

GREEN ENERGY MINERAL: KEY FACTS

# Chromium

US CRITICAL MINERAL?

**YES**

## MAIN USES IN GREEN ENERGY TECHNOLOGY



Wind



Energy storage



Geothermal

## KEY DEVELOPMENT ISSUES IN MINING



Environment



Governance



Labor and working conditions



Conflict

## DEMAND PROJECTIONS

While chromium is used in some battery technologies, most of its use in renewable energy stems from its role in steel alloys. Chromium-based ferroalloys are especially important in wind turbines and geothermal facilities due to anti-corrosive properties. Indeed, 36% of its demand linked to renewables comes from geothermal (Hund et al., 2020).

Chromium demand linked to green energy technology is projected to reach 366,000 tons per year by 2050 under a two-degree scenario (Hund et al., 2020). This represents only 1% of 2018 global production. Given that 90% of chromium is used in the steel industry, and steel is used in a variety of sectors, the increased demand from renewables is unlikely to have a major impact on its underlying economics.

## PRODUCTION/RESERVES



Source: OECD

The main ore for chromium is chromite. Worldwide resources of chromite are estimated at 12 billion tons, which is sufficient to meet demand for centuries. Current mining and known economic reserves are concentrated in southern Africa and Kazakhstan. **South Africa** dominated chromite mining in 2020 with 40% of global production, followed by **Kazakhstan** and **Turkey** with approximately 15% each.

**China** is the leading chromium-consuming country, which is linked to its role as the leading producer of steel. Indeed, 90% of chromium is used in the steel industry. The chromium used in steel is called ferrochromium which is derived from chromite. Ferrochromium can be further refined into chromium metal used in electroplating and other applications.

China also leads the world in ferrochromium production, but South Africa is close behind. Producing ferrochromium requires a large quantity of electricity, which has historically been low-priced in South Africa but is rising in cost in recent years. Most ferrochromium is produced at or near chromite mines.

Prices are cyclical and generally follow steel demand. Chromium is not traded in open markets like the LME so price data is less available. According to USGS figures, in the last five years, chromite has varied between \$180 and \$279 per ton, ferrochromium between \$1,800 and \$2,549 per ton and chromium metal between \$7,900 and \$11,344 per ton. The lower prices were in 2020 driven by COVID-19 causing a reduction in steel demand.

## MINING IN USAID-PRESENCE COUNTRIES

Both of the world's top producers of chromium ore (**South Africa** and **Kazakhstan**) are USAID-presence countries. Other important USAID-presence producers are **India, Mexico, Vietnam, and Brazil** (ScienceDirect, n.d.). Smaller or emerging producers include **Albania, Cuba, Madagascar, Pakistan, Sudan, Philippines, and Zimbabwe**.

### MAJOR INDUSTRIAL COMPANIES

Switzerland-based **Glencore**, the world's largest metals and mining company by revenue, is also the current leader in chromite mining with majority ownership of assets in South Africa. The second-largest producer in the world is **Samancor** (Samacor, n.d.), based in South Africa, but with a complex and controversial beneficial ownership structure (see below). **Eurasian Resources Group (ERG)**, based in Luxembourg with 40% owned by the Kazakh government, is the world's largest producer of high-carbon chromium (ERG, n.d.). **Tata Steel** is the main operator in India.

### ARTISANAL AND SMALL-SCALE MINING (ASM)

There is small-scale chromite mining in **Zimbabwe**, mainly the Mapanzure area of Zvishavane, but both mining and trade is dominated by Chinese operators (Chinembiri, 2020). Zimbabwean miners rely on Chinese partners to provide equipment and then get 15-30% of the sales at sometimes below-market prices, resulting in disputes and conflict. Much of the chromite is sold to local companies like the Zimbabwe Mining and Alloy Smelting Company, in which the Chinese are major shareholders. There are also informal artisanal chromite miners in Limpopo in **South Africa** (Ledwaba, 2019).

## ISSUES IN USAID-PRESENCE COUNTRIES

Financial crimes, corruption and other governance issues are linked to major chromite miners in South Africa and Kazakhstan, who together control over 50% of global production. Since 2004, leading company Samancor has undergone a series of ownership changes following the exit of multinationals BHP Billiton (60% ownership) and Anglo American (40%). The new majority owner is the Kermas Group, controlled by Croatian billionaire Danko Konkar. Investigative journalists and the leaked "Paradise Papers" highlighted transfer pricing through commissions in Malta-listed companies and the involvement of Kazakh oligarchs in Samancor deals, including those who founded company ENRC, which was taken private in 2013 as ERG (listed above) in part due to fraud and bribery charges (Goodley & Luyendijk, 2013). The reports also highlight alleged corruption around a subsidiary sale to Chinese steel manufacturer Sinosteel. Samancor's current beneficial ownership structure starts in Mauritius and continues through a chain of companies in tax havens (Rensburg, 2019).

Madagascar's small chromite company Kraoma SA has also been in the spotlight for corruption when a little-known Russian company Ferrum Mining took an 80% stake in 2019 (Malina, 2018; African Intelligence, 2018b). The company is reportedly owned by US-sanctioned Russian national Yevgeny Prigozhin who may have received the shares in exchanges for election interference in favor of the ruling party (Marten, 2020).

South Africa's chromite mines also have labor relations issues related to opposition to the creation of labor unions at Glencore-owned mines (Jamasmie, 2013), wage disputes and a lawsuit regarding the transfer pricing and other financial crimes allegedly committed by Samancor. In India, environmentalists have denounced leaching and worker exposure to the carcinogen hexavalent chromium in the Sakinda valley mines in the state of Odisha (Das et al., 2021; Mishra & Sahu, 2013). Environmental concerns are also an issue with the ASM chromite mines in the Mapanzure area of Zimbabwe which has left a pock-marked landscape (Mhlanga, 2018). Conflicts between Zimbabwean miners/landowners and Chinese ASM operators are also widespread, including an incident whereby a Chinese manager shot two Zimbabwean employees (Chinembiri, 2020).

## MINE DEVELOPMENT AND SUPPLY CHAIN DYNAMICS

Major chromite producers tend to refine to ferrochromium prior to export, but they also export chromite ore, showing some supply chain integration. Further vertical integration has been a recent phenomenon with Chinese and Indian steel companies (like Sinosteel and Tata Steel) becoming stakeholders in chromite mines and ferrochromium refineries. Japan is also a major investor in chromium mining and trading in South Africa. South African Platinum Group Metals (PGM) companies also recover chromium as a byproduct which helps diversify income streams (James, 2018). As noted chromium and chromite are not traded on public exchanges like the LME. Zimbabwe is an active frontier market at present with Chinese and South African investment (Whitehouse, 2018). South Africa's electricity crisis is also affecting the chromium mining sector.

## ORGANIZATIONS AND INDUSTRY GROUPS

The **International Chromium Development Association** (ICDA) founded in 1984 provides market research and health and safety studies.

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