The Core Four: Rare Earths Fueling Global Markets and Military Might

written by Melissa (Mel) Sanderson | June 11, 2025

Rare Earths have an identity crisis. Unlike singular critical minerals such as lithium (Li), graphite (C), copper (Cu), or magnesium (Mg), where generally people have an idea of what they think those are and how they are used, rare earths are confusing. Collectively, rare earth elements (REE) are the fifteen elements in the bottom right hand of the periodic table, plus yttrium (Y) and scandium (Sc). The latter two, like those mentioned above, are more recognizable due to their unique uses: scandium (Sc), for instance, is added to aluminum to strengthen it without adding weight. This is key for the electric vehicle industry, which needs lighter vehicles to optimize efficiency, and for fighter jets and space craft. But as for the other fifteen, it is harder to be sure of what each one is used for, or even if each one is useful for anything (and currently, not all fifteen are useful). On top of that there are 'light' rare earths and 'heavy' rare earths. So if you're a rare earth, it's like being from a large family versus an only child – it can be hard to get the respect you deserve.

There are **17 Rare Earth Elements (REEs)** in total:

Category	Elements (symbol)
Lanthanides (15)	Lanthanum (La), Cerium (Ce), **Praseodymium (Pr)**, **Neodymium (Nd)**, Promethium (Pm), Samarium (Sm), Europium (Eu), Gadolinium (Gd), **Terbium (Tb)**, **Dysprosium (Dy)**, Holmium (Ho), Erbium (Er), Thulium (Tm), Ytterbium (Yb), Lutetium (Lu)
Additional rare earth metals (2)	Scandium (Sc) and Yttrium (Y)
The Core Four – Dy, Nd, Tb, Pr	**1. Dysprosium (Dy)** **2. Neodymium (Nd)** **3. Terbium (Tb)** **4. Praseodymium (Pr)**

As in any large family, everyone is different although related. Sometimes certain rare earths – such as gadolinium (Gd), for instance – seize the spotlight. But some rare earths are actually ubiquitous, albeit not familiar. So allow me to present the Core Four. **These four rare earth elements have wide applications across both the economy and national defense.**

The **Core Four** comprises two light and two heavy elements – the distinction between light and heavy being the atomic weight and associated characteristics. The two light REE are neodymium (Nd) and praseodymium (Pr), and the heavies are terbium (Tb) and dysprosium (Dy). These also are known as the magnet metal REEs because of their key role in permanent metal magnets which are in everything from smart phones and cars (yes, even standard cars) and wind turbines to fighter aircraft, naval ships and spacecraft.

The light rare earths are excellent conductors of energy and generate powerful magnetic fields, increasing both the efficiency and life span of magnets and batteries. The heavies are important because they absorb heat, keeping the magnets from

overheating and exploding. The magnets themselves are used in the turning parts of equipment, so when you push the button to raise or lower your car window – that's rare earth motors. The rotating blades on the giant wind turbines – rare earth motors. Storage batteries for renewable energy, the same.

Crucially, three of the Core Four (neodymium (Nd), praseodymium (Pr) and terbium (Tb)) are needed for the semiconductors in smart phones and AI data centers. Their low resistance and high energy transfer rates enable the 5-G phones and, increasingly, the AI interfaces we all love such as ChatGPT. **China currently controls up to 98% of sourcing and processing of rare earths, giving them a distinct market edge and head start over the US and the rest of the West, whose countries are scrambling to source deposits and build mines and processing capability.**

It is no coincidence that as political tensions flared between the world's two largest economies that China produced a list of seven elements it plans to control under its export control regime. These 'dual-use' materials include the two heavies of the Core Four (terbium (Tb) and dysprosium (Dy)) because, although many like to say that 'rare earths aren't especially rare,' heavy rare earths definitely are more scarce than their light counterparts and generally speaking are harder to process, in part due to their higher uranium (U) and thorium (Th) by-products.

REE deposits which contain the Core Four basket, therefore, are highly desirable and the companies working to develop them in the US – such as MP Materials Corp. (NYSE: MP), currently the only rare earth mine in the US, and American Rare Earths Limited (ASX: ARR | OTCQX: ARRNF | ADR: AMRRY), building a project in Wyoming that also has the Core Four – are particularly strategic assets in the geopolitical struggle for high tech power.

Finally, it’s worth noting that 40 years ago, when the US decided it didn’t want to be in the rare earth mining/processing space, there was relatively little demand for the products. Technology changed everything in the ensuing decades, sharply accelerating demand while supply remained relatively flat, especially outside of China. **Unlike some other critical minerals such as lithium (Li), rare earths currently have very low substitutability, meaning that they are essential for the functions they perform.** That could change, of course: current research is looking promising on developing magnets and batteries that don’t need rare earths – not even the Core Four.

But in the meantime, when you hear rare earths mentioned, think of the phone in your pocket and remember the Core Four.