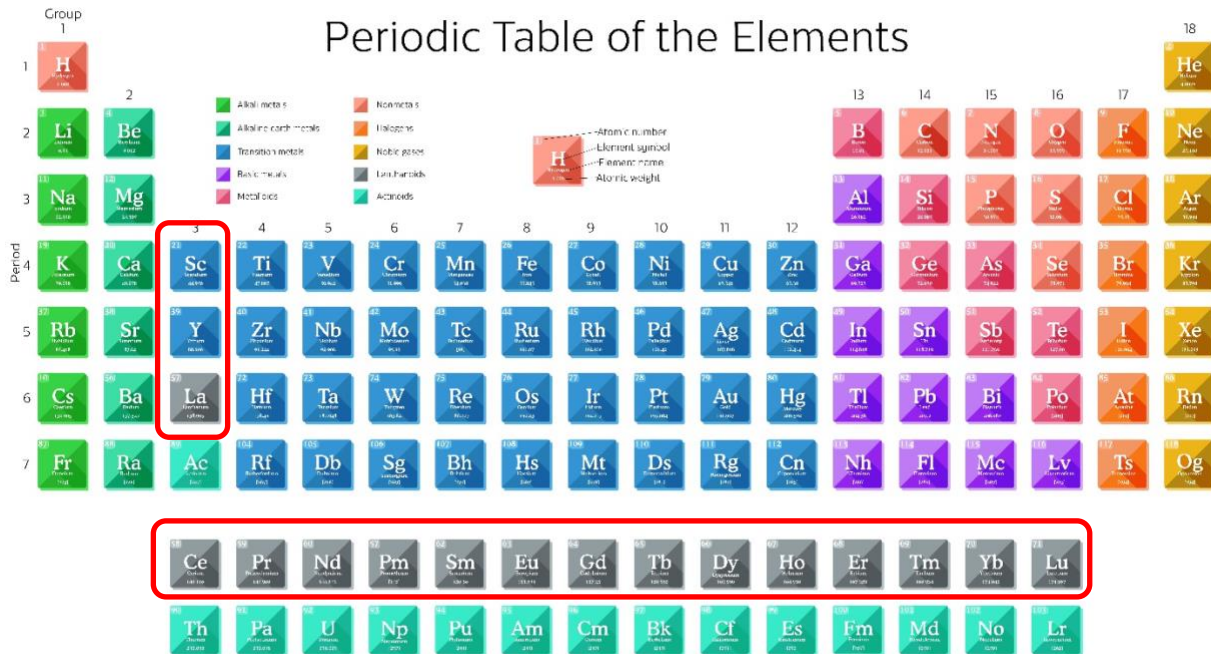


## Rare Earth Elements



### What are rare earth elements?

Referred to as the seeds of technology and technology metals, these elements have become fundamental in this high-tech world we live in. Whether it's the miniaturisation of electronics, the enabling of green energy and medical technologies, or the support of essential telecommunication and defense systems, we have come to rely on these rare earth elements (REE) more and more as technology improves.

Rare earth elements are a group of seventeen chemical elements in the periodic table, highlighted in the above diagram with a red frame. The group is composed of the fifteen lanthanides (in grey) plus scandium and yttrium (in blue). Scandium and yttrium are considered part of this group as they are usually found in the same ore deposits as lanthanides and have similar chemical properties.

### Are they rare?

Although they are referred to as "rare", they are quite abundant in Earth's crust. What makes them rare is that they are often found in small quantities, which means they cannot always be mined

economically. Their use in high tech equipment is nominal but critical to the performance of whatever they are used to make. In fact, all but one of the rare elements (promethium) are more abundant than gold.

### ***Why are they called “rare” then?***

These elements were given their misleading name back in the 1700s when they were first discovered. The element was called an “earth” if the pure metal could be extracted from its mineral by heating the mineral with coal. The separation of the pure metal from its mineral (typically oxide) form relied on a more extensive chemical process than heat, therefore leading to their naming.

### ***History of production and trade***

Before 1965 there was little demand for rare earth elements. Up until then there had been some production from deposits in Brazil and India. The demand really took off in the mid-60s when the first colour televisions started to enter the market. Europium was the essential material used for producing colour images. The Mountain Pass Mine in California, USA started producing europium and was at one stage the leading producer of rare earth elements in the world. China began producing notable amounts of rare earth elements in the 1980s and by the 1990s was world’s leading producer. China was selling these rare earth elements at such low prices that other producers around the world were unable to compete and halted production.

### ***Surge in popularity***

By the late 1990s advances in technology meant that the demand for these metals skyrocketed. They were used in defense, aviation, industrial and consumer products. China began to restrict exports and prices rose massively. By the last decade prices had risen so much that other producers around the world began to rethink their operations and countries such as Australia, Brazil, Russia and Thailand increased production. The Mountain Pass Mine in California, USA also came back into production.

### ***List of Rare Earth Elements***

Atomic No.	Element	Symbol	Uses
21	Scandium	Sc	fuel cells and alloys used in jet planes

39	Yttrium	Y	radars and as an additive within alloys in high-tech devices
57	Lanthanum	La	mixed within alloys used in batteries and hydrogen vehicles
58	Cerium	Ce	light bulbs, TVs and ovens
59	Praseodymium	Pr	aircraft engines, fibre optic cables and magnets
60	Neodymium	Nd	magnets and lasers
61	Promethium	Pm	pacemakers and guided missiles
62	Samarium	Sm	microwave devices and magnets
63	Europium	Eu	light bulbs, nuclear reactors and lasers
64	Gadolinium	Gd	magnets, nuclear reactors and magnetic resonance imaging (MRI)
65	Terbium	Tb	light bulbs, memory devices and x-rays
66	Dysprosium	Dy	mixed within alloys used in wind turbines, electric vehicles and nuclear reactors
67	Holmium	Ho	magnets and nuclear reactors
68	Erbium	Er	lasers and fibre optic cables
69	Thulium	Tm	lasers
70	Ytterbium	Yb	displays, x-ray machines and fibre optic cables
71	Lutetium	Lu	as a catalyst in refineries