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A Synthetic Approach to bioconversion of carbon dioxide to formic acid

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The reduction of gaseous industrial waste in the form of carbon dioxide is a shared goal of almost all civilised countries. One possible solution, to add to a basket of many, is to harness our knowledge of biology and chemistry to re-cycle waste CO₂ into useful chemicals. Our approach to this is to target a biochemical reaction that happens in some bacterial cells and is catalysed by a complicated metal-containing enzyme called formate hydrogenlyase (FHL). This enzyme usually converts formic acid (as simple one-carbon compound) into CO₂ and hydrogen gas. The aim of this proof-of-concept project was to find optimum conditions where this could run 'backwards' and so reduce gaseous CO₂ to liquid formic acid using H₂. Collaborations between mathematicians, biologists and industrial chemists were able to both predict and then demonstrate that this was indeed possible and were able to show more than 70% efficiency in conversion under test conditions. It may prove possible on the future to use biological system to further modify the formic acid into other useful chemicals.