THE UNIVERSITY OF SYDNEY

Net Zero Initiative
Greenhouse Gas Conversion and Utilisation

Our vision and mission

In many industries carbon dioxide (CO_2) is a valuable commodity and essential to maintaining a robust supply chain. Examples include pH control in water treatment, protected cropping and microalgae cultivation for food production, as well as and Modified Atmosphere Packaging (MAP) to extend food shelf-life. Unfortunately, much of the current supply derives from non-renewable fossil fuels.

Our vision is to enable the capture of greenhouse gases (GHG) and their subsequent conversion to industrially useful products to realise a valuable economic opportunity that could accelerate the transition to a net-zero economy and a more sustainable future.

Our approach

Our goal is to improve global sustainability by developing new technologies that capture GHG – including CO_2, methane (CH_4) and nitric oxides (NO_x) – and convert them into valuable fuels and chemicals.

We are also performing economic analyses to assess the feasibility of these technologies and facilitate their adoption by industry.

Our research

A key Enabling Research Theme of the Net Zero Initiative (NZI) is 'Carbon Removal', which is dedicated to finding better methods and incentives for GHG capture and storage. Under the pillar 'Greenhouse Gas Conversion and Utilisation', our researchers are:

- Developing highly-efficient technologies for selective conversion of CO_2 into valuable chemicals such as methanol and ethanol.
- Fabricating affordable, durable materials for capturing and converting both CO_2 and CH_4 into hydrogen and valuable chemicals.
- Exploring sustainable low-emission methods to produce fertiliser from GHG.
- Maximising carbon credits and economics for GHG reduction processes.

Our achievements to date include:

- Economically feasible direct CO_2 capture and conversion to fuels and chemicals;
- Selective conversion of CO_2 and CH_4 to hydrogen and market-preferred chemicals;
- Synthesis of cost-effective fertiliser from both CO_2 and NO_x ; and
- Carbon credit and economic evaluation of GHG capture, storage, and utilization technologies.

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Meet our research experts

Our interdisciplinary research team leverages outstanding capabilities and infrastructure. Experts include:

Laboratory for Catalysis Engineering
Jun Huang. Specialises in sustainable technologies, reaction engineering, carbon credit evaluation in GHG conversion and utilisation.
Weibin Liang. Specialises in bio-based porous materials for CO_2 capture and conversion.
Rui Tang. Specialises in photo/electro-catalytic biomass conversion and fuel generation.
Shenlong Zhao. Specialises in electrocatalytic process.

School of Chemical and Biomolecular Engineering
Ali Abbas. Specialises in technology and economic evaluation.
Alejandro Montoya. Specialises in computational modelling.
Fengwang Li. Specialises in electrocatalytic process.

School of Aerospace, Mechanical & Mechatronic Engineering
Xiaozhou Liao. Specialises in 3D printing and microanalysis for GHG conversion and utilization materials.
Assaad Masri. Specialises in combustion dynamics.

School of Physics
Rongkun Zheng. Specialises in solar driven process and photo/electro process for GHG conversion.
Catherine Stampfl. Specialises in AI and computational modelling for GHG conversion and utilisation.

How your business will benefit

By partnering with us, your business will be able to:

- collaborate with leading academic and industry experts from the University of Sydney to address the challenges faced by your business;
- help shape the next generation of postgraduate students with skills relevant for your business needs;
- host one of our talented PhD students, who will be placed in your business for up to one year; and
- benefit (pending eligibility) for the Australian Government's R&D Tax Incentive Scheme.

Past projects

Biomass gasification integrated with innovative CO_2 capture and hydrogen storage: This negative carbon emissions project collaborated with 3 EU industries and realised the maximum carbon credits.

Nanotechnology for carbon neutral manufacturing: This project brought together experts across 6 schools to form a world-leading team in carbon-neutral manufacturing. Outcomes included an international patent for a breakthrough technology that uses both CO_2 and CH_4 to produce hydrogen and high value chemicals. Two spin-offs are in process.

Tailoring metal-organic framework catalysts for carbon dioxide conversion: This project aims to develop high-performance solar-driven processes and catalysts for CO_2 conversion. This advancement will ultimately lead to a carbon-negative solution for the energy economy and environment.

Contact us

For further information or to discuss in greater detail, please contact:

Net Zero Initiative

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