Technology&Resources

Rare Earths & Microchips

To extract just a few tons, huge volumes of soil have to be dug up, rich in radioactive elements. Rare earth elements are essential for the of manufacture smartphones, computers and in high – speed, state-of-the-art technology. But the extraction process can be devastating and very polluting.

by Ascanio Vitale

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Baotou is a thriving city on the banks of the Yellow River in Inner Mongolia, close to the northern Chinese border. Chinese historians believe that the first section of the Great Wall as built close to this town, whose name means "the place where deer live". In 21st century China, riddled as it is with the most outrageous contradictions, the glorious past lives cheek to jowl with an ominous present. Just nearby lies one of China's worst 'toxic hot spots': the world's largest rare earths mine, which alone accounts for 50% of world production. This mine is emblematic of the criminal short-sightedness China has displayed in the management of its environmental protection and public health policies. It does much more than just devour 8 million tons of rock a year. The rock is then processed round the clock, using dangerous solvents to separate the raw metals from the tailing. A few thousand tons of rare earths leave behind a toxic and often radioactive waste that is discharged into an artificial lake. 10 km in diameter, which might already have polluted the water sources of over 120 million people irreparably.

The term 'rare earth' brings back images of past centuries, of explorer's expeditions to the exotic and unknown places. However, as often happens with classifications, the term is misleading. The term actually stands for a host of elements found in the periodic table, some of which are anything but rare. Lanthanum, for instance, first discovered at the end of the 19th century, is more abundant in the Earth's crust than silver or lead. The picture changes if one tries to identify areas of the planet with high enough concentrations of these elements to make their extraction viable. The demand for these materials has been rising constantly, particularly over the last three decades, when our lives have been increasingly been overwhelmed by technology. Their gradual introduction has enabled the miniaturization of electronic devices and the widespread distribution of increasingly efficient and high-performance technologies.

Rare earths are in fact the materials that enable our cell phones or laptops to be powered by lightweight and compact batteries. Neodymium and Praseodymium, for instance, have become essential in the industrial production of powerful magnets. Both are used to manufacture loudspeakers, wind turbine generators, heat pumps and thousands of other tools and devices. And precisely because they are essential to a number of industrial processes related to the green economy, rare earths are often referred to as a limited resource, and therefore as one of the killer factors that may strongly affect the inescapable transition of the world's energy production systems towards sustainable ones. Rare earths have also found uses in 'traditional' technologies as well — such as oil refining processes and war-related industries where they are used as catalysts — and their price remained stable over the years, despite a sharp increase in demand.

The market dynamics associated with these precious compounds are very much affected by geopolitical and economic factors, as are other industries in the global economy.

Firstly, on the production side, while at one time this involved a dozen or so countries in the world, nowadays it's an unchallenged monopoly: China accounts for more than 90% of the world's supplies. Cynical market-first thinking has prevailed over the last decades: always cutting production costs, to the detriment of working conditions and environmental protection.

Its exceptionally rich sites, combined with an almost complete disregard for any social or environmental safeguards by the national industrial system, have enabled China, over the course of just a few decades, to become the dominant producers in the world.

The global output, which currently stands at around 136,000 tons per year, is expected to rise constantly. The forecast is a 40% increase by 2015, boosted by demand from emerging markets, including the Chinese domestic market.

As a reaction to the political tension with Japan over the Diaoyu/Senkaku Islands, China decided to reduce exports. This led to a peak in market values in 2010, which triggered a race to reopen old and new mines, now competitive thanks to the higher prices.

Australia and the United States lead the way, with plants designed to drastically contain emissions and territorial exploitation at the excavation sites. Once up and running, these should produce approximately two thirds of China's production. It is expected that the largest of these sites, in California, should be completed within the year. An example of 'natural capitalism', as propounded by Amory Lovins, in which environmental and workers' rights are placed on a par with production efficiency and the quality of the financial management.

Even the EU is aware of the strategic importance of these elements, and has recently introduced new rules on the collection and recycling of 'electronic' waste. In a sustainable cycle, the elimination of all non-disposable waste produced by electronic devices and equipment is key, but it would also allows considerable amounts of highly priced rare earths to be recovered along with many other elements such as Palladium, Titanium, Gold and Silver.

In the United States, according to the Environmental Protection Agency, only 25% of 2.37 million tons of electronic waste collected in 2009 was sent for recycling. In virtuous Europe, all member states will have to recycle 45% of it by 2016, and move on to a 65% success rate by 2019. A few grams of metal from hundreds of millions of old computers, TV sets and mobile phones are an important step forward in an attempt to reconcile environmental concerns with progress and stabilize a market that is currently at the centre of one more international political dispute.

Their uses, who has them

Thanks to their very particular chemical and physical properties, rare earths are used in many technological applications.

- Magnets: electric motors, hard disks, magnetic resonance imaging, loud speakers, alternators
- Catalysts: oil refining, catalytic converters, chemical additives, chemical processes
- Metal alloys: hydrogen cells, NiMH batteries, spark wire
- Phosphors: fluorescent light bulbs, medical research, lasers, optical fibres
- Ceramic materials: electrical capacitors, sensors, dyes, refraction materials
- Glazing: UV screens for windows and goggles, X-rays

The U.S. and Japan dominate the import market with a share of about 15% each, followed by Germany and France with a 7% share. Imports by the U.S. are expected to drop as domestic output increases.

With a production of 95,000 tons per year, about four times the Australian output, China in 2010 maintained its status as the world's main rare earth exporter, followed by Australia with 26 thousand tons per year, the United States, Japan and Russia. These figures could change considerably and quickly if countries like the U.S. and Malaysia expand production. *(Source: M.I.T.)*