policymakers, experts, and practitioners to consider solutions to expedite climate action. Over a series of three roundtable conversations in the winter months between 2020 and 2021, these professionals focused on the following problem:

*Achieving net-zero emissions by 2050 is ecologically essential, technologically feasible, economically achievable, but procedurally impossible.*

The discussions led to a unanimous conclusion: to truly succeed in decarbonizing the economy, we must take bold action to modernize and reform our environmental review and permitting processes to implement decarbonization projects with the scale, speed, and predictability that confronting the climate crisis requires. Strong funding and the best intentions to invest in infrastructure will otherwise be met with years of delay and

[53] This reading is recommended by Jim Connaughton and Katie McGinty

[54] Disclaimer: This report seeks to capture the essence of participant conversations, but individual participants may not agree with every aspect of the report. Rather, in affixing their name as a signatory, a participant is signaling support for the overarching concept of the series and the broad outcomes discussed herein.

uncertainty that will hinder progress and threaten the viability of projects needed to solve the problem.

The group endorsed four critical paths to success:

1. **Immediate approvals**: For categories of decarbonization projects where environmental impacts are well understood, either due to the nature or location of the project, Congress should establish approval criteria that enable project clearance without delay.
2. **Accelerated approvals**: For decarbonization projects that may cause unique or significant negative local environmental impacts, Congress should establish a bifurcated process that documents the categories of climate-beneficial projects at the outset, and then focuses environmental review and permitting on any uniquely local conditions of a project on an accelerated timeline.
3. **Accelerated adjudications**: Once a project is approved, any adjudications for decarbonization projects must include a final decision timeline of well under one year to ensure that protracted litigation does not undermine project viability.
4. **State and local conformity**: Eligibility for any federal infrastructure or climate-related funding, tax incentives, or grants shall be conditioned on a state or locality conforming to the same framework and timeline for fast approval and adjudication of projects.

The ideas outlined below reflect our consensus that we must seize this moment of wide-spread support for decarbonization of infrastructure to accelerate project approval and adjudication for well under a year, while preserving good government principles of public participation through legislative and administrative processes. Such reforms should broadly encompass all sectors and technologies that can deliver emissions reductions at the gigatons of scale (either per project or with respect to a technology capable of being scaled) needed to confront the climate crisis and eliminate the inequitable public health burden of disproportionate environmental harms once and for all.

## Opportunity Statement: The Benefits of Speed and Certainty

Realizing the President's goal of net zero emissions by 2050—and net zero for the energy sector by 2035—will need more than just fiscal and policy support to succeed. Even with significant resources and strong policy direction, speed and certainty of project approvals will be critical to success.

Speed is essential to realizing climate objectives given the still growing trajectory of emissions, the increasing severity of climate change, and the lack of action since the signing of the Paris Agreement. A ton of carbon reduced today delivers 30 tons more cumulative abatement benefit than a ton reduced in 2050. A ton of air pollution reduced today improves the health and prolongs the lives of more people than a ton reduced in 2050. Speed also lowers the costs of achieving the objective. A clean infrastructure project with certainty of deployment in less than a year incurs substantially lower financing costs and produces jobs, revenues, and taxes a lot sooner than a project that is hung up for 3 to 10 years. Finally, speed produces more projects sooner to meet the objective. Prompt permitting and adjudication reduces the number of projects that are otherwise abandoned due to delay.

Certainty is also critical to realizing climate objectives. Only with final and durable decisions can public and private investors make commitments to secure funding, hire workers, mobilize supply chains, and initiate the complex logistics to rapidly complete the large scale infrastructure projects and deploy the innovative support technologies needed for decarbonization plans.

Unfortunately, speed and certainty are not the hallmarks of our present environmental review and permitting system at the federal, state, and local level, even when the net environmental outcomes of a project are clearly favorable. The environmental review and permitting system

now takes years and, in many cases, more than a decade to approve and adjudicate hundreds of major infrastructure projects. Delay and uncertainty cause cancellation of countless others along the way.

For decarbonization infrastructure projects intended to have net environmental benefits, this situation is particularly counterproductive since, during every stage of construction, operations, and ultimate decommissioning, every project must fully comply at all times with the world's most stringent federal, state and local environmental protection, natural resource conservation, and health & safety regulations. All of these regulations were developed through extensive legislative and administrative processes embodying critically important concepts of good government and the rule of law including record-based decision making, public participation, transparency, and judicial review. Project sponsors and owners face harsh civil penalties and even criminal liability for any noncompliance.

Understood in this context, the permitting system provides an up-front assurance of regulatory compliance prior to project construction and operation. The environmental review process, in turn, ensures project sponsors consider environmental factors other

than what is already subject to regulatory compliance to better inform project siting and design choices. For projects intended to advance environmental goals, these processes of compliance assurance should have improved substantially over time to handle current infrastructure approval workloads with greater agility and finality, particularly given advances in science and information technology.
But unfortunately, the situation has worsened and environmentally beneficial projects that are already subject to heavy regulation face the same delays, risks, and uncertainty as other projects whose environmental impacts are less certain.

Decarbonization of the economy is projected to require trillions of dollars in new investment and tens of thousands of increasingly distributed and interconnected energy, transportation, industrial and agricultural infrastructure. The goal of these projects first and foremost is to improve the environment and promote a more sustainable planet. But federal, state, and local agencies do not currently have the workforce, resources, processes, or adjudication capacity to handle the forthcoming volume of necessary activity. Accordingly, even if we get everything else right on the road to net-zero in terms of fiscal support and strong policy, our current permitting system threatens to be an insurmountable barrier to success.

To succeed, we must bring the same bold thinking to the environmental review and permitting process as we are to fiscal investments and to infrastructure and climate policy. In other times and places, national leadership and nationwide determination combined to overcome such obstacles to achieving critical objectives. For example, in just 15 years, the US delivered rural electrification to 80% percent of farmers and not much longer than that to reach almost 100%. In just 15 years, France built an 80 percent independent and emissions free electricity system using nuclear and renewable energy, and not much longer than that to essentially achieve net zero electricity sector emissions by becoming a clean energy exporter. These efforts required national, regional, and local leadership, a dramatic acceleration of development and investment, and the removal of needless procedural barriers to construction and deployment.

Similarly, for projects that are intended to solve climate change and advance decarbonization

and the energy transition, we must commit to realizing the principles of record-based decision making, public participation, transparency, and adjudication within a reasonable time period and well under a year. The ideas below are intended to address the problems associated with both speed and uncertainty.

Importantly, in putting forth the ideas described here to fix our current system of progress- preventing processes and deliver fully reviewed and permitted clean

infrastructure projects in one year or less, as noted above, we can be assured that all such projects will be as environmentally protective as our laws and regulations require. We recognize that some environmental impact analyses may need to extend beyond a year (for example, for local analyses of migratory patterns or seasonal water flows), but these should be the exception, not the rule. Similarly, community engagement and public participation are a must and time is needed fully to build partnership with neighbors of the proposed project (see more on this topic below). The thought here is that much of such analysis and engagement would occur before a project is proposed for permitting. It is the permit review process and time that we are addressing here. With appropriate upfront planning, engagement, and analysis we believe needed reviews can and should be completed in the timeframes described here.

Accordingly, a dramatically faster and certain process of clean infrastructure permitting can be established with full confidence that our highest levels of protection of public health and the environment will be assured, with full respect for and partnership with local communities and without having to put the project sponsor through years of having to preliminarily prove the sponsor will comply with the law. Federally legislated carbon emission reduction requirements could provide further confidence of a positive environmental outcome.

## Step 1: Immediate Approvals for Critical Projects with Well Documented Net Environmental Benefits

Every president since Jimmy Carter has sought to improve the cumbersome and inefficient process for siting and reviewing major infrastructure projects, mainly through complex, ad hoc efforts to improve administrative management, consolidate decision-making, and coordinate more closely with state and local officials making most of the decisions. None of these efforts have resulted in lasting, large scale improvements. The imperative to quickly construct thousands of low carbon energy, industrial, transportation and agricultural systems and to address the risks posed by our nation's crumbling infrastructure demands a policy outcome proportionate to the imperative. That is why legislating automatic approval of certain qualifying projects and qualifying locations is the best and most consequential action that could be taken for categories of projects where the opportunity for greenhouse gas abatement is high, and the net beneficial impacts are well understood. Precedent exists for such action, such as legislated categorical exclusions under NEPA and state equivalents, national security waivers, and general permits. The international and domestic urgency of the climate crisis is equally or more compelling justification for adopting such measures.

Pre-Qualified Projects

Legislation should authorize all categories of projects where the opportunity for greenhouse gas abatement is the highest and other potential environmental impacts are well understood and documented. For example, projects to improve the resilience of the energy ecosystem and grid to accommodate more renewable energy and abate threats due to weather events, such as the recent Texas storms, are overdue and deploy technologies and methods that have well understood impacts that do not require repetitive, boilerplate re-analysis.

Another example are projects that, de facto, deliver substantial net climate and environment benefits by replacing existing infrastructure with new infrastructure which has less impact than what is already permitted. A good example is the conversion of coal-fired plants, either through repowering to natural gas, retrofit for CCUS, or repurposing the site for renewable energy, green data centers, and other projects that can take advantage of the existing electrical and mechanical infrastructure. Absent automatic permitting, these complex and heavily regulated locations may be among the last to see meaningful redevelopment, when they could and should be among the first in order to enable a meaningful and equitable transition.

Identification of such clean infrastructure project categories and particular projects that qualify for pre-approval should be embodied in legislation to the extent possible, which would enable both expedited approvals and avoid the potential for protracted judicial review where Congress has deemed such projects pre-qualified. Such categories can be linked to existing federal, state, and local processes of categorization of projects as clean infrastructure driving decarbonization. These could include projects that: 1) qualify for federal, state, or local tax credit, such as the ITC,PTC or 45Q; 2) recipient of a DOE loan guarantee, USDA grants/loans, or similar public funding programs established to reduce emissions; 3) subject to a Clean Energy Standard, Renewable Energy Standard, or equivalent mandatory legislation.

A further variation on the theme and additional approach would have Congress establish a non- discretionary presumption of project approval so long as a project satisfies certain predefined criteria. Congress could require an agency to review and approve or reject such an application within 90 days, and then allow public comment only as to whether the application meets the criteria specified by Congress, with judicial deference afforded to the agency's initial determination.

Pre-Qualified Locations

Identification of locations that qualify for pre-approval should be embodied in federal, state, and local legislation for the same reason as pre-qualified projects, and likewise could take advantage of already existing federal, state, and local processes of priority. Recent bipartisan Opportunity Zone legislation provides a particularly compelling example and alignment of constituent interests. Each state has already worked with local communities to prioritize specific economically disadvantaged areas for substantially tax incentivized private sector

redevelopment, including infrastructure. A very substantial portion of these areas are ideal for clean infrastructure investment, not only supporting good construction and operations jobs, but also local ownership of valuable new community infrastructure that can attract new business. This program is ripe for a second round of designations which could include specific attention to urban and rural areas particularly well suited to green infrastructure investment enabling (as noted above) conversion of Environmental Justice communities into Environmental Opportunity communities.

Both in this context and separately, other already established categories should be considered for pre-approval such as: 1) federal and state designated Brownfields that have been cleared for redevelopment; 2) former military bases; 3) local enterprise zones and their equivalent; 4) dam sites where hydro-power generation can be added; 5) pre-zoned BLM, Forest Service, and other public lands.

### Step 2: Accelerated Approvals for Projects with Documented Impacts but Local Analysis

As part of the push toward clean energy infrastructure, some projects will have a high sense of urgency and need but less documented environmental impacts. For example, an automatic approval process may not be feasible for particularly complex or novel projects such as new advanced designed nuclear energy plants, hydrogen production and distribution facilities, or for "linear" infrastructure such as smart highways, natural gas pipelines, CO2 pipelines and repositories for CCUS, and certain intrastate and interstate transmission, and supporting digital infrastructure. In such cases, there is an opportunity to ensure permitting is still accountable for timelines and certainty and achieve through government and public review on the fastest rather than the most protracted timeline achievable. The way to accomplish this is to do as much of the work in advance as possible.

Here, a bifurcated approach could be used in which agencies would prepare environmental reviews and permit templates for certain types of complex and linear projects that analyze the pertinent impacts of such projects generally. The public would

be provided three months of review and comment before finalizing the general framework. A specific permit application would then incorporate by reference that review and focus specifically on local or unique impacts of the project, with a period of no more than three months of public comment limited to the local and unique aspects under consideration. Modern communication and information technology makes possible such substantially more efficient processes, focused and transparent exchange and evaluation of such information. Precedent for this approach exists in the context of programmatic environmental impact statement under NEPA and in various general permit programs and permits-by-rule at the federal and state level.

This bifurcated approach enables the opportunity for record-based decision making, public participation, transparency, and adjudication while promoting timeliness and certainty for projects. The bulk of the impacts among a category of projects would be assessed in advance,

enabling the review of a specific project to be tailored to local and specific impacts. When combined with accelerated adjudication (Part III below) this would achieve the dual goals of public participation and project approval within a year of application for critical clean energy infrastructure projects.

Development and adoption of local ordinances to establish standards for siting and permitting various clean energy and infrastructure systems ahead of individual project permit applications could also be considered in order to expedite needed consultations and reviews. State efforts to adopt uniform siting and permitting standards with specified deadlines for action are already emerging, with examples in New York and Minnesota. Federal leadership will be necessary to accelerate nationwide adoption of responsible siting and permitting ordinances with fixed time limits for permitting decisions at the state and local level where permitting occurs. The tools range from development of model ordinances (similar to federal government development of model building efficiency codes) to funding, and could involve joint industry resources and personnel working with local officials to put ordinances in place.

To ensure success in these initiatives, we recommend considering coalescing or collocating into a single location on a regional basis, or even into a single federal agency, the policy, regulatory and permitting initiatives needed to quickly approve and build clean infrastructure to support a net-zero carbon emissions future. An excellent example of this is the National Interagency Fire Center in Idaho, which houses multiple federal, state, tribal and private agencies to coordinate fire response on lands under their respective management.

### Step 3: Rapid Adjudication to Enable Review and Certainty for Critical Clean Energy Projects

Both immediate and faster approvals are of no value if there is not a correspondingly speedy and certain process of adjudicating disputes over permitting decisions. In other contexts, Congress has established extremely fast adjudication processes where a prompt and definitive outcome was deemed to be among the highest national priorities. For example, in the area of federal procurement, Congress established a very aggressive 100-day time limit for administrative resolution of contract award disputes with the GAO, and similarly limited timelines for any appeal, limited to the jurisdiction and expertise of the Federal Court of Claims, with very limited grounds for review of the administrative decision. The rationale for such a process is straightforward: the government cannot function if the procurement of the technology, equipment, systems and services for defense and other vital government services is held up in years of litigation. In a related context, Congress broadened the scope of the interagency Committee on Foreign Investment in the United States (CFIUS) review of such investments to determine whether they undermine national security. Concerned about the significant economic consequences to US business from prolonged delay in clearing transactions through CFIUS, Congress expressly created a new streamlined process of only 30 days for CFIUS to provide clearance—a process available for all transactions. In rare situations, a more intensive review may be required, but even then Congress limited full investigation and final decision to no more

than 105 days. The urgency of the climate crisis warrants the same adjudicatory speed as that provided for government contracting and foreign investment in US companies.

For infrastructure projects identified as leading to decarbonization (described above), a process for review can be created that provides appropriate adjudicative review while avoiding the risk to important projects due to uncertainty and delays associated with conventional final agency action review in the federal courts. Many Executive Branch agencies—including those in the environmental and resource agencies—have an administrative review board comprised of subject matter expert administrative law judges and magistrates who review permitting decisions and other federal actions. A similar board should be created, or adapted from an existing board, with adequate resources to provide for timely reviews of appeals within 120 days. Within 30 days from a decision, a petitioner would carry the burden in their opening appeal to identify "clear error" and "arbitrary and capricious" decision making by either failing to assess a significant harmful impact or by misapplying a legal/regulatory standard in the review. This already is a common standard of review for such appeals. If no petition is filed, the decision shall be deemed complete and not subject to further review. In the case of a

petition, the government and interested parties shall have 21 days to respond, with petitioners' reply papers due 7 days later. The appeals board shall issue an opinion no later than 120 days from the date of the original decision. The scope of review shall be limited to the clear error and arbitrary and capricious standard above. To the extent the panel issues a remand under this standard, the permitting agency must respond to amend the record within 60 days.

## Addressing Environmental Justice

Important work is underway to address the historic injustices suffered by disadvantaged communities—including communities of color, low income, children, and elderly—as it relates to hosting heavily polluting sources of energy. We strongly support the proposals in the President's announcements to address environmental justice more broadly. In the context of accelerating decarbonization infrastructure and addressing environmental justice, we find two complementary approaches to be particularly compelling.

First, disadvantaged communities need a seat at the table in considering, helping to shape, and reaping economic opportunity from new, clean energy and infrastructure projects. We must both avoid the risk of new projects harming disadvantaged communities and ensure that we are creating opportunities to remedy past harms as the nation builds its decarbonization infrastructure. As described above, the process of designating a second round of Opportunity Zones to support clean infrastructure development near disadvantaged communities is one example of how this could be accomplished on a nationwide basis.

In the District of Columbia and elsewhere structured, time-bound processes are proposed that enable (1) inclusion; (2) equity ownership and (3) decision-making measured in months, not years or decades. Crucial elements of the approach include identification of a neutral arbitrator; selection of a group representative of the community by the arbitrator; creation of an equity

participation vehicle to ensure community financial benefit; access by the representative group to needed technical support resources; and a firm agreed timeline for decision-making.
Resources for these activities would be provided by the project developer and these activities would be concluded before the project is submitted for the accelerated approval options discussed above.

Second, an additional way to promote environmental justice and benefit communities that continue to live in the shadow of harm could be to add a surcharge on all

infrastructure projects qualifying for expedited consideration that would accelerate access to clean energy for disadvantaged communities—communities of color, low income, children, and the elderly.

These communities are readily identifiable based on census tract information. An initiative of this kind would be similar to the surcharge on phone bills administered by the FCC to support the build out of internet infrastructure in disadvantaged communities. We know that fossil fuel infrastructure has historically been situated in or near low-income communities and communities of color. We also know that solar access is deeply skewed based on race. According to a recent study, majority black communities (normalized for income and home ownership) have over 61% less rooftop solar installed than those communities with no racial or ethnic minority. A surcharge could create funds needed to level the playing field and enable low income and communities of color to participate in and benefit from the many health, environmental and economic benefits of clean energy resources. The recent Biden Administration infrastructure proposal would substantially amplify this objective through a large appropriation and prioritization of funding directed into these communities.

Finally, it is important to make cost effectiveness for ratepayers a pillar of environmental justice platform for clean energy. Properly conceived, the clean energy transition will save people on fixed income a lot of money. If not properly conceived, ratepayers who are least well positioned to absorb cost impacts will bear a disproportionately high burden.

## Aligning State and Local Processes

Acceleration only works if the federal, state, and local government are fully aligned on fast and certain permitting and adjudication. To this end, we propose that eligibility for any federal infrastructure or climate-related funding, tax incentives, or grants should be conditioned on a state or locality conforming to the same framework and timeline for fast approval and adjudication of projects. The best way to secure this alignment is for Congress to prohibit states from receiving federal clean infrastructure funds and incentives, unless they adopt permit acceleration measures equal to or better in speed and certainty than the federal standards.

Transmission siting and approval present particularly well-known challenges that significantly impede necessary speed and call for federal-state-local coordination to achieve decarbonization goals.

Assuming more rapid permitting can be established, a number of measures can further accelerate outcomes, including:

- Create a "supergrid authority" inside of DOE or elsewhere to purchase capacity on long haul transmission lines under certain criteria. Because generation gets built when transmission is built, there is little risk that the government will be able to sell off its transmission rights before the lines complete construction.
- Have the supergrid authority fund grid enhancing technologies to maximize the efficiency and capacity of existing grid at a cost in the low billions of dollars.
- Provide ITC to the billions of dollars of transmission projects that are ready for construction today for which there is no need for the government to purchase capacity.
- Provide a short-term fix to tax equity markets via full or almost 100% "direct pay" for tax credits from renewables.
- Require FERC to incorporate carbon emissions in all transmission planning processes.
- Require FERC to order NYISO, PJM, and ISO-NE to work together to come up with an offshore grid to handle offshore renewable resources in the Northeast.

## Signatories

**Co-Chairs:**
*Jim Connaughton*, CEO, Nautilus Data Technologies
*Katie McGinty*, Vice President & Chief Sustainability, Government & Regulatory Affairs Officer, Johnson Controls

**Participants:**
*Brent Alderfer*, Co-Founder & Director, Community Energy, Inc. Roger Ballentine, President, Green Strategies, Inc.

*Donnel Baird*, Founder, BlocPower

*Dan Esty*, Hillhouse Professor of Environmental Law and Policy, Yale University
*Roger Martella*, General Counsel, Environment, Health & Safety, General Electric

*Manisha Patel*, Vice President for Environmental Policy Practice, WSP USA

*Nancy Pfund*, Founder & Managing Partner, DBL Partners

*Rich Powell*, Executive Director, ClearPath

*Gov. Bill Ritter*, Founder & Director, Center for the New Energy Economy, Colorado State University
*Emily Schapira*, Board Member, President & CEO, Philadelphia Energy Authority
Michael Skelly, CEO, Grid United

# Norway's Quest to Transform European Energy Security through Mining[55]

**Sigurd Neubauer**

At a time of intensifying geopolitical competition between the U.S. and China, Norway is positioning itself to help supply its Western allies with access to rare earth minerals and natural resources as part of a strategic push to diversify supply chains for critical infrastructure and industries.

In an exclusive interview, we discuss how Norway is going about this with Member of Parliament Bård Ludvig Thorheim, a conservative lawmaker representing a district in the northern part of the country.

Thorheim, a former diplomat turned politician, knows the U.S. well from his time serving at the Norwegian Embassy in Washington. He also serves as the Chairman of the Friends of America Caucus in Parliament.

We have previously interviewed the trailblazing lawmaker for a separate feature.

"After Russia's invasion of Ukraine, it became clear that Moscow would stop its gas supplies, which triggered a European energy crisis. This experience made it clear to Europe and the West that we're vulnerable to other actors potentially denying access to rare earth minerals in the event of conflict," the lawmaker explains.

He points out that rare earth minerals needed for critical technologies are primarily controlled as of today by Russia, China and other nations that are not Western allies.

"Russia's invasion of Ukraine was a strategic game changer for Norway's decision to enhance its mining industry" – Thorheim.

"Being able to access these minerals are critical in order to succeed with the energy transition towards renewals and reaching climate goals," which are needed to build critical infrastructure for the future such as wind farms; solar cells; and batteries.

[55] This article was originally published by Man & Culture Magazine on July 28, 2023. https://manandculture.com/2023/07/norways-quest-to-transform-european-energy-security-through-mining/

Combatting climate change is a top priority for Norway. Unlike in the U.S., this issue is not politicized as the political establishment remains mostly unified on the matter.

Norway warns that unless a reliable supply chain is established, Western nations, including the U.S., could be outcompeted by other countries. Fortunately, he argues, "Norway stands out as one of the few European countries that possesses the minerals needed to facilitate the energy transition."

The country is already mining the following natural resources; cesium; aluminum; titanium and graphite. While Norway extracts these minerals in large quantities, it possesses large deposits of untapped minerals that Thorheim believes will be critical for the coming decades.

"We have one of the world's biggest fields of rare-earth minerals, including iron, nickel and cobalt which are needed to build permanent magnets." These metals are used in electric vehicles and in wind turbines.

Then there's the China factor, which Washington considers to be its main strategic competitor.

"As of today, China supplies Europe with 90 percent of these rare earth metals," he says, then pauses and cuts to the chase: "In the central Norwegian region of Telemark alone, there are enough untapped rare earth minerals to supply 30 percent of the European Union's needs. Once extractions begin, this will be a strategic game changer."

In a separate region, Rogaland, which is off Norway's southwestern coast, one of the world's largest fossil rock deposits is located, which can be used for solar panels and batteries.

"As of today, most of the fossil rocks come from Morocco and Russia." And in northern Norway, where the lawmaker is from, "we have the potential for developing large-scale mines for copper and iron ore, which can even be manufactured in a climate neutral manner which adheres to the highest environmental standards in the world."

Responding to what prompted Norway to overcome initial hesitancy to develop these natural resources, the lawmaker points out that prior to the war in Ukraine, the potential for mining in Norway was one out of many opportunities the government considered when it came to fostering economic growth and jobs.

“Now, however, it is no longer just about creating jobs but rather about security policy. We’re now collaborating with other countries to provide value, including for the green industry, which is at the very top of the government’s agenda.”

Strengthening alternative supply chains is also a top priority for the EU, which passed The European Union’s Critical Raw Minerals Act (CRMA) in March of this year.

The lawmaker nonetheless cautions that in addition to extracting more resources, this has to be done responsibly as they are not unlimited but rather that this requires more recycling as well. “It is no longer just about job creation but it's about national security.”

Seabed mining off Jan Mayen could eventually be developed.

## The Environment and Regulatory Reform

But before Norway’s national mining strategy can be realized, its regulatory environment needs to be overhauled. “It takes too long to get a license to operate a mine but we’re overhauling the regulations so that we can attract more investors. We are also looking at seabed mining, but the top priority for now is mining on land.”

When it comes to extracting natural resources through seabed mining, Thorheim explains that more knowledge about its impact on the marine environment is required first.

He’s specifically referring to the island of Jan Mayen, which is located some 1,233 miles (1,985 km) off the coast of Norway. The island has large deposits of minerals along the MidAtlantic Ridge between Jan Mayen and southern Svalbard/Bear Island, which include copper, zinc, cobalt, gold, and silver.

Jan Mayen is uninhabited, but could be of geopolitical interest, especially to Russia but the Norwegian claim is undisputed by any country.

Currently, Australian, British, and Swedish companies are operating in Norway’s mining sector but the country is open to other international investors as well. The land of the midnight sun also stands out as one of Europe’s easiest countries to do business in, according to a top corporate lawyer who we interviewed for a separate article in November of last year about the country’s business climate.

While Thorheim welcomes U.S. and European companies investing in the Norwegian mining sector, he would also like to see Norwegian industry such as Hydro and Aker Solutions participating in new mining projects.

## Washington Talks

Responding to what's next, Thorheim reveals that there are three land mines that have been granted all the necessary licenses and that they will become operational in a couple of years. "We have additional ones that are in the pipeline," but when it comes to seabelt mining, he concedes, this might be possible in about 15 years. In September, the lawmaker will travel to Washington for talks with his counterparts in the U.S. House of Representatives and Senate about outlining trade regulations between Norway and the U.S. in addition to strengthening security collaboration. He will also hold talks with the U.S. National Security Council at the White House.

# China Controls the Supply of Crucial War Minerals[56]

*Recent moves to restrict their flow highlight a danger to the West*

***The Economist***

In 2014 Tom Price, a commodities strategist, visited a "funny little building" in China's south-west. It was a warehouse where Fanya, a local trading firm, stored metals including gallium, germanium and indium. The company's "stockpiles" simply sat in boxes on shelves. Yet for some of the minerals, these meagre supplies represented the majority of global stocks. A year later Fanya was closed by China's government, which kept the stash—as well as the reserves and plants to produce more.

Today Western countries wish they, too, could produce some more. On July 4th China announced that it would restrict exports of gallium and germanium, of which it supplied 98% and 60% of global output, respectively, in 2022. Produced in tiny quantities, the metals have little commercial value. They are nevertheless crucial for some military equipment, including lasers, radars and spy satellites. The decision highlights that "critical" minerals are not limited to those which underpin economic growth, such as nickel or lithium. A dozen obscure cousins are also vital for a more basic need: maintaining armies.

The eclectic family of war minerals spans generations. Antimony, known in biblical times as a medicine and cosmetic, is a flame retardant used in cable sheathing and ammunition. Vanadium, recognised for its resistance to fatigue since the 1900s, is blended with aluminum in airframes. Indium, a soft, malleable metal, has been used to coat bearings in aircraft engines since the second world war.

The family grew rapidly in the cold war. Long before cobalt emerged as a battery material, nuclear tests in the 1950s showed that it was resistant to high temperatures. The blue metal was soon added to the alloys that make armour-penetrating munitions. Titanium—as strong as steel but 45% lighter—also emerged as an ideal weapons material. So did tungsten, which has the highest melting point of any metal and is vital for warheads. Tiny amounts of beryllium, blended with copper, produce a brilliant conductor of electricity and heat that resists deformation over time.

The superpowers of other minerals became known decades later, as military technology made further leaps. Gallium goes into the chipsets of communication systems,

[56] This article was published by The Economist on July 13, 2023: https://www.economist.com/finance-and-economics/2023/07/13/china-controls-the-supply-of-crucial-war-minerals#

fibre-optic networks and avionic sensors. Germanium, which is transparent to infrared radiation, is used in night-vision goggles. Rare earths go into high-performance magnets. Very small additions of niobium—as little as 200 grams a tonne—make steel much tougher. The metal is a frequent flier in modern jet engines.

Beyond their varied properties, this group of mighty minerals share certain family traits. The first is that they are rarely, if ever, found in pure form naturally. Rather, they are often a by-product of the refining of other metals. Gallium and germanium compounds, for example, are found in trace amounts in zinc ores. Vanadium occurs in more than 60 different minerals. Producing them is therefore costly, technical, energy-intensive and polluting. And because the global market is small, countries that invested in production early can keep costs low, giving them an impregnable advantage.

This explains why the production of war minerals is extremely concentrated (see chart 1). For each of our 13 war materials, the top three exporters account for more than 60% of global supply. China is the biggest producer, by far, for eight of these minerals; Congo, a troubled mining country, tops the ranking for another two; Brazil, a more reliable trading partner, produces nine-tenths of the world's niobium, though most of it is sent to China. Many minerals are impossible to replace in the near term, especially for cutting-edge military uses. When substitution is possible, performance usually suffers.

The combination of concentrated production, complex refining and critical uses means trading happens under the radar. The volumes are too small, and transacting parties too few, for them to be sold on an exchange. Because there are no spot transactions, prices are not reported. Would-be buyers have to rely on estimates. These vary widely. Vanadium is relatively cheap: around $25 per kilogram. Hafnium might cost you $1,200 for the same amount.

All this makes building new supply chains much more difficult. America is investing in a purification facility for rare-earth metals in Texas, which is scheduled to come online in 2025. It is nudging Australia and Canada, the only two Western countries with decent reserves, to produce and export more rare metals. It is also doing its best to forge ties with emerging markets in the Indo-Pacific, where there are deposits waiting to be tapped.

Even so, America's army will remain vulnerable to a supply squeeze until at least 2030, reckons Scott Young of Eurasia Group, a consultancy. Its cold-war stockpiles, once sizeable, were liquidated after the fall of the Berlin Wall (see chart 2). Its strategic stash now mostly comprises energy commodities such as oil and gas.

Weaning themselves off China might take decades longer for Europe, Japan and South Korea, which are devoid of deposits and lack America's diplomatic clout. That does not mean their armies will run short of high-tech metals, but they will probably have to buy them from America—at a price already buoyed by their ally's scramble to rebuild stockpiles. Last year's gas drama, prompted by Russia's invasion of Ukraine, amplified Europe's dependence on American fuel. The metals squeeze threatens to make Uncle Sam a still bigger magnet for panicked procurement officials.

# America Dropped the Baton in the Rare-Earth Race[57]

*Washington keeps trying to play catch-up in the rare-earth game with China. It's losing ground.*

**Christina Lu**

If the global scramble for rare earths—the elements behind F-35 fighter jets and missile guidance systems—were a relay race, China grabbed the baton in the 1980s and bolted. The United States, once an industry leader, was left in the dust, along with the rest of the world.

Souring U.S.-China relations have reignited U.S. efforts to get back in the game. Eager to slash its reliance on Beijing, Washington has ramped up efforts to resurrect its own rare-earth industry. But even with this new momentum, experts say lawmakers remain stumped over how to counter China's economies of scale and plug a gaping expertise gap, two key vulnerabilities that have long hampered the American sector. Rare-earth mining is also notoriously dirty—one reason the U.S. industry has shrunk—and prospective companies must contend with lengthy regulatory and permitting processes.

To reconstitute the U.S. rare-earth industry, "You need educated people; you need experienced people; you need mines and processing systems that are operational," said Jack Lifton, the executive chairman of the Critical Minerals Institute. "None of this exists in the United States. None."

Rare earths, a group of 17 elements, are anything but rare, but they do underpin everything from high-tech weapons to wind turbines. Yet China overwhelmingly dominates the supply chains that transform ore into powerful permanent magnets, commanding 85 percent of processing and 92 percent of magnet production. Beijing briefly wielded its rare earths as political leverage in the past—and has reportedly weighed an export ban on certain types of magnet technology recently—further underscoring how its industry could be a major pressure point for both Washington and U.S. defense companies alike.

"More than 95 percent of rare-earth materials or metals come from, or are processed in, China. There is no alternative," defense giant Raytheon chief Greg Hayes warned this week. "If we had to pull out of China, it would take us many, many years to reestablish that capability either domestically or in other friendly countries."

[57] This article was originally published by Foreign Affairs on June 23, 2023: https://foreignpolicy.com/2023/06/23/america-rare-earths-industry-china/

From submarine sonar to aircraft disk drive motors, the U.S. military is almost wholly reliant on China's extensive rare-earth value chains. Every Lockheed Martin F-35 fighter jet, for example, is built with 920 pounds of rare earths; an Aegis destroyer requires around 5,200 pounds. The Mongols' great weakness was the lack of siege engines; America's problem is that they are made by its rival.

Alarmed by this dependence, former U.S. President Donald Trump issued an executive order on rare earths and boosted funding for domestic firms. The Biden administration built on these actions, including by incorporating rare-earth projects into its Defense Production Act and expanding its rare-earth stockpile. But U.S. efforts have, by and large, failed to move the needle, said James Kennedy, the president of ThREE Consulting, a rare-earth consultancy.

"For 15 years now, the United States has been pursuing or promoting or pushing policies, and every one of them has been an abysmal failure," he said.

Christopher Ecclestone, a mining strategist at the financial advisory firm Hallgarten & Company, likened Washington's approach to a hamster running circles on a wheel. U.S. policy has been "going round and round like some sort of hypnotic sort of wheel," he said. "It mesmerizes people, but it's not actually producing anything at the other end."

Part of the trouble is that lawmakers are facing a policy challenge of a near-Herculean scale: building out an entire industry from scratch, when China already has a decadeslong lead. Mountain Pass in California, the United States' sole rare-earth mine, has very limited amounts of the heavy rare earths required for military purposes and currently ships nearly all of its output to China. But it's now attempting to carve out a bigger stake in the global industry, with plans to build out separating and processing capabilities backed by a $35 million Biden administration package.

In recent months, Reps. Guy Reschenthaler and Eric Swalwell have also introduced bipartisan legislation that would use tax credits to stimulate domestic magnet production, the latest in a slew of government efforts to incentivize production at the top of the rare-earth value chain. (They also attempted to advance a similar bill in 2021.) Some experts warn it may not have the desired effect: Kennedy noted that the bill's language doesn't differentiate between types of magnets, so firms could still qualify for the tax credit if they produce cheap, low-grade magnets. The goodies are the smaller, precision-milled permanent magnets that do wonders in the defense sector.

Stan Trout, the founder of Spontaneous Materials, said that the legislation would likely incentivize the production of physically larger magnets—like those that go into wind turbines—as opposed to magnets with defense applications. "That bill, whether they knew it or not, actually would tend to push people toward making magnets for wind turbines over anything else, because they get paid by the kilogram," he said.

The challenges in crafting this legislation underscore how U.S. lawmakers are still struggling to crack the code on kick-starting an industry that can compete with China's. Decades of investment and intense subsidies have given China sweeping economies of scale, making it nearly impossible for U.S. firms to enter the market.

"You can roll up to the Pentagon or Washington and say, well, give us some money and we're going to do rare earths, and then Washington will peel off, you know, $2 million, $4 million, whatever, and say here, go play with this," Ecclestone said. "But it's not money that moves the dial."

Beyond the economics, U.S. efforts have also been hampered by a vast expertise gap that has only widened over the years. While China funneled resources and money into research efforts at universities, laboratories, and other agencies, interest and investment receded in the United States. In 1996, Washington also shuttered the U.S. Bureau of Mines, a key research agency—dealing yet another blow to an already-crumbling industry.

"In China, rare-earth mining, refining, processing, fabricating, and making end-use products like rare-earth permanent magnet motors is a respected and profitable business, and there's tens of thousands of people involved in that," Lifton said. "Here [in the United States], there is no one."

Whether Washington can build up its own industry—or if it will remain largely reliant on China—is a question that has ramifications that extend far beyond the defense sector.

"If EVs are the mode of transportation in the future, there's really not much of a place for the United States or the EU," Kennedy said. "China can continue to leverage its position and continue to force more and more components to be made in China, and then more value-added systems, and then complete automobiles."

"China can decide who wins and loses," he added.

# SITE VISITS

## Heidelberg Materials Sement Norge – Brevik Carbon Capture and Storage (CCS)[58]

***Cement for a Sustainable Society***

Heidelberg Materials Sement Norge is the leading Norwegian supplier of cement, the main component of concrete. Its distribution network consists of depots along the entire coastline. It is the sole producer of cement in Norway, with plants in Brevik and Kjøpsvik.

Heidelberg Materials Sement Norge is a member of Heidelberg Materials Group, one of the world's largest integrated manufacturers of building materials, with leading market positions in aggregates, cement, and concrete. The Group employs around 51,000 people at over 3,000 locations in more than 50 countries.

Brevik CCS is the world's first CO2-capture facility at a cement plant. It is Heidelberg Materials' most advanced project within CCS, which will be in operation by 2024. Brevik CCS is part of the Norwegian Government's "Longship" program, aimed to demonstrate the capture of $CO_2$ from industrial sources, as well as the safe transport and storage of $CO_2$.

Reducing CO2 emissions is crucial for preventing global climate change. Nevertheless the world will depend on oil, gas, and cement for decades to come.
CCS is a technology that can reduce substantial volumes of CO2 emissions from power plants based on coal and oil, and from industries such as cement, steel, and petrochemicals. It comprises elements for capturing, transporting, and storing.

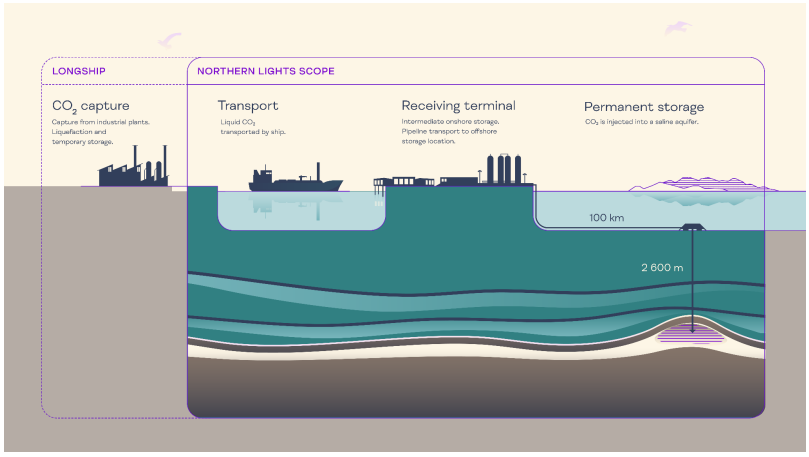
[58] Information from https://www.brevikccs.com

# Northern Lights[59]

***Accelerating Decarbonization***

Delivering CO2 transport and storage as a service, Northern Lights enables mitigation of industrial emissions that cannot be avoided and accelerates the decarbonisation of European industry.

CCS is a necessary solution to decarbonise industry and reach net zero goals. Northern Lights is developing an open and flexible infrastructure to transport CO2 from capture sites by ship to a receiving terminal in western Norway for intermediate storage, before being transported by pipeline for safe and permanent storage in a reservoir 2,600 meters under the seabed.




The first phase development of the project is the transport and storage component of "Longship" – the Norwegian Government's full-scale carbon capture and storage project. By developing an open-source infrastructure for CO2 transport and storage, Northern Lights aims to contribute to establishing a commercial CCS market in Europe. On track for operations in 2024, Northern Lights will be the first to deliver cross-border CO2 transport and storage as a service.

[59] Information from https://norlights.com/