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GREEN ENERGY MINERAL: KEY FACTS

Iron

US CRITICAL MINERAL?	NO

MAIN USES IN GREEN ENERGY TECHNOLOGY

Wind

Energy storage

KEY DEVELOPMENT ISSUES IN MINING

Environment

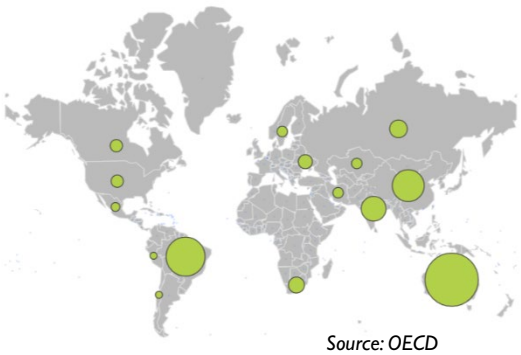
Governance

Leveraging minerals for economic growth (local/national)

DEMAND PROJECTIONS

Iron is a widely used metal generally combined with carbon and other elements to produce steel, which is a foundation of the modern economy worldwide. Iron is an essential component in wind turbines used in the induction generator core as well as rotor hubs. Iron represents 85% of the mineral demand foreseen from wind technologies. Iron is also used in newer battery technologies such as iron-based flow batteries used for grid-level energy storage as well as a cobalt-free battery type called lithium-iron phosphate. The evolution of batteries will impact projected iron demand but is projected to reach 7.5 million tons per year by 2050 which is 1% of 2018 global production levels (Hund et al., 2020). This projection does not include any increased use of steel which is used for wind turbine towers, grid installations and other parts of energy infrastructure.

PRODUCTION/RESERVES



Source: OECD

The main iron ores are hematite and magnetite. Australia produced 900 million tons in 2020, representing nearly 40% of the world total of 2.4 billion tons. **Australia** was followed by **Brazil** which produced a sixth of world production (400 million tons) and **China** (340 million tons). World resources are widespread (iron is the fourth most abundant element in the earth's crust). There is an estimated 800 billion tons of iron ore containing more than 230 billion tons of iron metal. However, economic iron ore deposits generally require more than 50% iron for hematite and 25% iron for magnetite.

Nearly 98% of iron ore is used to make steel. **China** is the world's largest steelmaker (producing over 50% of global supply) and as such is the world's top iron ore consumer. In the last five years, iron ore prices per ton ranged from $73.11 in 2016 to $108.00 in 2020. In 2021, prices rose over 100% to more than $200 per ton (Dela Cruz).

MINING IN USAID-PRESENCE COUNTRIES

Brazil is the world's second biggest iron ore producer, representing a sixth of world production (400 million tons). **India** is the fourth largest producer at 240 million tons produced in 2020. Other current or likely future producers include: **Bosnia-Herzegovina, South Africa, Ukraine, Kazakhstan, Chile** (limited presence), **Peru, Bolivia** (limited presence), **Colombia, Republic of Congo, Egypt, Guinea, Indonesia, Laos, Liberia, Mauritania, Mexico, Mongolia, Namibia, Nigeria, Pakistan, Republic of Congo, Senegal, Sierra Leone, Thailand,** and V**ietnam**.

MAJOR INDUSTRIAL COMPANIES

Three companies have dominated iron ore mining for decades. In 2020 they remained in the top 3: Brazilian **Vale** with 300 million tons from its mines alone, Australia-based **Rio Tinto** and Australia-based **BHP**. **Fortescue Metals Groups**, also Australia-based but with mining and exploration in USAID-presence countries, was fourth. In fifth place was London-listed **Anglo-American** with mines in both South Africa and Brazil (NS Energy, 2021b).

ARTISANAL AND SMALL-SCALE MINING (ASM)

None

ISSUES IN USAID-PRESENCE COUNTRIES

Governance shortcomings and geopolitics around iron mining concessions in frontier countries, especially in West and Central Africa, are a major development challenge. Guinea's Simandou range, for example, hosts over 2 billion tons of high-grade iron ore reserves, making it potentially one of the most lucrative mines in the world. However, mining rights have been in dispute and turmoil for many years, including corruption and bribery allegations against Israeli diamond investor Benny Steinmetz, and involving iron majors Rio Tinto and Vale (Keefe, 2013).

Corruption and risk of arbitrary license revocation under the guise of resource nationalism is a risk for major investments which require stability over a long period of initial investment. Recently the Republic of Congo revoked iron mining licenses of Australian firms in favor of a local company backed by Chinese investors with no iron mining experience. The case is in international arbitration (Reuters, 2021b). Sierra Leone similarly revoked licenses from its two iron ore mines and went against an international arbitration ruling to give the rights to a private Chinese company Kingho Investment (Kinch & Hao, 2020). Chinese operators have an advantage in these markets partly because they can more easily access finance from state-backed funds like the $5-billion China-Africa Development Fund.

Another challenge but also opportunity is the fact that iron mining requires significant infrastructure in order to transport and export enormous quantities of ore. This increases the capital expenditure requirements significantly and partly explains the "mine-for-infrastructure" deals with China, but some countries are seeking to develop infrastructure separately to attract mines investment. Senegal, for example, is seeking to develop a rail system to support its iron ore potential (Whitehouse, 2020). Senegal is also aiming at processing its iron ore before export in order to keep more value in-country (Africa Intelligence 2020). If done right iron mining can therefore prove structurally transformative given associated infrastructure investments. These investments will not happen if there is not a minimum level of stability, however. For a time, Mali was also hoping to develop the infrastructure needed to develop its iron ore (Diallo & Felix, 2014), but militant groups and general instability have dampened these plans.

Environmental concerns are also issues in iron ore mining. In Laos, for example, Chinese mining has brought protest from communities due to pollution (Radio Free Asia, 2021). In Mongolia, India and Liberia, similarly, negative impacts from iron ore mining have been studied by academics and advocacy groups (B. Das, 2014; Gleekia, 2016; Steinweg & Schuit, 2014).

MINE DEVELOPMENT AND SUPPLY CHAIN DYNAMICS

The iron ore market used to be governed by a "benchmark" system whereby an annual price was negotiated between steelmaker giant Japan and the three major miners (Rio Tinto, BHP, and Vale). The rapid rise of China, however, led companies to favor short-term contracts in a spot market instead. Iron prices have since been characterized by instability driven mainly by the ups and downs in China's economy. Prices have been as low as $41 per ton in 2015 to well over $200 in the current record-setting boom linked to production and logistical bottlenecks due to COVID-19 in 2020 as well as speculative behavior.

Another key feature of the iron ore sector is its long project development cycle and very high capital expenditures even though operating costs themselves are low. This has placed China at an advantage in newer USAID-presence countries. Western banks are less likely to finance these large, long-term investments in risky environments while Chinese state-backed financiers are less risk averse. Developing iron ore in emerging markets could be transformational, however, given its potential to spur infrastructure investment as well as provide facilitate local steelmaking essential for construction and industrial development.

ORGANIZATIONS AND INDUSTRY GROUPS

There are multiple steel-focused industry groups. The **International Iron Metallics Association** groups some iron actors. However, most iron mining companies are diversified mining majors who are members of national industry groups as well as the ICMM.