Titanium is a metal that is as strong as steel but weighs half as much, making it valuable for a variety of applications including aerospace, sporting goods, and medical equipment. However, 95% of titanium use stems not from its refined metal form but from titanium dioxide which is used as a pigment in paint, ink, plastics, and cosmetics (Titanium, n.d.). In renewables titanium metal is an important component of geothermal technologies since titanium is one of the few minerals that can survive extremely corrosive environments for more than a few years. Titanium also features in experimental energy storage and PV technologies. Titanium demand in renewables is projected to reach 3,440 tons per year by 2050, which represents no increase over 2018 global production levels (Hund et al., 2020).
**MAJOR INDUSTRIAL COMPANIES**

- **Rio Tinto** (Australia) owns the largest mineral sands producer in South Africa called Richard Bay Minerals as well as the ilmenite mine in south Madagascar. Australian **Iluka Resources** owns Sierra Rutile, the producer of most of Sierra Leone’s rutile. **Kenmare Resources** (London-listed) is the main company operating in Mozambique. **Tronox** is an American chemical company that owns mines in South Africa and Australia as well as trading titanium-based products.

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

Sierra Leone has some artisanal mining of mineral sands, often as a byproduct of artisanal gold mining (EITI, 2021).

**ISSUES IN USAID-PRESENCE COUNTRIES**

In South Africa, Rio Tinto’s operations have been affected by violent protests by contractors in addition to shootings of employees, including the murder of its general manager in May 2021 (Mining.com, 2021). The issues which have led to the suspension of operations are different points in recent years appear to be linked to general insecurity and high unemployment in the province.

In Madagascar, Rio Tinto’s mine has come under scrutiny for negative environmental impacts, namely the contamination of drinking water in surrounding communities by unsafe levels of lead and uranium concentrated due to extraction (Reid, 2019). While mineral sand mining is generally considered less destructive than open-pit mining and other minerals requiring chemical extraction, it is known to concentrate naturally occurring radioactive material. Rio Rinto has also been criticized for its handling of indigenous community land rights in its program of creating biodiversity offsets from its mining operation (Orengo, 2020).

**MINE DEVELOPMENT AND SUPPLY CHAIN DYNAMICS**

Sierra Leone’s rutile sector is uncertain as its main company suspended operations for six months in order to reduce costs and boost productivity (Iannucci, 2021). Companies like Iluka must determine based on costs as well as deposit characteristics the induce price at which a project begins to produce an adequate return. Investment decisions also take into account technical and socio-political risk.

Titanium metal is derived from titanium sponge which is produced in an energy-intensive and high-cost process. Most titanium sponge is produced in China (36%), Japan (25%) and Eastern Europe (34%) (ILUKA, 2013).

**ORGANIZATIONS AND INDUSTRY GROUPS**

The **Zircon Association** (Zircon Industry Association, n.d.) members include the major rutile and ilmenite producers.