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Adapting Planar Solid Oxide Fuel Cells for use with Solid Fuel Sources in the Production of Distributed Power

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Objectives

Program Objectives

- Quantify impacts of synthesis gas composition on performance of a commercial planar solid oxide fuel cell system (cell and stack)
  - H_2S content
  - CO/H_2 ratio and energy content of gas
  - Particulate
  - Metal content
- Demonstrate long term operation of pSOFCs using actual sold fuel-derived synthesis gas
- Integrate CHP into distributed H_2 production

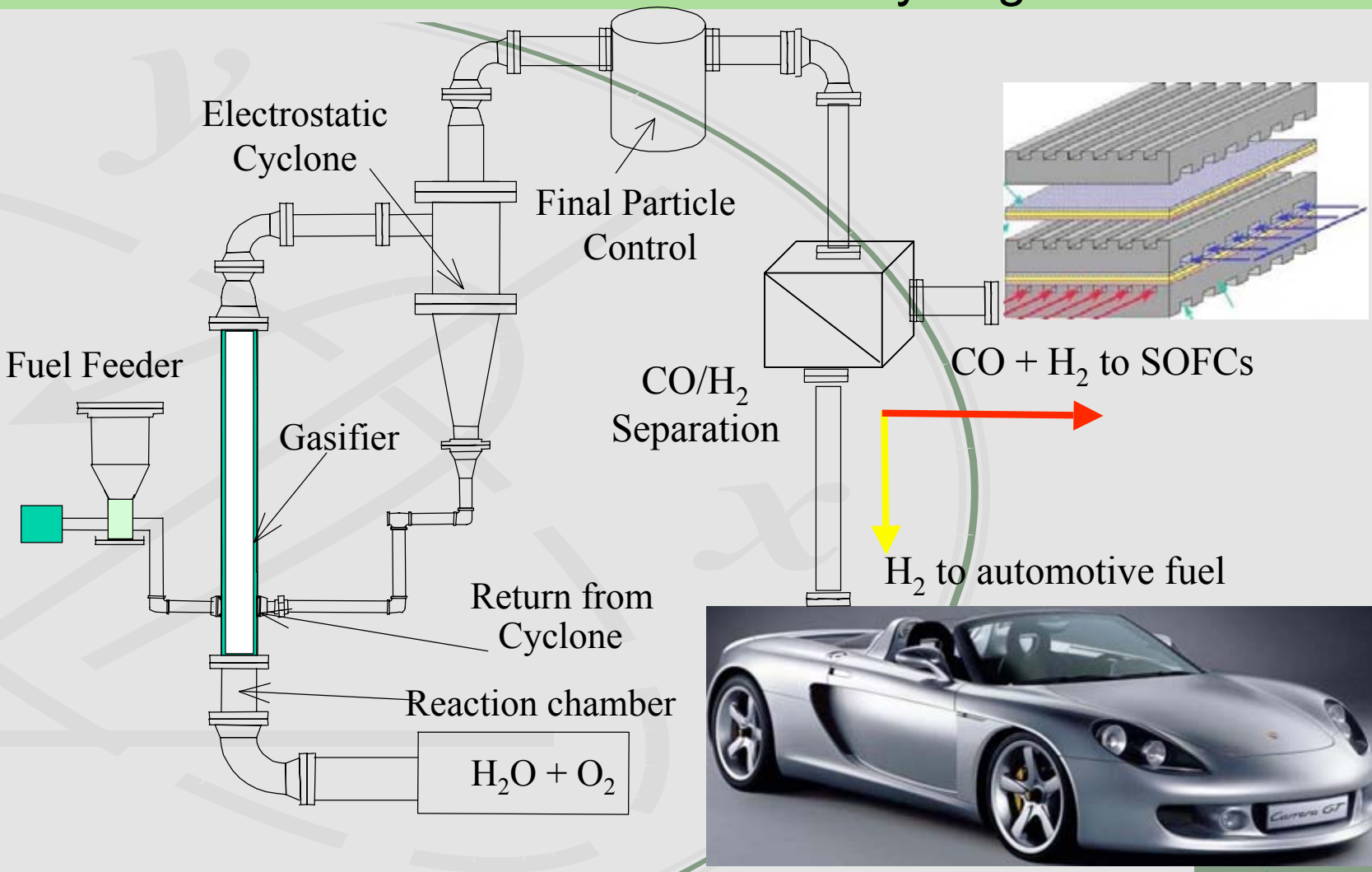
Project Approach

Distributed CHP and Hydrogen

- Develop fuel cell CHP from solid fuels
- Test pSOFCs for tolerance to syngas contaminants using single cell and stack platforms
- Use of CO tolerant pSOFCs allow H_2/CO separation without gas shift reactors
- Integrate CHP into distributed H_2 production

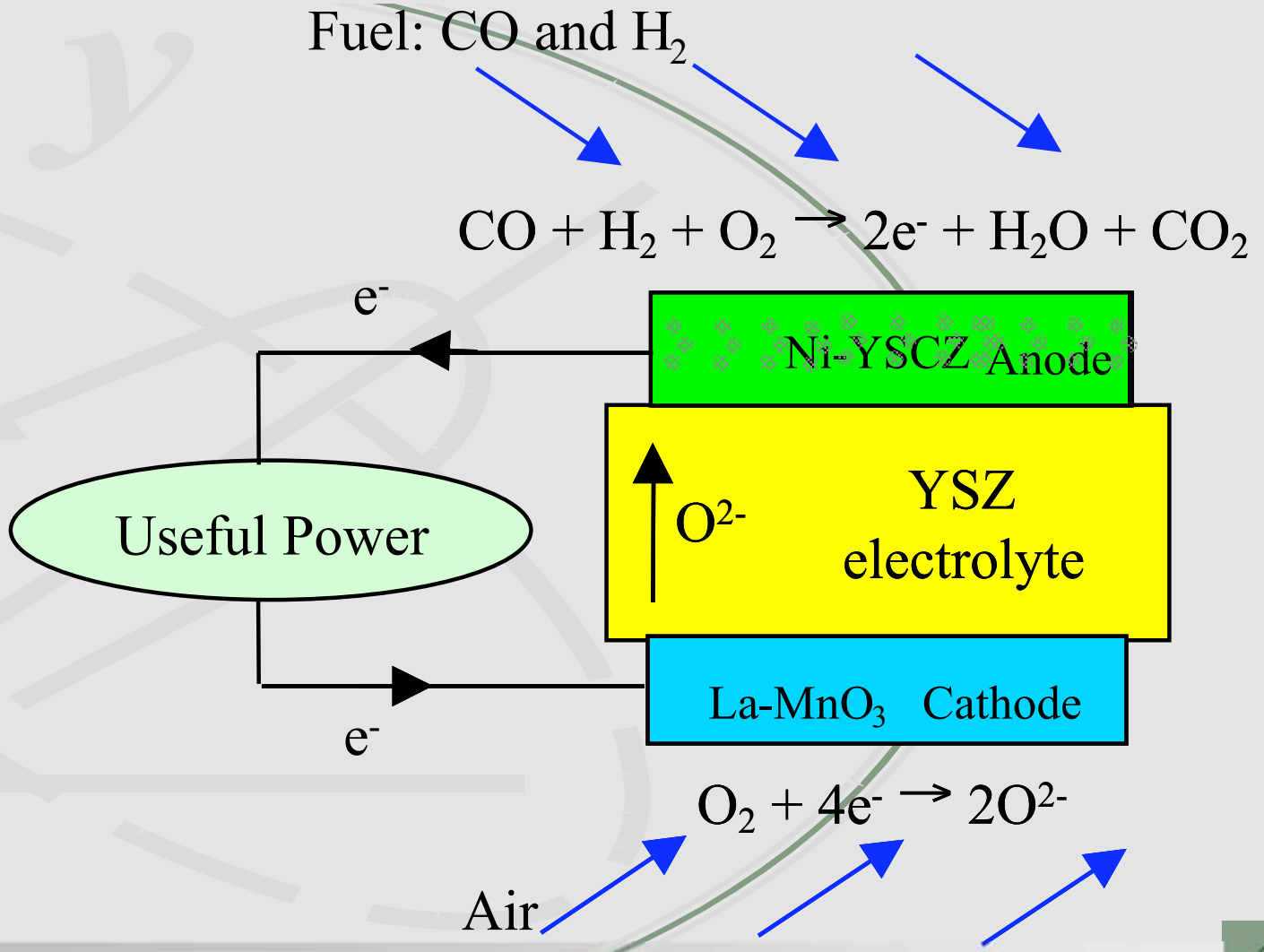
Project Approach

Distributed CHP and Hydrogen



Project Approach

Solid Oxide Fuel Cells



Technical Barriers and Targets

HFCIT Program Plan

- DOE Technical Barriers for Distributed Generation
  - Improved CO tolerance
  - Develop CHP fuel cell systems
  - Verify integrated stationary fuel cell systems
  - Mitigate technical barriers to stationary fuel cells
- DOE Technical Targets for 2010
  - 40,000 hours durability
  - $1000/kWe

Budget

Budget and Expenditures

Category	Budget	Expenditures
Personnel	$673,269	$175,157
Fringe Benefits	$140,579	$37,029
Travel	$16,500	$6,523
Equipment	$107,749	$27,989
Supplies	$84,483	$61,058
Contractual	$419,990	$111,096
Construction	$0	$0
Other	$263,165	$84,483
Total Direct Charges	$1,705,735	$503,335
Indirect Charges	$589,835	$125,768
Total	$2,295,570	$629,103
DOE Share	$1,926,744	$505,133
Cost Share	$368,826	$123,970

Project Safety

Hydrogen, Carbon Monoxide and H_2S Concerns

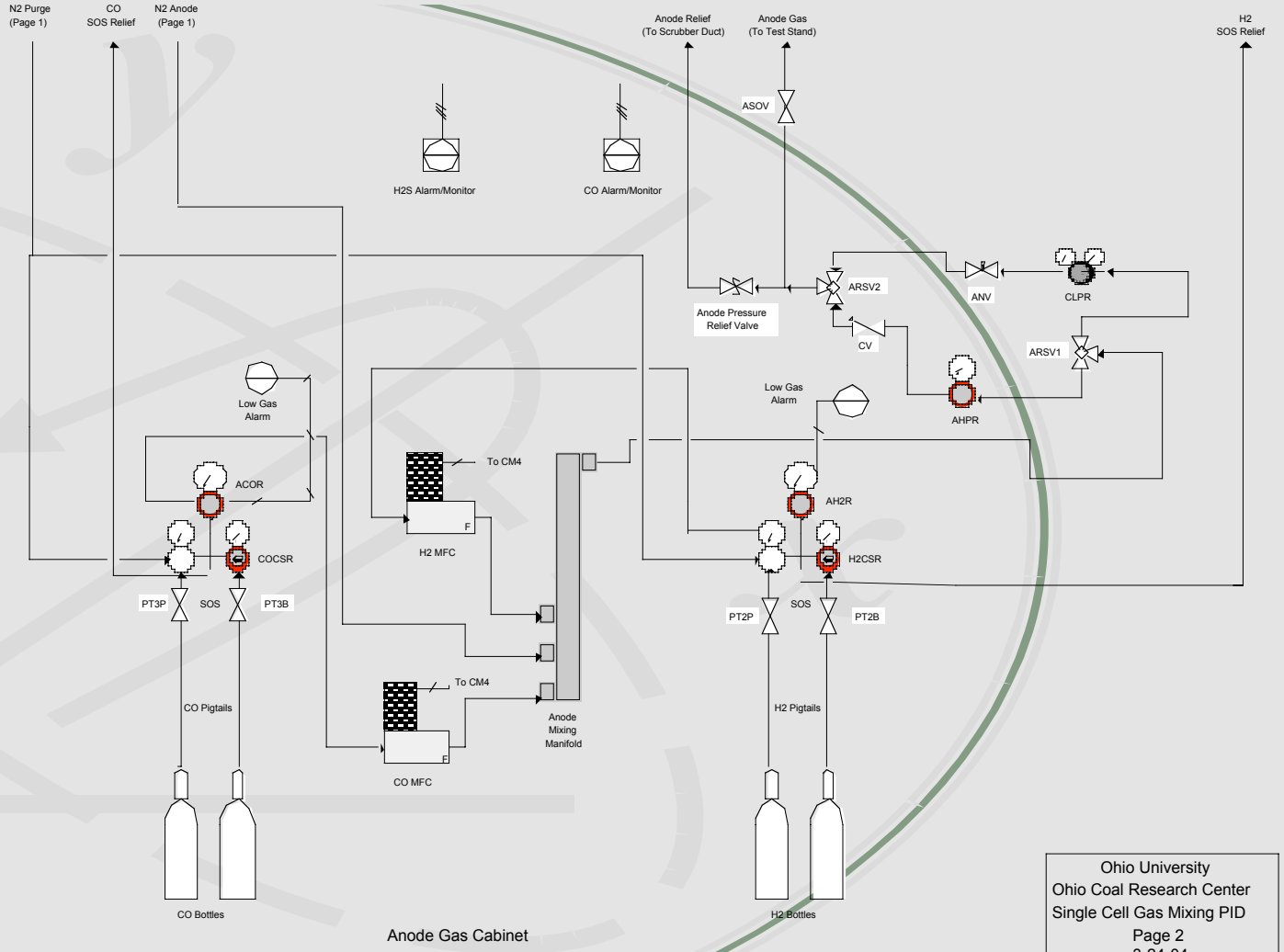
- FMEA Analysis
- Chemical hygiene training
- H_2S training
- Gas containment and scrubber system
- Operational SOP's
- PSD's – gas monitors, SKAT packs, room monitors
- Verification gases to test monitors/detectors
- Notification and review with local authorities for the types and quantities of gases used

Project Timeline

1. Modeling syngas/SOFC interface	Aug 03-Dec 04
2. Fabricate/install syngas system	Sep 03-May 04
3. Fabricate/install cell test stands	Sep 03-May 04
4. SOFC training for interns	Apr 04-Jun 04
5. SOFC material analysis baseline	May 04-Aug 04
6. Synthetic syngas testing	May 04-Dec 05
– 6.1 Baseline syngas	
– 6.2 Effect of Hg	
– 6.3 Effect of sulfur	
– 6.4 Effect of particulate	
– 6.5 Effect of energy content	
– 6.6 Effect of O_2 in oxidizer	
7. Electrostatic separation testing	Aug 04-Sep 06
8. H_2:CO separation or shift	Aug 05-Aug 07
9. Integration of fuel cells/gasifier	Jan 06-Aug 07

Project Accomplishments

Gas Delivery (including H_2S)



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Project Accomplishments

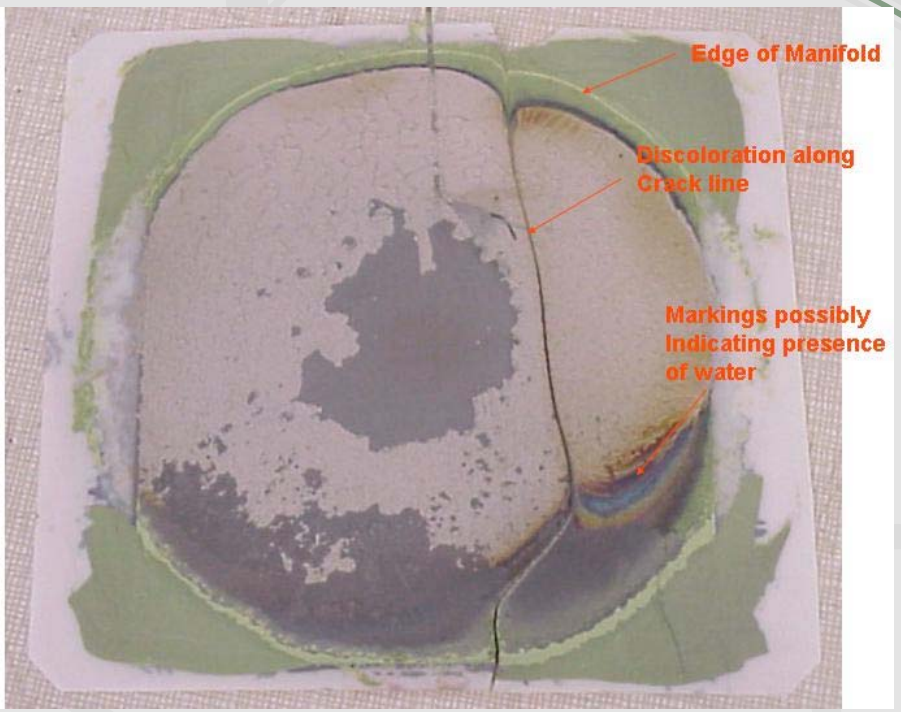
Gas Delivery (including H_2S)

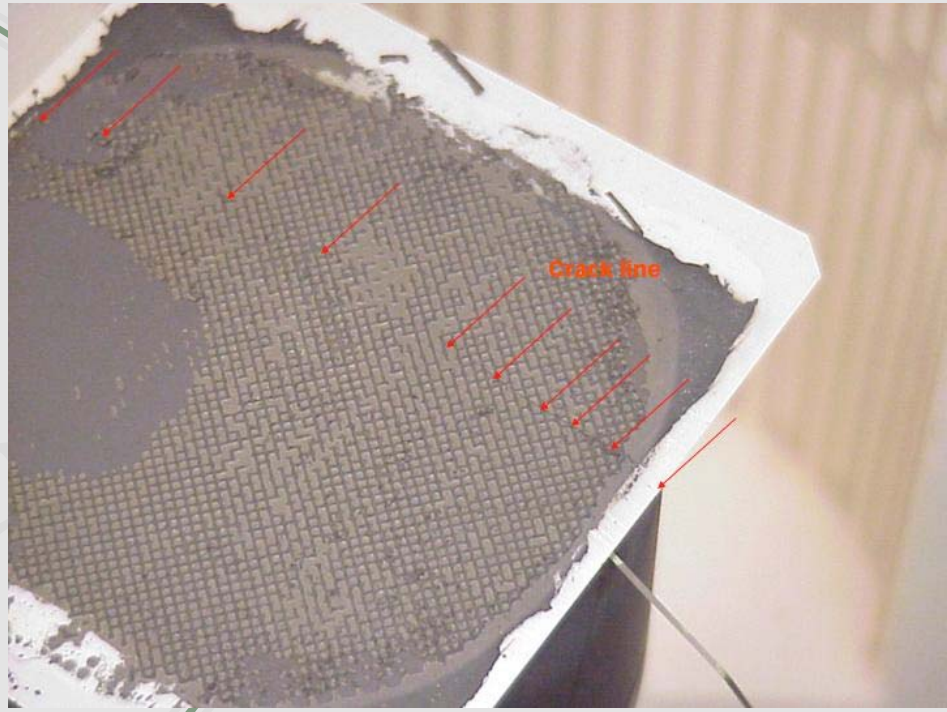
Project Accomplishments

Test Stands

Project Accomplishments

Fuel Cell





Project Accomplishments

Modeling

- Aspen platform
- Electrochemical model
- Thermal model
- Reforming/Gas Cleaning model
- Flow model

Interactions and Collaborations

Academic and Industrial Partnerships

- SOFCo-EFS (Fuel Cells)
- Case Western Reserve University
- University of Cincinnati
- State of Ohio's Air Quality Development Authority
- BAARD (Power Generation)
- Enercon (Gasification/Steam Reforming)

Future Work

Near and Long Term Plans

- Quantify impacts of synthesis gas composition on performance of a commercial planar solid oxide fuel cell system (cell and stack)
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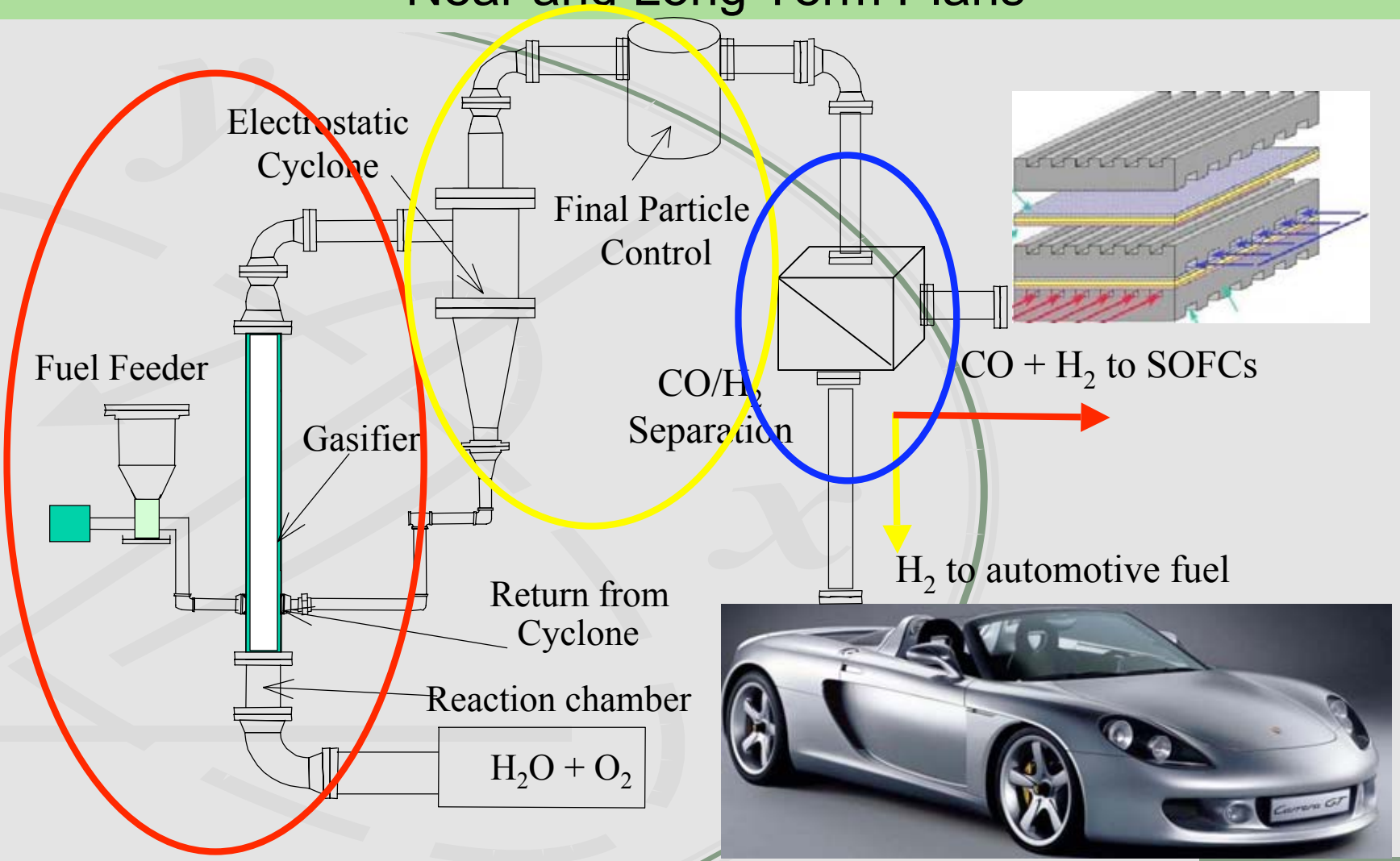
Future Work

Near and Long Term Plans



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