Message

To achieve carbon neutrality by 2050, we must reduce CO_2 emissions while maintaining socioeconomic activities. As a means of achieving this, the use of heat obtained from renewable energy sources and the combustion of fuels such as hydrogen and ammonia that do not contain carbon is being considered, and research and development regarding such carbon-free energy production methods are underway. In addition, to reduce carbon dioxide emissions, it is considered important to use a technology called carbon recycling, in which carbon dioxide is consumed, i.e., effectively used as a new resource.

The Carbon Recycling Energy Research Center (CRERC) at Ibaraki University aims to develop and implement carbon-neutral technologies in the area of heat utilization, which is difficult to electrify. CRERC is conducting research and educational activities focusing on the development of carbon recycling technology as well as technology for the safe use of decarbonized fuels.

In the development of carbon recycling technology for use in society, we will promote research on the three pillars of carbon dioxide capture, fuel synthesis, and highly efficient use of fuels.

In particular, energy is required for CO_2 capture and fuel synthesis, and we aim to develop a method that significantly reduces this energy compared to existing methods.

Through research and technological development at CRERC, we hope to contribute to the promotion of carbon neutrality in Hitachi City and Ibaraki Prefecture where we are based.

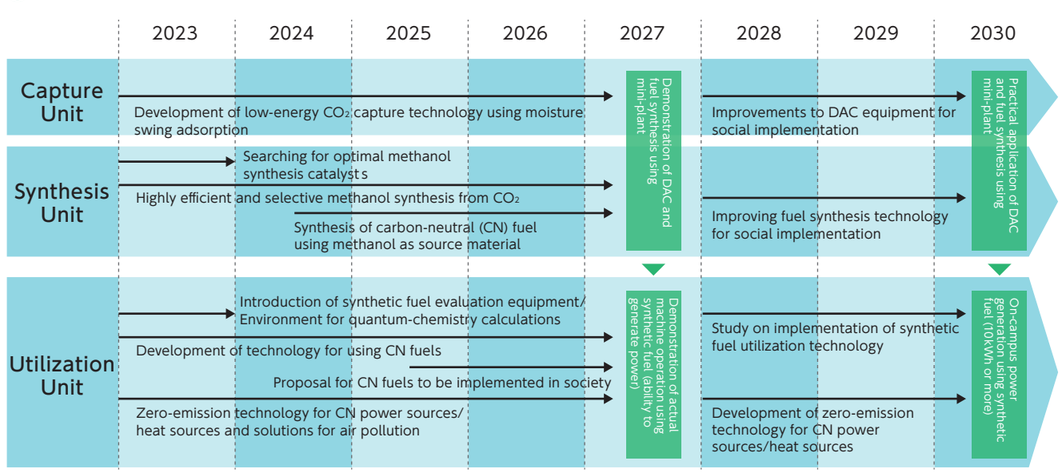
Furthermore, we are committed to sharing new technologies with the world and contributing to the reduction of global CO_2 emissions.

If you are interested in these research activities, you are welcome to join us and study with us.

We sincerely appreciate your continued support and cooperation.

Kotaro Tanaka
Director, CRERC

Roadmap for Carbon Recycling Energy Research Center



CRERC

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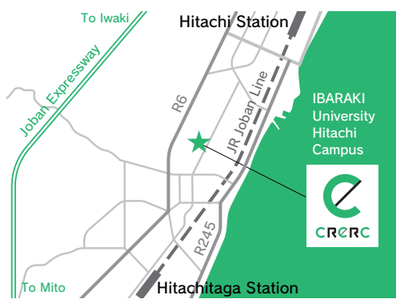
https://crerc.ibaraki.ac.jp/en/



Carbon Recycling Energy Research Center

CRERC

Capturing CO_2 from the atmosphere and turning it into resources.
The world's leading carbon recycling project starts
in Hitachi Campus.

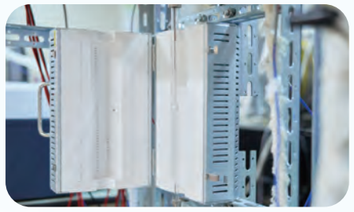
茨城大学
Ibaraki University

Reducing Greenhouse Gases in the Atmosphere: A Comprehensive Trinity Research System

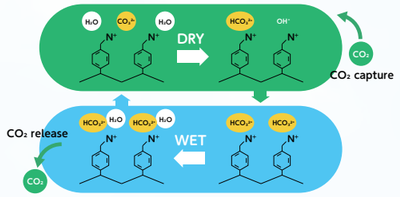
Capture Unit

DAC Technology with Moisture Swing Adsorption

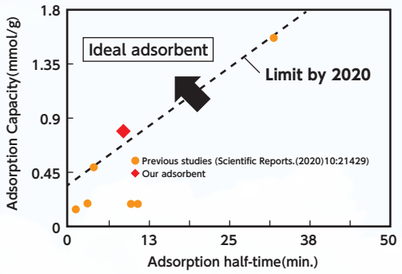
The CRERC Capture Unit is conducting research aimed at the social implementation of direct air capture (DAC) using moisture swing adsorption. CO_2 is adsorbed and desorbed by controlling the humidity of the adsorbent using water. When the adsorbent is dry, it adsorbs CO_2, and when it is supplied with water and becomes wet, the CO_2 becomes desorbed from the adsorbent. The greatest advantage of this technology is that it uses only water at room temperature to desorb CO_2. As a result, the energy required for the adsorption and desorption of CO_2 can be greatly reduced compared to existing methods. Another advantage is that the adsorbent can be reused repeatedly.



CO_2 capture by moisture swing adsorption



Current CO_2 adsorption capacity

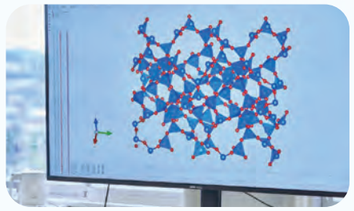


At present, we are conducting research focusing on the development of adsorbents. Our research aims to increase the amount of CO_2 that can be captured per unit mass of adsorbent and to make the adsorption rate as high as possible. In the future, we will build a DAC system using improved adsorbents and conduct demonstration experiments.

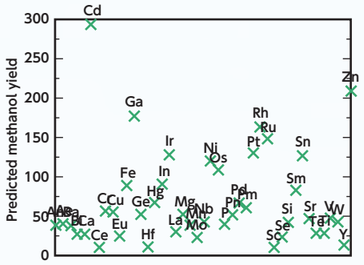
Synthesis Unit

Towards the development of new catalysts to improve the conversion for methanol

The goal of the CRERC Synthesis Unit is to synthesize methanol from CO_2 with higher efficiency and selectivity (prioritizing it over other chemical reactions that could occur at the same time). We are currently studying to find the optimal catalyst composition for methanol synthesis and are promoting research and development to further improve performance. We are exploring new catalyst candidates by combining computational science and information science, as well as verifying the effectiveness of the catalysts through experiments. Our main target is fuel synthesis, but we are also conducting research on the synthesis of high-value-added chemical products in collaboration with experts in organic synthetic chemistry and polymer chemistry.



Estimation of the methanol conversion with different precious metals



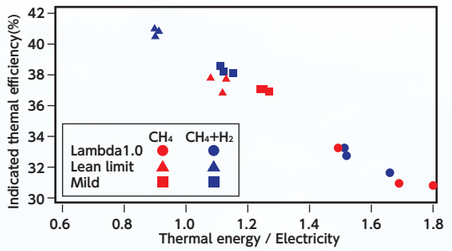
We are performing quantum-chemistry calculations to investigate the effect of the type of precious metal used and to search for potential precious metals that are likely to increase the conversion for methanol. We have already identified several promising candidates, and are now planning to experimentally evaluate their performance.

Utilization Unit

Leading Japan in research into carbon recycling fuels

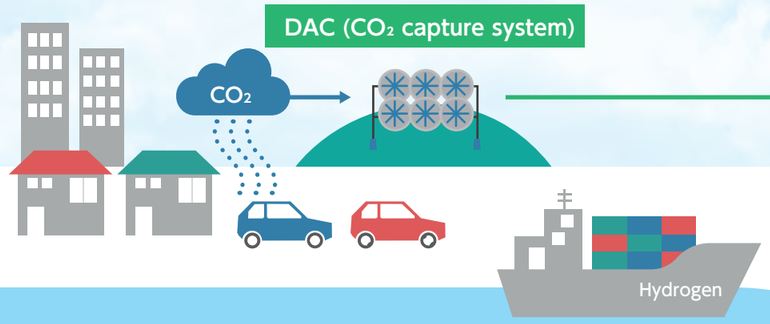
The CRERC Utilization Unit is researching how to use fuel synthesized from captured CO_2 and hydrogen in an efficient manner. In our research, we are particularly focusing on the use of thermal energy in transportation equipment, which is difficult to electrify, as well as thermal power generation as a balancing power source for renewable energy. While carbon recycling fuels can be used to reduce CO_2 emissions, care must be taken regarding the production of air pollutants such as nitrogen oxides and particulate matter, and research is also being carried out to reduce these emissions.

Evaluation of a spark ignition engine fuelled by methane-hydrogen mixtures

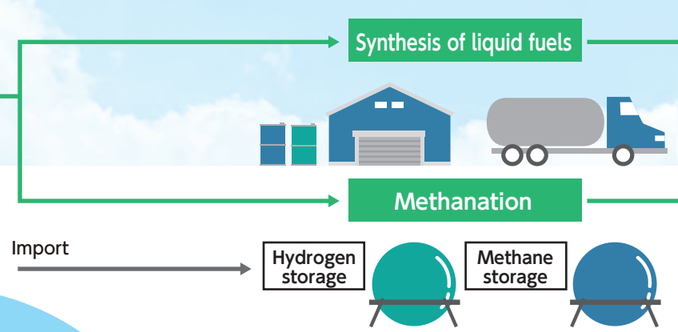


We evaluated the performance of an internal combustion engine using fuels with different mixtures of hydrogen and methane, with the aim of converting surplus renewable energy into hydrogen or methane for storage, and then using it to generate power. We found that the thermal efficiency shows a dependence on the hydrogen mixture ratio. Going forward, we will also conduct evaluations using other fuels.

CO_2 capture



Fuel synthesis



Fuel utilization