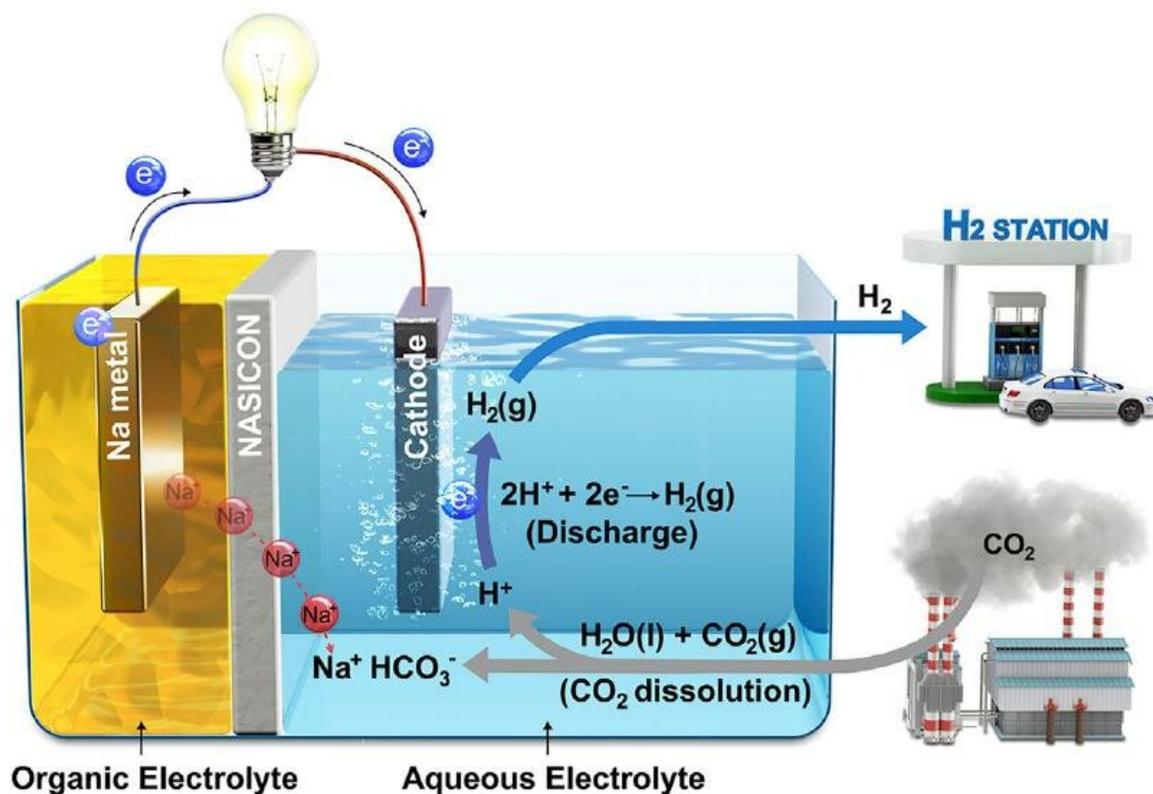


# Scientists turn carbon emissions into usable energy

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Schematic illustration of Hybrid Na-CO<sub>2</sub> System and its reaction mechanism.  
Credit: UNIST

A recent study affiliated with UNIST has developed a system that produces electricity and hydrogen (H<sub>2</sub>) while eliminating carbon dioxide

(CO<sub>2</sub>), the main contributor of global warming. This breakthrough has been led by Professor Guntae Kim in the School of Energy and Chemical Engineering at UNIST in collaboration with Professor Jaephil Cho in the Department of Energy Engineering and Professor Meilin Liu in the School of Materials Science and Engineering at Georgia Institute of Technology.

In this work, the research team presented a hybrid Na-CO<sub>2</sub> system that can continuously produce electrical [energy](#) and hydrogen through efficient CO<sub>2</sub> conversion with stable operation for over 1,000 hours from spontaneous CO<sub>2</sub> dissolution in aqueous solution.

"Carbon capture, utilization, and sequestration (CCUS) technologies have recently received a great deal of attention for providing a pathway in dealing with global climate change," says Professor Kim. "The key to that technology is the easy conversion of chemically stable CO<sub>2</sub> molecules to other materials." He adds, "Our new system has solved this problem with CO<sub>2</sub> dissolution mechanism."

A percentage of human CO<sub>2</sub> emissions is absorbed by the ocean and turned into acid. The researchers focused on this phenomenon and came up with the idea of melting CO<sub>2</sub> into water to induce an electrochemical reaction. If acidity increases, the number of protons increases, which in turn increases the power to attract electrons. A [battery system](#) based on this phenomenon can produce electricity by removing CO<sub>2</sub>.

Their Hybrid Na-CO<sub>2</sub> System, just like a [fuel cell](#), consists of a cathode (sodium metal), separator (NASICON), and anode (catalyst). Unlike other batteries, catalysts are contained in water and are connected by a lead wire to a cathode. When CO<sub>2</sub> is injected into the water, the reaction starts, eliminating CO<sub>2</sub> and creating electricity and H<sub>2</sub>. The conversion efficiency of CO<sub>2</sub> is 50 percent.

"This hybrid Na-CO<sub>2</sub> cell, which adopts efficient CCUS technologies, not only utilizes CO<sub>2</sub> as the resource for generating [electrical energy](#) but also produces a clean energy source, hydrogen," says Jeongwon Kim in the Combined M.S/Ph.D. in Energy Engineering at UNIST, the co-first author for the research.

This system has shown stability to the point of operating for more than 1,000 hours without damage to electrodes. The system can be applied to remove CO<sub>2</sub> by inducing voluntary chemical reactions. "This research will lead to more derived research, and will be able to produce H<sub>2</sub> and electricity more effectively when electrolytes, separator, system design and electrocatalysts are improved," said Professor Kim.

**More information:** Changmin Kim et al, Efficient CO<sub>2</sub> Utilization via a Hybrid Na-CO<sub>2</sub> System Based on CO<sub>2</sub> Dissolution, *iScience* (2018).  
[DOI: 10.1016/j.isci.2018.10.027](https://doi.org/10.1016/j.isci.2018.10.027)

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