
U.S. Department of Energy Hydrogen Program

Fuel Cells Subprogram Sessions

Nancy L. Garland

**2008 DOE Hydrogen Program
Merit Review and Peer Evaluation Meeting**

June 10, 2008





Goal and Objectives

GOAL: Develop and demonstrate fuel cell technologies for transportation, stationary, and portable power applications

- **Transportation applications**

- By 2010, develop a 60% peak-efficient, direct hydrogen fuel cell system at a cost of \$45/kW with 5000 hours of durability; by 2015, a cost of \$30/kW.

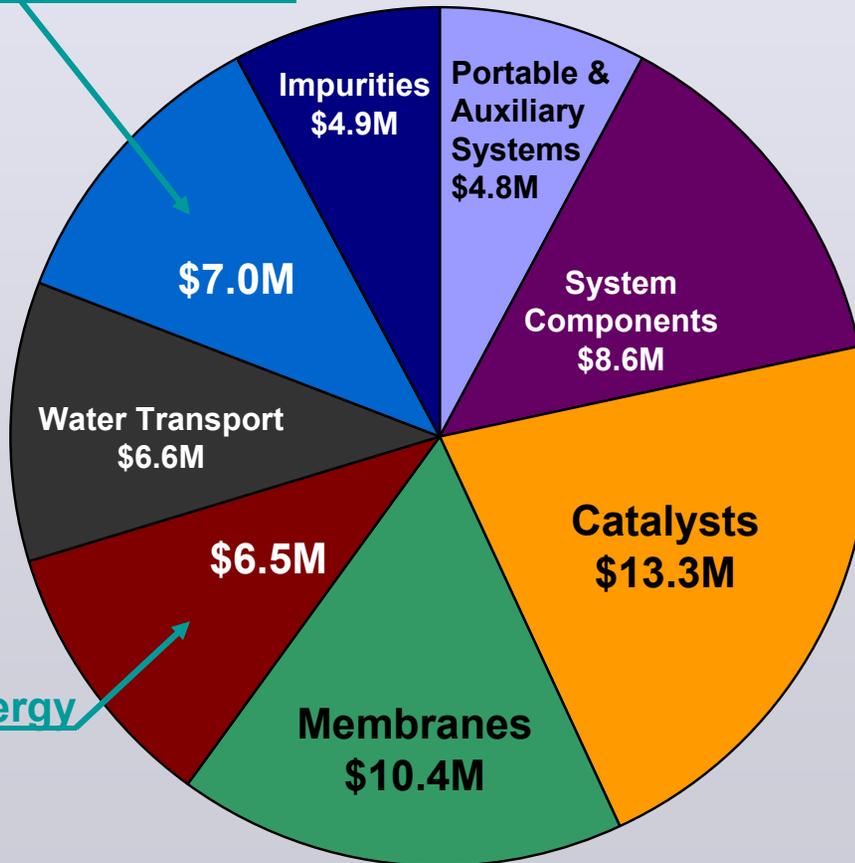
- **Stationary power and other early market fuel cell applications**

- By 2011, develop a distributed generation PEM fuel cell system operating on natural gas or LPG that achieves 40% electrical efficiency and 40,000 hours durability at \$750/kW.
- By 2010, develop a fuel cell system for consumer electronics (<50 W) with an energy density of 1,000 Wh/L.
- By 2010, develop a fuel cell system for auxiliary power units (3-30 kW) with a specific power of 100 W/kg and a power density of 100 W/L.



FY 2008 Budget by Topic

Characterization / Analysis



FY08 Emphasis

- Develop high-temperature, low-relative humidity membranes; assess progress against interim targets
- Increase catalyst activity and reduce platinum group metal loading to lower fuel cell cost
- Design strategies to mitigate stack component degradation
- Continue/complete stationary fuel cell system projects
- Develop models relating performance loss to impurity concentration
- Optimize GDL properties and pore structure

FY2008 Appropriation = \$62.1M

FY2009 Budget Request = \$79.3M



Current Research Partners

Innovative Concepts

ANL, CWRU, PNNL

Water Transport

RIT, CFD, Nuvera, LANL

Stationary Fuel Cell System Demonstrations

*Intelligent Energy,
Plug Power (2)*

Congressionally Directed

*Nanosys, Inc., Superprotonic, Inc.,
Lilliputian Systems, Inc.,
Michigan Technical University,
University of Southern Mississippi,
Microcell Corporation, CSM,
Nanodynamics Energy, Inc.,
Stark State College of Technology, EMTEC,
Rolls Royce, University of Akron,
University of South Carolina, UT- Arlington*

Membranes

*Arkema, LBNL, 3M, Colorado School of Mines (CSM),
Penn State, Virginia Tech, Giner, U of Tenn.,
Case Western Reserve U (2), FuelCell Energy, Clemson U,
Arizona State U, U of Central Florida*

Catalysts and Supports

3M, ANL, LANL, PNNL, BASF, Ion Power, UTC Power

Impurities

Clemson, U Conn, LANL

Cell Hardware

GrafTech, UTC Power, ORNL

Portable/APU/Off road

Cummins, Delphi, IdaTech, MTI, PolyFuel

Characterization/Analysis

*ANL, Battelle, DTI, LANL,
NIST, ORNL, TIAX*

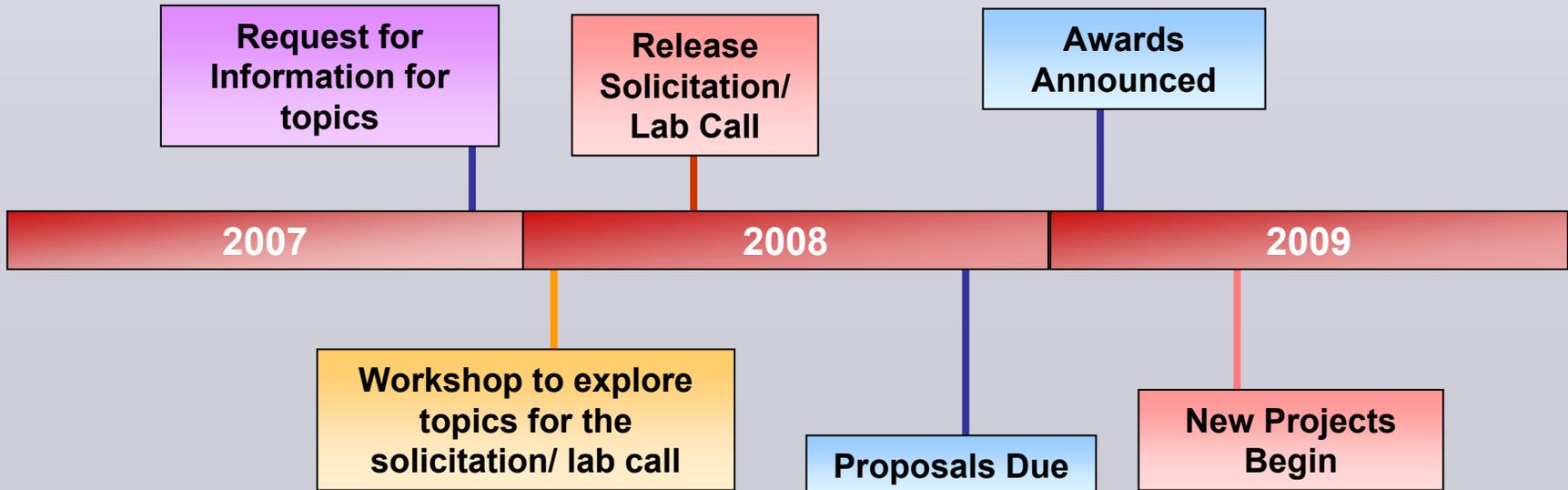
Distributed Energy Systems

UTC Power



Fuel Cell Subprogram 2008 Solicitation/Lab Call

- *Request for Information (RFI) issued in Federal Register in November 2007 for suggested topic areas*
- *Workshop explored potential fuel cell research and development topics*
- *Ideas from the RFI and workshop taken into consideration for the solicitation/lab call released in May 2008¹*

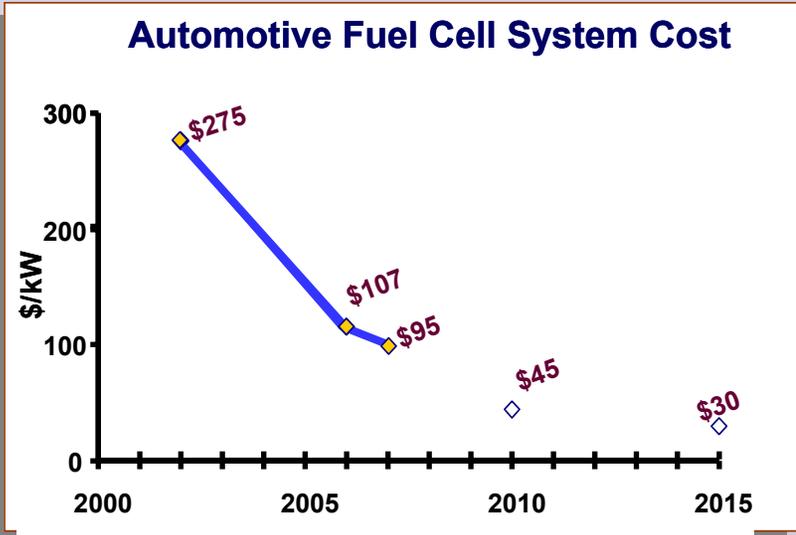
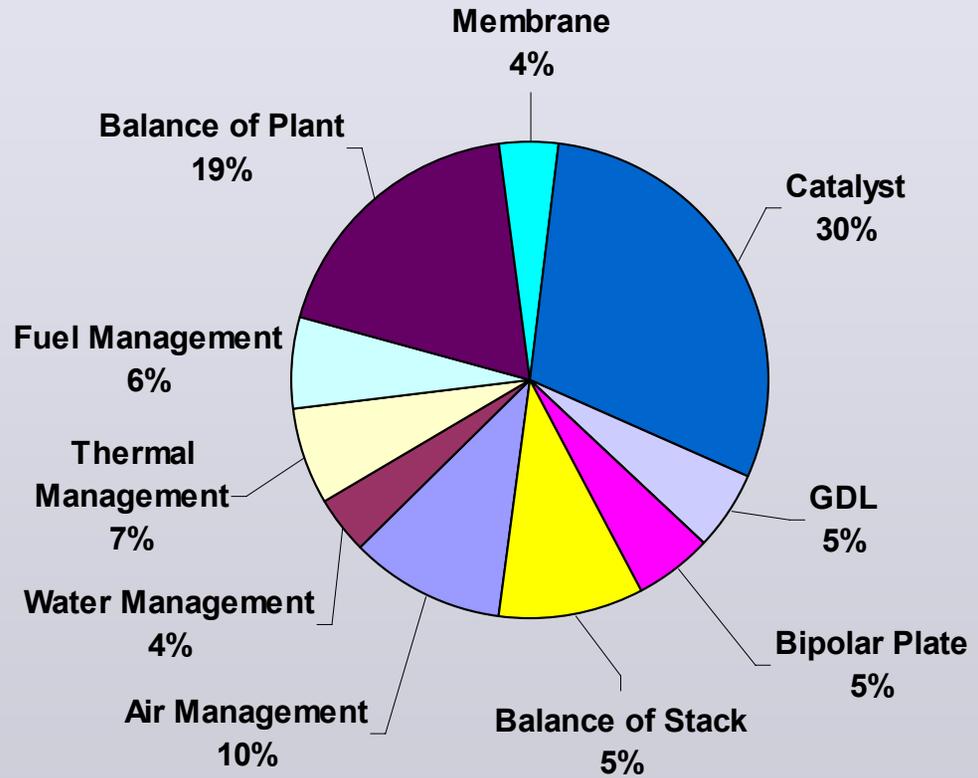


¹http://www.hydrogen.energy.gov/news_afct_investment.html



Projected Automotive System Cost Reduced to \$95/kW

- Based on DTI DFMA 2007 cost analysis
- Projected to manufacturing volume of 500,000 units/year.



**80 kW, direct-hydrogen automotive
PEM fuel cell system**



Tuesday Fuel Cell Presentations

Start	Presenter	Organization	Title
8:45 AM	Nancy Garland	DOE	Fuel Cells
9:00 AM	Mark Debe	3M Company	Advanced Cathode Catalysts and Supports for PEM Fuel Cells
9:30 AM	Debbie Myers	ANL	Non-Platinum Bimetallic Cathode Electrocatalysts
10:00 AM	Piotr Zelenay	LANL	Advanced Cathode Catalysts
10:30 AM	Break		
11:00 AM	Yong Wang	PNNL	Development of Alternative and Durable High Performance Cathode Supports for PEM Fuel Cells
11:30 AM	Thomas Jarvi	UTC Power	Highly Dispersed Alloy Cathode Catalyst for Durability
12:00 PM	Rajesh Ahluwalia	ANL	Fuel Cell Systems Analysis
12:30 PM	Lunch		
1:45 PM	Brian James	DTI	Mass Production Cost Estimation for Direct H ₂ PEM Fuel Cell System for Automotive Applications
2:15 PM	Jayanti Sinha	TIAX	Direct Hydrogen PEMFC Manufacturing Cost Estimation for Automotive Applications
2:45 PM	Karren More	ORNL	Microstructural Characterization Of PEM Fuel Cell MEAs
3:15 PM	Bryan Pivovar	LANL	Applied Science for Electrode Cost, Performance, and Durability
3:45 PM	Break		
4:15 PM	Fred Mitlitsky	Bloom Energy Corp.	Low-cost Co-production of Hydrogen and Electricity
4:45 PM	James Goldbach	Arkema	Improved, Low-Cost, Durable Fuel Cell Membranes
5:15 PM	Steven Hamrock	3M	Membranes and MEA's for Dry, Hot Operating Conditions
5:45 PM	John Kerr	LBNL	New Polyelectrolyte Materials for High Temperature Fuel Cells



Wednesday Fuel Cell Presentations

Start	Presenter	Organization	Title
9:00	James Fenton	U of Central Florida	Lead Research and Development Activity for DOE's High Temperature, Low Relative Humidity Membrane Program
9:30	James McGrath	Virginia Tech	Advanced Materials for Proton Exchange Membranes
10:00	Dominic Gervasio	Arizona State	Protic Salt Polymer Membranes: High-Temperature Water-Free Proton-Conducting Membranes
10:30	Break		
11:00	Stephen Creager	Clemson	Fluoroalkyl-phosphonic-acid-based proton conductors
11:30	Morton Litt	Case Western Reserve University	Rigid Rod Polyelectrolytes: Effect on Physical Properties Frozen-in Free Volume: High Conductivity at low RH
12:00	Peter Pintauro	Case Western Reserve University	NanoCapillary Network Proton Conducting Membranes for High Temperature Hydrogen/Air Fuel Cells
12:30	Lunch		
1:45	Andy Herring	Colorado School of Mines	Novel Approaches to Immobilized Heteropoly Acid (HPA) Systems for High Temperature, Low Relative Humidity Polymer-Type Membranes
2:15	Serguei Lvov	Penn State	New Proton Conductive Composite Materials with Co-continuous Phases Using Functionalized and Crosslinkable VDF/CTFE Fluoropolymers
2:45	Ludwig Lipp	FuelCell Energy, Inc.	High Temperature Membrane with Humidification-Independent Cluster Structure
3:15	Cortney Mittelsteadt	Giner	Dimensionally Stable Membranes
3:45	Break		
4:15	Jimmy Mays	U of Tennessee	Poly(cyclohexadiene)-Based Polymer Electrolyte Membranes for Fuel Cell Applications
4:45	Rod Borup	LANL	PEM Fuel Cell Durability
5:15	Peter Tortorelli	ORNL	Nitrided Metallic Bipolar Plates
5:45	Orest Adrianowycz	GrafTech International, Ltd.	Next Generation Bipolar Plates for Automotive PEM Fuel Cells



Thursday Fuel Cell Presentations

Start	Presenter	Organization	Title
9:00	James Goodwin	Clemson University	Effects of Impurities on Fuel Cell Performance and Durability
9:30	Fernando Garzon	LANL	Effects of Fuel and Air Impurities on PEM Fuel Cell Performance
10:00	Trent Molter	University of CT	The Effects of Impurities on Fuel Cell Performance and Durability
10:30	Break		
11:00	Vernon Cole	CFD Research Corp	Water Transport in PEM Fuel Cells: Advanced Modeling, Material Selection, Testing, and Design Optimization
11:30	James Cross	Nuvera Fuel Cells	Subfreezing Start/Stop Protocol for an Advanced Metallic Open-Flowfield Fuel Cell Stack
12:00	David Jacobson	NIST	Neutron Imaging Study of the Water Transport in Operating Fuel Cells
12:30	Lunch		
1:45	Satish Kandlikar	Rochester Institute of Technology	Visualization of Fuel Cell Water Transport and Performance Characterization Under Freezing Conditions
2:15	Rod Borup	LANL	Water Transport Exploratory Studies
2:45	Zia Mirza	Honeywell	Water/Thermal Management
3:15	Ward TeGrotenhuis	PNNL	Low-Cost Manufacturable Microchannel Systems for Passive PEM Water Management
3:45	Break		
4:15	Durai Swamy	Intelligent Energy	Development and Demonstration of a New-generation High Efficiency 1-10 kW Stationary PEM Fuel Cell System
4:45	John Vogel	Plug Power Inc.	International Stationary Fuel Cell Demonstration
5:15	Rhonda Staudt	Plug Power Inc.	Intergovernmental Stationary Fuel Cell System Demonstration
5:45	Eric Strayer	UTC Power	Stationary PEM Fuel Cell Power Plant Verification



Friday Fuel Cell Presentations

Start	Presenter	Organization	Title
9:00	Daniel Norrick	Cummins	Diesel Fueled SOFC System for Class 7/Class 8 On-Highway Truck Auxiliary Power
9:30	Gary Blake	Delphi	Solid Oxide Fuel Cell System Development for Auxiliary Power in Heavy Duty Vehicle Applications
10:00	Chuck Carlstrom	MTI Micro Fuel Cells	DMFC Prototype Demonstration for Consumer Electronic Applications
10:30	Break		
11:00	Brian Wells	Polyfuel Inc.	DMFC Power Supply for All-Day True-Wireless Mobile Computing
11:30	John Van Zee	U of So. Carolina	Fuel Cell Research at the University of South Carolina
12:00	Di-Jia Liu	ANL	Novel PEMFC Stack Using Patterned Aligned Carbon Nanotubes as Electrodes in MEA
12:30	Stuart Snyder	Montana State	Detection of Trace Platinum Group Metal Element Particulates with Laser Spectroscopy



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 limited to 20 minutes to allow for 10 minutes for Q&As
- 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.
- On Thursday, there will be a brief (5-15 minutes) reviewer feedback session following the last presentation.



For More Information

Contact the Fuel Cell Team

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