

RFI ON ENERGY SECTOR SUPPLY CHAIN REVIEW

Rare Earths – Introduction

Rare earths are critical metals to the U.S. and are essential to manufacturing strategic products including electric motors, airplanes and defense equipment. China currently controls approximately 55% of the global rare earths mining capacity and approximately 85% percent of the global rare earths refining capacity. Importantly, this strategic imbalance is even more acute for heavy rare earths, with China producing over 95% of global heavy rare earths.

Rare earths are essential for advanced energy applications, including their use in compact and powerful motors in electric vehicles, wind turbines as well as for U.S. defense applications, primarily in targeting weapons systems, including smart bombs and missiles, as well as air, sea and subsea weapons platforms.

The U.S. is 100% import reliant on major rare earth compounds and metals, with 80% imported from China. U.S. dependency on foreign sources of rare earth materials creates strategic vulnerabilities for both its economy and national security when adverse foreign government actions, natural disasters and other events such as global pandemics can disrupt critical raw materials supply.

Hyperion Metals - Background

Hyperion's mission is to be the leading developer of zero carbon, sustainable, critical material supply chains for advanced American industries including space, aerospace, electric vehicles and 3D printing.

Hyperion holds a 100% interest in the Titan Project, covering approximately 11,000 acres of titanium, rare earth minerals, high grade silica sand and zircon rich mineral sands properties in Tennessee, one of the largest such projects in the United States. Metallurgical testwork has demonstrated the potential for high-value rare earth products to be produced at the Titan Project. The rare earths are contained within the minerals monazite and xenotime, and are planned to be produced at the Titan Project as a component of its heavy mineral sand concentrate product portfolio.

Hyperion has also established a partnership with Energy Fuels (NYSE:UUUU) that aims to build an integrated, all-American rare earths supply chain. The MOU considers the potential supply of rare earth minerals from Hyperion's Titan Project to Energy Fuels for value added processing, plus the potential to partner on further downstream activities related to magnet manufacturing.

The MOU allows the potential for rapid and low capex entry to the U.S. rare earth supply chain by utilizing Energy Fuels' existing White Mesa mill in Utah, and highlights the importance of Hyperion's Titan Project as a domestic source of high value U.S. rare earth minerals, in particular heavy rare earths which are expected to be crucial in building sustainable American transportation, energy and defense sectors.

DOE RFI – Recommendations (Rare Earths & Critical Materials)

1. In order to reduce critical material supply chain vulnerabilities, the U.S. Federal Government should take action to incentivize the private sector to build end-to-end critical material supply chains in the U.S., and not rely on foreign supply chains. This includes key energy related materials such as rare earth elements.
2. The U.S. Federal Government's actions should build on current and proposed initiatives, including potential legislative solutions to enable the U.S. to compete with international trade, large scale development funding programs such as the DOE Loan Program Office, intermediate & smaller scale

RD&D programs such as through the Advanced Manufacturing Office, ARPA-E, or the new Office of Clean Energy Demonstrations.

3. The U.S. Federal Government should also consider further innovating actions, including:
 - a. Increased utilization of “Buy American” provisions
 - b. Increased direct incentives for the private sector, including concepts such as funding pre-payments for pre-production efforts
 - c. Explore establishment of government funded venture capital platforms for investment in targeted entities within the domestic supply chains
 - d. The U.S. Federal Government should proactively engage with and support the very limited number of companies which are already working to move downstream in the domestic neodymium magnet supply chain,.

DOE RFI – Responses

Area 3 – Wind Energy Technology

8. How can the federal government most effectively support increasing circularity (collection and reuse, remanufacturing or refurbishing, and recycling) in wind energy technologies and supply chains, especially for rare earth element magnets and hard-to recycle components such as blades?

Currently, the U.S. does not have significant involvement in the rare earth element magnet supply chain other than as:

1. A producer of raw minerals, including MP Materials’ Mountain Pass operations; and
2. The end consumer of rare earth element magnets

To partially address this situation, the U.S. Department of Energy plans to provide RD&D support to recycle and recover critical materials and composites from wind turbine blades, for one example. However, the U.S. Federal Government should also support efforts to create domestic circularity of a rare earth element magnet supply chain. Investments should support domestic control over the complete end-to-end supply chain. This would include developing the steps between mineral extraction and end use of rare earth magnets in the U.S., including cracking & leaching, separating & finishing, rare earth metal refining and rare earth magnet manufacturing.

Current and proposed initiatives, including potential legislative solutions to enable the U.S. to compete with international trade (such as tax provisions for the mining, reclaiming, recycling, and purchasing of rare earth elements from deposits in the U.S.) will be helpful in incentivizing the development of the industry in the U.S. However, much more could be done in the near term.

For example, Hyperion Metals and Energy Fuels have proposed a [joint venture to collaborate in the development of an integrated U.S. rare earth supply chain](#). The effort will initially leverage Hyperion’s large rare earth containing critical mineral deposit in Tennessee with Energy Fuels’ rare earth cracking facility in Utah, with the intent to then move further downstream towards magnet manufacturing. DOE assistance in developing this project would accelerate establishment of an end-to-end rare earth supply chain in the United States.

Area 10 - Neodymium Magnets

1. What are the current and future supply chain vulnerabilities as we scale up our efforts to transform the energy sector to support decarbonization (such as significant increases in demand for magnets in direct drive or hybrid wind turbines and traction motors for electric vehicles)? Of these vulnerabilities, which are the most crucial for the U.S. to address and focus on and why? Are there supply chain vulnerabilities associated with manufacturing equipment, and, if so, what are they?

The key energy sector supply chain issue for the U.S. will be linked to the supply side, not demand. It is clear that the demand for magnets in direct drive or hybrid wind turbines and traction motors for electric vehicles is rapidly growing, and this should not be a surprise.

What is concerning is the control that foreign nations hold over key supply chains to support this growth, including rare earths.

For rare earths, the U.S. is 100% import reliant on major rare earth compounds and metals, with 80% imported from China. U.S. dependency on foreign sources of rare earth materials creates strategic vulnerabilities for both its economy and national security when adverse foreign government actions, natural disasters and other events such as global pandemics can disrupt critical raw materials supply.

The U.S. Federal Government should consider innovative actions to incentivise a domestic end-to-end supply chain, including increased utilization of "Buy American" laws and other measures to provide existing and new market entrants confidence that strong local market conditions will exist in order to pursue development of new and technically challenging industries for the U.S.

2. Where in the supply chain does it make sense for the U.S. to focus and prioritize its efforts both in the short-term and long-term and why?

The U.S. has an immediate opportunity to rapidly move downstream from mine to magnet through collaboration and incentivizing existing participants in the U.S. market, including Hyperion Metals and Energy Fuels, which collectively are developing plans to establish a domestic end-to-end mine to magnet supply chain in America. The U.S. Federal Government should collaborate with these and other companies to accelerate establishment of domestic, secure supply chains.



Figure 1: Neodymium magnet supply chain and involvement by Hyperion & Energy Fuels

3. What challenges limit the U.S.'s ability to realize these opportunities to build domestic neodymium magnets manufacturing? What conditions are needed to help incentivize companies involved in the neodymium magnets supply chains to build and expand domestic manufacturing capabilities?

Key challenges include:

1. Sourcing large amounts of heavy rare earth minerals, particularly for military applications
2. Permitting of cracking & leaching facilities

Hyperion Metals and Energy Fuels' agreement solves both of these problems. Hyperion's Titan Project in Tennessee has been shown to be a large deposit of high value U.S. rare earth minerals, and in particular heavy rare earths. Energy Fuels' White Mesa mill in Utah is already permitted, enabling the potential for rapid and low capex entry to the U.S. rare earth supply chain.

The question *“What conditions are needed to help incentivize companies involved in the neodymium magnets supply chains to build and expand domestic manufacturing capabilities?”* is an interesting one. Currently, there is no U.S. company involved beyond Phases 1&2 in Figure 1 above, with Energy Fuels the only company active in Phase 2. The question could be better asked:

- *“What conditions are needed to help incentivize companies involved in **the rare earth supply chains to enter** the neodymium magnets supply chains and build and expand domestic manufacturing capabilities?”*

Companies involved in the rare earth supply chain are typically small to medium capitalisation companies fighting for access to limited pools of capital in what is often seen as a risky sector and is generally not well understood by capital market participants in the U.S.

Accordingly, the U.S. Federal Government should consider actions to de-risk, or provide additional sources of capital that are similar in nature to that found in capital markets, in order to incentivize domestic manufacturing capabilities. These could include concepts such as funding pre-payments for pre-production efforts, and establishing government funded venture capital platforms for investment in neodymium magnet supply chains.

7. How can the federal government most effectively support increasing circularity (collection, reuse or processing, and recycling) of neodymium magnets?

To support increasing circularity of the rare earth element magnet supply chain, the U.S. Federal Government should support domestic control over the end-to-end supply chain, supporting development of the steps between mineral extraction and end use of rare earth magnets in the U.S., including cracking & leaching, separating & finishing, rare earth metal refining and rare earth magnet manufacturing.

Relying on foreign nations to support the circularity goals of the U.S. is not an effective strategy, nor one in which the U.S. Federal Government and its agencies currently assert any significant control. An effective and near term approach for increased domestic circularity is to incentivize the establishment of a U.S. based neodymium industry, starting with those already working in the rare earth supply chain.