



Renewable Hydrogen

Our Expertise

Advanced Production Technologies | Performance and Durability Characterization and Evaluation | Manufacturing Processes and Scale-Up | Hydrogen Storage Materials and Systems | Delivery and Fueling Infrastructure | Fast-Flow Fueling for Heavy-Duty Transportation | Megawatt-Scale System Validation and Demonstration | Systems Integration | Grid and Renewables Coupling | Power Generation | Energy Storage | End Use Applications | Safety and Sensors | Component Reliability and Modeling | Data Collection and Validation | Natural Gas Blending | Systems and Techno-Economic Analysis

The Need

Abundant, Affordable, and Reliable Energy Solutions

Lowering the cost and increasing the scale of technologies to make, store, move, and use hydrogen across multiple energy sectors is critical to tapping its potential as an energy-dense and low-emission energy carrier. But for hydrogen to become a significant player in the clean energy transition, the cost of clean hydrogen needs to be reduced by

80% to \$1 per kilogram in the next decade (U.S. Department of Energy's Hydrogen Shot goal). This will accelerate hydrogen's adoption across difficult-to-decarbonize sectors such as heavy-duty trucks, steel manufacturing, clean ammonia, heating and power generation applications, and long-duration energy storage.

The Solution

Lower Cost and Increase Scale of Hydrogen Technologies

NREL researchers are examining the possibilities and challenges of using renewable energy sources for producing hydrogen via the electrolysis of water. NREL evaluates integrated electrolysis systems and investigates design options to lower capital and operating costs, increase durability, and enhance performance.

NREL is home to leading-edge hydrogen infrastructure research facilities, including hydrogen storage, compression, and dispensing capabilities for fuel cell vehicle fueling and component testing. As the first facility of its kind, NREL's heavy-duty hydrogen fueling station allows researchers and partners to evaluate high-flow-rate hydrogen fueling components and protocols for fuel cell trucks, rail, and marine vessels to ensure safety and improve reliability.

Ongoing work also focuses on developing durable, efficient fuel cell technologies and high-throughput manufacturing processes for long-life, high-use applications, such as trucking and non-road mobility applications.

The Advanced Research on Integrated Energy Systems platform supports projects to demonstrate direct renewable hydrogen production, energy storage, power production, and grid integration at the megawatt scale. And NREL's systems analysis expertise identifies pathways for innovative hydrogen end uses.

The Impact

Tangible Emission Reductions Across Sectors

NREL's hydrogen and fuel cell research is enabling hydrogen to be a central component for a clean, sustainable, efficient, and

economic energy system. Leveraging hydrogen will play a key role in the energy transition for difficult-to-decarbonize sectors.

Partners

Air Liquide | California Air Resources Board | Chemours | Chevron | Cummins | Electric Hydrogen Electrocatalysis Consortium | Fortescue Future Industries | Honda | Honeywell Aerospace | HyBlend: Hydrogen Blending in Natural Gas Pipelines Initiative | Hydrogen and Fuel Cell Technologies Office | HydroGEN Advanced Water Splitting Materials Consortium | Hydrogen from Next-generation Electrolyzers of Water Consortium | Hydrogen Materials Advanced Research Consortium | Million Mile Fuel Cell Truck Consortium | Nel Hydrogen | Port of Corpus Christi | Plug Power | Roll-to-Roll Consortium | Shell | Southern California Gas Company | Toyota | U.S. Department of Energy