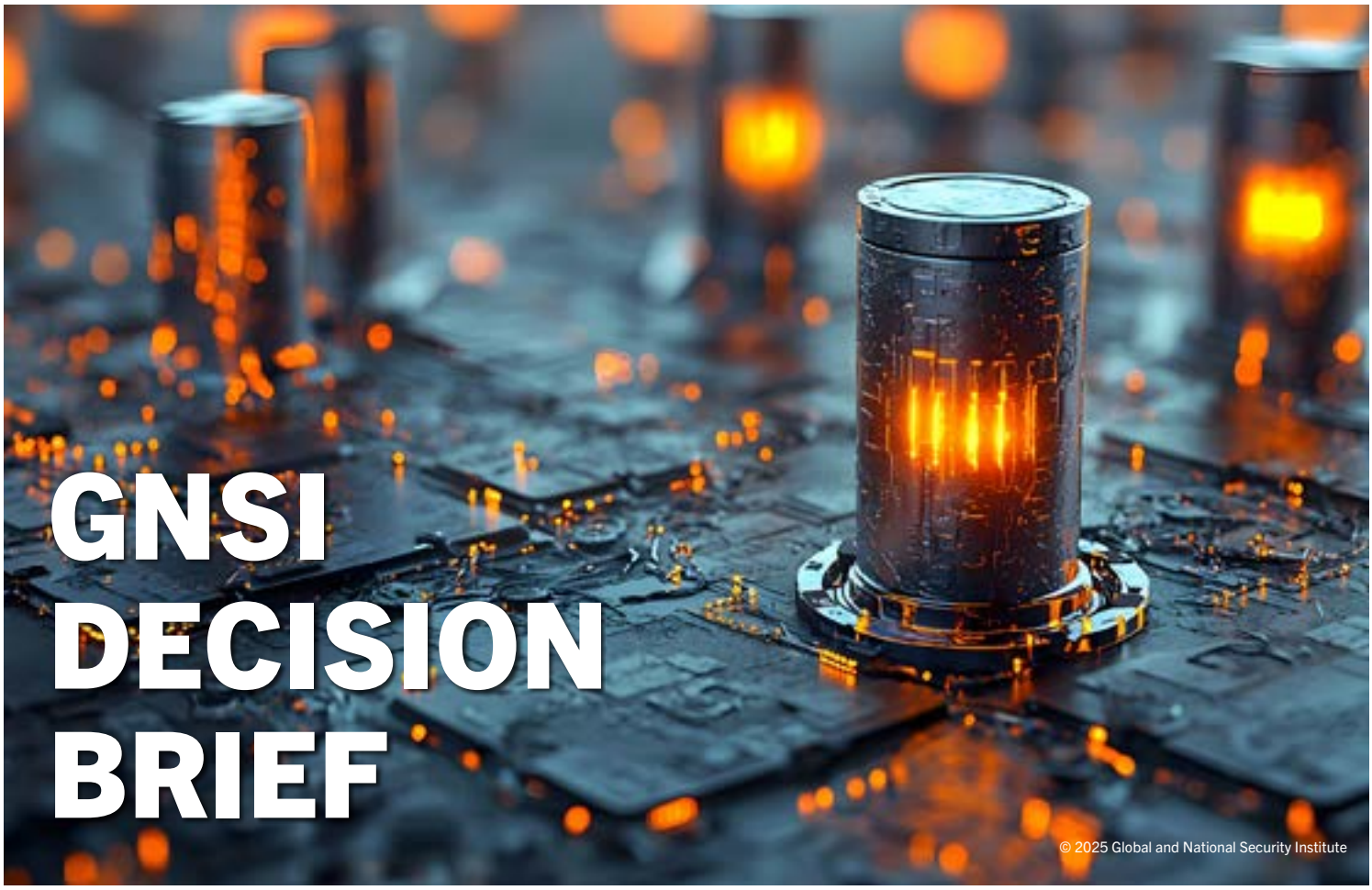

Critical Resources for National Security

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Decision Brief

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Introduction

Natural resources consist of any raw material, whether biological, mineral, or environmental, that nature provides without human intervention, but which humans can utilize for their benefit (both material and immaterial).[i] These resources play a crucial role in a country's economic prosperity and influence various aspects of domestic and military operations as these materials are used in manufacturing and infrastructure projects.

Natural resources have always played a critical role in national security – from the grain basins of Egypt to feed the armies of Rome[ii] to the oil-rich Dutch West Indies required for Imperial Japan's Navy in the Pacific War.[iii] In fact, U.S. oil reserves and production proved a critical enabler to winning World War II.[iv] As military technology has evolved, so has the type of resources which prove critical. Both fossil fuels and iron appear a constant requirement for modern warfare, as demonstrated by the Russian/Ukraine conflict.[v] Yet, other resources, like rare earth minerals, appear to hold predominance in exquisite capabilities, including fifth-generation fighter aircraft.

What are the most important materials for today's strategic competition? In case of war, can the U.S. meet its natural resource requirements to feed its military-industrial complex domestically? Is self-reliance required or can the U.S. leverage its allies and partners for some of these resources? Beyond production and extraction, does the U.S. have access to resources within secure logistic lines? This brief identifies some of the essential critical resources for U.S. national security, their domestic availability, and strategic considerations for securing U.S. grand strategy in the 21st Century.

Energy that Drives Nations

Fossil Fuels

In 2023, the U.S. produced far more energy than it consumed, and, to a greater extent, produced more natural gas and petroleum than any other nation.[vi] Unlike other giant producers of energy resources, the U.S. has the capability to maintain a high level of production for the foreseeable future. During WWII, the U.S. produced 60% of the world's crude oil[vii] but after reaching its peak in the 1970s, U.S crude oil production saw declines until 2009 when new drilling and hydraulic fracturing techniques were applied.[viii] Even though the U.S. is now extracting more oil than ever, it is a light crude oil as opposed to heavy crude oil. While light crude oil is easier to refine, most infrastructure in the U.S. is designed to run heavier crude oil [ix] The U.S. exports light crude oil and then imports heavier crude oil, most of which comes from Canada.[x] The historically strong relationship between the U.S. and Canada insulated the U.S. oil supply from geopolitical turmoil; however, the recent threat of tariffs could destabilize the U. S's oil supply.

To achieve energy independence the U.S. would not only need to stop importing energy resources but also secure its energy infrastructure. According to the Department of Energy, the nation could satisfy its projected energy demand by 2050 if renewable energy sources are fully maximized.[xi] The U.S.'s natural resources of coal and gas ensure that the U.S. could be completely independent of any external sources of energy if the refinery and pipeline infrastructure was adapted to favor only those sources. Additionally, the benefit of the U.S. increasing production could also extend to its allies as it could lessen their fossil fuel reliance on malign actors.

Renewable Energy

Unlike fossil fuels, renewable energy comes from naturally occurring resources—wind, solar, geothermal, and hydro—that are continuously replenished. Currently, renewable energy generates over 20% of all U.S. electricity, with the potential to generate more than 100 times the amount of electricity Americans use per year.[xii]

Renewable energy sources come with their own resource requirements as the technology needed to capture and produce renewable energy relies heavily on Rare Earth Elements (REE) and minerals. Additionally, the integration of renewable energy into the power grid also requires higher-grade steel, and other critical minerals as well as raw materials essential to renewable technologies. All of which are also vulnerable to supply chain disruptions. For example, the increased demand for wind turbines and solar panels has caused increased demand for steel, copper, and aluminum; all of which have experienced significant price increases due to the volatility of the market. Extensive investments in the renewable supply chain will be required to meet the increased demand. This means securing access to raw materials, infrastructure development, and increased factory utilization.[xiii]

Critical Metals and Minerals

Vulnerability in the global supply chain coupled with resource nationalism and the growing demand for natural resources has led to concerns in the supply reliability of nonfuel mineral

commodities.[xiv] In 2023 the Department of Energy created a Critical Materials Assessment list, defining any non-fuel mineral, element or material that has a high risk of supply chain disruption while also serving as an essential function in one or more energy technologies. Critical materials for energy are dubbed the "electric eighteen" and include aluminum, copper, electric steel, lithium and silicon. Additionally, the United States Geological Survey (USGS) began assessing domestic mineral resources in 2013 and has determined that the U.S. is 100% reliant on imports for an additional 50 mineral commodities.[xv]

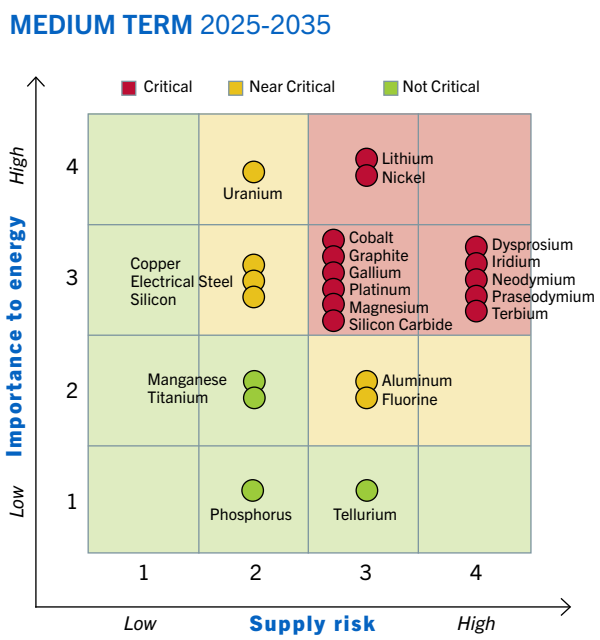

Figure 1: Medium-term (2025-2035) criticality matrix (source/DOE)

Steel

Steel remains an integral part of national security as it impacts the military industrial complex and the nation's critical infrastructure. A country's ability to not only produce its own steel but quickly increase production in times of conflict can have a direct impact on that country's geopolitical standings. The U.S.'s ability to meet domestic demands for steel requires a more nuanced answer as production is tied to the availability of natural resources such as iron ore and coking coal, and in the case of electric steel, silicon.

The U.S. produces a large quantity of steel but demand for it is cyclical, often being influenced by outside factors including large infrastructure projects and automotive demands. That said, domestic steel consumption supplied by U.S. based mills fluctuated between 70%-90% over the past decade.[xvi] The U.S.'s steel capacity utilization reached its peak in August 2021 at 84.8%, and the most current estimates from August 2024 put it at 77.7%. [xvii] In 2024, steel imports account for 23% of all domestic steel consumption.[xviii]

Electric steel, also known as silicon steel, is an iron-silicon alloy that is utilized in the cores of electromagnetic devices, such as transformers, and electric motors.[xix] It is essential to the production of and transition to electric vehicle motors and the demand for electric steel has increased.[xx]

To meet domestic demand and ensure resiliency during conflicts, while also supporting innovation and expansion in emerging renewable energy sectors, the U.S. should be increasing its focus and investments in steel production. This would inevitably require that reliable access to silicon, iron ore and coking coal is either increased or maintained.

Copper

Due to its wide usage as a conductor, few resources are more essential in modern technologies than copper. Similar to steel, copper powers the existing fossil fuel economy and is poised to be a critical resource in the renewable energy process. In 2023, the U.S. was the world's fifth largest producer of copper[xxi] with domestic mine production at 1.1 million tons of recoverable copper content, which was an 11% decrease from 2022. [xxii]

Despite being one of the largest producers of copper and possessing sufficient copper deposits to cover its consumption needs, American mining and production is far from enough to meet current and expected demand. Between 2019-2023, the U.S. imported roughly 44% of the refined copper it consumed.[xxiii] Due to the increased use of copper in the transition to renewable energy sources, electricity generation, urbanization, advancements in technology and supply chain restraints, demand will continue to grow.[xxiv] As a result, current projections show that import reliance could rise to 60% by 2035 if domestic copper production and refinement are not increased. [xxv] Overall, it is estimated the entire global supply chain would need to mine 115% more copper than it has historically until now.[xxvi] That said, the U.S. has an estimated 48 trillion tons of copper in reserves across some of its western states that it could tap into.[xxvii] Countries in Latin America, such as Peru and Chile, are poised to be the world's main producers of copper. China is heavily investing in mining projects throughout Latin America and controls seven of Peru's largest mines and 25% of their copper output.[xxviii]

Rare Earth Elements

Rare earth elements (REEs) are crucial components in a wide range of consumer goods and industrial and defense technology applications. REEs are a set of seventeen metallic elements that are essential "for manufacturing touchscreens in electronic products and magnet-based motors that drive large wind turbines, electric vehicles, and other products."[xxix] More

importantly, in a national security context, REEs and other critical minerals are key to many U.S. military weapon systems. For example, it takes more than 900lbs of rare earth materials to build a single F-35.[xxx] However, China leads the world production of REEs and accounts for more than 90% of global production and supply

The capacity of U.S. rare earth mining has decreased since 1980 and it imports 95% of the total REE it consumes.[xxxi] The U.S. does not have equivalent substitutes for many REEs which do not perform at the same level and cost more to produce.[xxxii] Ukraine is a potential source for REEs that the U.S. could utilize. However, their mining and production of rare earth elements is underdeveloped due to the ongoing conflict and sparse geological data.[xxxiii] Even so, the reliance on a singular country for REEs creates a single point of failure within the supply chain and is a national security threat.

The Department of Defense (DoD) created a National Defense Industrial Strategy in 2023, with the goal of creating a resilient defense industrial ecosystem. Part of NDIS includes investment in domestic REE supply chains and processes needed for refining and converting the materials into metals and magnets.[xxxiv]

Resources Independence and Security

Although reducing reliance on the U.S. imported resources is possible in some sectors, the effort and costs involved in gaining total resource independence would be immense. The U.S. has been implementing strategies to bolster the production of critical natural resources. One recent attempt was the introduction of the Modern Steel Act which would help bring new iron and steel plants to deindustrialized towns in the U.S.[xxxv] Additionally, the Critical Material Assessment List expanded its definition to include copper, thereby requiring the Department of Energy to ensure reliable supply chains of copper.[xxxvi] Regardless, challenges to global supply chains will continue to persist, therefore a strategic approach to the U.S. creating a resilient supply chain and investing in modern manufacturing and domestic production is needed to ensure resource security.

Decision Points

- Should the United States government direct industry to produce, mine and develop all the critical natural resources it needs, despite the financial and environmental costs it may incur?
- Should Congress mandate a National Energy Strategy to better align energy policies with long term national interests?
- Global competition and being a global leader are not necessarily supported by fossil fuels. The world is moving toward clean energy, so should the U.S. make more investments there? What would that mean regarding the demand for REEs?

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