

Fuel Cell R&D

Nancy Garland

2006 DOE Hydrogen Program Annual Program Review

May 16, 2006

Fuel Cell Team

● DOE Team

- Valri Lightner, Fuel Cell Team Leader
- Jesse Adams (Golden Office)
- Kathi Epping
- John Garbak
- Nancy Garland
- Jill Gruber (Golden Office)
- Donna Ho
- Jason Marcinkoski
- Amy Manheim
- Reginald Tyler (Golden Office)
- David Peterson (Golden Office)

● ANL Technical Team

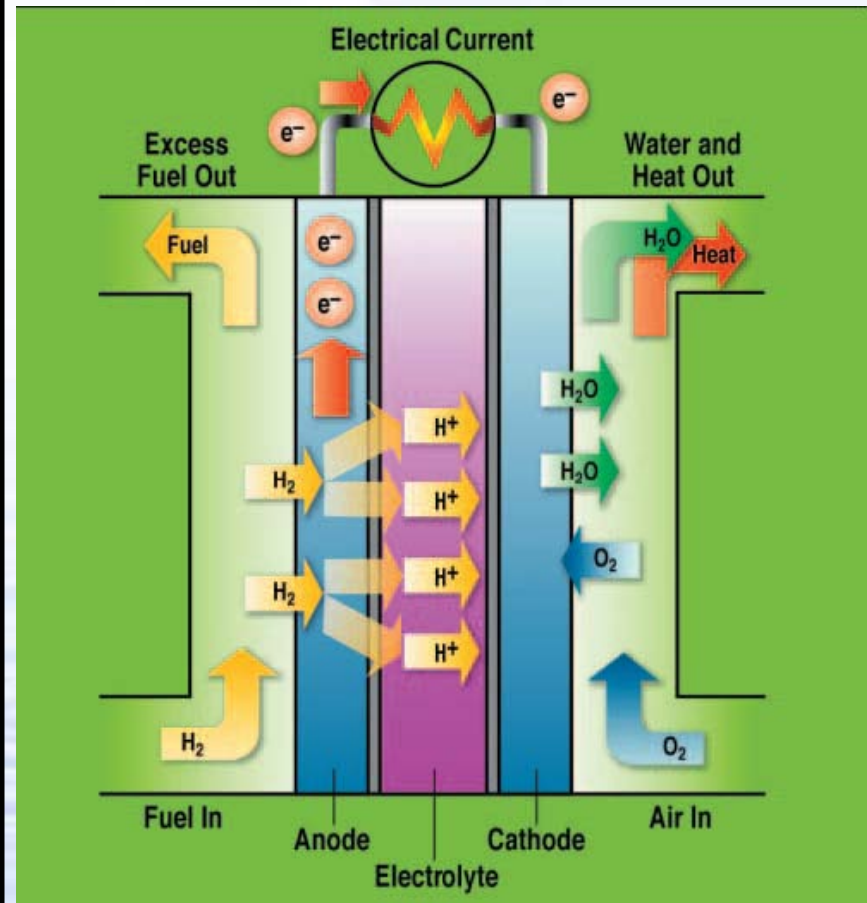
- Walt Podolski, Team Leader
- Tom Benjamin
- John Kopasz

Fuel Cell Barriers

Cost and durability are two of the more significant barriers to the achievement of clean, reliable, cost-effective systems.

BARRIERS

- A. Durability
- B. Cost
- C. Electrode Performance
- D. Thermal, Air, Water Management
- E. Compressors/Expanders
- F. Fuel Cell Power System Integration
- G. Power Electronics
- H. Sensors
- I. Hydrogen Purification/CO Cleanup
- J. Startup Time/Transient Operation



Key Targets



Transportation (PEMFC)

- \$45/kW by 2010
- \$30/kW by 2015
- 5,000 hours durability

Distributed Energy (PEMFC)

- \$750/kW by 2010
- 40,000 hours durability

Auxiliary Power Units (SOFC)

- specific power of 100 W/kg by 2010
- power density of 100 W/L by 2010

Consumer Electronics (DMFC)

- energy density of 1000 W-h/L by 2010



Technical Tasks

Technical Task	Description
Develop membranes that meet all targets	<ul style="list-style-type: none">• Identify ionomers & fabricate membranes• Test and characterize membranes
Develop electrodes that meet all targets	<ul style="list-style-type: none">• Improve catalysts & catalyst supports• Optimize electrode design & assembly
Develop MEAs that meet all targets	<ul style="list-style-type: none">• Integrate components & expand operating range• Test, analyze & characterize MEAs
Develop gas diffusion layers	<ul style="list-style-type: none">• Improve GDL performance & durability• Develop testing and characterization protocols & techniques
Develop bipolar plates	<ul style="list-style-type: none">• Improve performance & durability; decrease cost
Develop seals	<ul style="list-style-type: none">• Improve durability & performance
Develop balance-of-plant components	<ul style="list-style-type: none">• Develop sensors & air management technologies• Develop water & thermal management technologies
Develop stationary and other early market fuel cells	<ul style="list-style-type: none">• Develop stationary FC systems, APUs, and fuel cells for portable power and off-road applications
Conduct analysis	<ul style="list-style-type: none">• Conduct cost & tradeoff analyses• Improve technical understanding of durability and freeze issues
Characterize and benchmark fuel cells	<ul style="list-style-type: none">• Benchmark fuel cell technology to establish technology; develop protocols for testing• Investigate impact of impurities on fuel cell performance
Develop innovative concepts	<ul style="list-style-type: none">• Improve BOP designs and FC performance

Research Partners

BOP Components

*(delayed) Honeywell (2),
Advanced Fluids Tech.
(SBIR)*

Characterization and analysis

*NIST, ORNL, LANL,
LBNL, ANL, TIAX, DTI,
Battelle (revised)*

Membranes

*3M, Arkema, DuPont, Plug Power,
LANL, ANL, NREL, SNL, Colorado
School of Mines, Penn State,
Virginia Tech, Giner, U of Tenn,
Case Western Reserve U (2),
FuelCell Energy, Clemson U, GE
Global Research, Arizona State U,
U of Central Florida*

MEAs

UTC Fuel Cells, 3M, DeNora

Catalysts

*Ballard, U. of South Carolina, 3M,
Cabot-Superior Micropowders,
NRL, NASA/JPL, ANL, LBNL, BNL,
Farasis Energy (SBIR), NuVant
Systems (SBIR), Englehard, Ion
Power*

Bipolar Plates

*Porvair, ORNL, PNNL, NREL,
Nanosonic (SBIR)*

Stationary and other early market Fuel Cells

*(delayed) IdaTech (2),
UTC Fuel Cells, Plug
Power, Nuvera,
ChevronTexaco, Delphi,
Cummins, PolyFuel,
MTI Micro*

FY 2005 & FY 2006 Congressionally Directed Projects

*OSRAM Sylvania, Del
Co. Electric Coop, U of
S. Carolina, U of Akron,
U of S. Miss., UTCFC,
Kettering U*

Key Decisions



Go/No-Go Decision on Chemical and Physical Sensors



Go/No-Go Decision on FCs for Portable Power, APU and Off-Road Applications

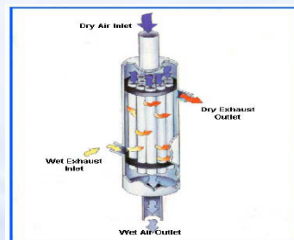
FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
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No-Go Decision for On-Board Fuel Processing



Nuvera - 200 kW_{th} fuel processor

Go/No-Go Decision on Air/Water/Thermal Management Technologies



Perma Pure membrane humidifier



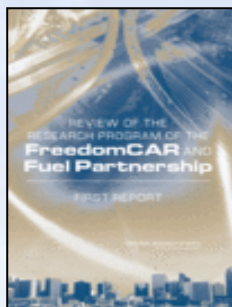
Mechanology-Toroidal intersecting vane machine

Go/No-Go Decision on Distributed Energy Systems



11/21/2004

Planning and Implementation



New Membrane Projects Selected for Award

Annual Program Review

New Fuel Cell Projects Selected for Award

NRC Review of FreedomCAR Partnership

High Temp Membrane Working Group & New Membrane Project Kick-off

Aug '05

Jan '06

May '06

Jul '06

Oct '06

Jan '07

Funding Opportunity Announcement/Lab Call for new Fuel Cell Projects to Meet 2010 Targets



MYRD&D Plan Updated

New Projects Begin

For More Information

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