Hydrogen Storage – DOE Program/Targets and Workshop Objectives

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Hydrogen Storage Workshop
Argonne National Laboratory
August 14, 2002

Outline

- The Hydrogen, Fuel Cells, and Infrastructure Program
- Role of FreedomCAR
- R&D Priorities
- DOE Fuel Cell & Hydrogen Activities
- DOE Targets/Status
- Workshop Objectives

Hydrogen and Fuel Cells are a High Priority within EERE

<u>National Energy Policy</u> - "Focus research and development efforts on integrating current programs regarding hydrogen, fuel cells, and distribution…"

Hydrogen Vision/Roadmap Workshops held Nov 2001 & April 2002 with industry stakeholders

- Hydrogen Vision complete
- Hydrogen Roadmap draft completed
- www.eren.doe.gov/hydrogen/features.html

Technology development for hydrogen fuel cell vehicles is the thrust of the FreedomCAR Partnership

"The President's Plan directs us to explore the possibility of a hydrogen economy…."
Spencer Abraham, Secretary of Energy

Hydrogen and Fuel Cells Program R&D Priorities

1. Hydrogen Storage

2. Hydrogen Production

3. Fuel Cell Cost Reduction

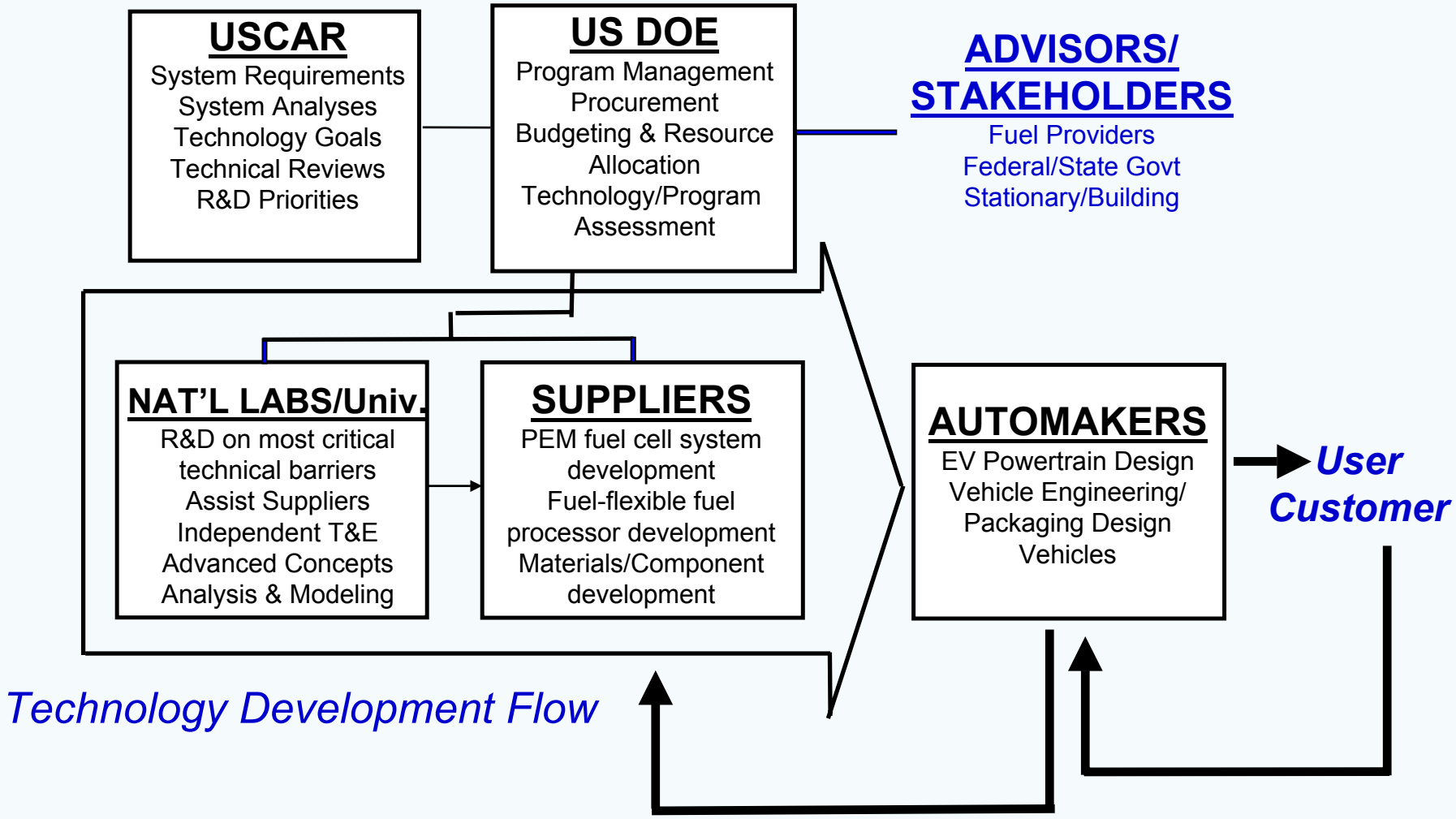
Safety & Codes/Standards, Education, and Vehicle/Infrastructure Testing and Validation will be areas which receive much greater attention

Office of Hydrogen, Fuel Cells and Infrastructure Technologies

Steve Chalk, Program Manager

- Safety and Codes/Standards
- Hydrogen Production Team
- Hydrogen Storage Team
- Fuel Cell Team

Program Implementation (FreedomCAR Partnership)



DOE Technical Targets: On-Board Hydrogen Storage

	Units	Target	Status Physical Storage	Status Chemical Storage
Storage Weight Percent	%	6	5.2	3.4
Energy Efficiency	%	97	94	88
Energy Density	W-h/L	1100	800	1300
Specific Energy	W-h/kg	2000	1745	1080
Cost	$/kW-h	5	50	18
Operating Temperature	ºC	-40–50°C	-40–50°C	-20–50°C
Start-Up Time To Full Flow	sec	15	<1	<15
Hydrogen Loss	scc/hr/L	1.0	1.0	1.0
Cycle Life	Cycles	500	>500	20-50
Refueling Time	min	<5	TBD	TBD
Recoverable Usable Amount	%	90	99.7	>90

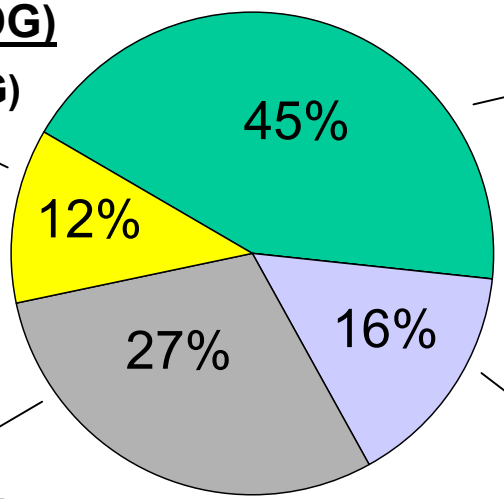
EERE Fuel Cell and Hydrogen Funding ($K)

Interior Appropriations					
TRANSPORTATION FUEL CELL R&D	**FY 2001**	**FY 2002**	**FY 2003 Req.**	**Increase**	
Systems	7,405	7,600	7,600	0	(0%)
Components	12,052	12,825	14,900	2,075	(+16%)
Fuel Processing & Storage	20,806	21,300	24,100	2,800	(+13%)
Field Evaluations	0	0	3,000	3,000	(New)
Technical Support Services	400	200	400	200	(+100%)
TOTAL	**40,663**	**41,925**	**50,000**	**8,075**	**(+19%)**
DISTRIBUTED GENERATION TECH.					
TOTAL, Stationary Fuel Cells	**5,440**	**5,500**	**7,500**	**2,000**	**(+36%)**
Energy & Water Appropriations					
HYDROGEN RESEARCH					
Core Research and Development	14,438	14,426	19,331	4,905	(+34%)
Technology Validation	9,009	10,320	15,000	4,680	(+45%)
Analysis and Outreach	3,147	4,437	5,550	1,113	(+25%)
TOTAL	**26,594**	**29,183**	**39,881**	**10,698**	**(+37%)**

FY02 EERE Fuel Cell Activities

Activities Focus on Removing High Risk Technical Barriers

FY 2002 Budget = $47.425M



Distributed Generation (DG)

- Reforming Technology (NG)
- Critical Components
- Systems Development
- Codes and Standards

Transportation Fuel Processing/Storage Subsystem

- On-Board Fuel Processor R&D
  - gasoline, diesel, methanol
- Hydrogen On-board Storage

Transportation Fuel Cell Stack Subsystem

- Catalyst Loading Reduction
- MEA/Bipolar Plate Manufacturing
- Durability Studies

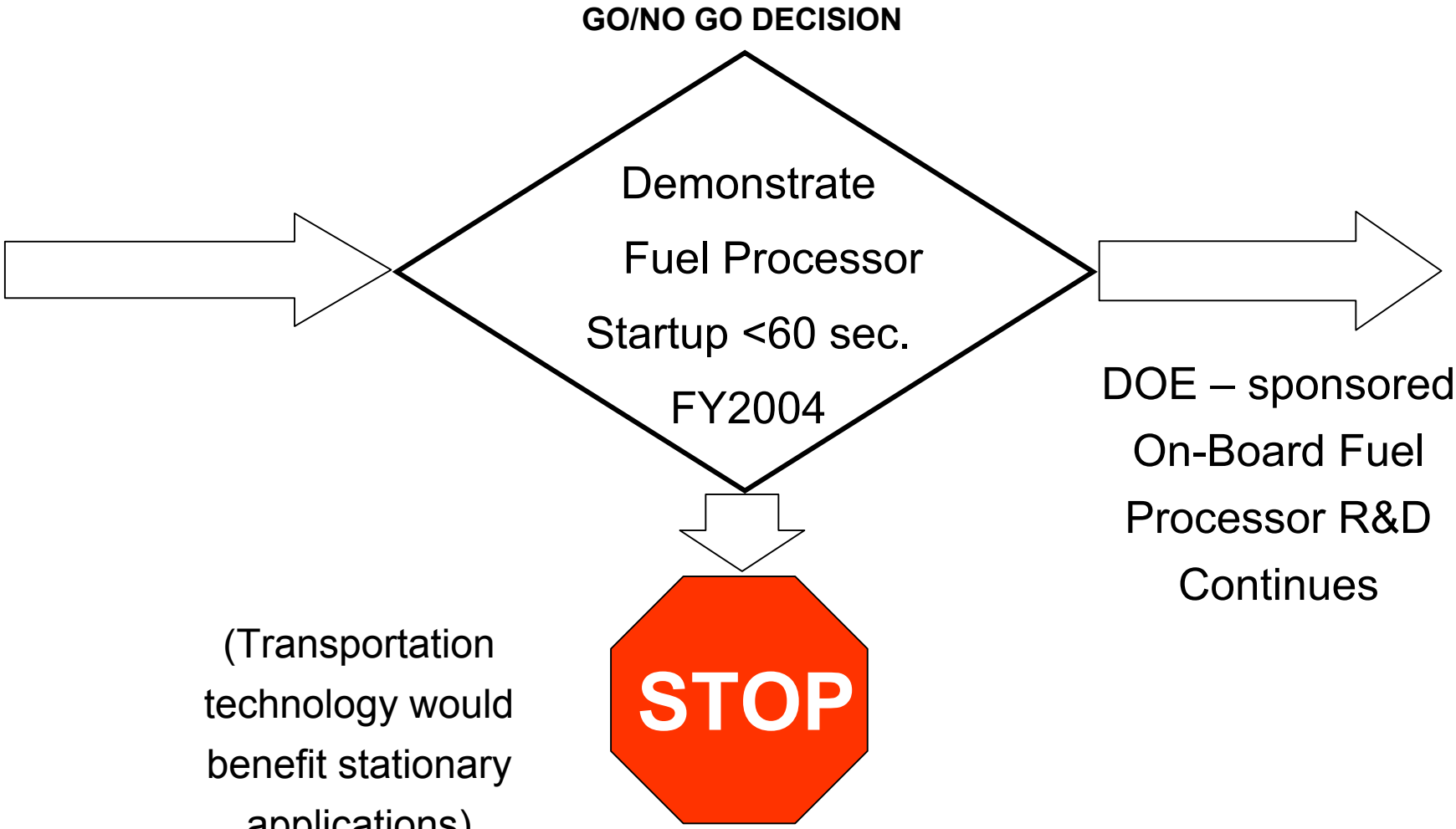
Transportation System

- Modeling/Validation
- Cost Analyses
- Ancillary Components (Compressors, Sensors)

R&D is carried out by industry suppliers, national labs and universities.

Major Program R&D Decisions – Vehicle Applications

On-Board Fuel-Flexible Fuel Processing

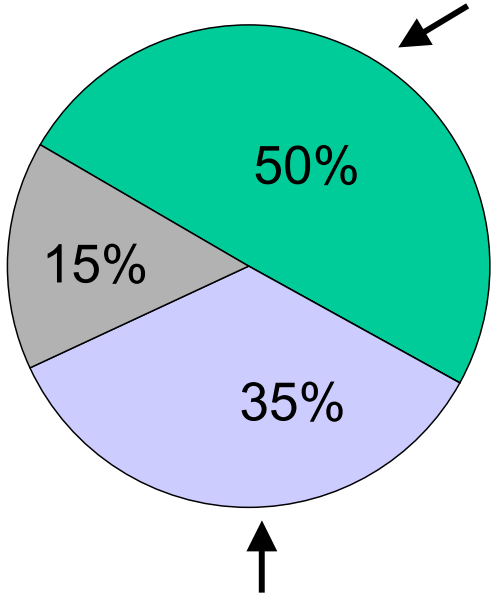


FY02 EERE Hydrogen Activities

FY 2002 Budget = $29.183M

Core R&D

- Storage technology
- Hydrogen generation



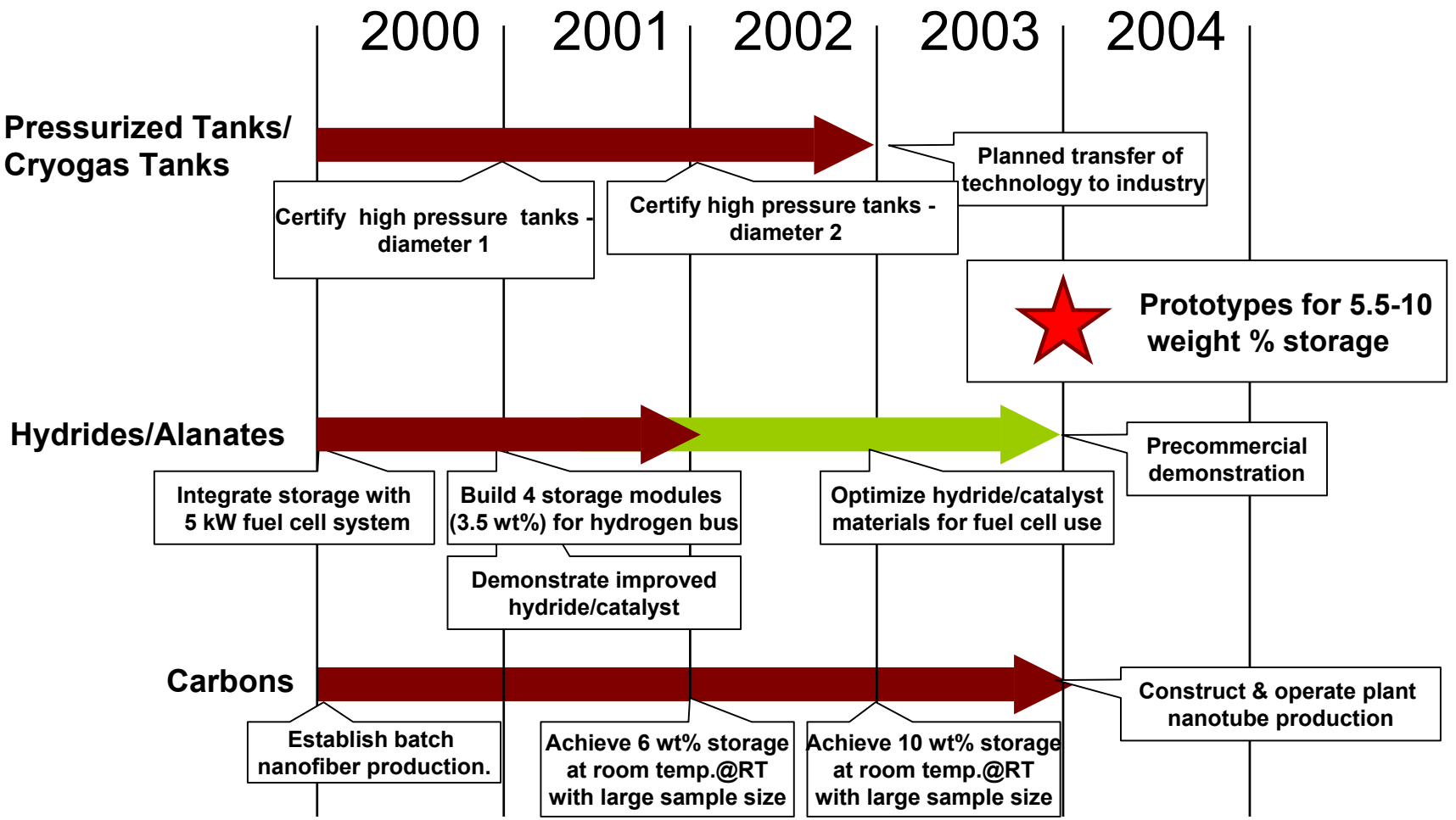
Analysis and Outreach

- Codes and Standards
- Educational Training
- Tank Standards

Technology Validation

- Hydrogen refueling station demonstration
- Development of Power Parks concept

Hydrogen Storage Program Milestones



FY03 Planned Programmatic Highlights

Transportation:

- **Continuation of R&D through 30 new cost-shared industry contracts and national laboratories to address key barriers**
- **Field Evaluations - Initiate activity to perform field evaluations of fuel cell vehicles in fleets**

Distributed Generation:

- **Major Procurement to be released in late FY02, awards mid-FY03**
- **Program will continue to focus on critical component and systems development**

Hydrogen Program:

- **Increased efforts in hydrogen storage and infrastructure in support of the FreedomCAR program**
- **Support for Power Parks and Uninterruptible Power Sources**

'04 Transportation:

- **Fuel processing Go/No Go decision**

Workshop Objectives

- **Identify and prioritize the most promising approaches to development of viable hydrogen storage technologies for vehicles**
- **Identify the technical challenges related to those approaches**
- **Draft a research and development plan to overcome those challenges**

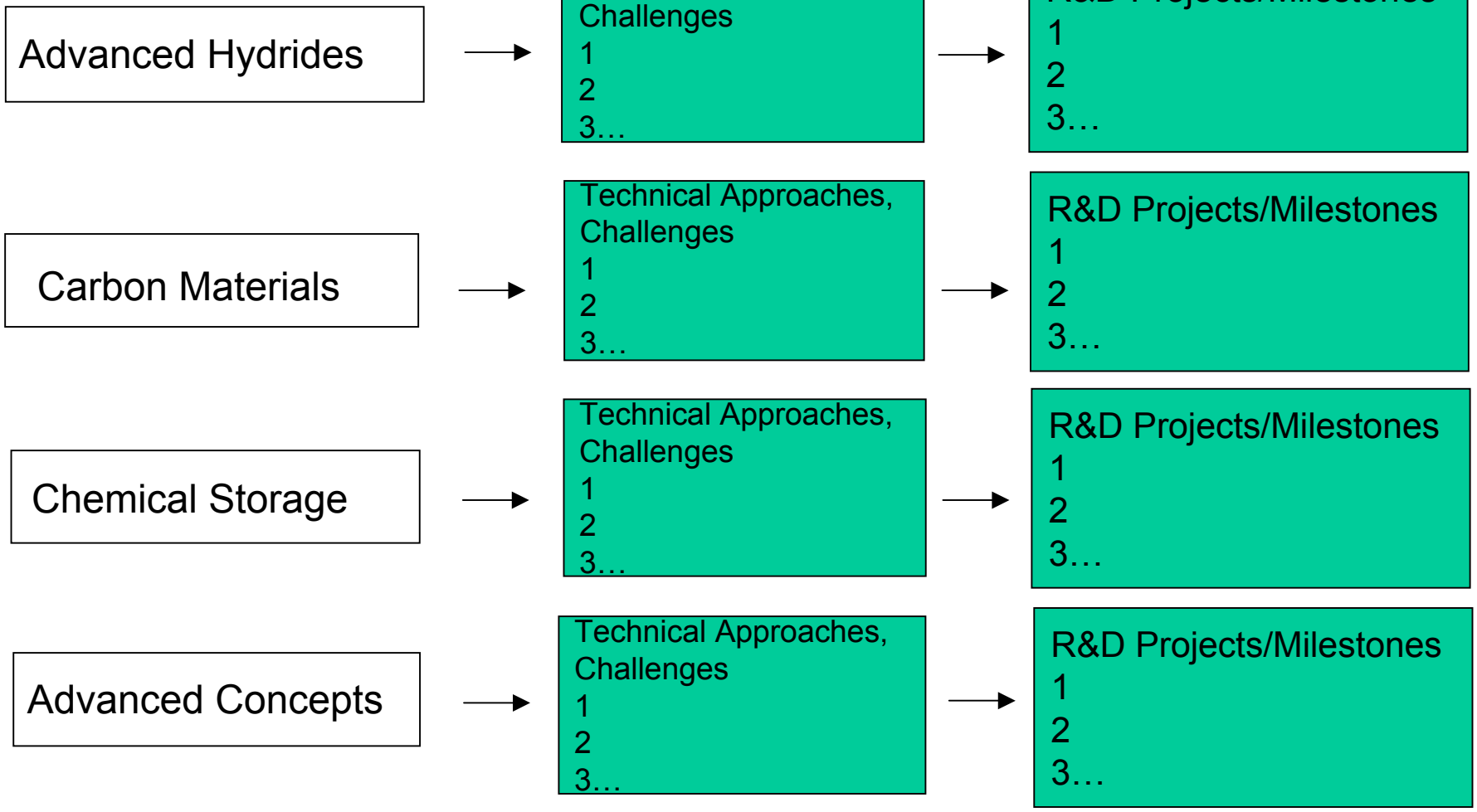
Key Points

The focus is on materials – building upon the existing foundation, when and where appropriate, BUT primarily exploring new ideas.

This is a working meeting – not an information meeting. We ask that everybody open up and contribute.

System level requirements must be considered.

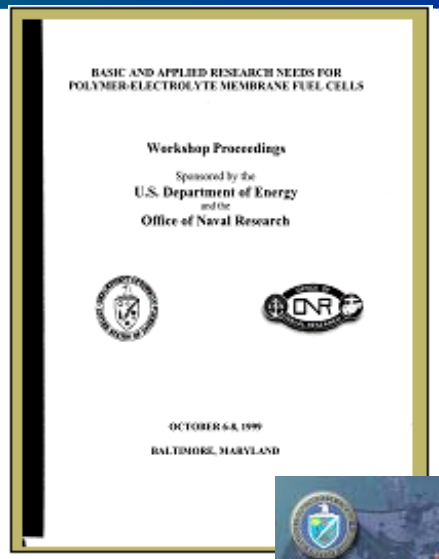
The Workshop Product: A 5-Year R&D Plan



Previous DOE Workshops/Outcomes

Basic and Applied Research Needs for PEMFCs

- Established a high-temperature membrane (HTM) R&D program
  - LANL, multiple universities
  - Industry projects w/ 3M, UTC Fuel Cells, DeNora/DuPont
  - HTM Working Group
- Initiated projects to improve cathode
  - LANL, LBNL, Superior MicroPowders, other industry
- Expanded projects to reduce Pt content
  - NRL, BNL


BASIC AND APPLIED RESEARCH NEEDS FOR POLYMER-ELECTROLYTE MEMBRANE FUEL CELLS

Workshop Proceedings

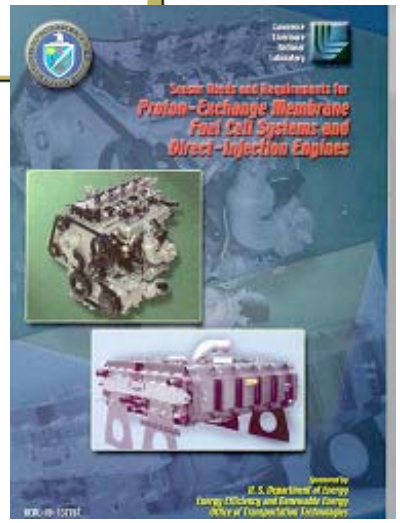
Sponsored by the
U.S. Department of Energy
and the
Office of Naval Research

OCTOBER 6-8, 1999

BALTIMORE, MARYLAND

Sensor Needs for PEM Fuel Cells and DI Engines

- Initiated a Sensor R&D Program
  - National Labs – LANL, LLNL
  - Industry – UTRC, Honeywell



Fuel Cells for Portable Power (January 2002)

- Proceedings/Solicitation to be released October 2002