

Metso Outotec Direct Reduction technologies are based on almost 50 years' experience of delivering solutions for customers in the ferrous direct reduction sector, encompassing the full range of plant types. Our innovative technologies, developed through our world-class R&D capabilities, enable sustainable energy use, the use of lower-grade ores, and the minimization of lifetime operating costs and emissions.

- High value addition through direct use of ore fines
- Sustainable, energy-efficient production with minimized atmospheric emissions
- Optimal performance and ROI ensured with our lifecycle services

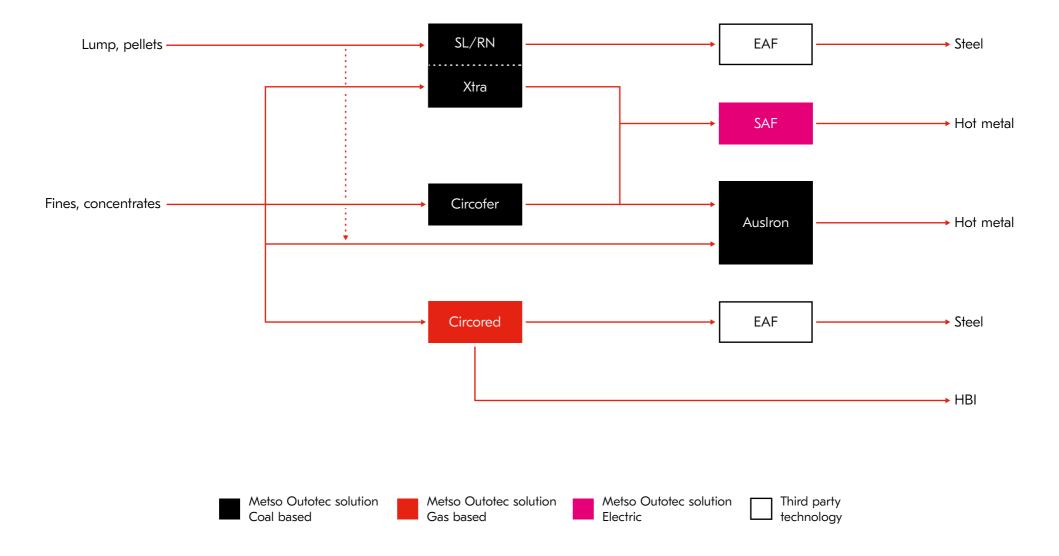
A history of innovation in direct reduction technologies

Metso Outotec Direct Reduction technologies include solutions for the full range of plant types, and have been developed through extensive research and testing with a wide range of raw materials and process parameters. Our innovations focus on improving plant performance, reliability, and sustainability, while reducing capital investment and lifetime operating costs.

Our research facilities include a dedicated competence center for direct reduction in Germany. At this facility we have the capabilities to perform in-depth testing programs with customer raw materials to optimize the direct reduction process, including laboratory and pilot plant programs.

Our direct reduction offering covers:

- Design, engineering, delivery, and services for traditional SL/RN direct reduction plants based on a rotary kiln, with non-coking coal as the reductant and fuel.
- Design, engineering, delivery, and services for SL/RN-Xtra plants, which use a combination of a pre-hardening grate and traditional SL/RN kiln for the treatment of iron ore fines.
- Hydrogen-based Circored fine ore reduction plants with both circulating (CFB) and bubbling (BFB) fluidized bed reactors.
- Services for our shaft-furnace direct reduction plants built by Metso Outotec based on a Midrex[®] license.



Reliable and flexible solutions for SL/RN plants

In the SL/RN process, iron ore, coal, and a desulfurizing agent — dolomite or limestone — are charged into the rotary kiln and heated by a countercurrent gas flow and the partial combustion of volatiles, with carbon monoxide being released from the charge.

Our numerous technical developments have enabled continuous improvement in the reliability, flexibility, and environmental performance of the SL/RN process since it was first introduced in the 1960s. These include:

- The capability to operate with a wide range of ironbearing materials, including pellets, lump ore, beach sand, and ilmenite.
- The capability to use an extensive range of reductants, such as sub-bituminous coals and lignites, bituminous coals, and in some cases anthracite and coke breeze.
- Significant improvements in thermal efficiency enabled by waste heat recovery systems combined with the generation of power for export
- Reduced environmental impact through improved emissions control.
- The possibility to implement multiple-line installations for scaling up plant capacity while optimizing material flow.

Treat fine-grained ores and improve kiln throughput with SL/RN-Xtra

The standard SL/RN process has been used for over 40 years to produce direct reduced iron (DRI) from lump ores or iron ore pellets. However, with the decreasing availability of lump ores the ability to process fine-grained ores and concentrates is becoming increasingly important. The SL/RN process cannot be used to treat iron ore concentrates consisting of finely ground particles with a grain size of less than 0.1 mm as they form accretions within the kiln when metallized at temperatures above 1000°C.

To address this challenge, we developed the SL/RN-Xtra process for producing DRI for steelmaking directly from concentrates. By integrating pelletizing and direct reduction in a single-plant setup, this process can improve kiln throughput by up to 30 percent.

Avoid costly agglomeration with Circored and Circofer

The development of our fluidized bed based fine ore reduction processes was driven by the growing demand for processes that can avoid costly agglomeration altogether and make direct use of iron ore fines. Fluidized bed technology is ideally suited to energy-intensive processes like direct reduction because it enables high heat and mass transfer rates.

We have developed two fluidized bed based direct reduction processes for iron ore fines: the hydrogen-based Circored process and the coal-based Circofer process. Circored has a two-stage configuration that combines a circulating fluidized bed with a bubbling fluidized bed to achieve high metallization (90–95%), whereas Circofer has a single-stage configuration that can achieve prereduction up to a metallization of about 70%.

For both Circored and Circofer processes, capacities above 1 million t/a are possible in a single production strand, resulting in improved economies of scale.

Unique raw-material flexibility with Auslron

Based on the proven top submerged lance (TSL) technology that is widely used in non-ferrous applications, Auslron is an iron ore smelting reduction process with unique raw material flexibility. It is suitable for treating low or high-grade lump ore and ore fines, and uses non-coking coals.

Because Austron can accept any type of ore fines, including concentrates, tailings from beneficiation, calcine residues, iron sands, and high-grade pellet fines, it eliminates costly agglomeration. Fine coal is used as the energy source, with no additional gas or oil required, while lump coal is used as the reductant.

The simple, pressure-less process feeds ore and coal by gravity and uses a TSL to provide the necessary energy through coal combustion. Austron is ideal for smaller hotmetal capacities of around 0.5 million t/a. The process can generate approximately 600–950 kWh of electric power for export per ton of hot metal.

A lifetime of support

Metso Outotec is committed to supporting your operations throughout the plant life cycle, helping you achieve and maintain peak performance levels and guaranteeing the best long-term return on your investment. Our global network of service centers covers more than 25 countries and provides lifecycle services for everything from spare parts, maintenance, and technical services to modernizations, operations and maintenance agreements, training, and consultancy.





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