

OBJECTIVES



Upgrading of low-quality iron ores by combining them with iron-rich by-products.



Development of innovative techniques to produce high-quality pre-material for decarbonised future.



Separation of disturbing components from by-products to replace scrap.



Development of the technological basis and digital tools supporting the transition towards zero waste in the European steel industry.

Research Partners



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 TransZeroWaste



Funded by the European Union

 **13**

SPECIALIZED PARTNERS

 **8**

EUROPEAN COUNTRIES

 **60**

SCIENTISTS & RESEARCHERS

HORIZON-CL4-2022-TWIN-TRANSITION-01 program under grant agreement No 101091960

Upgrading of low-quality iron ores and mill scale with low carbon technologies

Research for novel technological approaches

Project Start Date: December 2022 – ongoing
For the latest updates, visit: <https://transzerowaste.eu>





“ Circular economy is an economic system that uses a systemic approach to maintain a circular flow of resources, by recovering, retaining or adding to their value, while contributing to sustainable development (ISO 59020:2024) ”



REASON WHY

As raw materials, iron ore and scrap are forming the base of iron and steel production. Due to the transition from carbon-based to green steel production with hydrogen (H₂), most current production units such as sinter plant, blast furnace (BF) and basic oxygen furnace (BOF) will be replaced by the direct reduction process (DR process), followed by an electric arc furnace (EAF) for DRI-use. As a result, the current recycling routes for iron-containing by-products (e.g. mill scale, dust, sludge) will be cut off and the demand for high-quality direct reduction pellets and scrap will rise, becoming a critical factor. New by-products from the gas treatment of the DR process and iron pellets sieving will emerge.



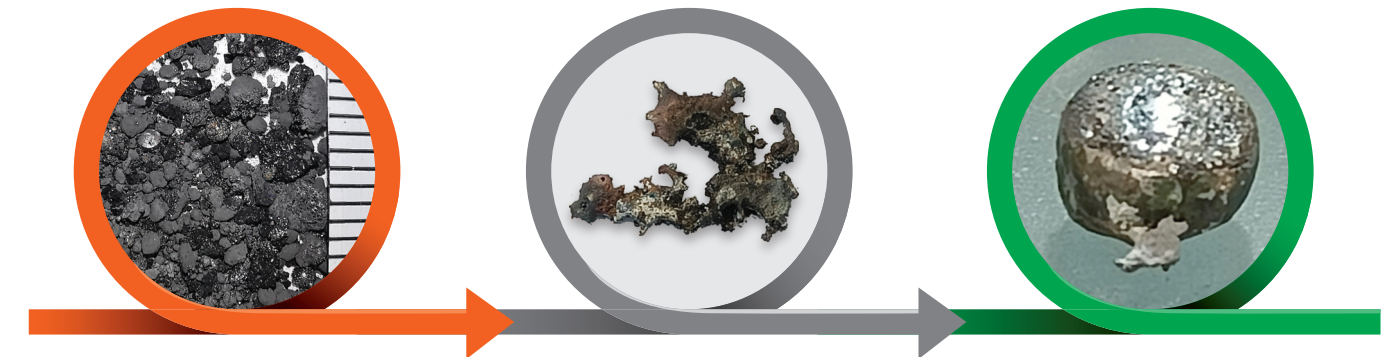
DESCRIPTION

The specific potential of the TransZeroWaste project is to develop new recycling technologies for iron-containing by-products, low-quality ore fines and those of new green steel production routes. These scrap-equivalent materials have a volume of up to 9 Mt/y in Europe and are currently recycled via CO₂ intensive BF-BOF route with sinter plants which provide separation of disturbing impurities. Since “green” steel process routes do not facilitate recycling or ensure adequate impurity separation, the following alternative technologies are developed to higher TRL in

TransZeroWaste to ensure sufficient supply of raw materials in iron and steel production, even in the case of increasing demands:

- ▶ **Hydrometallurgy de-oiling by-modified magnet separator and cleaning agent recovery**
- ▶ **Low CO₂ cold briquetting and pelletising**
- ▶ **Hot microwave pelletising with reduction potential**

So far, knowledge of requirements for the reuse of these materials in the DR, EAF and downstream processes, as well as of their mutual influencing factors is lacking or still at low TRL. TransZeroWaste further develops these technologies, including pilot plants at industrial partners sites. Those technologies will be supported by the development of a decision support platform providing circularity, environmental and economic indicators for higher sustainability performances.



EXPECTED IMPACT

The developed TransZeroWaste technologies aim for the upgrade and use of low-quality iron ore fines and iron-containing by-products, focusing on impurity separation and reduction, as well as enhancing the valorisation potential of these low-quality scrap equivalents while achieving a high recycling rate. Their further development will contribute to climate neutral and circular industrial value chains supporting transition towards low-CO₂ DR and EAF production routes, enhancing recycling potential to reduce the use of critical raw materials, and enabling the implementation of energy-efficient processes.

The development of a decision support platform modelling the sustainability performance of steel production pathways supports the understanding of the environmental, economic and circularity impact of the steel value chain. The project outcomes will thus aim to decrease the environmental footprint and support the resilience and competitiveness of the steel

sector in Europe. As the transition to low-CO₂ DR and EAF routes leads to the shutdown of carbon-intensive processes such as sinter plants, BF, and BOF - which currently support a high recycling rate - the recyclability and usability of low-grade ore and scrap will also be significantly reduced. Therefore, the TransZeroWaste technologies aim to provide solutions at TRL 4-6 to fill the gaps for recycling and upgrading for ore- and scrap-based green steel production. Considering sinter plant operation generating between 161 and 368 kg CO₂/t sinter (Best Available Techniques), the replacement of sinter plant with low-carbon technologies for the addressed 27 Mt/y raw materials could save between 4.3 and 9.9 Mt CO₂/y. The replacement by TransZeroWaste technologies could ensure the recycling and upgrading of iron-containing by-products and provide additional potential for low-CO₂ zinc recovery.