

# MAGNEX and PILCCU in Finland: deployment of CO<sub>2</sub> mineralisation in circular economies

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**Abstract.** Two ongoing projects in Finland, MAGNEX (*Viable magnesium ecosystem: exploiting Mg from magnesium silicates with carbon capture and utilization*) and PILCCU (*Piloting of ÅÅ CCU*) aim at using CO<sub>2</sub> mineralisation technology for the overlapping purposes of large-scale CO<sub>2</sub> emissions mitigation and bringing several valuable material streams into circular economies, including construction. Of central importance are magnesium-based materials, such as magnesium carbonate hydrate (MCH), besides (amorphous) silica and several metallic species. On top of revenues from these, CO<sub>2</sub> emissions mitigation lowers the financial penalty from CO<sub>2</sub> emission rights under for example the European ETS.

The ÅÅ process routes are stepwise processes based on extraction of magnesium (and other species) from serpentinite-containing mining tailings from Finland, followed by precipitation of metallic species, carbonation using a CO<sub>2</sub> containing gas-stream (no separate capture step needed) and recovery of solvent salt, respectively. Several separation steps involve (ion-selective) membrane electrodialysis. Besides ongoing mapping and characterisation of Finnish rock resources as tailings or other side-streams at metal and mineral mines in Finland, the projects address public acceptance, legislation and other non-technical issues related to large-scale roll-out of this type of CCU technology.

For the use of the solids, magnesium-based cement binders and plaster-like recipes are investigated as well as applications for the (amorphous) silica and other residues, including the use of MCH for cyclic thermal energy storage (TES). Special focus is on accelerating the carbonation step and the final outcome of MCH production, considering pressure (including supercritical CO<sub>2</sub> levels), and the role of recoverable catalysts and other additives.

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**Keywords:** CO<sub>2</sub> mineralisation, Finland, technology deployment, circular economies, public acceptance, rock resources, process chemistry.

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