

# NREL's Hydrogen and Fuel Cell Activities

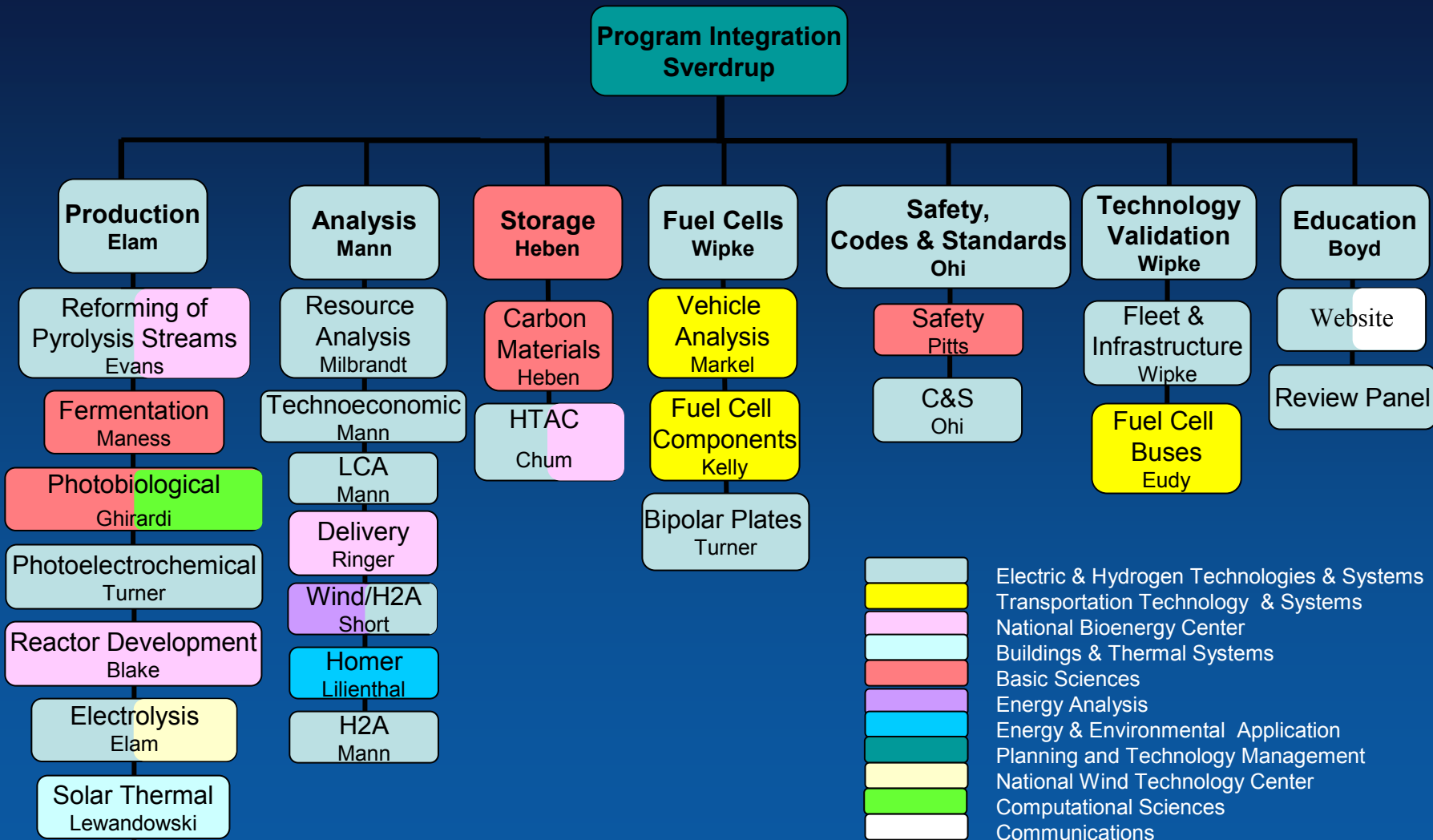
Sue Hock  
Director

Electric & Hydrogen Technologies & Systems Center

# Hydrogen at NREL

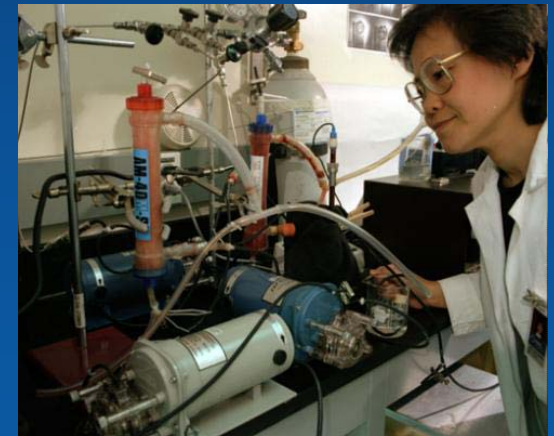
- Crosscutting nature of hydrogen research relies on and contributes to advances in PV, bioenergy, transportation, buildings, basic science, etc.
  - Benefits intermittent renewables
  - Opportunities for combined heat, power and fuel production
- NREL is the integration point for technical expertise in industry, universities, and other national laboratories for renewable systems

# We Contribute to All Elements of DOE's Program Using NREL-Wide Resources

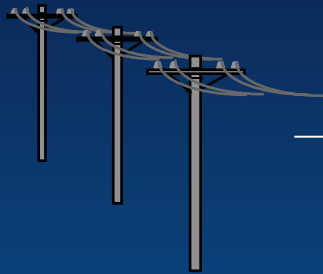


# Hydrogen Production

- Photobiological production technique developed that produces measurable quantities of hydrogen using algae (for the first time anywhere in the world)
- Genetic and classical techniques being perfected for generation of oxygen-tolerant variants.
- Fermentation technologies for producing hydrogen from renewable biomass.
- World-record efficiency for directly splitting water with a photoelectrochemical device.



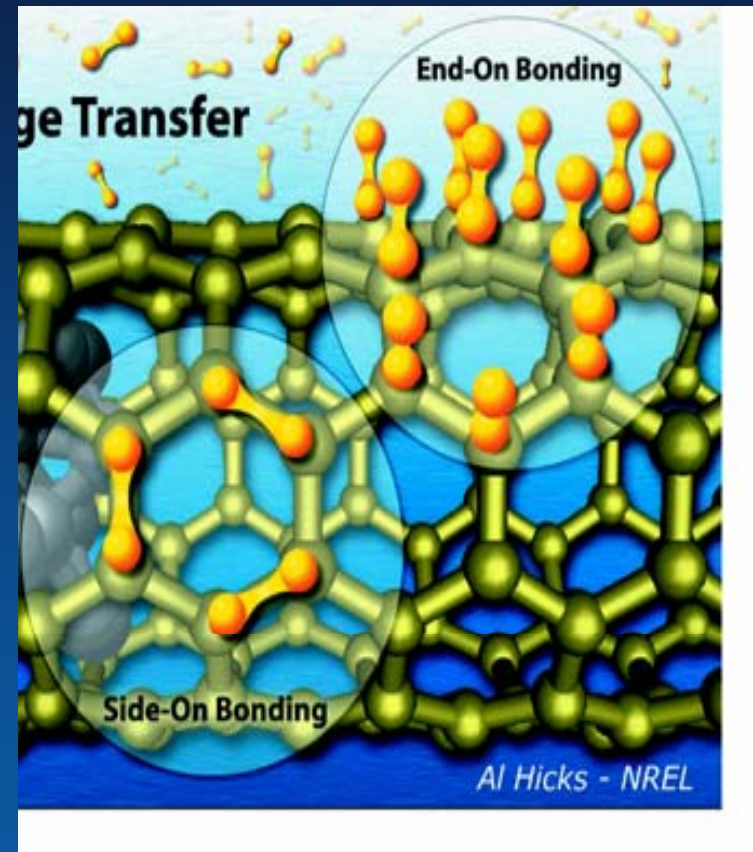
# Integration of Hydrogen Production with Intermittent Renewables



Performance data used to develop shared power electronics package to reduce system cost and improve efficiency

# Hydrogen Storage

- Leader in Carbon Nanotubes for Hydrogen Storage
- Synthesis, purification, cutting techniques, and measurement standards developed for high-purity samples and reproducible results





# Technology Validation

- Coordination and support for the Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project solicitation
- Data acquisition plans and support for vehicle demonstrations
  - California Fuel Cell Partnership



# Codes & Standards

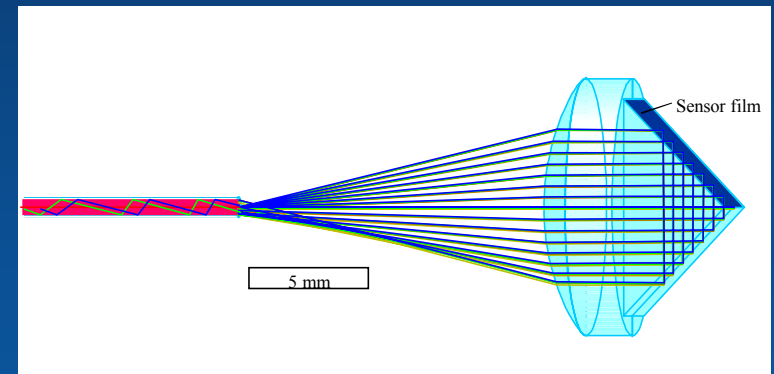
- Coordination and support for the development of National and International Codes & Standards
- Produced “Blueprint for Hydrogen Infrastructure Development”
  - posted on website for public comments
  - workshop held to develop detailed plan
- Developed “Hydrogen Primer” for building and fire code officials
- Working closely with the natural gas infrastructure working group to build on their experiences





# Hydrogen Safety

- Leader in renewable hydrogen production technologies
- Sensors for leak detection
  - leak detection for vehicles and buildings, and for hydrogen production, storage, and transport applications
  - weld integrity



# Education

- Development of teaching materials and curriculum for K–12
- Expansion of education opportunities for teachers
- Content development and maintenance of DOE's hydrogen Web site



U.S. Department of Energy  
**Energy Efficiency and Renewable Energy**  
Hydrogen, Fuel Cells & Infrastructure Technologies Program

About the Program | Information Resources | Financial Opportunities | Technologies

Hydrogen and fuel cells have the potential to solve several major challenges facing America today. Dependence on petroleum imports, poor air quality, and greenhouse gas emissions. The Hydrogen, Fuel Cells & Infrastructure Technologies Program is working with partners to accelerate the development and successful market introduction of these technologies.

**Hydrogen**  
Hydrogen is a clean and sustainable form of energy that can be used in mobile and stationary applications.

**Fuel Cells**  
Fuel cells harness the chemical energy of hydrogen to generate electricity without combustion or pollution.

**Safety, Codes & Standards**  
Codes and standards ensure the safe use of hydrogen and fuel cells.

**For Students and Teachers**  
Learn the basics of hydrogen and fuel cells and view a [Fuel Cell Activities](#)

The vision of a new energy economy based on clean, renewable hydrogen is described in the National Business Energy Alliance (NBEA) report.

Although we have a vision for a hydrogen economy, changes that we can not predict and are likely to occur in the next few years. The Hydrogen, Fuel Cells & Infrastructure Technologies Program is working with partners to accelerate the development and successful market introduction of these technologies.

The first steps toward the hydrogen future are already underway. The 2002 Global Hydrogen Roadmap provides a complete list of 100 targeted hydrogen fuel cell projects for 2002.

- In November 2002, the world's first energy station featuring hydrogen and electricity co-generation opened in San Diego, Nevada. [Click here.](#)
- In December 2002, DOE's education workshop looked off a new initiative effort to educate teachers nationwide about hydrogen and fuel cells. [Click here.](#)

Some of the above documents are available on Adobe Acrobat PDF. [Click here.](#)

U.S. Department of Energy  
NREL  
Current Web Updates: 06/20/2003

Search  
View More  
See an Energy Expert  
News  
Hydrogen Production and Delivery  
Fuel Cell Station Announcements  
April 2003  
Energy Secretary's Comments on  
the Road to the Hydrogen Future  
April 24, 2003  
Hydrogen Shows: Academy, Rosen  
Units, and NREL for DOE Award Fuel  
Cell Applications Selection  
April 9, 2003  
News Topics  
EVENTS  
2003 Hydrogen and Fuel Cells  
Award Luncheon Meeting  
May 19-21, 2003  
News Events  
Fuel Cell Report to Congress  
April 2002  
FreedomCAR and  
Fuel Initiative