Jack-in-the-Stox: Hafnium, Another Critical Mineral in Search of a Business Case

written by Jack Lifton | November 4, 2026

In his ongoing *Jack-in-the-Stox* series, Jack Lifton comments on public companies, technologies, capital markets, supply chains and geopolitics. He is not a licensed investment adviser, and his views are provided for informational purposes only. Nothing in this column constitutes investment advice or a recommendation to buy, sell or hold any security.

Hafnium, atomic number 72, is one of those critical metals that almost nobody outside of a few specialized industries has ever heard of, yet without which some of the world's most advanced technologies would be difficult, if not impossible, to manufacture. It is used in nuclear reactor control systems, high-temperature aerospace alloys, and advanced semiconductor devices. It also illustrates the difference between the geological availability of a critical mineral and the economic feasibility of producing it in commercially useful forms.

Hafnium is found in nature almost invariably associated with zirconium, its chemical neighbor in Group 4 of the periodic table. The two elements have nearly identical chemical properties because of the lanthanide contraction, which makes their separation difficult and expensive. In ordinary zirconium-bearing minerals, the zirconium-to-hafnium ratio typically ranges from 50:1 to 1:1, though it varies with mineralogy and

geological origin. This association is fundamental to hafnium production economics. Hafnium is not generally mined for its own sake. It is recovered during the processing of zirconium-bearing minerals, particularly when zirconium is purified for applications requiring hafnium removal.

The most important such application is nuclear reactor technology. Zirconium metal has a very low thermal neutron absorption cross section, which makes it especially useful for cladding nuclear fuel rods. Hafnium, by contrast, has a very high neutron absorption cross section and is therefore valuable in control rods used to regulate nuclear fission. Thus, the nuclear industry requires both metals, but for almost opposite reasons. It needs zirconium substantially free of hafnium and hafnium in sufficiently high purity for neutron-absorbing applications.

This creates an interesting industrial relationship. **Producing nuclear-grade zirconium requires separating hafnium, and that separation can provide a source of hafnium compounds for subsequent conversion into metal**. The economic justification for the separation process, however, is principally the production of nuclear-grade zirconium, not hafnium. Hafnium is the byproduct of an industrial necessity.

The United States has deposits of zircon, the zirconium silicate mineral that is the principal commercial source of both elements. Zircon occurs in heavy mineral sands deposits, frequently associated with titanium minerals such as ilmenite and rutile. In the southeastern United States, The Chemours Company (NYSE: CC) operates mineral sands businesses in Florida and Georgia. Chemours acquired Southern Ionics Minerals in 2019, so these are no longer two independent American mining enterprises. The former Southern Ionics operations in Georgia and the Chemours operations along Trail Ridge in Florida are

important examples of domestic zircon-bearing mineral sands production.

However, it is important to distinguish zircon concentrate production from zirconium metal production. Most zircon is not converted into metal. It is consumed in ceramics, refractories, foundry applications, and the manufacture of zirconium chemicals. A domestic zircon mining industry therefore does not imply a large domestic zirconium metal industry, much less a large domestic hafnium metal industry.

The United States does produce some zirconium and hafnium metal. The United States Geological Survey has identified domestic production associated with facilities in Oregon and Utah, historically including ATI in Albany, Oregon, and Western Zirconium, a Westinghouse subsidiary, in Ogden, Utah. But American hafnium production is small, and publicly available production statistics do not establish its precise annual output.

The American market also depends on imports. USGS estimates for 2025 indicate imports of approximately 72 metric tons of unwrought hafnium and another 12 metric tons of wrought hafnium. These figures illustrate the existence of an American industrial market, but they should not be confused with domestic consumption or domestic production. Before concluding the market's actual size, consider imports, exports, inventories, and domestic output.

The principal point is that hafnium is a critical mineral whose production is governed largely by the economics of another metal. This is characteristic of many minor metals, and it is one reason conventional mining economics can be misleading when applied to critical minerals. A mineral deposit may contain a valuable element, but unless there is an economically justified

process to recover, separate, refine, and market that element, its theoretical value may never become revenue.

Hafnium is especially interesting because its applications are technologically sophisticated and its customers are demanding. Aerospace manufacturers use hafnium in certain high-temperature alloys and specialized components. Semiconductor manufacturers use hafnium compounds, particularly hafnium oxide, in advanced dielectric applications. Nuclear customers require materials that meet stringent specifications. These are not markets where a producer can simply announce that it has recovered a hafnium-bearing concentrate and expect customers to buy it.

A substantial commercial difference exists between producing hafnium oxide, producing hafnium metal, and producing hafnium metal qualified for a particular nuclear or aerospace application. Each step requires additional processing, quality control, capital investment, technical expertise, and customer qualification. A market for one form does not automatically create a market for another.

This brings me to USA Rare Earth, Inc. (Nasdaq: USAR), which has identified hafnium and zirconium oxides among the potential products of its Round Top processing program. The company has proposed developing processing capabilities that would recover a range of critical mineral products from the Round Top deposit in Texas. Hafnium is one of the elements it could recover.

But the question investors should ask is not simply whether Round Top contains hafnium or whether a laboratory or demonstration process can recover it. The questions are what chemical form the company intends to produce, what purity it can achieve consistently, what the processing cost will be, and whether it has identified customers who will qualify for and purchase that product.

If the proposed product is hafnium oxide, the company must demonstrate that it can produce an oxide that meets the specifications of an identified market. If the intention is ultimately to produce hafnium metal, the company must account for the additional conversion, refining, and qualification steps. The economics of producing an oxide cannot be assumed to be the economics of producing a qualified metal.

Scale is also a factor. Hafnium is not copper, aluminum, or even a major rare earth such as neodymium. Its market is relatively small and specialized. An increase in production that would be insignificant in a major industrial metal market could be substantial in the hafnium market. A new producer must therefore determine not only whether it can produce the material economically, but whether the market can absorb the proposed output without significantly affecting prices.

This is particularly important when hafnium is included in the projected revenue of a polymetallic mineral project. Investors should be cautious about adding together the theoretical market values of every recoverable element in an orebody. The sum of those values is not the value of the project. Each product requires a processing route, a capital allocation, a customer, a qualification process, and a realistic assessment of the market’s ability to absorb the proposed production.

Hafnium also illustrates why the phrase *domestic critical mineral production* can conceal more than it reveals. A country may mine zircon, process zirconium chemicals, manufacture zirconium metal, separate hafnium, and refine hafnium metal, but these are distinct industrial activities. Having one capability does not mean having the others. A secure domestic supply chain requires the particular capabilities needed to deliver qualified materials to end users, not simply the presence of the elements in domestic mineral deposits.

For American industrial policy, this distinction is fundamental. If the objective is to secure hafnium for nuclear, aerospace, and semiconductor applications, then the first question should be what forms and quantities American manufacturers actually require. The next question should be which stages of the supply chain are missing or inadequate. Only then should we determine whether expanding domestic mineral production, separation capacity, metal refining, or some combination of these activities would solve the problem.

The United States has zircon resources, existing mineral sands production, and a small specialized zirconium and hafnium metallurgical industry. It also has industrial consumers with some of the world's most demanding specifications. What remains unclear is whether the domestic market could economically support a major expansion of hafnium production independent of the zirconium industry.

This is why I regard hafnium as a particularly instructive critical mineral for investors. Its importance is not in question. Its applications are real, and its technological value is substantial. But technological importance does not by itself create a profitable business.

The fundamental problem is that hafnium is generally produced because zirconium must be purified, not because hafnium is needed. That relationship structurally limits hafnium supply and complicates the economics of any proposed independent production operation.

My conclusion is that hafnium deserves its designation as a critical mineral, but its criticality should not be confused with the commercial viability of every project proposing to produce it. The American objective should not be to maximize the number of announced hafnium projects. It should be to build the

capability to produce the forms of hafnium American industry actually needs, at prices and in quantities the market can support.

In critical minerals, as in every other industrial business, it is the qualified customer and the economics of production, not the mere presence of an element in the ground, that ultimately determine whether an investment creates wealth.