The metallurgical industry is one of the largest CO2-emitting industries. In order to reduce the CO2 footprint of the steel production process, Tata Steel developed HIsarna: a process that reduces the CO2 emission by 20%. The Works Arising Gases (WAGs) of the HIsarna have a high CO2 content, but also contain CO, H2O, metal particulates and sulfur-containing compounds. On top of that, the temperature of the HIsarna stream is very high (~1500°C)1. The CO2 footprint of the steelmaking process can be further reduced by valorizing these CO2-rich WAGs.

The goal of this project is to investigate two solid catalysts for a two-staged thermochemical CO2 hydrogenation reaction: CO2 will be converted into methane and subsequently into aromatics via the methane dehydroaromatization (MDA) reaction, as shown in Figure 1. An autothermal reactor will be designed to take advantage of the high temperature of the HIsarna WAGs to drive the strongly endothermic MDA reaction (CH4 to aromatics).

One of the main challenges of this project is to find stable catalysts that are resistant to the poisons present in the HIsarna stream. CO2 methanation over nickel-supported catalysts has been extensively studied due to their excellent catalytic performance and low cost2. On the other hand, Mo supported on ZSM-5 is the catalyst of choice for the MDA reaction3. However, the HIsarna waste stream contains components that act as poisons for these catalysts and can severely affect the performance. Not only metal particulates and sulfur-containing compounds can poison the catalysts, but also the high amount of steam present will form an issue for the zeolite-based catalyst for the conversion of methane into aromatics. Therefore, the effect of these poisons on the catalysts will be studied with techniques such as XRD, XAS, and *operando* UV-Vis spectroscopy which will eventually lead to the valorisation of waste streams in the steel industry.