Materials for Flexible Chemical Synthesis in Integrated Carbon Dioxide (CO_2) Capture and Conversion

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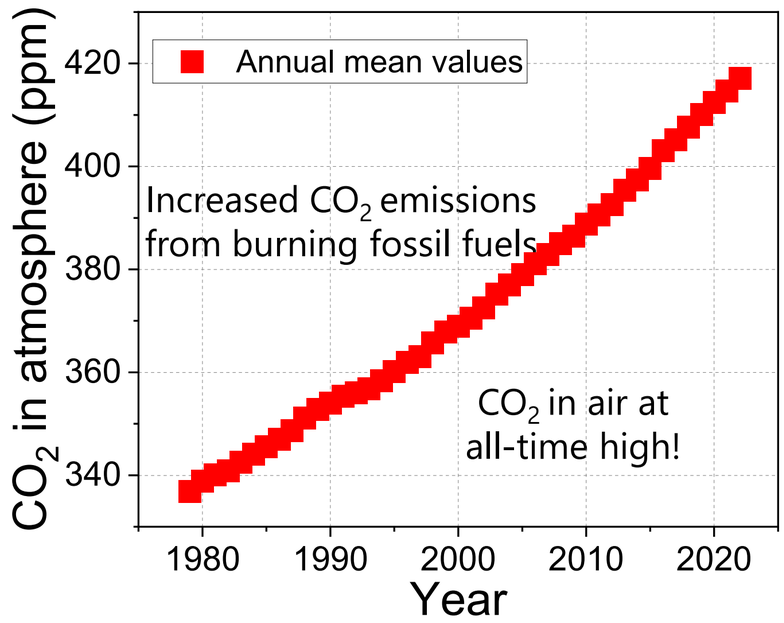
STEM for BRITAIN

THE PROBLEM

36.8 Gt (gigatonnes) of CO_2 in 2022

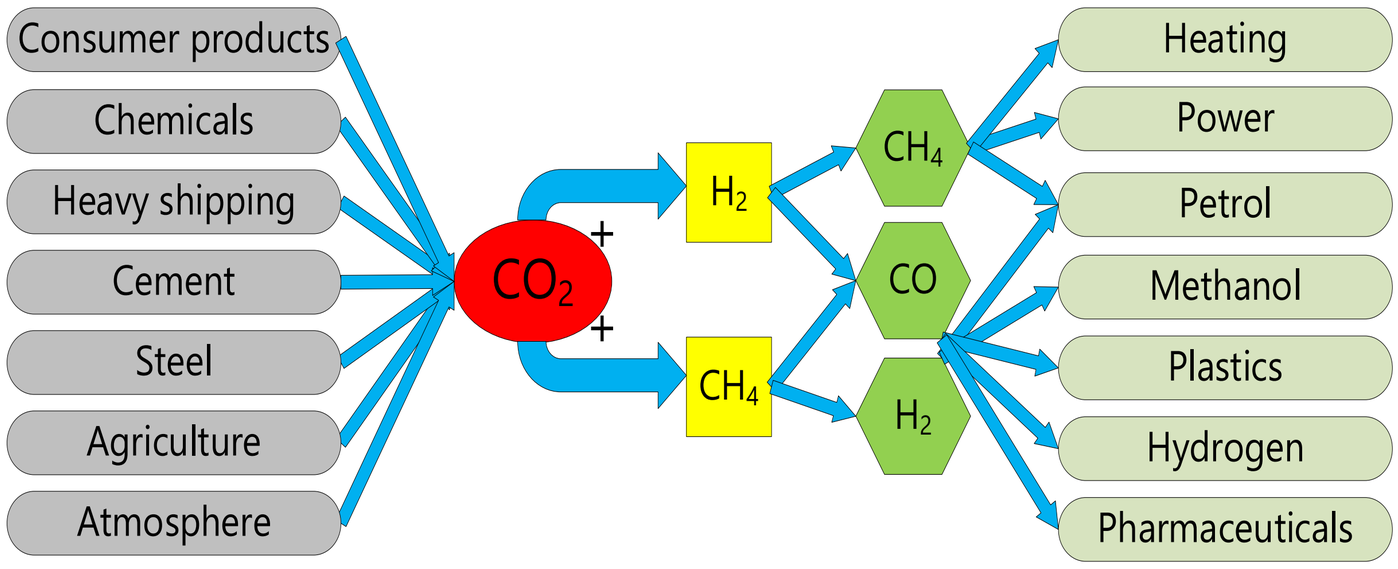


Captured CO_2 costs £40-140 per tonne - **very expensive**

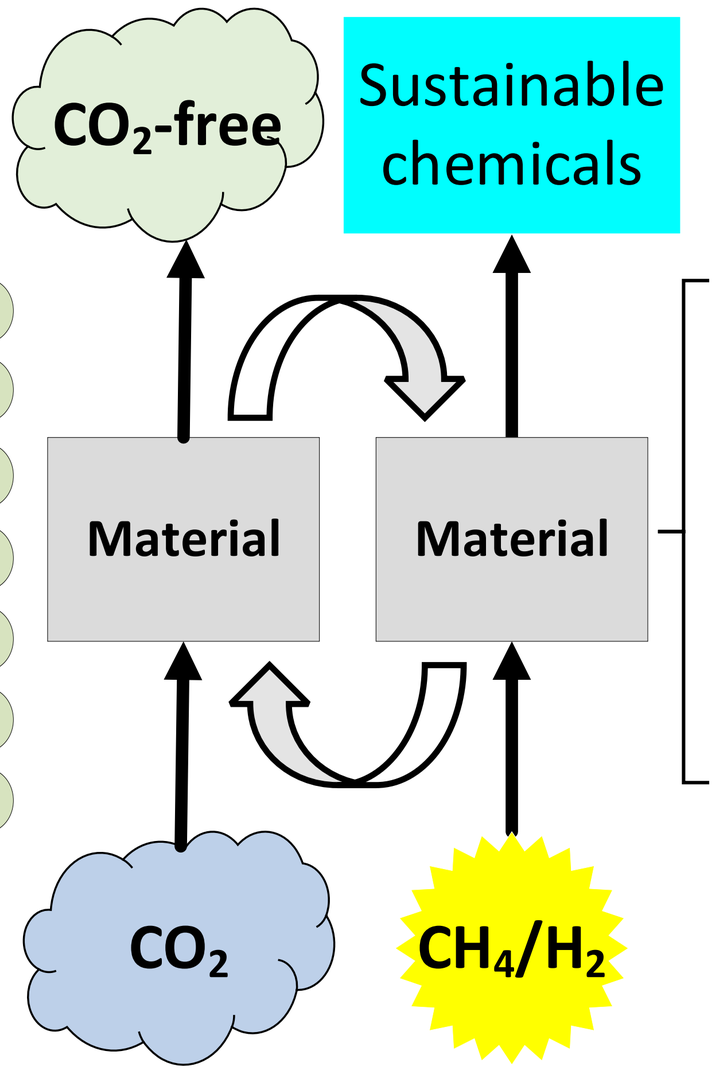
We need to find a way to produce chemicals **independent of fossil fuels** that can work **anywhere in the world**!

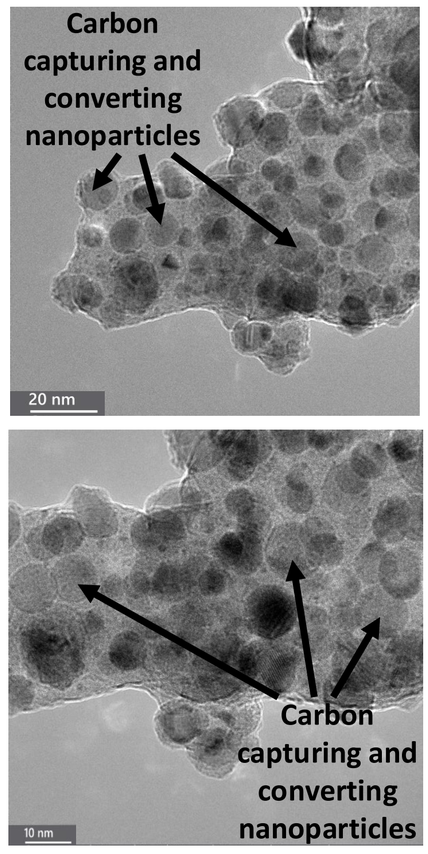
THE SOLUTION

✓ **Integrating** the CO_2 capture with the utilisation step, and designing the process to be **flexible**
✓ Producing **on-demand chemicals,** using **CO_2 as a carbon source** to turn vice into **virtue**

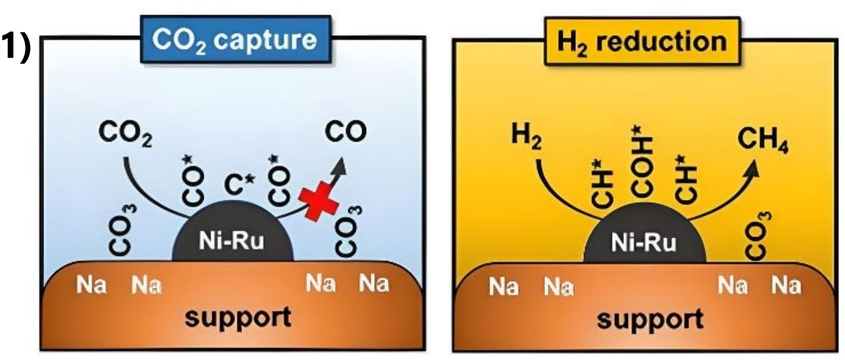


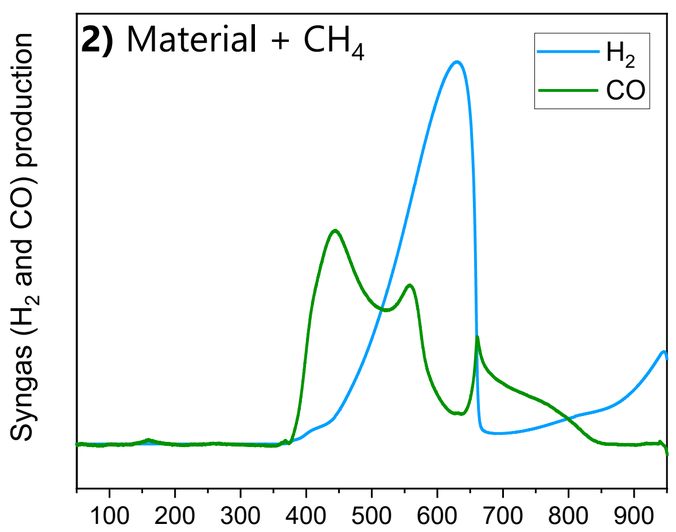
Our **switchable dual-function materials** capture CO_2 and convert it directly into a product, using hydrogen or hydrocarbons in a cyclic operation.

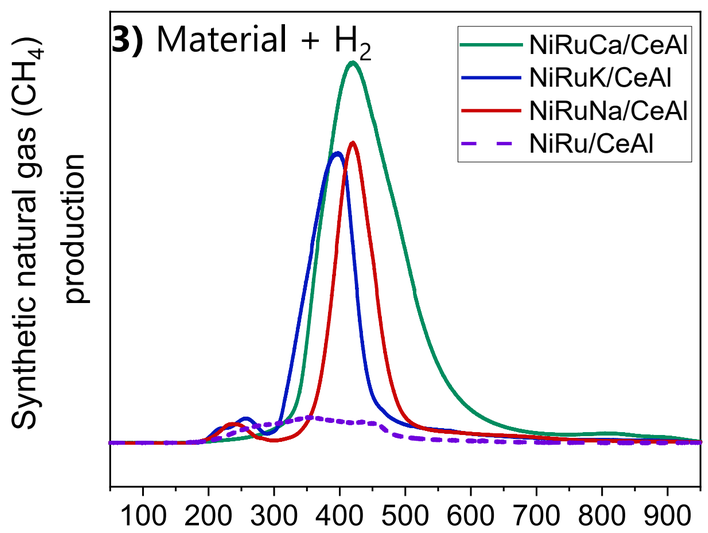




THE RESULTS







1) By using spectroscopic techniques, we discovered the reaction mechanism of the materials studied in this work.

2) Our materials captured CO_2 directly from the air and converted it into a mixture of carbon monoxide (CO) and hydrogen (H_2), called syngas.

3) Our materials captured CO_2 directly from the air and converted it into synthetic natural gas (CH_4).

TAKE-HOME MESSAGE

We have designed and patented a material which produces most of the chemicals that our society needs out of every possible source, ranging from thin air to the majority of the heavy emitters, like cement and steel.

References
[1] Merkouri, L.P.; le Sache, E.; Pastor-Perez, L.; Duyar, M.S.; Reina, T.R. Fuel 2022, 315, 123097
[2] Merkouri, L.P.; Reina, T.R; Duyar, M.S. Nanoscale 2022, 14, 12620-12637.
[3] Merkouri, L.P.; Reina, T.R; Duyar, M.S. Energy and Fuels 2021, 35, 19859-19880.
[4] Merkouri, L.P.; Paksoy, A.I; Reina, T.R; Duyar, M.S. ACS Catalysis 2023, 13, 7230-7242.
[4] Merkouri, L.P.; et. al. Journal of Materials Chemistry A 2023, 11, 13209-13216.

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