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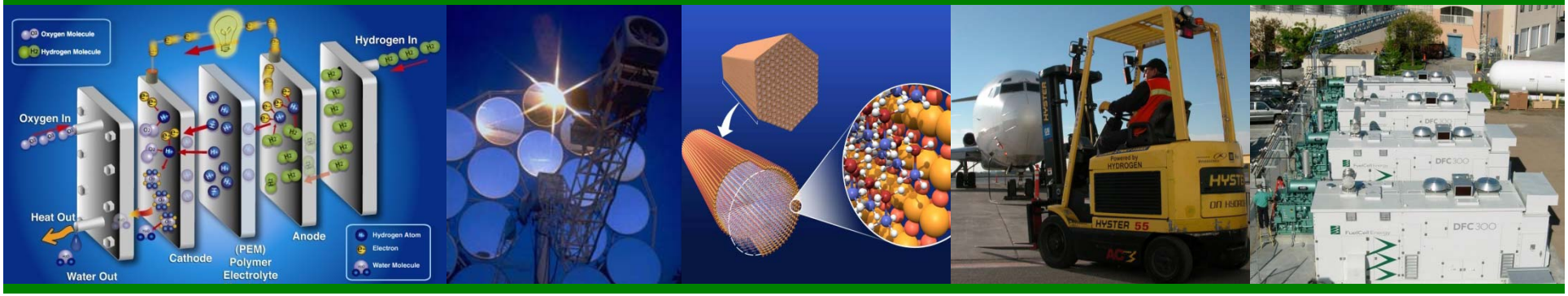

Fuel Cell Bus Workshop

Overview and Purpose

Dimitrios Papageorgopoulos

Fuel Cell Technologies Program

DOE and DOT Joint Fuel Cell Bus Workshop, Washington DC

June 7, 2010

Fuel Cells - *Addressing Energy Challenges*

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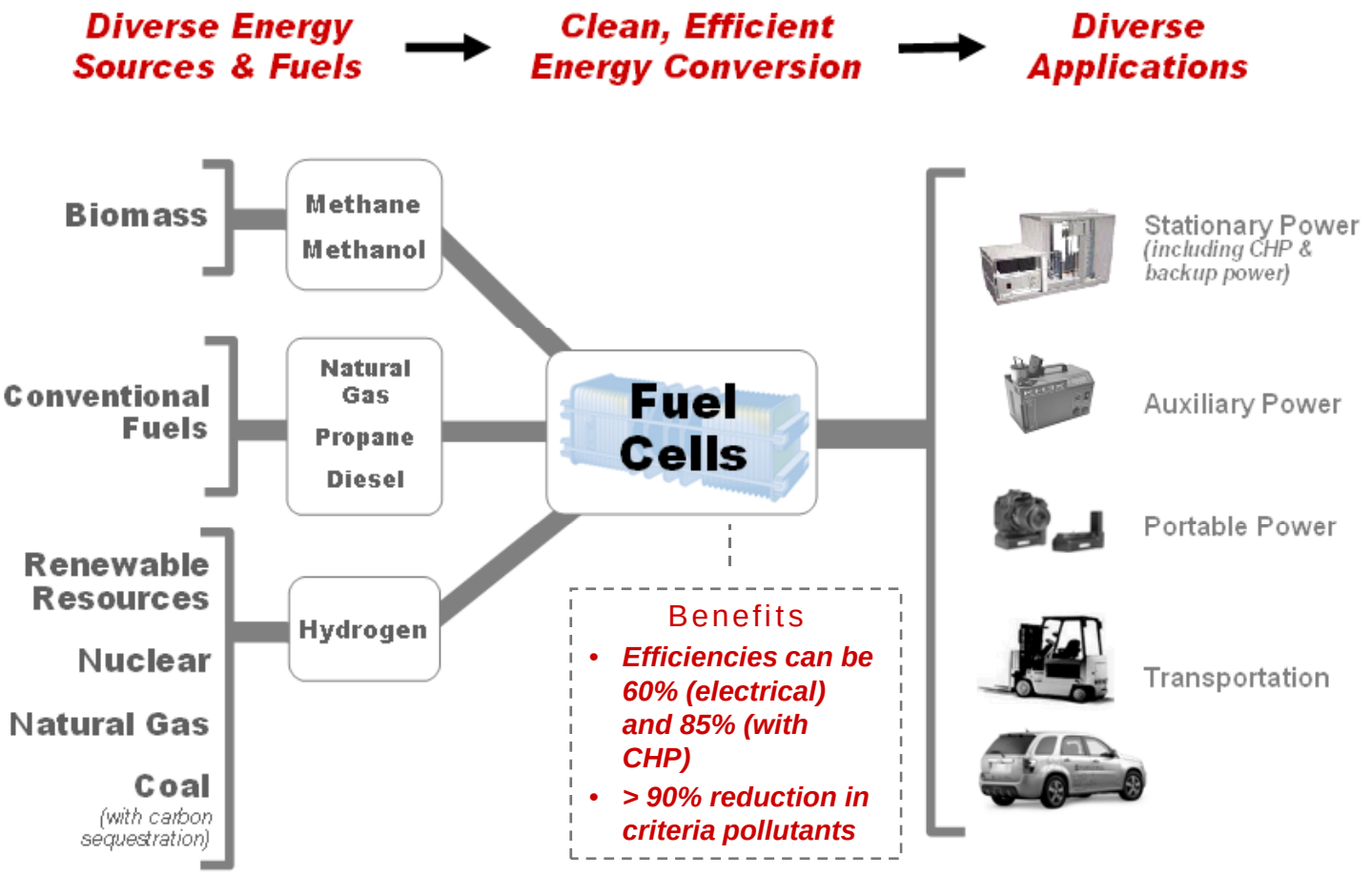
Energy Efficiency and Resource Diversity

- ***Fuel cells offer a highly efficient way to use diverse fuels and energy sources.***

Greenhouse Gas Emissions and Air Pollution:

- ***Fuel cells can be powered by emissions-free fuels that are produced from clean, domestic resources.***



Fuel Cell Systems R&D

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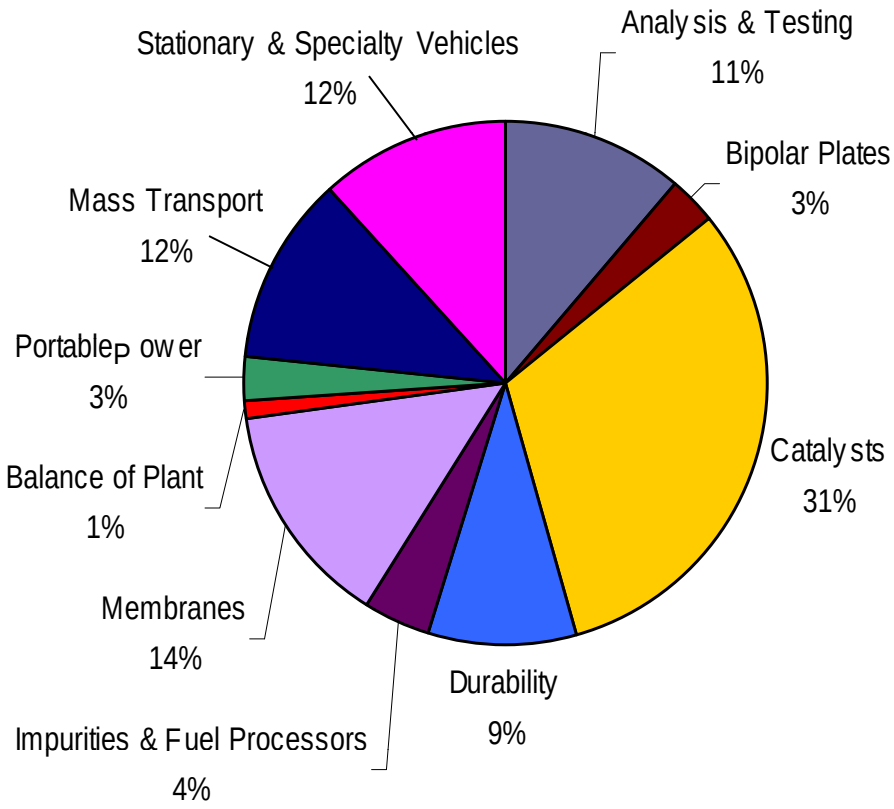
FY 2010
APPROPRIATION = $77.4M



FY 2010 Emphasis

R&D of materials, stack components, balance-of-plant subsystems, and integrated fuel cell systems targeting lower cost and enhanced durability

- Develop improved fuel cell catalysts and membrane electrolytes
- Characterize and optimize transport phenomena improving MEA and stack performance
- Optimize fuel cells and systems for early market applications
- Develop innovative concepts leading to a new generation of fuel cell technologies

Applications include: transportation, combined heat and power (CHP), auxiliary power units (APUs), direct methanol fuel cells for portable power, and backup power for critical infrastructure.

Fuel Cells R&D for Bus Applications: Durability

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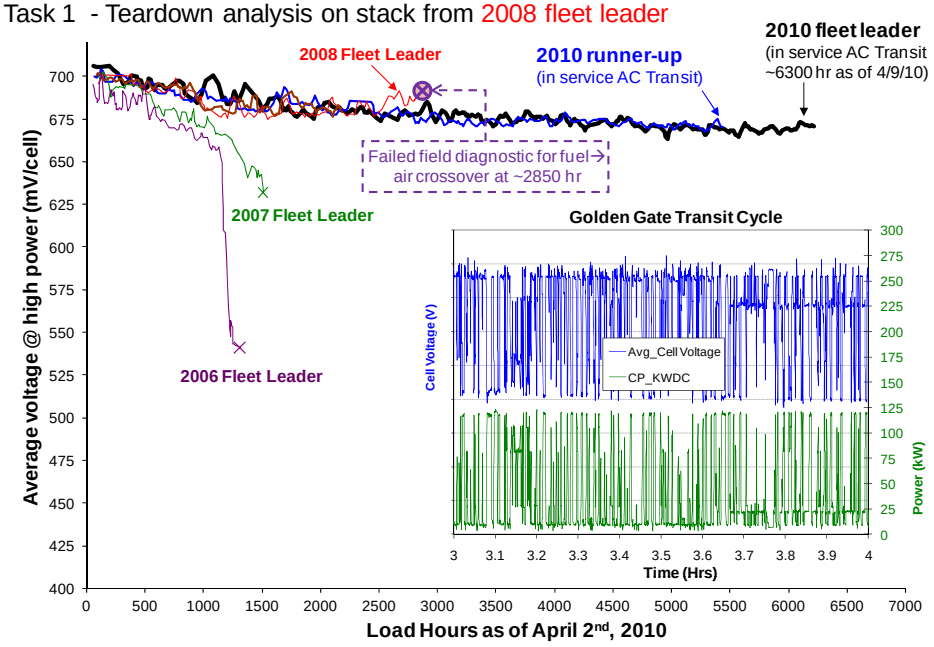
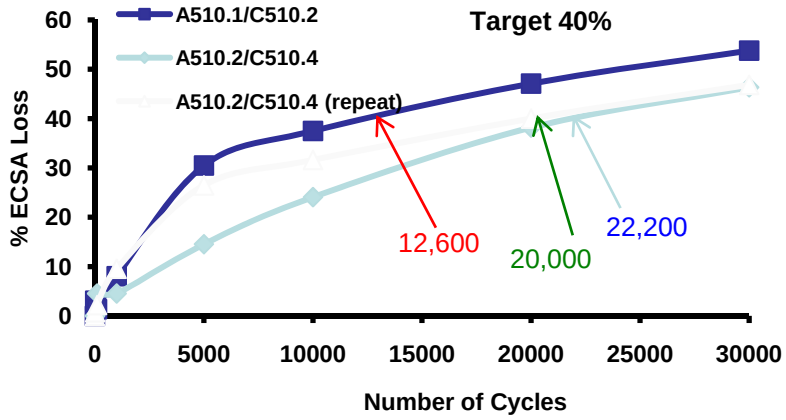
UTC, Ballard, and LANL are studying durability and developing improved ASTs

UTC: demonstrating long lifetime in real-world bus operation

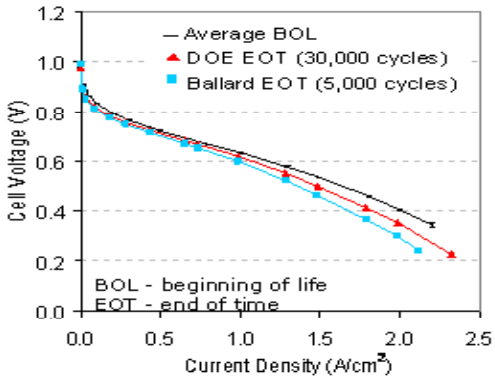
Task 1 - Teardown analysis on stack from 2008 fleet leader

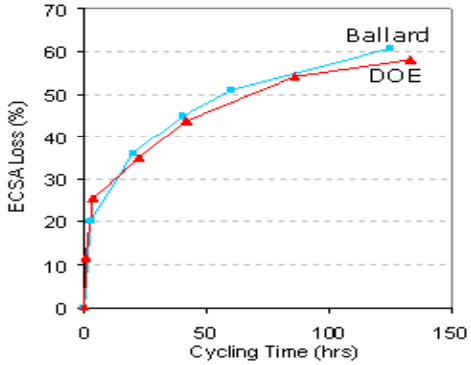


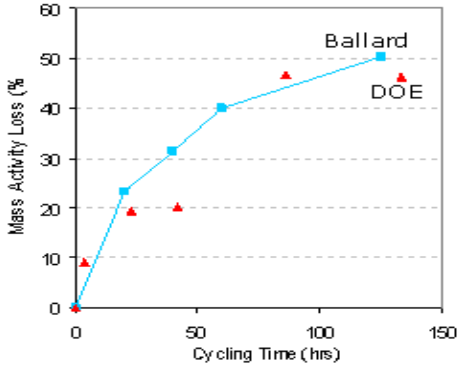
LANL: improved ASTs using materials from Gore and Ballard



Ballard: developing strategies to mitigate degradation







Fuel Cell Bus Evaluation

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DOE (FCT-Tech .Val.), NREL, and FTA are working closely to evaluate fuel cell technologies in transit applications

A comparison to conventional bus technology *

Attribute	Fuel Cell Technology	Conventional Diesel Technology
Fuel Economy	2 times higher than conventional buses	3 – 4 miles per gallon (diesel)
Reliability (measured in "miles between road call," or MBRC)	919 – 1,600 MRBC	10,000 MBRC
Availability	58-77%	85%
Capital Cost	$2 – $3 million	$328,000
Fuel Cost	$8.90 to $18.80 per diesel gallon equivalent	$4.72/gallon*

Source: L. Eudy, et al., *Fuel Cell Buses in U.S. Transit Fleets: Summary of Experiences and Current Status* (September 2007), NREL/TP-560-41967, http://www.nrel.gov/hydrogen/pdfs/41967.pdf, accessed May 2008.

* Energy Information Administration, Weekly On-Highway Diesel Prices, 07/07/08, http://tonto.eia.doe.gov/oog/info/wohdp/diesel.asp, accessed July 2008.

*** DOE's 2008 Fuel Cell School Buses Report to Congress (http://www.hydrogen.energy.gov/congress_reports.html)**

Fuel Cell Bus Workshop: Purpose

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DOE and DOT have invited the fuel cell bus community and other stakeholders to participate in a discussion of the most relevant research and development topics to fuel cell buses for government funding.

Specific emphasis will be placed on:

- Fuel cell stack components
- Fuel cell system balance of plant
  (excluding infrastructure, demonstration, drive-train, and non-fuel cell related bus components)

Plenary speakers include:

- Fuel cell manufacturers
- Fuel cell bus integrators and end users
- Government funding agency representatives

Fuel Cell Bus Workshop: Agenda

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08:00 **Fuel Cell Bus Workshop: Overview and Purpose**

DOE – Dimitrios Papageorgopoulos

08:10 **DOT/FTA national Fuel Cell Bus Program**

DOT – Venkat Pindiprolu

08:20 **Users Perspective on Advanced Fuel Cell Bus Technology**

CaFCP - Nico Bouwkamp NREL - Leslie Eudy

08:30 **Progress and Challenges for PEM Transit Fleet Applications**

UTC - Tom Madden

08:45 **Fuel Cell Buses – Current Status and Path Forward**

Ballard Power Systems – Greg James

09:00 **Powering a Full-Size Transit Bus with Two 16kW Forklift Fuel Cells – The Proterra Story**

Proterra – Dale Hill

09:15 **HybriDrive Propulsion System – Cleaner, Smarter Power for Transit**

BAE Systems – Bart Mancini

09:30 **Break**

09:45 **Brainstorming: Technical Barriers, R&D Needs, Technical Targets & Timeframes**

DOE – Papageorgopoulos

11:45 **Summary & Wrap-Up**

DOE/DOT – Papageorgopoulos/Pindiprolu

12:00 **Adjourn**