

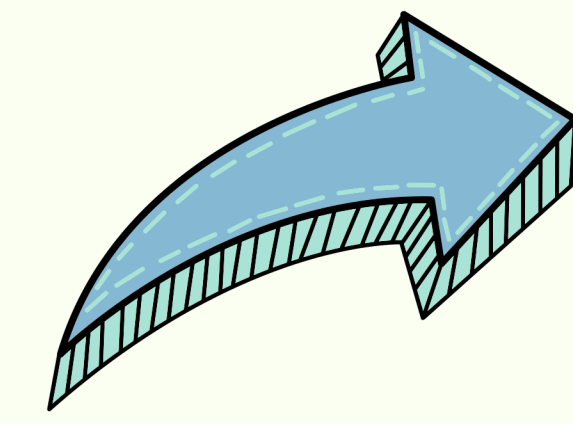
# IRON POWDER AS A CLEAN AVIATION FUEL SOURCE



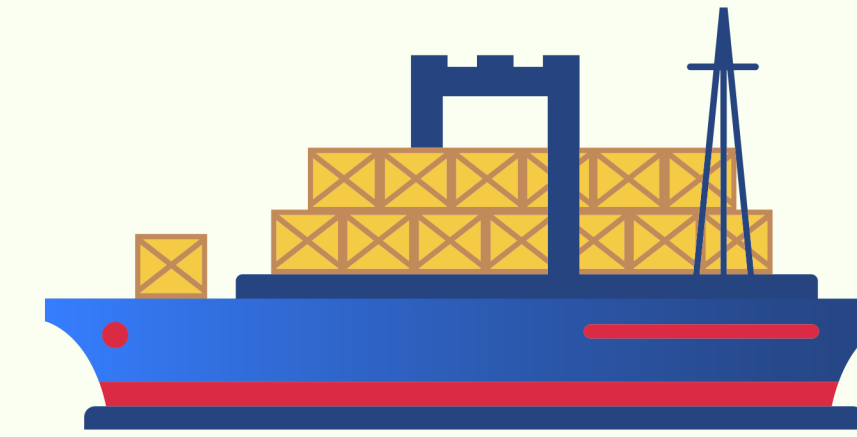
## 1 Iron Mining



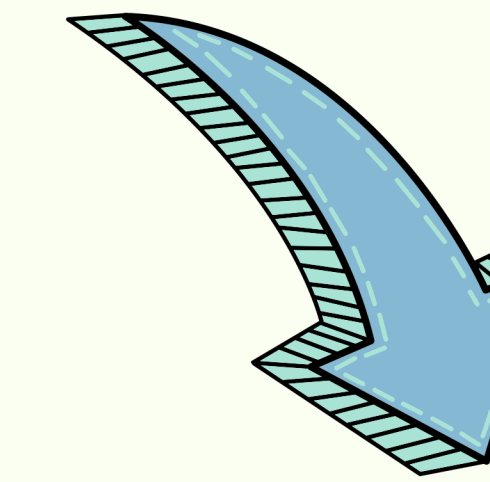
The process begins with iron ore mining. Australia is the largest producer of iron ore in the world. Typically, raw iron requires the excavation of a large area of land. Mining will cause CO2 emissions; however, once the initial investment is made, the output will be negligible to the cyclical process. Individual companies buy the land, excavate, and then ship the materials.



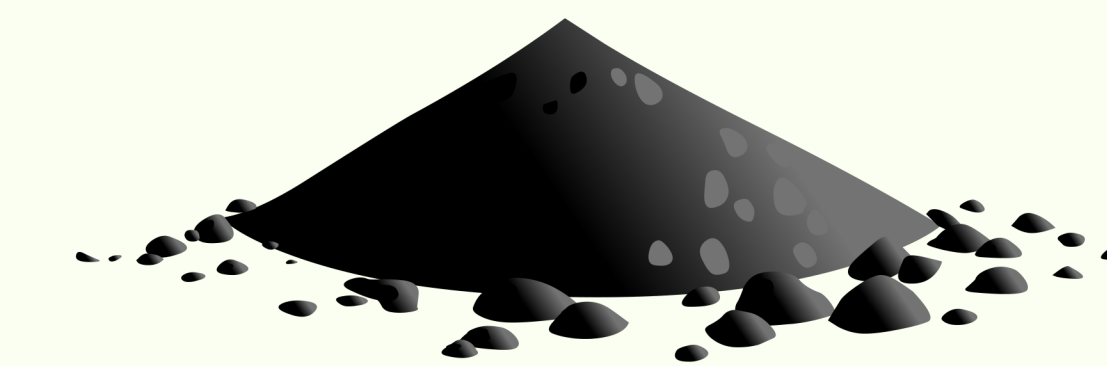
## 2 Transportation



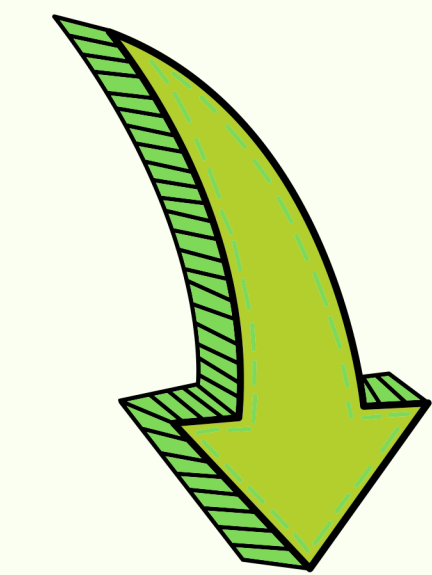
Bulk carrier ships transport the iron ore overseas and bulk carrier trains are used for land transportation. These bulk carriers will emit CO2 but once enough iron is mined, the cyclical process will occur without emissions.



## 3 Powder Production



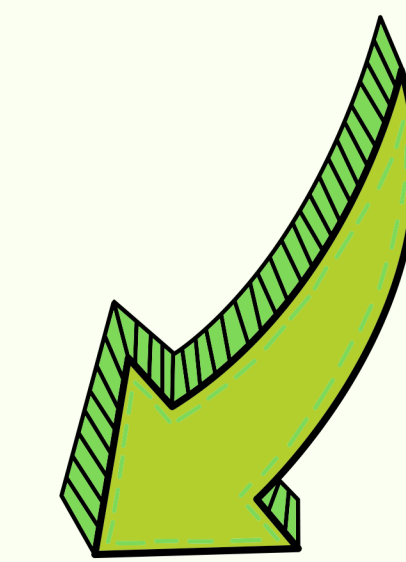
The iron powder will be manufactured through atomization. In this process, molten scrap metal is poured between jets of high-pressure fluid, usually water. The powder disintegrates and forms a fine solid powder. Induction furnaces will be used to melt the iron since they do not emit CO2 or any hazardous waste. This technology works by alternating a current through a metal chamber. The magnetic flux produces Eddy currents, thereby converting energy from electricity into heat.



## 4 Combustion in Heat Cycle



The heat from combustion will fuel a Brayton-Rankine combined heat cycle, which has a proven efficiency of 63%, and generate electricity to power the batteries. Realistically, NOx emissions could be a product of iron powder combustion as a result of iron impurities but can be mitigated using existing denitrification technology.



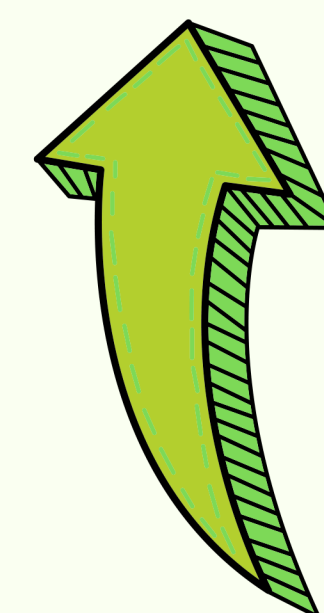
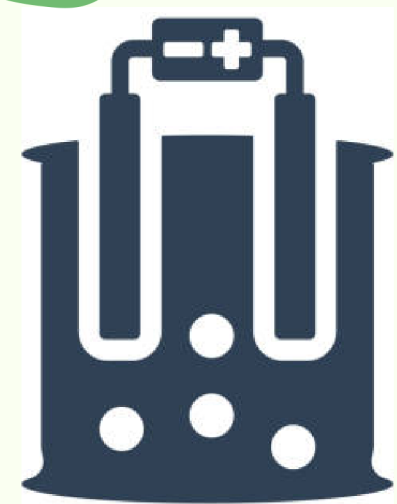
## 5 Charging Batteries

The energy produced from the heat cycle is then used to charge lithium-sulfur batteries. Lithium-sulfur batteries have a 10-year life span and can withstand extreme hot and cold temperatures. The elements combined nearly quadruple the energy output of a typical battery. The initial development of batteries will lead to small amounts of CO2 output, but once purchased they will be viable for many flights.



## 6 Recycling via Electrolysis

The iron oxide byproduct of the combustion reaction will be recycled back into iron via electrolysis, which will utilize excess energy produced by renewable energy sources to drive the non-spontaneous, reverse reaction. The resulting oxygen gas will be released into the atmosphere, while the iron will be returned to the cycle.



## 6 Airport Implementation

Each airport will have a nearby combustion site where batteries will be charged. Electric trucks will be used to transport batteries to and from the airports. All airports will be equipped with several additional batteries to prevent travel delays. There will be no emissions associated with this step due to the use of clean technology.



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