NET-ZERO INDUSTRIES
MISSION

Project Title	**CCUpScale** CO2 to value: Mineral Carbonation CCU upscaling & product validation
Industry Partner	RHI Magnesita
Industry Sector	Iron & Steel Cement & Lime Chemicals & Refining Other Energy Intensive & Hard to Abate sectors (Refractories)
Technology Pathway (Primary)	CCUS
NIM Pillar	Technology Demonstration
Source	NIM Awards 2024
Description	The CCUpScale project as a cooperation between RHI Magnesita and MCi Carbon and aims to convert CO2 emissions into saleable, alternative materials for use in construction and industry by reacting CO2 at near ambient pressure and temperature with abundant mineral feedstocks. It will advance mineral carbonation from technology readiness level (TRL 7) towards an investment decision in a 50,000 tpaCO2 commercial pilot plant (TRL 8) and encompasses: 1. a demonstration campaign at the 1000 tpa scale in Australia to generate scale-up data and bulk product samples, utilising Austrian mineral feedstocks 2. collaboration between engineers from both countries to translate demonstration results into a fully costed engineering design supported with optimization based site design and parameter studies for a first-of-a-kind commercial pilot plant integrated with a hard-to-abate industrial site 3. product development and bulk trials to demonstrate the commercial potential of mineral carbonation products for construction and industrial use 4. knowledge sharing of project outcomes to promote global uptake of the technology. In the proprietary process, minerals are crushed, milled and thermally treated to enhance their reactivity with flue gas CO2 to produce Precipitated Magnesium Carbonate and Amorphous Silica products. MCi's technology captures and processes CO2 directly from flue gases with no chemical usage, eliminating the need for a separate capture technology. We expect to deliver a NET CO2 reduction of 85-95% of CO2 per plant, depending on localised conditions. These features make MCi´s technology well suited to abating emissions from hard-to-abate industries including steel, cement, lime, chemicals and refractories, with materials produced from MCi´s process having the potential to partially displace conventional high embodied materials in construction products like concrete, further reducing emissions in that industry.
Innovations Employed	The CCUpScale project aims to tackle the challenge of reducing substantial geogenic CO2 emissions by leveraging MCi's unique technology, which captures and processes CO2 directly from flue gases, eliminating the need for a separate capture technology. In MCi's proprietary process, minerals (e.g. serpentinite) are crushed, milled and thermally treated to enhance their reactivity with flue gas CO2 to produce Precipitated

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	Magnesium Carbonate and Amorphous Silica products. Including all energy associated with MCi's feedstock, processing and material transport, it is expected to a net reduction of approximately 85-95% of CO2 per plant, depending on local conditions. On top of that materials produced from MCI's process have the potential to partially displace conventional high embodied materials in construction products like concrete, further reducing emissions in that industry.
Dimension of Novelty	It was new to the International Market
Innovation Collaboration	External Partners: MCi Carbon Pty Ltd
Intellectual Properties	Patent family: 76525790 (US202137233 AA) Patent family: 76525786 (US2021069641 AA)
IP Links	
Timetable & Progress	Development started: 2015 Already running: MCi Pilot - 20tpa CO2 captured = TRL 6 Start of Operation Q1/ 2025: MCi Demonstration plant (Myrtle) - 1000tpa CO2 captured = TRL 7 2028: Commercial pilot in Austria - 50k tpa CO2 captured = TRL 8
Financing (Public/ Private)	Australian Federal Government, DISR, NSW Government
Finance Links	
Project Phase TRL	TRL 7
Problems to be Solved and Risks to be Managed	Apart from general process parameter settings, the most suitable feedstock for an efficient carbonation process had to be found in an abundant quantity. The sampling, analysis of different materials and shipping thereof from Austria to the pilot facility in Australia posed several hurdles that were eagerly addressed by the engaged experts in both countries. The sample size and quantity of the outcoming products of the carbonation process was small with respect to the specification needs of the different potential market applications. Each scale-up step of the technology (20 tpa pilot -> 1000 tpa demo plant -> 50k tpa commercial pilot) poses new challenges in each process step but will improve its overall efficiency. Therefore, the ongoing project is so important to serve as a model for similar facilities globally, enhancing the sustainability of industrial hard-to-abate processes.
Preliminary or Final Results Achieved	The demo plant in Newcastle Australia, bringing the technology from TRL 6 to 7, is going in operation in Q1/2025. It involves a comprehensive campaign at the Australian demonstration plant, focusing on the production of carbon-embodied materials using Austrian serpentinite. The goal is to produce hundreds of tonnes of precipitated magnesium carbonate and amorphous silica for various industrial applications.

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	The process includes rigorous sampling and analysis to optimize plant operations and ensure the materials meet specific requirements. The campaign covers all operational phases from start-up to shutdown with a commitment to producing at least 200 tonnes of the specified products. This initiative is crucial for material development trials and the assessment of serpentinite's efficacy in MCi's production process.
CO2 Emissions Reduction Potential - Implementation and Future Market	Starting with 50k tpa CO2 captured in Austria, Mineral carbonation has the potential to abate 10s of millions of tonnes per year of CO2 in a first stage and Gt/year globally. Apart from technology upscaling and validation of mineral carbonation products, the project will play a key role in reducing both the technical and commercial risk of adopting mineral carbonation CCU technology. The production of valuable products from the mineral carbonation process provides the opportunity to achieve low cost or profitable decarbonisation outcomes. Alongside the delivered technical and commercial risk reduction, the outcomes of the project will encourage future private sector investment further assisting in deployment of the technology to meet Paris goals. Lastly modernizing legacy systems, the industry can expect not only enhanced efficiency but also aim to replace material with a higher CO2 footprint by products from the mineralization process.
Market Positioning	
Project Location	Austria / Australia
Project & Technology Links	RHI Magnesita