USAID
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GREEN ENERGY MINERAL: KEY FACTS

Rare Earth Elements

US CRITICAL MINERAL?	YES

MAIN USES IN GREEN ENERGY TECHNOLOGY

Wind

Electric cars (batteries excluded)

KEY DEVELOPMENT ISSUES IN MINING

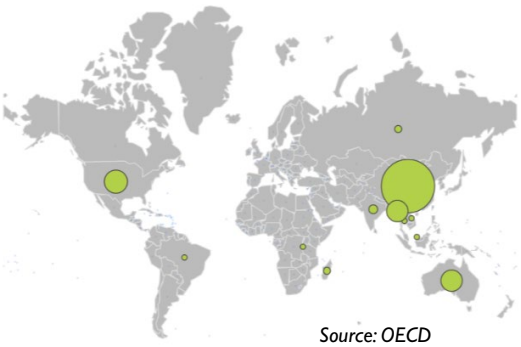
Environment

Governance

DEMAND PROJECTIONS

Rare Earth Elements (REEs) comprise the 15 elements in the lanthanides group (57-71 on the periodic table) plus scandium and yttrium. REEs are often grouped together because they occur in similar deposits and because of their similar chemical properties. REEs are used to create permanent magnets, which are powerful magnets vital to generating power in a wind turbine's induction generator. Four REEs can be used: neodymium, dysprosium, praseodymium, and terbium. Neodymium is the most used sometimes in combination with others. By 2050, demand for neodymium is projected to be 8,400 tons per year, or 37% higher than 2018 production levels (Hund et al., 2020). Permanent magnets are also used in electric vehicle motors (Dias et al., 2020).

PRODUCTION/RESERVES



Source: OECD

Most REEs come from monazite, which often occurs as a sand, and bastnaesite. **China** accounted for 60% of global REE production in 2020 with 140,000 tons. China has the bulk of refinery capacity and is the lead important of REE ores from other producers. The **US** is the second most important producers with 38,000 tons followed by **Burma's** 30,000 tons which are all exported to China for processing (Reuters, 2021d). Prices for dysprosium oxide at 99.5% purity has risen steadily from 2016 at $198 per kilo to $258 per kilo in 2020. Prices for neodymium oxide at 99.5% purity have fluctuated from $40 in 2016 to $50 in 2018 and $47 in 2020.

MINING IN USAID-PRESENCE COUNTRIES

Burma is the third-largest REE producer. Other small and emerging producers include Madagascar (Chinese/Singapore investment; Reuters, 2019), India, Thailand, Vietnam (Japanese owner; Fuyuno, 2012), Brazil and Burundi (UK-based owner; NS Energy, n.d.a). Exploration projects that could lead to new mines are located in Namibia (Namibia Critical Metals, n.d.), Angola (Reuters, 2020), and Malawi (NS Energy, 2020a). The same company developing the Burundi deposit has a project in South Africa to extract REEs as a byproduct from processing gypsum residue from phosphate mining (Rainbow Rare Earths, n.d.).

MAJOR INDUSTRIAL COMPANIES

The major Chinese companies involved in rare earths are **China Northern Rare Earth, China Minmetals, Aluminum Corporation of China Limited (Chinalco)**, and **China Non-Ferrous Metal Mining (CNMC)**. At present the only company outside of China with REE refining capacity is Australia-based **Lynas Resources**, though its refinery is in Malaysia and there are plans to open refineries in the US (Subin, 2021).

ARTISANAL AND SMALL-SCALE MINING (ASM)

Some rare earth mining in China has been characterized as small-scale and illegal, though there has been a crackdown on such mines (Standaert, 2019).

ISSUES IN USAID-PRESENCE COUNTRIES

There is little REE mining in USAID-presence countries. In Burma, REE mining in Kachin state has been linked to criminal networks protected by the military junta and the Chinese government (Bangkok Post, 2021). In Madagascar, a REE project came under scrutiny and local opposition due to its location in a high conservation value location (Carver, 2017) REE mining and processing can generate radioactive waste which could be a problem as new projects are developed.

MINE DEVELOPMENT AND SUPPLY CHAIN DYNAMICS

REE have been a focus of the geopolitical "resource scramble" in recent years, especially given China's dominance in mining and in processing. The US in particular is keen to create domestic refining capacity. However, many of the new projects in frontier locations including USAID-presence countries are signing offtake agreements with Chinese companies, making it unlikely that they will feed into non-Chinese supply chains. Moreover, with respect to REE use in renewables, the manufacturers of permanent magnets are also dominated by China-based enterprises, with a 90% market share (PR Newswire, 2019).

ORGANIZATIONS AND INDUSTRY GROUPS

China has several regional REE industry associations, plus the national **Association of China Rare Earth Industry**. The EU spearheaded the creation of the **Rare Earth Industry Association (REIA)** in 2019 aimed at creating a unified industry voice (Mine, n.d.).