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

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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.

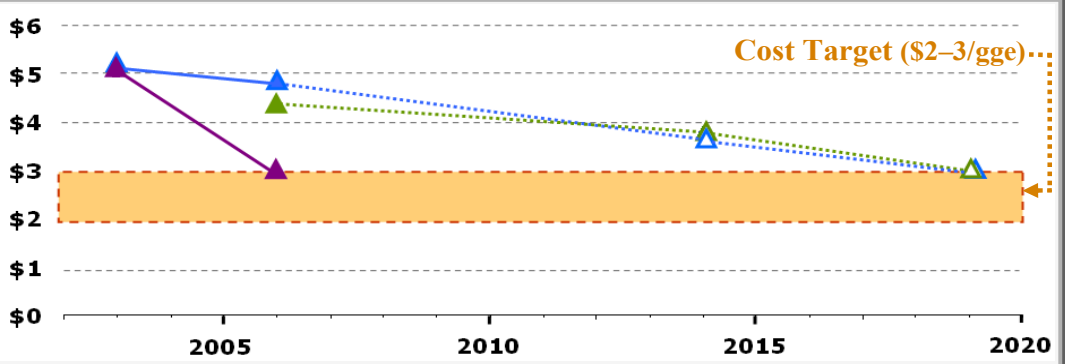
Cost of Hydrogen (Delivered) — Status & Targets

(in $/gallon gasoline equivalent (gge), untaxed)

NEAR TERM: Distributed Production

→ *Hydrogen is produced at station to enable low-cost delivery*

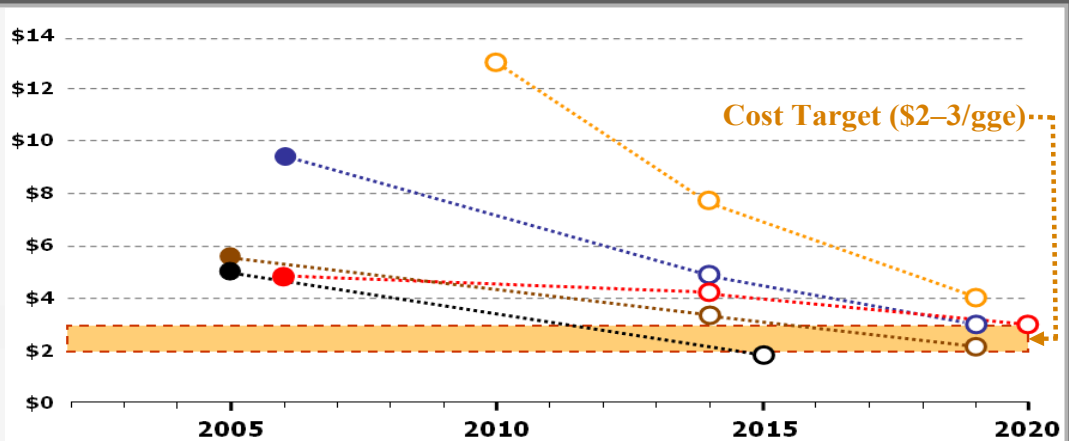
- Distributed Natural Gas
- Distributed Electrolysis
- Distributed Bio-Derived Renewable Liquids



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

Natural Gas

- Integrated Short Contact Time Hydrogen Generator **GE Global Research**
- Low-Cost Hydrogen Distributed Production System **H2Gen**

Production Analysis

- Distributed BILI Economic Analysis **DTI**
- OTEC Cost Analysis for NH3/H2 Production **ANL**

Bio-Derived Liquids

- Bio-Derived Liquids Reforming **PNNL**
- Biomass-Derived Carbohydrates via Aqueous-Phase Reforming **Virent**
- Investigation of Bio-Ethanol Steam Reforming Over Cobalt **Ohio State**
- Distributed Bio-Oil Reforming **NREL**
- High-Pressure Ethanol Reforming **ANL**
- OTM Distributed Reforming of Renewable Liquids **ANL**

Separation and Purification

- Zeolite Membrane Reactor for Water-Gas-Shift **Arizona State**
- Water Gas Shift via Single Stage Reactor **Media & Process**
- High-Performance, Durable, Pd-Alloy Membrane **Pall Corporation**
- Integrated Hydrogen Production, Purification & Compression **Linde (BOC)**
- Low-Temperature Ion Transport Membrane **ORNL**
- Ultra Thin Getter-coated Membranes **SNL**

Oral Presentation
Poster Presentation
Not Presented

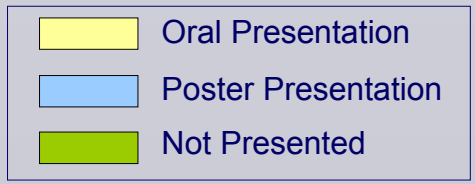
Electrolysis and Biomass Gasification Projects

Electrolysis

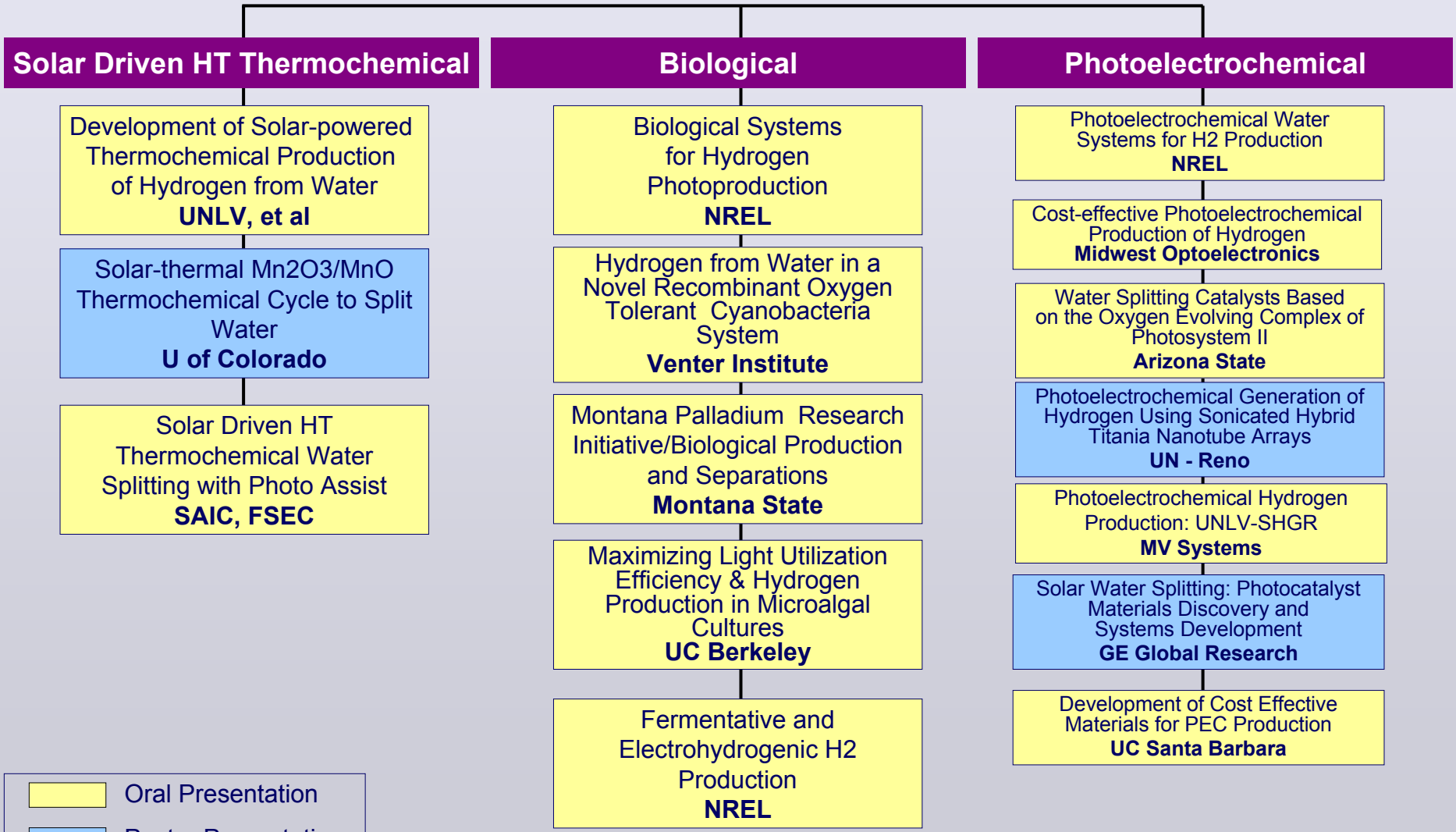
- Renewable Electrolysis Integrated System Development and Testing
  NREL
- Low-Cost, High-Pressure Hydrogen Generator
  Giner Electrochemical
- Cost Reduction of High-Pressure Hydrogen Generation
  Distributed Energy Systems
- Solid-Oxide Hybrid for Co-generation of Hydrogen and Electricity
  Materials and Systems Research
- High Capacity, High Pressure Electrolysis Stream with Renewable Power
  Avalence LLC
- Advanced Alkaline Electrolysis
  GE
- PEM Electrolyzer with Low Cost Membrane
  Giner

Biomass Gasification

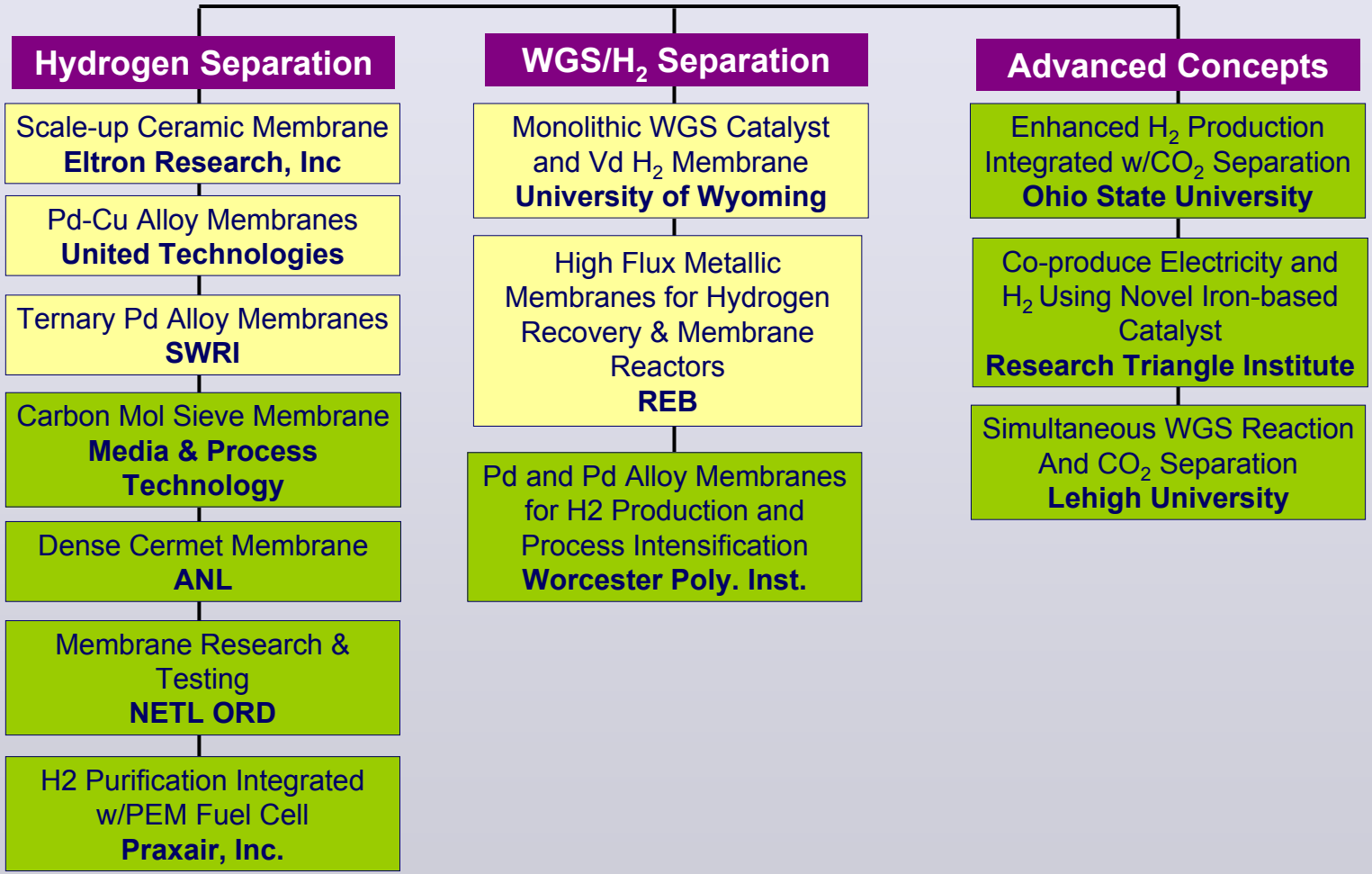
- Fully Integrated Pilot Scale Biomass to Hydrogen Unit
  NREL
- Novel Slurry-Based Biomass Reforming
  UTRC
- Biomass Gasification and Process Intensification
  GTI, et al



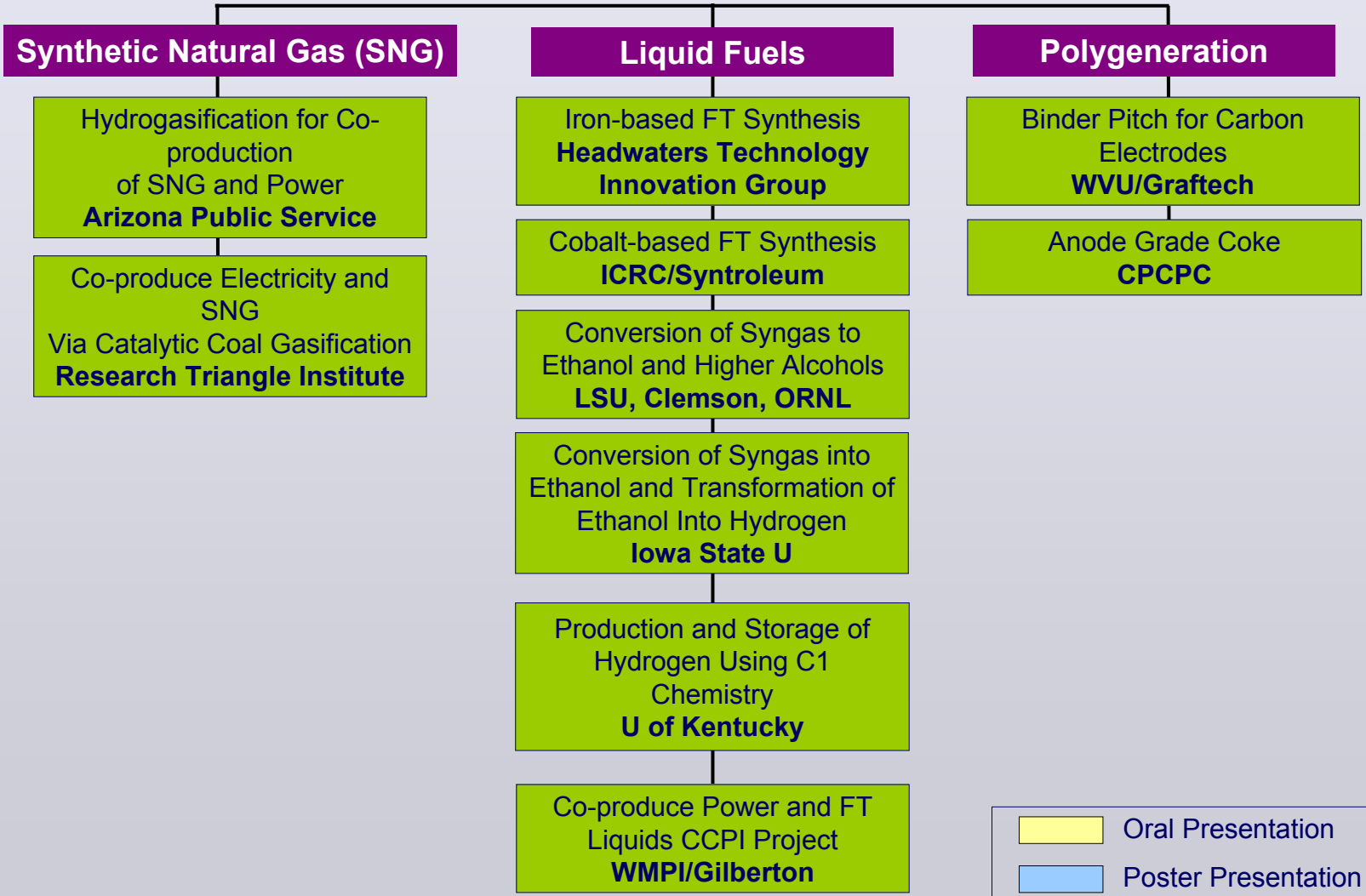
Longer Term Pathway Projects



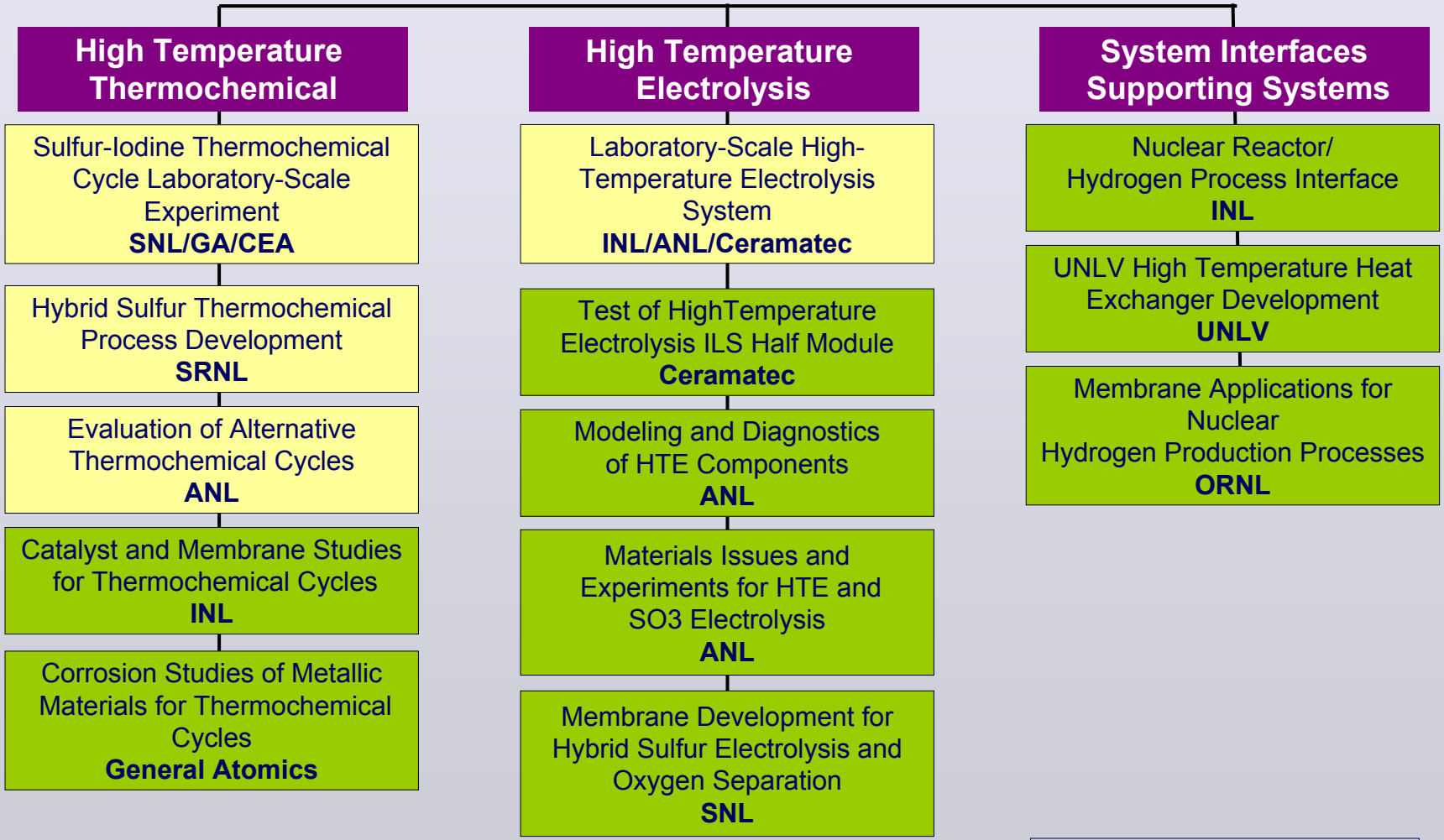
Coal Hydrogen Central Production Pathway Projects



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.