NREL
NATIONAL RENEWABLE ENERGY LABORATORY

ENERGY SYSTEMS INTEGRATION

ESI optimizes the design and performance of electrical, thermal, fuel, and water pathways at all scales.

PARTNERSHIPS

NREL + SOUTHERN CALIFORNIA GAS

"POWER TO GAS" PILOT CONVERTS ELECTRICITY TO HYDROGEN, STORES IT AS METHANE

NREL and Southern California Gas Company are evaluating a new "power-to-gas" approach—one that produces methane through a biological pathway and uses the expansive natural gas infrastructure to store it. This approach has the potential to change how the power industry approaches renewable generation and energy storage.

The process involves using a low-temperature water electrolyzer to produce hydrogen from renewable power, such as wind and solar, and then feeding the hydrogen and carbon dioxide into a bioreactor where methanogens produce methane and water. With minor filtration, the product gas from the bioreactor will meet pipeline quality, allowing it to be injected into the existing natural gas infrastructure.

Crews work to install the first U.S. Power-to-Gas system outside the ESIF. Southern California Gas partnered with NREL on the project, which takes excess electricity and converts it to hydrogen which can be used, stored or combined with cargo dioxide to produce renewable natural gas.
Photo by Werner Slocum, NREL 47268

R&D STRATEGY

NREL and Southern California Gas are characterizing and modeling the dynamic and steady-state performance of a pilot-scale power-to-gas system at the ESIF, with up to 250 kilowatts of varying power fed into the electrolyzer. The team will then develop monitoring, control, and safety software based on these studies. The results from the optimization and experimental work will then be used to characterize the potential impact of this power-to-gas approach to energy storage—both financially and operationally.

This performance characterization will indicate the commercial viability of the biological methanation approach relative to other energy storage technologies and provide insights into megawatt-scale system designs. The research team will combine these insights with renewable energy resource data to identify optimal locations in California and the western half of the U.S. power grid where this grid-scale energy storage system would be most economical.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

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PROJECT OBJECTIVES

This project presents a unique energy integration challenge involving electricity, renewable hydrogen production, anaerobic gas fermentation in a bioreactor, steam methane reforming, and fuel cells.

This project will allow for:

- Improvements in the next-generation reactor design, currently conceived as being 10–50 megawatts in capacity for large-scale, long-term energy storage systems
- Large-scale hydrogen production, which can serve as a feedstock for a variety of chemical and energy needs—including transportation in hydrogen-powered fuel cell vehicles, ammonia production, and synthetic fuel production
- Informing policy makers who may want to enable or incentivize the deployment and expansion of this large-scale energy storage system for utility grids.

Photo by Dennis Schroeder, NREL 40870

Partner with NREL at the ESIF

User facility access to the ESIF is awarded through the review and approval of user proposals, depending on the scientific merit, suitability of the user facilities, and the appropriateness of the work to DOE objectives, and includes a signed user agreement for the facility.

For more information, please visit:
www.nrel.gov/esi/working_with.html
or contact:
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The Energy Systems Integration Facility (ESIF) at the National Renewable Energy Laboratory (NREL) provides the R&D capabilities needed for private industry, academia, government, and public entities to collaborate on utility-scale solutions for integrating renewable energy and other efficiency technologies into our energy systems.

To learn more about the ESIF, visit: ***www.nrel.gov/esif***.

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