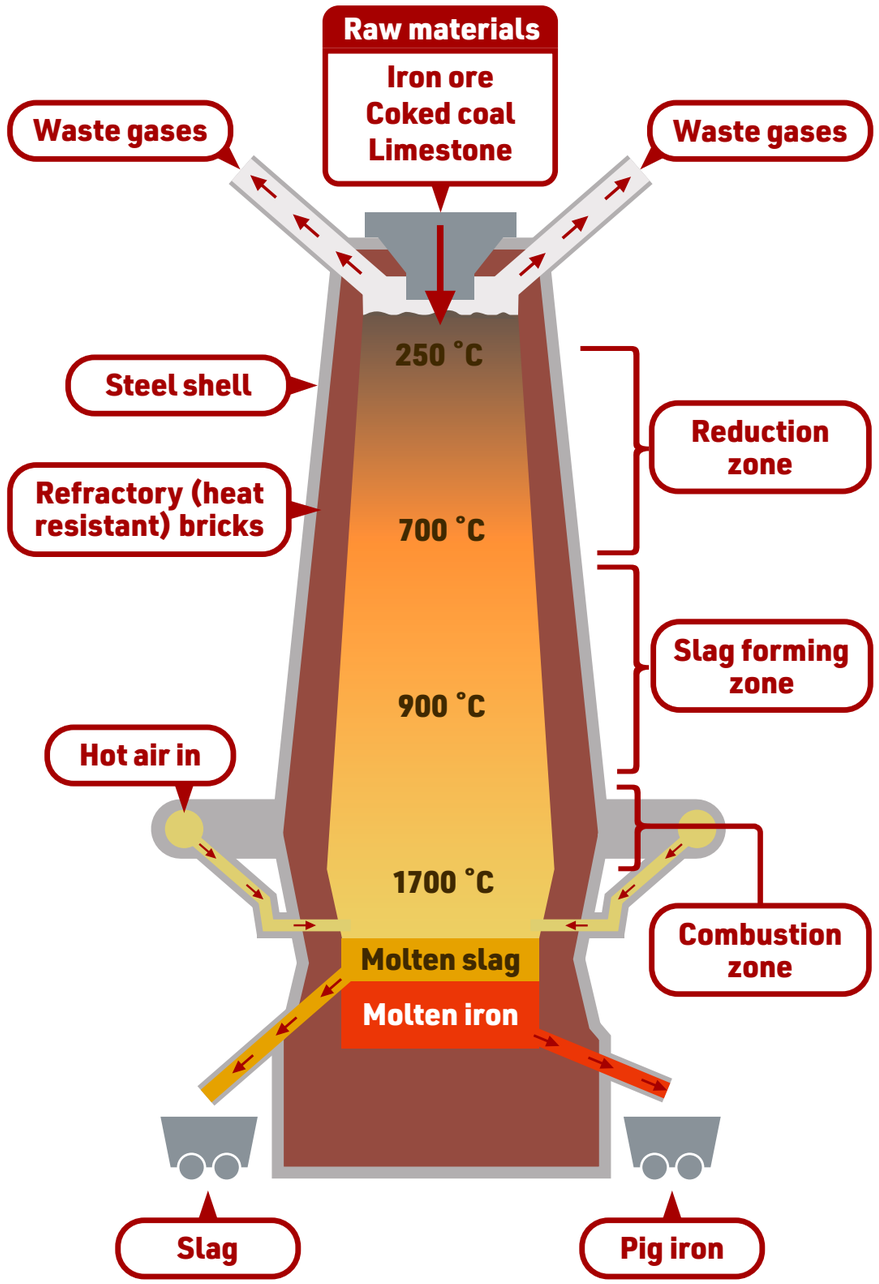
How is iron produced in blast furnaces?

compound interest

The blast furnace: An overview



Blast furnace reactions

Blast furnaces require a steady supply of iron ore and coked coal to keep running.

Coked coal (coal heated without oxygen to remove impurities) reacts with oxygen in the **combustion zone**, making carbon dioxide and carbon monoxide.

$C(s) + O_2(g) \longrightarrow CO_2(g)$ — Carbon dioxide

$C(s) + CO_2(g) \longrightarrow 2\ CO(g)$ — Carbon monoxide

Carbon monoxide reduces iron oxide (Fe_2O_3) to iron (Fe) through reactions in the **reduction zone**. The molten iron collects at the base of the blast furnace.

$3\ Fe_2O_3(s) + CO(g) \longrightarrow 2\ Fe_3O_4(s) + CO_2(g)$

$Fe_3O_4(s) + CO(g) \longrightarrow 3\ FeO(s) + CO_2(g)$

$FeO(s) + CO(g) \longrightarrow \mathbf{Fe(s)} + CO_2(g)$

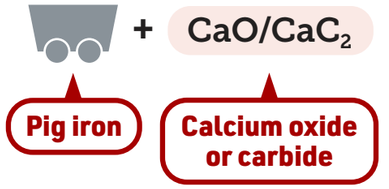
Limestone removes silica impurities. It decomposes to calcium oxide (CaO) which reacts in the **slag forming zone** to form calcium silicate (slag, $CaSiO_3$). This forms a layer on the molten iron.

$CaCO_3(s) \longrightarrow CaO\ (s) + CO_2(g)$

$CaO(s) + SiO_2(s/l) \longrightarrow CaSiO_3(s/l)$ — Slag

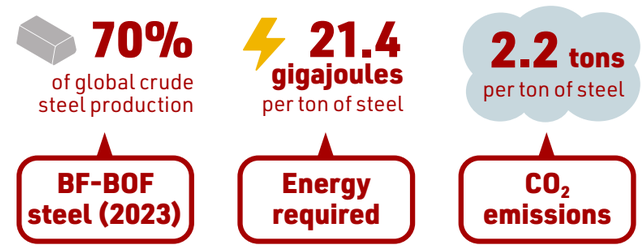
From iron to steel

The pig iron produced in the blast furnace is brittle due to impurities and high carbon content. To turn it into usable steel it has to be refined.



The future of blast furnaces

The blast furnace and basic oxygen furnace (BF-BOF) process requires large amounts of energy and emits significant quantities of carbon dioxide.



Alternatively, electric arc furnaces pass electricity through graphite electrodes to melt metal. These furnaces use less energy, can use scrap steel as a raw material, and have lower associated emissions.