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# **U.S. Department of Energy Hydrogen Program**

## **Hydrogen Production and Delivery Program Element**

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**2007 DOE Hydrogen Program  
Merit Review and Peer Evaluation Meeting**

**June 10, 2008**





# Goal and Objectives

***Goal: Research and develop low-cost, clean, highly efficient hydrogen production technologies from diverse domestic resources, including fossil, nuclear and renewable sources.***

- Reduce the cost of hydrogen to \$2.00 - \$3.00/gge (Untaxed & Delivered)

## **Near-term: Distributed Production**

*(produced at station to enable low-cost delivery)*

- *Natural gas reforming*
- *Renewable liquid reforming*
- *Electrolysis*

## **Longer-term: Centralized Production**

*(large investment in delivery infrastructure needed)*

- *Biomass gasification*
- *Coal with sequestration*
- *Wind, solar, and nuclear-driven electrolysis*
- *Solar/nuclear high-temperature thermochemical water splitting*
- *Photoelectrochemical, biological production*

- Reduce total hydrogen delivery cost to < \$1.00/gge



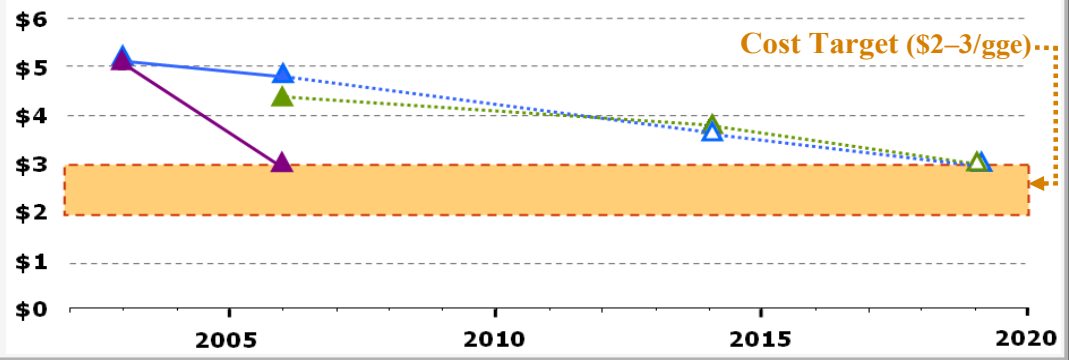
# Summary

*The Program has reduced the cost of producing hydrogen from multiple pathways.*

## Cost of Hydrogen (Delivered) – Status & Targets (in \$/gallon gasoline equivalent (gge), untaxed)

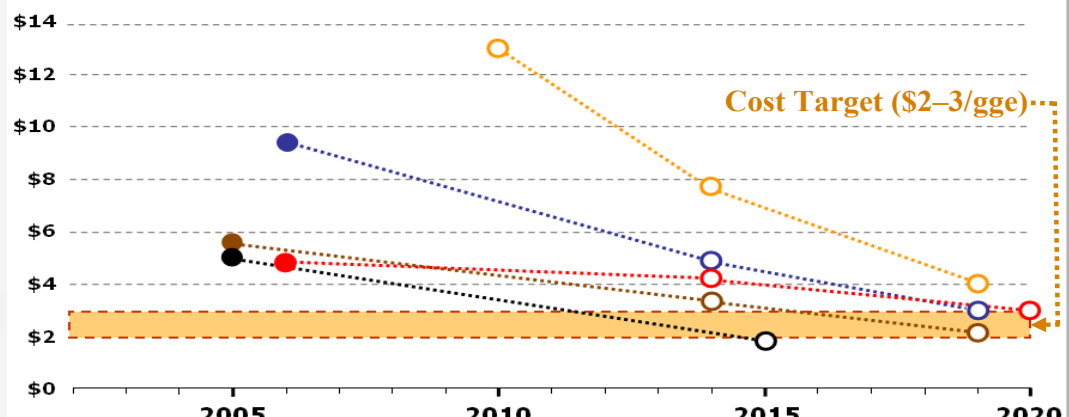
**NEAR TERM: Distributed Production**  
 → Hydrogen is produced at station to enable low-cost delivery

- ▲ Distributed Natural Gas
- ▲ Distributed Electrolysis
- ▲ Distributed Bio-Derived Renewable Liquids



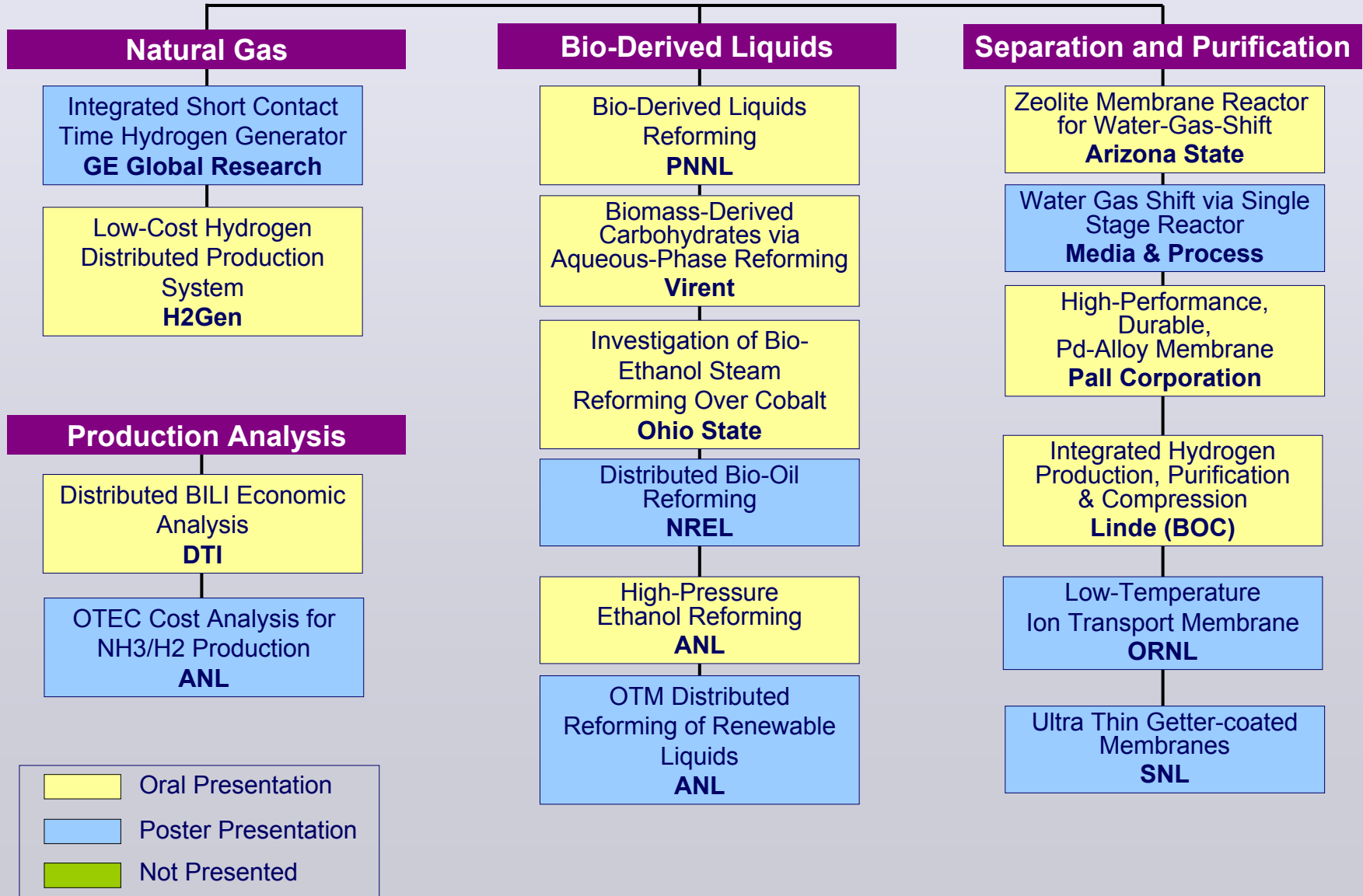
**LONGER TERM: Centralized Production**  
 → Large investment in delivery infrastructure needed

- Biomass Gasification
- Coal Gasification with Sequestration
- Solar High-Temperature Thermochemical Cycle
- Central Wind Electrolysis
- Nuclear



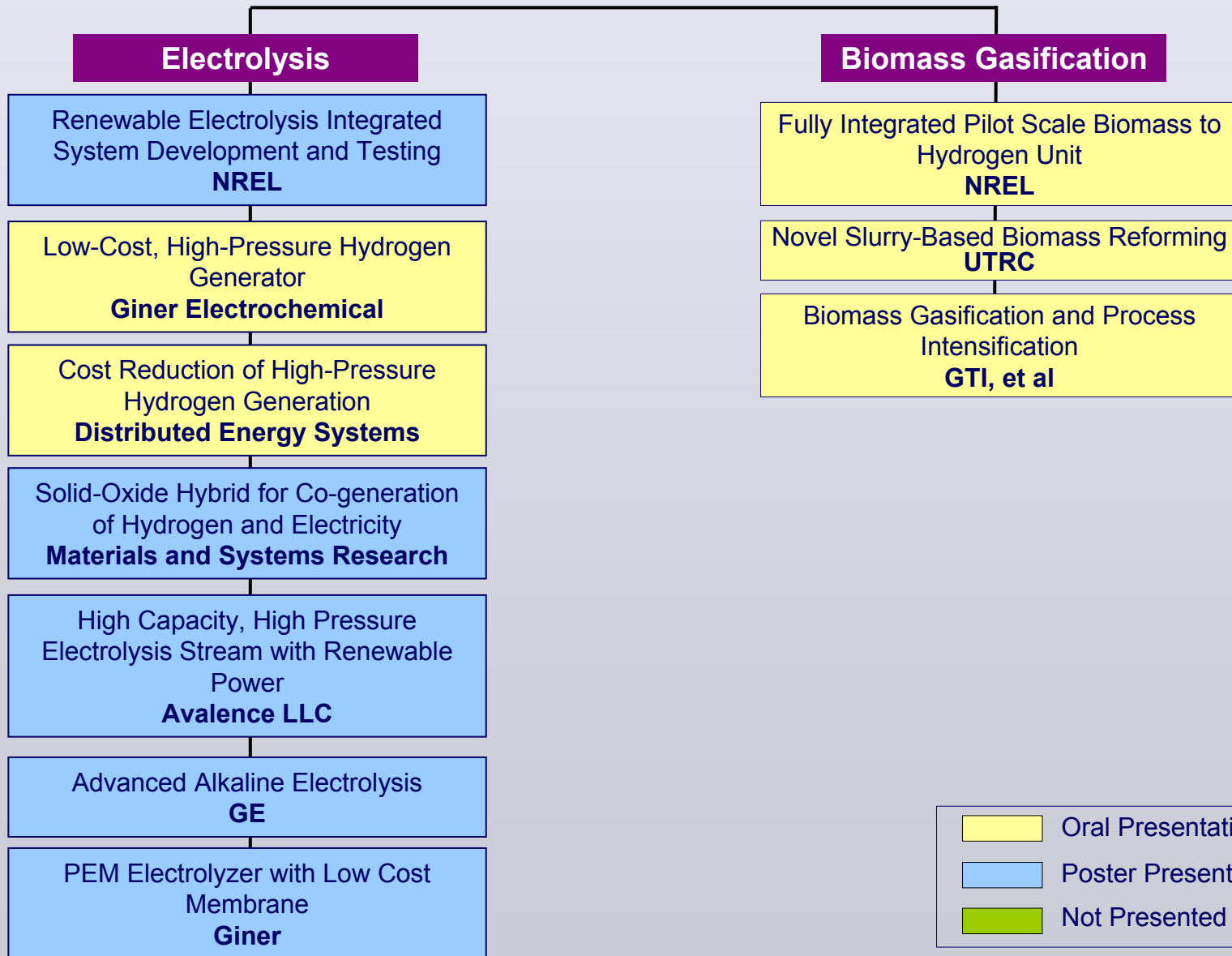


# Distributed Reforming Hydrogen Production Pathway Projects





# Electrolysis and Biomass Gasification Projects





# Longer Term Pathway Projects

## Solar Driven HT Thermochemical

Development of Solar-powered Thermochemical Production of Hydrogen from Water  
**UNLV, et al**

Solar-thermal Mn<sub>2</sub>O<sub>3</sub>/MnO Thermochemical Cycle to Split Water  
**U of Colorado**

Solar Driven HT Thermochemical Water Splitting with Photo Assist  
**SAIC, FSEC**

## Biological

Biological Systems for Hydrogen Photoproduction  
**NREL**

Hydrogen from Water in a Novel Recombinant Oxygen Tolerant Cyanobacteria System  
**Venter Institute**

Montana Palladium Research Initiative/Biological Production and Separations  
**Montana State**

Maximizing Light Utilization Efficiency & Hydrogen Production in Microalgal Cultures  
**UC Berkeley**

Fermentative and Electrohydrogenic H<sub>2</sub> Production  
**NREL**

## Photoelectrochemical

Photoelectrochemical Water Systems for H<sub>2</sub> Production  
**NREL**

Cost-effective Photoelectrochemical Production of Hydrogen  
**Midwest Optoelectronics**

Water Splitting Catalysts Based on the Oxygen Evolving Complex of Photosystem II  
**Arizona State**

Photoelectrochemical Generation of Hydrogen Using Sonicated Hybrid Titania Nanotube Arrays  
**UN - Reno**

Photoelectrochemical Hydrogen Production: UNLV-SHGR  
**MV Systems**

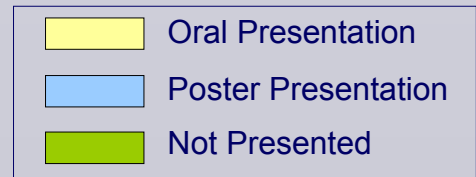
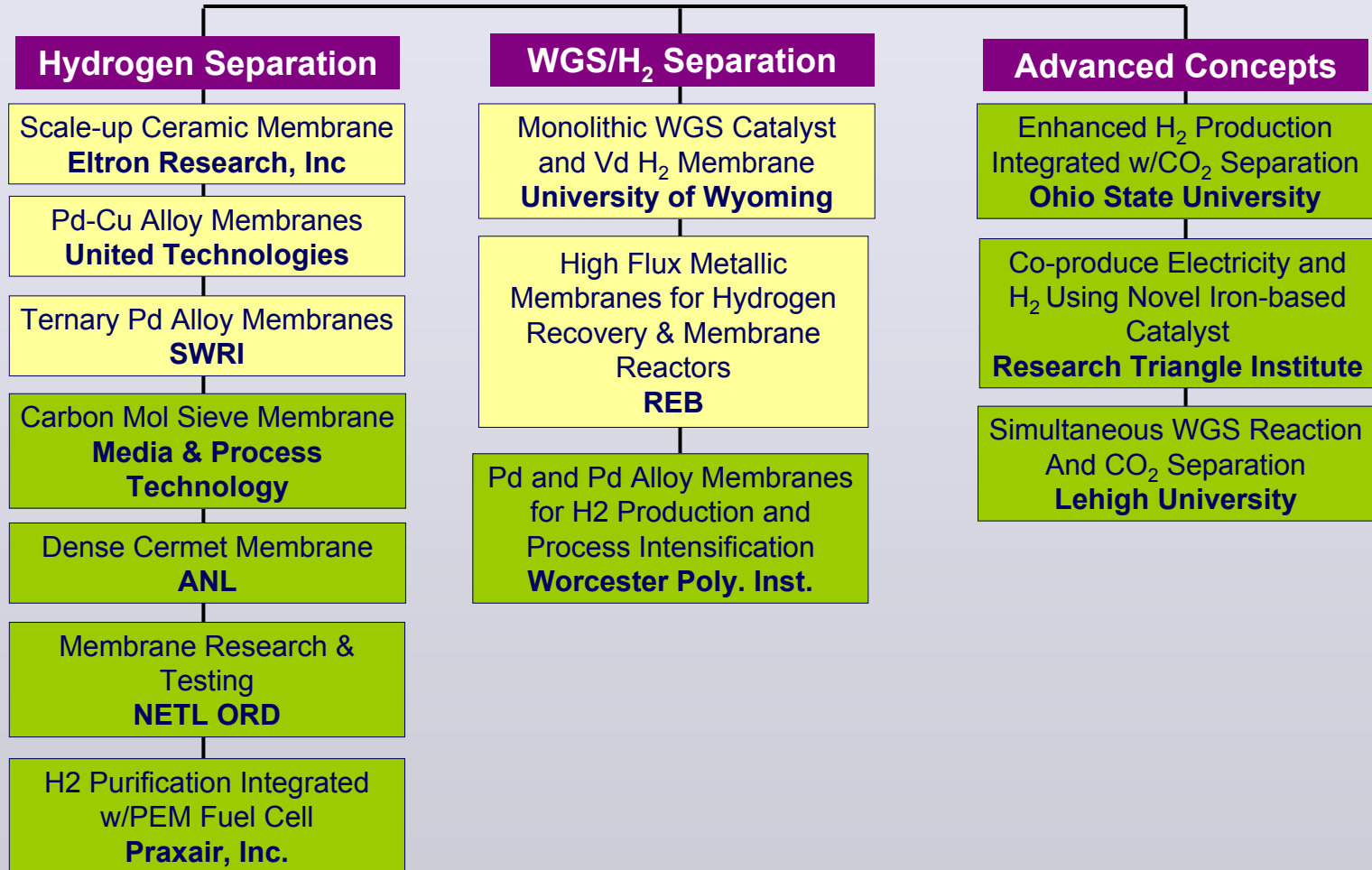
Solar Water Splitting: Photocatalyst Materials Discovery and Systems Development  
**GE Global Research**

Development of Cost Effective Materials for PEC Production  
**UC Santa Barbara**

- Oral Presentation
- Poster Presentation
- Not Presented

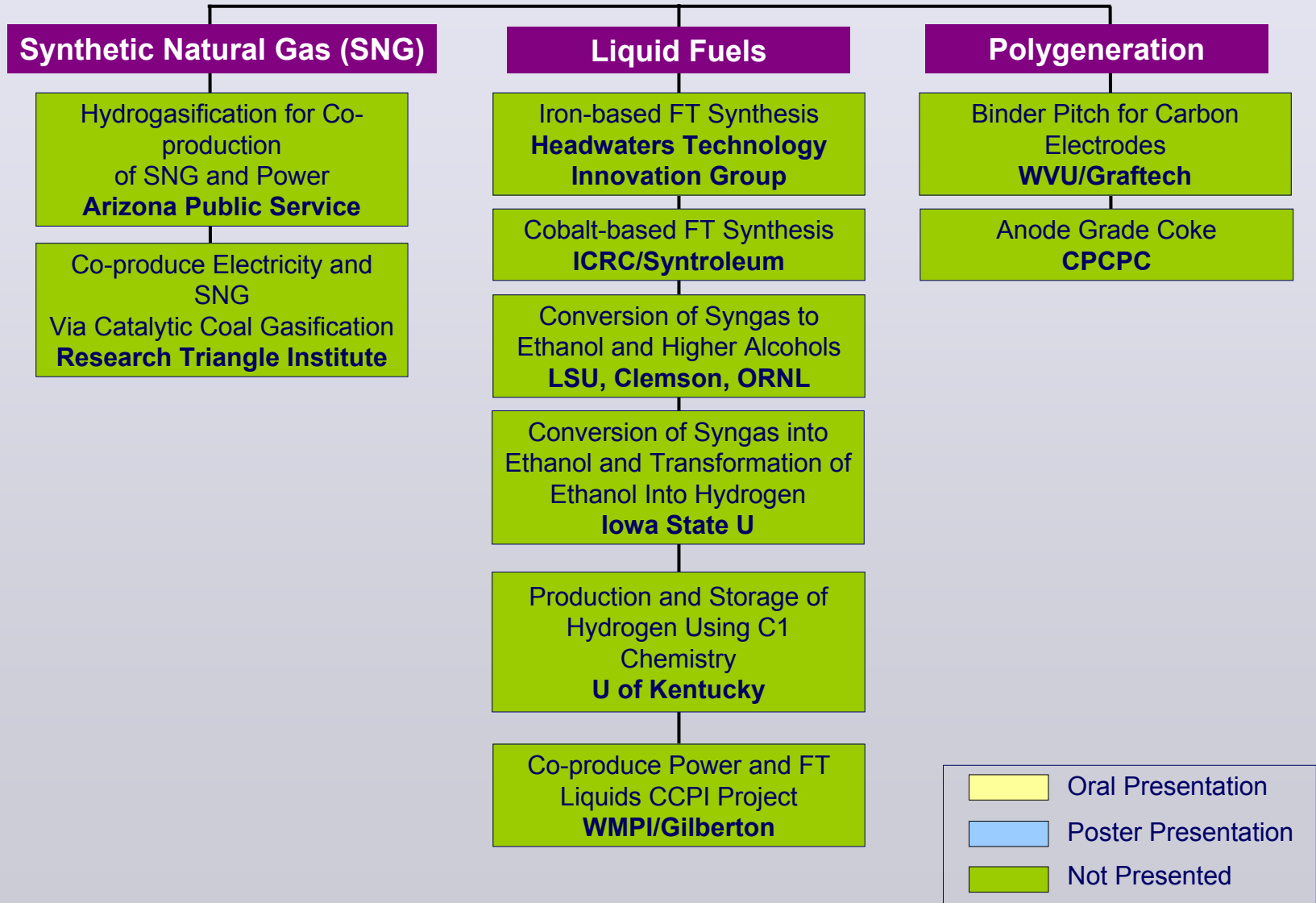


# Coal Hydrogen Central Production Pathway Projects





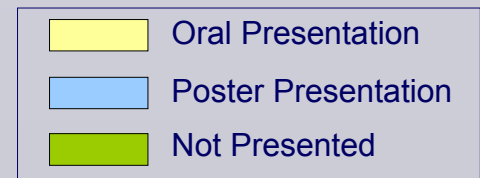
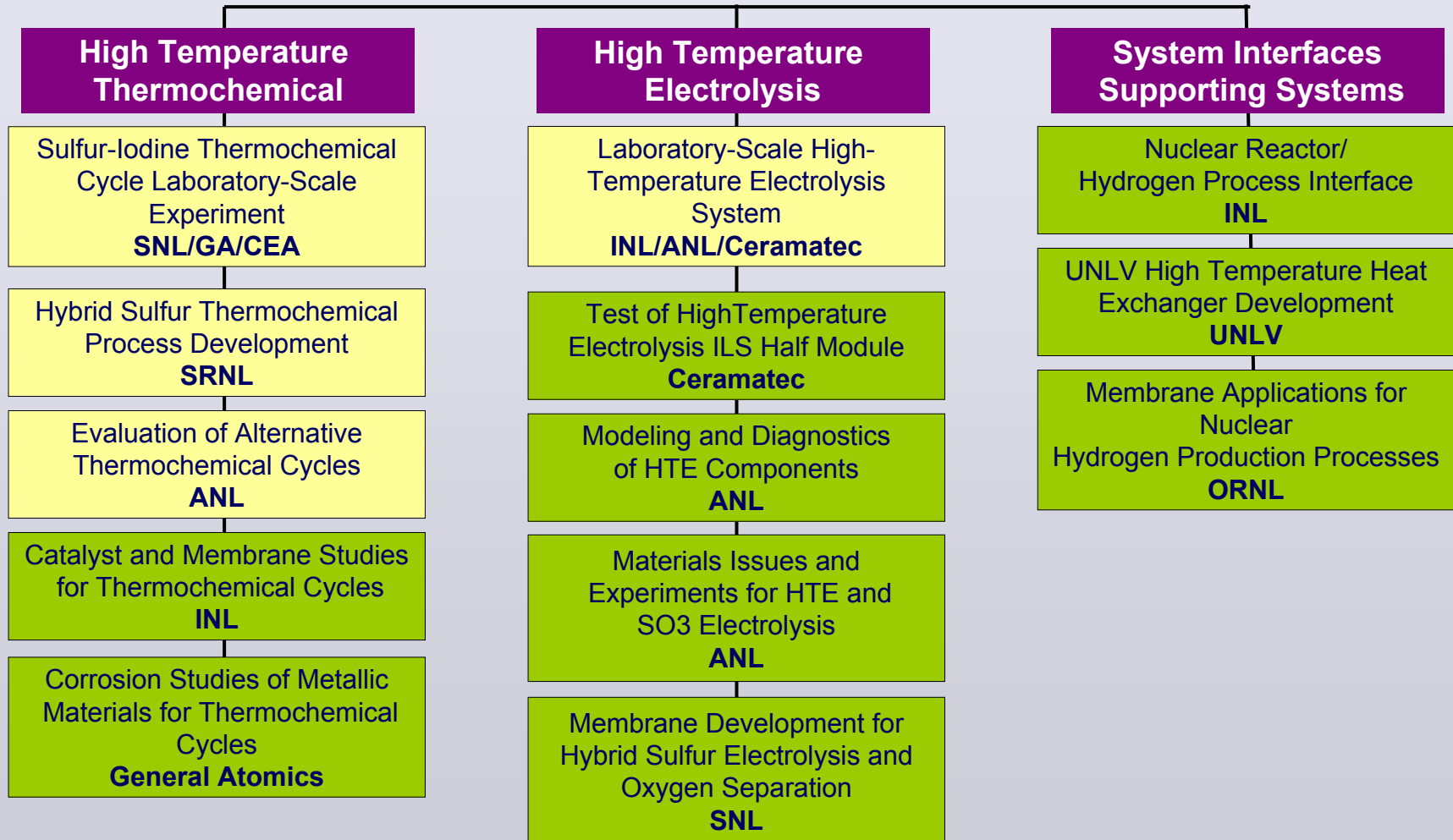
# Coal Hydrogen Pathway Related Projects







# Nuclear Hydrogen Production Pathway Projects





## **Additional Projects**

- **Photobiological Hydrogen Research, FIU**
- **Developing Improved Materials to Support the Hydrogen Economy, Edison Materials Tech Center**
- **Production of Hydrogen for Clean and Renewable Sources of Energy for Fuel Cell Vehicles, University of Toledo**
- **Production, Fuel Cell, and Delivery Research, University of South Florida**
- **Photoelectrical Hydrogen Production, University of Arkansas – Little Rock**



## Session Instructions

- Presentations will begin precisely at the scheduled times.
- If a review presentation ends early, there will be a short break before the next review.
- Talks will be <20 minutes, Q&A <10 minutes.



## Session Instructions

- Reviewers have priority for questions over the general audience.
- Reviewers should be seated in front of the room for convenient access by the microphone attendants during the Q&A.



## Reviewer Reminders

- Reviews should be submitted at the end of the day.
- Reviews must be submitted before departure from the Annual Merit Review & Peer Evaluation meeting.



## Reviewer Reminders

- On Thursday, there will be a brief (5-15 minutes) reviewer feedback session following the last presentation.