



ENERGY SYSTEMS  
INTEGRATION FACILITY

U.S. DEPARTMENT OF ENERGY



Photo from iStock/03364509. Illustration courtesy of SmithGroup.

13



## Energy Systems Sensor Laboratory

The mission of the Energy Systems Sensor Laboratory at NREL's Energy Systems Integration Facility (ESIF) is to research, develop, test, and evaluate the performance of commercial and developing hydrogen sensor technologies to support the needs of the emerging hydrogen infrastructure. Sensor performance metrics analogous to national and international standards are quantified. Information gained from the sensor testing is provided to the sensor manufacturers to aid in sensor development, to end users to guide sensor selection and deployment, and to committees to support the development of codes and standards. The laboratory also provides support to end-users, including assessment of technologies for applications, information on deployment.

### Laboratory Specifications

The laboratory consists of a sophisticated sensor testing apparatus developed at NREL. The system is fully automated for around-the-clock operation with remote control and monitoring capabilities via the internet. Standard testing protocols have been developed, but can be adjusted based upon individual needs.

Advanced capabilities of the Energy Systems Sensor Laboratory include:

- Parallel testing of multiple sensors
- Sub-ambient to elevated temperature extremes (ca. -40° C to +80° C; an expanded higher range is possible)
- Sub-ambient to elevated pressure (0.6 to 1.2 Bar, but an expanded range is possible)
- Active humidity control
- Accurate control of gas parameters with six precision digital mass flow meters operating in parallel
- Test conditions (T, P, RH and flow) monitored with traceable probes
- Gas composition continuously verified by mass spectrometric analysis to provide near real-time analysis of the test gas
- Evaluations carried out in the sensor chamber, which isolates the test sensor from the external environment
- LabVIEW based DAQ system for sensor data logging and system control
- Response time apparatus developed to determine sensor response and recovery time upon exposure to unsafe conditions.

### Application Scenarios

- Testing and analyzing sensors are over a range of controlled and monitored environmental conditions.
- Testing the impact of interferants and poisons.
- Evaluating the life span of sensors with separate dedicated life test fixtures.
- Testing of hydrogen sensors for process applications, including responses under high hydrogen concentrations.

### Partner with Us

Work with NREL experts and take advantage of the state-of-the-art capabilities at the ESIF to make progress on your projects, which may range from fundamental research to applications engineering. Partners at the ESIF's Energy Systems Sensor Laboratory may include:

- Hydrogen sensor manufacturers
- Codes and standards development organizations
- Certification laboratories
- Government agencies
- Universities
- Other National laboratories

### Contact Us

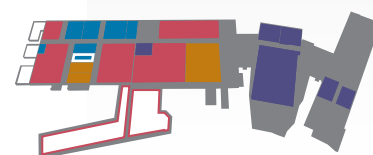
If you are interested in working with NREL's Energy Systems Sensor Laboratory, please contact:

#### ESIF Manager

Carolyn Elam  
Carolyn.Elam@nrel.gov  
303-275-4311

### Major Laboratory Equipment

- SSTL sensor test apparatus (designed and built by NREL)
- National Instruments Data Acquisition System
- LabVIEW 2011
- Gas parameters controlled by precision digital mass flow controllers
- Pressure controlled by a precision digital pressure controller
- Relative Humidity controlled by HPLC pump interfaced to a custom built vaporizer
- Temperature controlled via a circulating cooler
- Gas flow monitored by a certified precision digital mass flow meter
- Pressure monitored by a certified digital pressure transducer
- Relative humidity and temperature monitored by a certified transmitter
- Quadrupole Mass Spectrometer



**National Renewable Energy Laboratory**  
15013 Denver West Parkway, Golden, CO 80401  
303-275-3000 • [www.nrel.gov](http://www.nrel.gov)

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

NREL/FS-5500-52853 • October 2011

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.