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'Underground battery' could store energy, CO2

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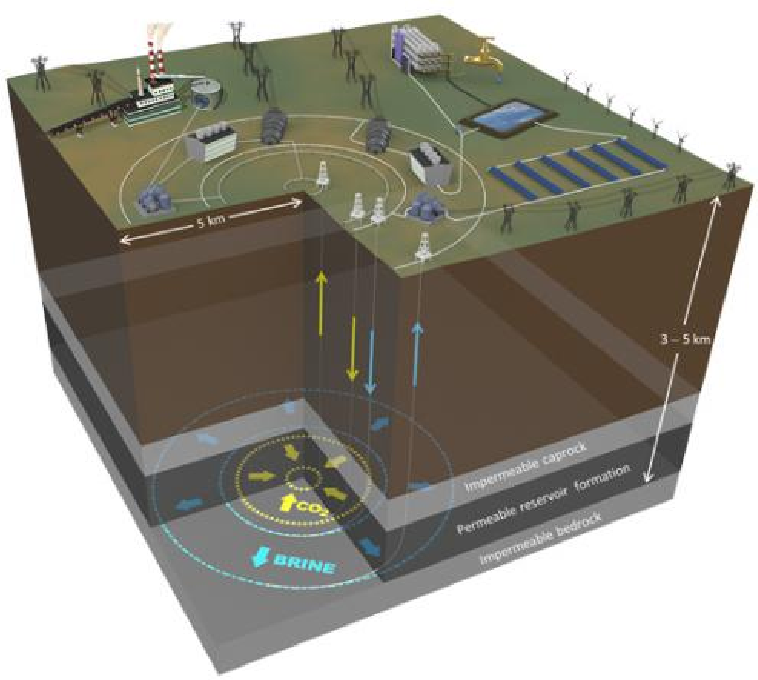

This integrated system would store carbon dioxide in an underground reservoir, with concentric rings of horizontal wells confining the pressurized CO2 beneath the caprock. Stored CO2 displaces brine that flows up wells to the surface where it is heated by thermal plants (e.g., solar farms) and reinjected into the reservoir to store thermal energy.

Meeting the Paris Climate Agreement goal of limiting the increase in the global average temperature to well below two degrees Celsius compared to pre-industrial levels will require increased use of renewable energy and reducing the CO_2 intensity of fossil energy use.

The intermittency of when the wind blows and when the sun shines is one of the biggest challenges impeding the widespread integration of renewable energy into electric grids, while the cost of capturing CO_2 and storing it permanently underground is a big challenge for decarbonizing fossil energy.

However, researchers from Lawrence Livermore National Laboratory, Ohio State University, University of Minnesota and TerraCOH, Inc. think they've found an answer to both of these problems with a large-scale system that incorporates CO_2 sequestration and energy storage.

The team's paper, published in the December issue of *Mechanical Engineering* magazine, describes a subsurface energy system that could tap geothermal energy, store energy from above-ground sources, and dispatch it to the grid throughout the year like a massive underground battery, while at the same time storing CO_2 from fossil-fuel power plants.

"If you want to store the large quantities of renewable energy necessary to balance seasonal supply-demand mismatches and store it efficiently, we believe the best way to do that is underground," said the paper's author, Thomas Buscheck, leader of the Lab's Geochemical, Hydrological and Environmental Sciences Group. "We believe this is a cost-effective way to store the energy long enough so it can be used later."

Buscheck's team's approach involves injecting liquid-like CO_2 into underground reservoirs located in sedimentary rock, creating a pressurized plume that pushes brine up production wells to the surface. The brine could be heated and reinjected into the reservoir to store thermal energy, and the resulting pressurized CO_2 would act as a shock absorber, enabling the system to be charged or discharged depending on supply and demand. When there's insufficient renewable energy, the pressurized CO_2 and brine could be released and converted to power.

"Storing such vast quantities of CO_2 creates so much pressure. This is the biggest challenge for keeping it permanently underground, but it is manageable," Buscheck said. "To make sure we don't have too much pressure, we can divert some of the produced brine to generate water through desalination. Then, if we tap into the remaining pressure, we can recharge the system selectively and put energy into our storage system when there's excess and deliver it when it's needed."

According to the computer models, the amount of CO_2 that could be stored underground by the system would be at least 4 million tons per year over 30 years, the equivalent of the CO_2 impact of a 600 megawatt coal plant.

Seven years in development, the concept, which combines Multi-Fluid Geo-Energy Systems developed at the Lab and Ohio State University with CO_2 Plume Geothermal (CPG) from researchers at the University of Minnesota, is drawing interest from industry, Buscheck said.

Provided by Lawrence Livermore National Laboratory

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