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ABSTRACT
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# Carbfix - $CO_2$ mineral storage in basaltic rocks

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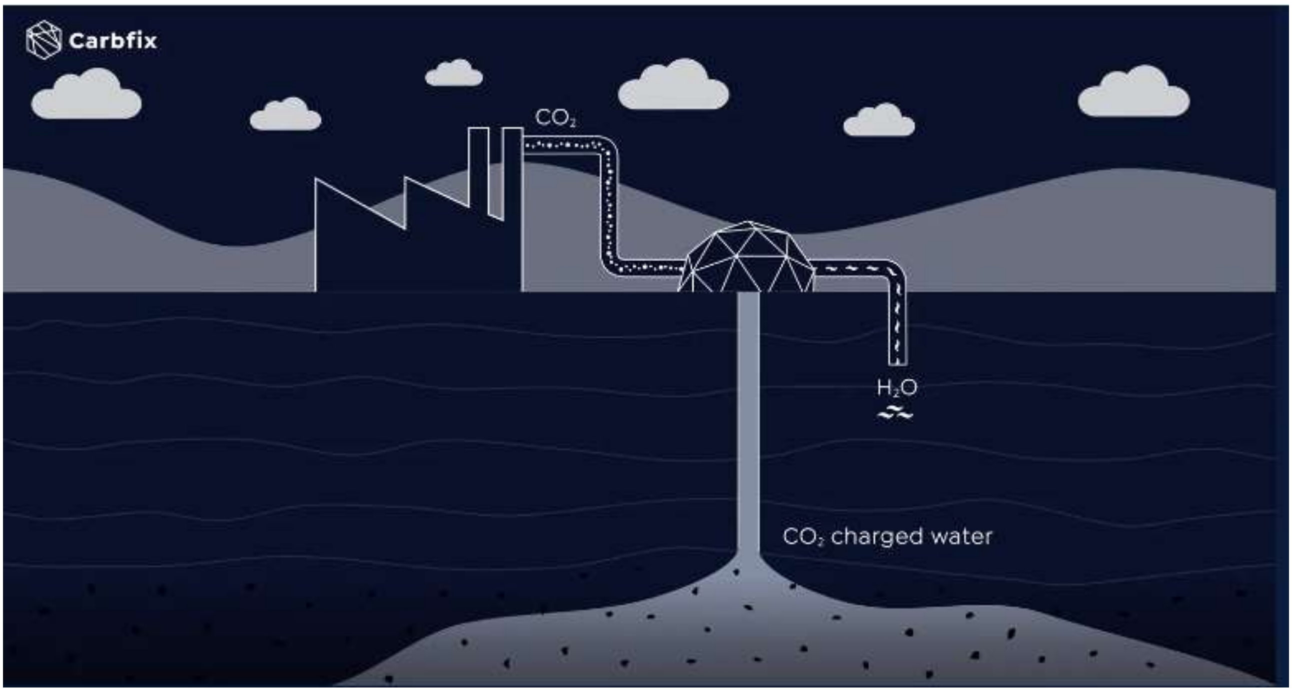
Substantial and sustained reduction of anthropogenic $CO_2$ emissions to the atmosphere are needed to achieve the goals of the Paris agreement and constrain the current rapid warming to 1,5-2°C. Carbon capture and storage (CCS) solutions play an important role in the transition towards carbon neutrality. CCS includes a range of processes for $CO_2$ capture, separation, transport, storage, and monitoring, and is considered the key technology for reducing emissions from fossil fuel power plants while these are still part of the energy systems, limiting emissions from many industrial processes such as steel, aluminium and cement production, and to deliver "negative emissions" by removing and permanently storing $CO_2$ captured directly from air by the second half of the century.


*What we do*

Despite the urgent need for rapid deployment of widespread carbon storage sites, experience demonstrates that low public acceptance, high upfront investment costs and uncertain future liabilities have hindered the implementation of conventional carbon storage methods in Europe. The success of $CO_2$ storage depends on its long-term security. Injection of $CO_2$ into young basaltic formations provides significant advantages, including great storage potential, and permanent storage by mineralization by combining the injected $CO_2$ with metals contained in the basalts to form stable carbonate minerals.

Mineral carbonation is a part of the natural carbon cycle, where the carbon moves from one terrestrial reservoir to another. Within the natural cycle, carbon has few years average residence time in the atmosphere, decades in vegetation, decades to tens of thousands of years in soils and in the oceans, and thousands to millions of years in rocks, which is by far largest carbon reservoir on Earth. Mineral carbon storage, however, will only be practical if it is possible to accelerate this process at large enough scales to address the current global challenge. Within this approach the captured carbon is stored via injection into reactive rocks such as mafic or ultra-mafic rocks for rapid mineralisation. Mineral carbonation can be promoted by the dissolution of CO2 into water before or during its injection. No cap rock is required when injecting water charged CO2, as it is denser than CO2-free water. As such it does not have the tendency to migrate back to the surface. By dissolving CO2 into water before or during its injection, solubility trapping is achieved immediately, and the bulk of the carbon is trapped in carbonate minerals within two years of injection at 20-50°C. By provoking the mineralisation of the injected CO2 into carbonate minerals such as calcite (CaCO3), dolomite (CaMg(CO3)2) or magnesite (MgCO3) via its injection into reactive host-rocks, the injected carbon is permanently fixed and there is a negligible risk of it returning to the atmosphere.

Mineral CO2 storage offers a vast storage potential and unlocks large regions in the world where CCS has until now not been considered possible. The largest potential lies offshore within the sub-marine basaltic crust, but suitable formations are also widespread onshore, including volcanic formations, mine tailings and unconventional petroleum reservoirs.




*How we do it*

Carbfix has since 2014 injected over 90,000 tonnes of CO2 from the Hellisheidi geothermal plant in SW-Iceland into the basaltic reservoir for mineral CO2 storage. Emphasis is currently being placed on making this technology more cost effective and exploring its limits in terms of potential sites and injection methods, including injection of CO2 captured directly from the atmosphere.