Federal Ministry of Education and Research

An Initiative of the Federal Ministry of Education and Research
CLIENT II
International Partnerships for Sustainable Innovations

$CoalCO_2$-X – Converting CO_2 using green ammonia in South Africa

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Hard-to-decarbonise branches of the industry in South Africa not only emit vast quantities of CO_2 but harmful nitrogen oxide (NO_x), sulphur oxide (SO_x) and particulate matter as well. In order that coal can be used in as environmentally friendly a manner as possible, until such a time as we have fully converted to renewable energies, the $CoalCO_2$-X™ programme aims to make flue gas components usable in the recycling-oriented manufacture of fertilisers and chemicals. Green ammonia plays a key role in this respect; Fraunhofer IGB demonstrates its synthesis within the project.

Challenges in South Africa

As a signatory of COP21, the Paris Agreement on climate change, South Africa has committed to reducing its CO_2 greenhouse gas emissions. As such, the South African Ministry of Natural Resources and Energy announced the development of renewable energies and the shutdown of numerous fossil fuel power plants in its Integrated Resource Plan 2019. In order to cover the high energy demand, a number of hard-coal-fired power plants will continue to play a role in the supply of energy even after 2030. The hard-coal-fired plants used to generate power and manufacture cement and paper emit large quantities of greenhouse gas CO_2, while simultaneously releasing harmful nitrogen oxide (NO_x), sulphur oxide (SO_x) and particulate matter. The intensification of agriculture over the last two decades has driven up demand for fertilisers. With domestic production lagging behind on account of an outdated infrastructure, South Africa currently imports more than 60 percent of its required nitrogen fertiliser.

With the $CoalCO_2$-X™ programme South Africa hopes to reduce the environmental footprint of sectors in which the reduction of emissions has proven difficult. The programme aims to make use of the problematic components of exhaust gas from carbon combustion as a raw material for the recycling-oriented and value-creating manufacture of products, thereby cleaning the exhaust gas. Doing so requires green ammonia, which has thus assumed a key role in the decarbonisation of the (agro)chemicals and energy industry.

Harnessing flue gas – with green ammonia

Funded by the DSI and coordinated by EPCM Global Engineering, the South African sub-project pursues the objective of demonstrating the capture of CO_2, NO_x, SO_x and particulate matter from flue gas at a production site operated by a large-scale cement manufacturer, at a rate of 300 m^3/h. The captured gases are converted into synthetic diesel fuel and various chemical precursors: ammonium bicarbonate, potassium carbonate, nitric acid and sulphuric acid. Omnia is developing a formulation which will use the extracted inorganic salts to produce marketable fertilisers. On the German side, the BMBF is funding a $CoalCO_2$-X™ sub-project coordinated by Fraunhofer IGB. The focus here is on a pilot project to test the synthesis of green ammonia using the Haber-Bosch process, at a rate of 1 kg/h. The required green hydrogen is generated via electrolysis in the plants operated by HySA (Hydrogen South Africa). Besides developing the technology and optimising the process for intermittent operation, the project team will conduct an economic assessment to support the scaling of ammonia synthesis.

Ammonia is processed with the sulphuric acid extracted from flue gas to produce ammonium sulphate, a marketable base chemical and valuable fertiliser. Green hydrogen and green ammonia thus represent important links between the technologies developed within the scope of the programme.

Pilot plant for combined exhaust gas treatment, carbon capture, storage and conversion.

Contribution to sustanaible goals

The project addresses technological developments (SDG 9 Industry, Innovation and Infrastructure), with a view to achieving circular and sustainable processes (SDG 12 Responsible Consumption and Production). An intercontinental, German-South African partnership has made cooperation within the project possible on a political, academic and technical level (SDG 17 Partnerships for the Goals). It contributes to achieving further SDGs in the medium to long term.

Screening station for testing the synthesis of green ammonia.

Funding initiative
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Project title
$CoalCO_2$-X – Converting CO2 from hard-coal fired power plants using green ammonia in South Africa

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