2005 DOE Hydrogen Program
Review Presentation Template

DMFC Prototype Demonstration for Consumer Electronic Applications

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This presentation does not contain any proprietary or confidential information

FC-32

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Overview

Timeline

- Project start – Aug '04
- Project end – Aug '07
- Percent complete - 15

Barriers

- Energy/power density
- Cost
- Codes and regulations

Budget

- Total project funding
  - DOE share - $3.0M
  - Contractor - $3.2M
- Received FY04 - $200K
- Planned FY05 - $2.2M

Partners

FLEXTRONICS

Methanol Foundation

Tessy PLASTICS

Donaldson.

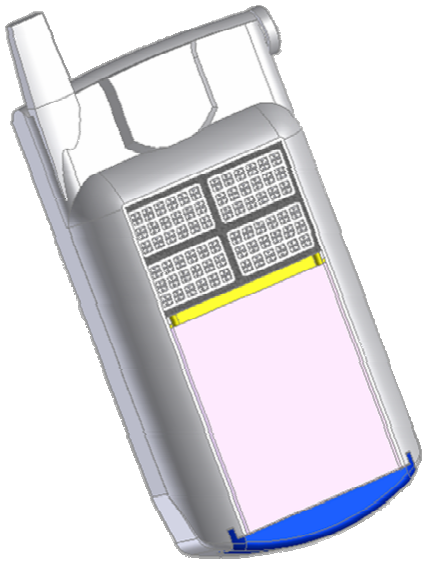
Dupont

Gillette/Duracell

Objectives

"This program will lead to the demonstration and real-world validation of a complete, integrated portable DMFC system for consumer electronics"

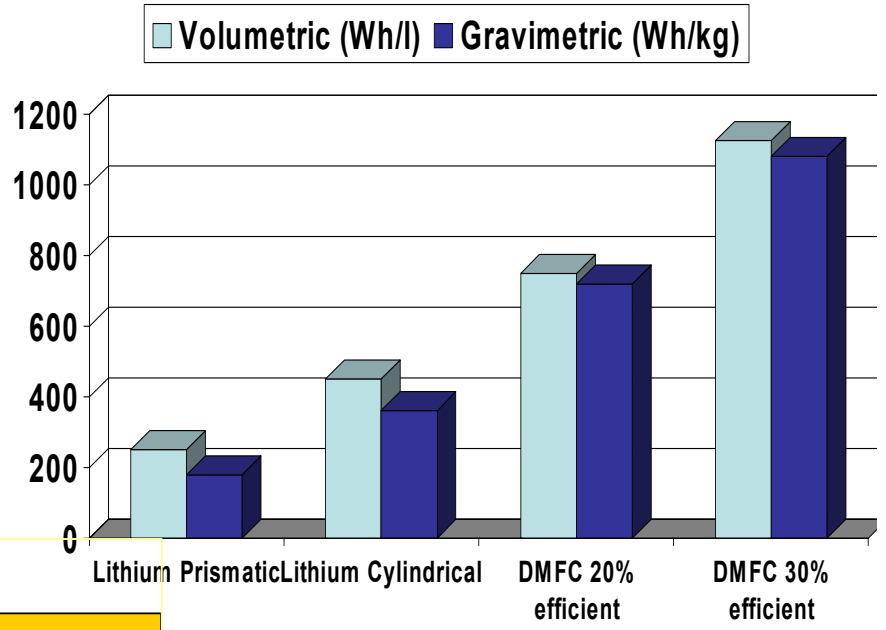
1. Overall energy density equal to or better than 800 Wh/liter
2. Develop power density for the fuel cell array of 100-200 mW per cm^3
3. Demonstrate prototypes
4. Accelerate codes and standards activities leading to appropriate regulations that allow shipping and airline passenger cabin usage
5. Demonstrate continual operation of up to 1,000 hours
6. Design and manufacturing pathway to $5 per unit [in high volume applications]

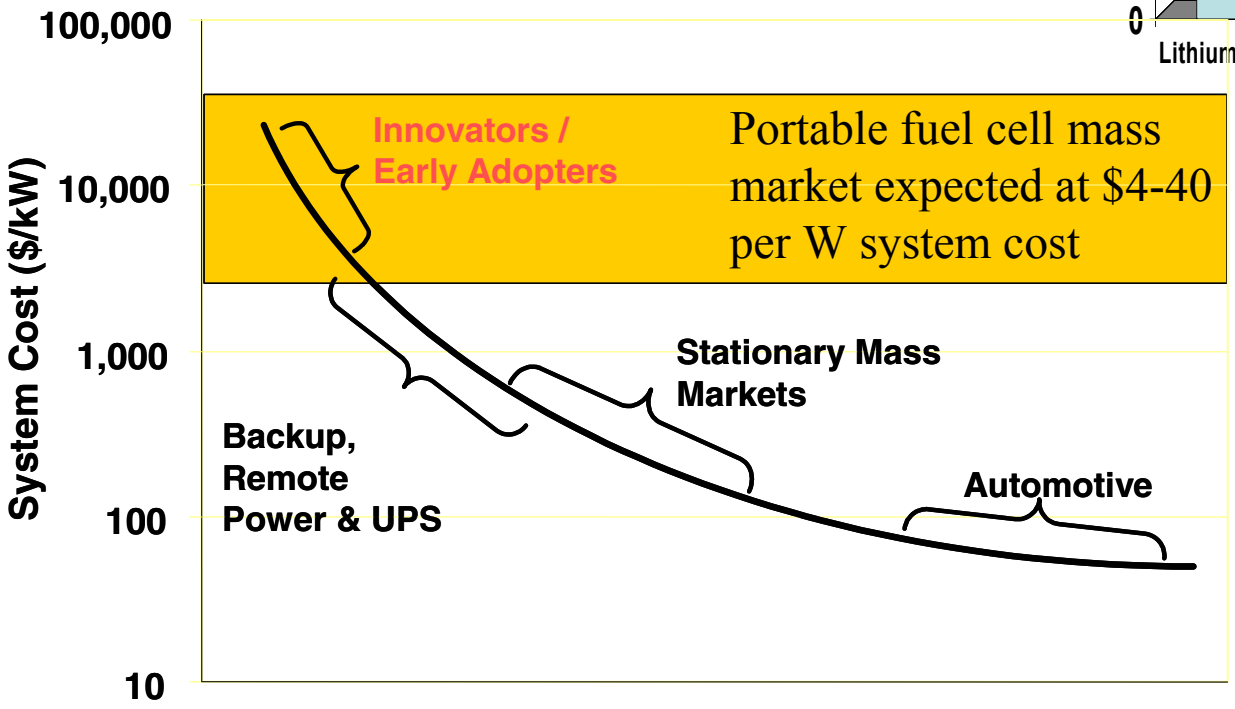


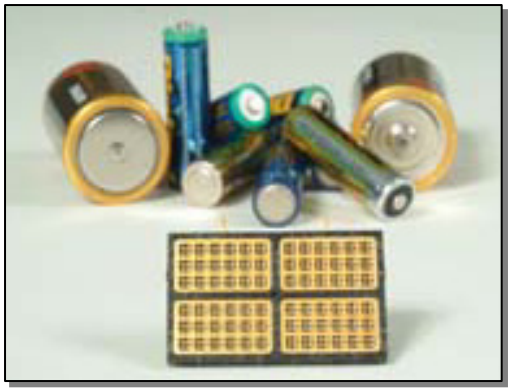
Develop an early pathway for the large scale, public introduction to fuel cell benefits

Merits of the DMFC Track

Value Proposition for Handhelds Provides an Early Track to Market







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DOE Sub-Watt System Targets

Sub-watt targets are driven by hand-held electronics product requirements

- 100 W/kg reached through hybridization
- Handheld electronics market opens up well above the $5/W target

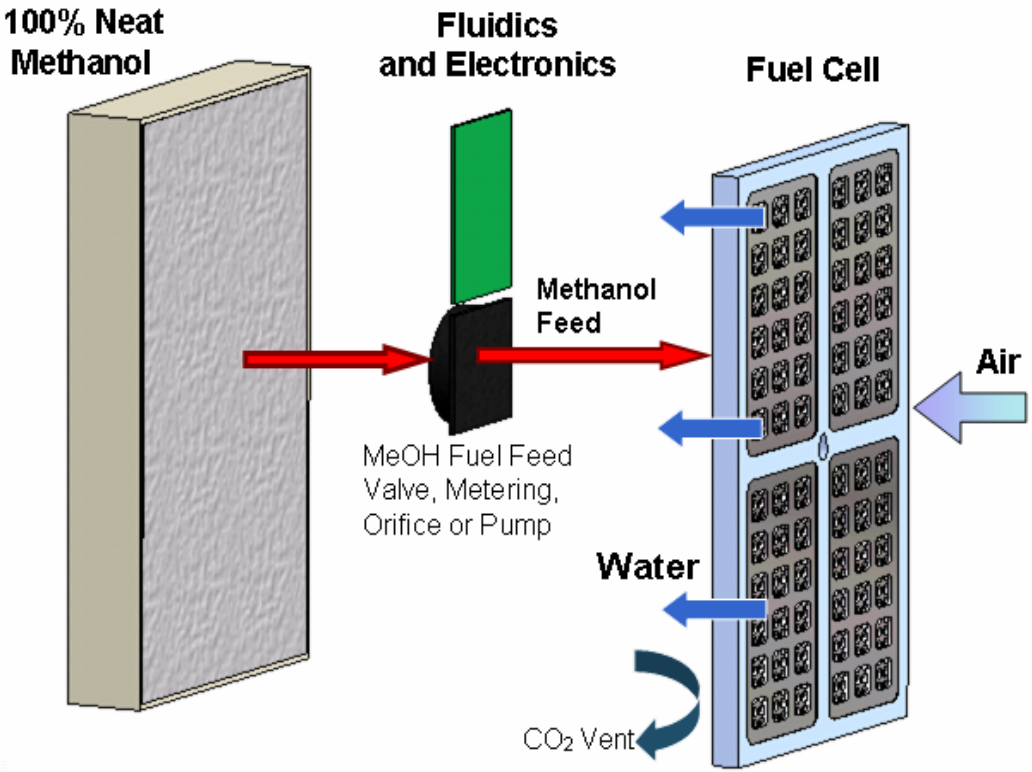
Table 3.4.8. Technical Targets: Consumer Electronics (sub-Watt to 50-Watt)

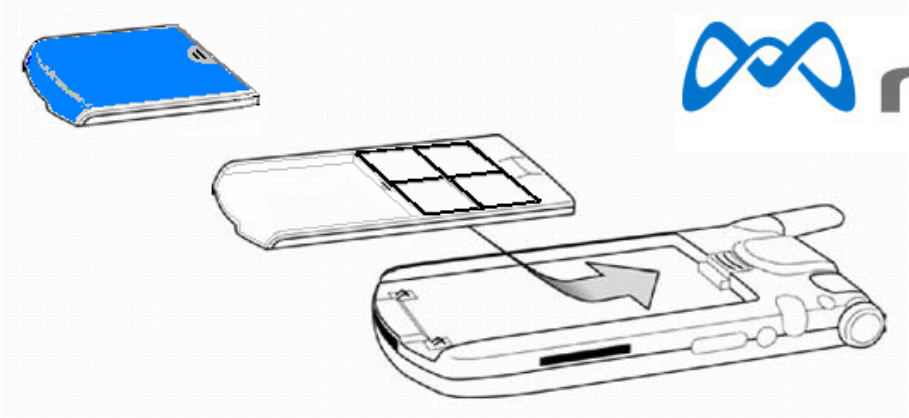
Characteristic	Units	2004 Status	2006	2010
Specific Power	W/kg	10–20	30	100
Power Density	W/L	10–15	30	100
Energy Density	W–h/L	50–200	500	1,000
Cost	$/W	40[a]	5	3
Lifetime	hours	<1,000	1,000	5,000

[a] Fuel Cell Seminar Abstracts, 2004, p. 290.

Approach

- Develop system designs that reduces complexity, size and number of components
- Use non-dilute methanol fuel
- Apply high volume manufacturing technology
- Work with OEM's to develop product introduction strategy
- Pursue early product codes and standard
- Develop supply chain





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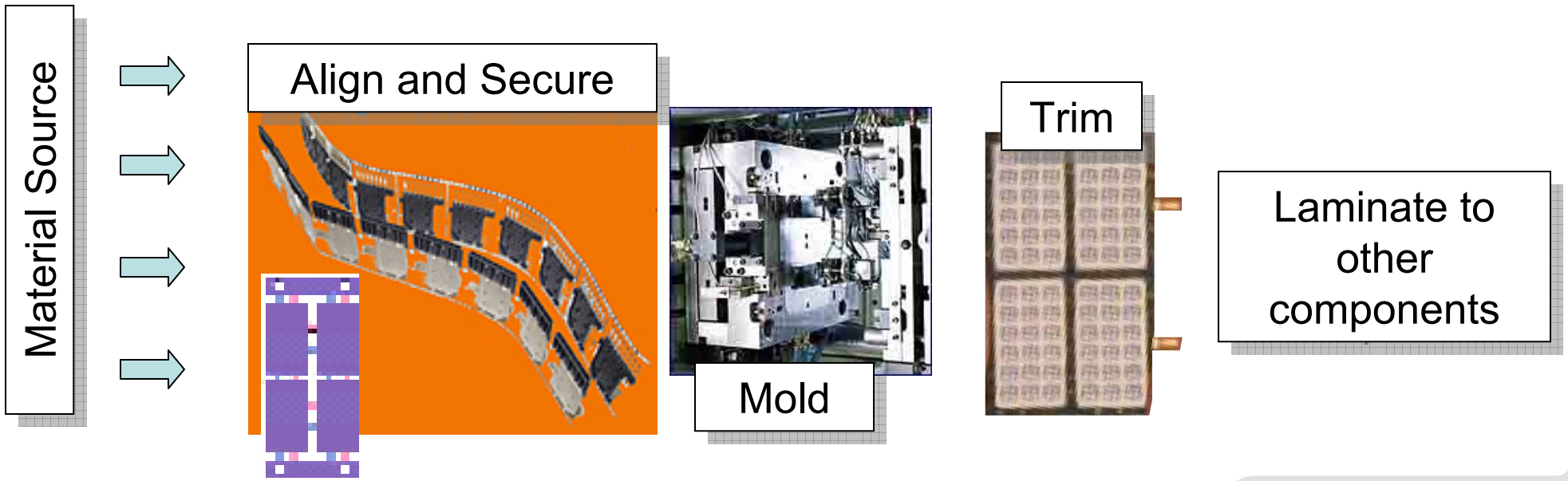
Manufacturing Development

Current Status

- Demonstrated, assembly, molding and trim process
  - Process capability at hundreds per day
  - Performance validated
- Used in prototypes

Under Evaluation

- Source component forms and fabrication process
- Component integration – batch vs continuous
  - Form
  - Fabrication
- Feed to mold
- Post processes



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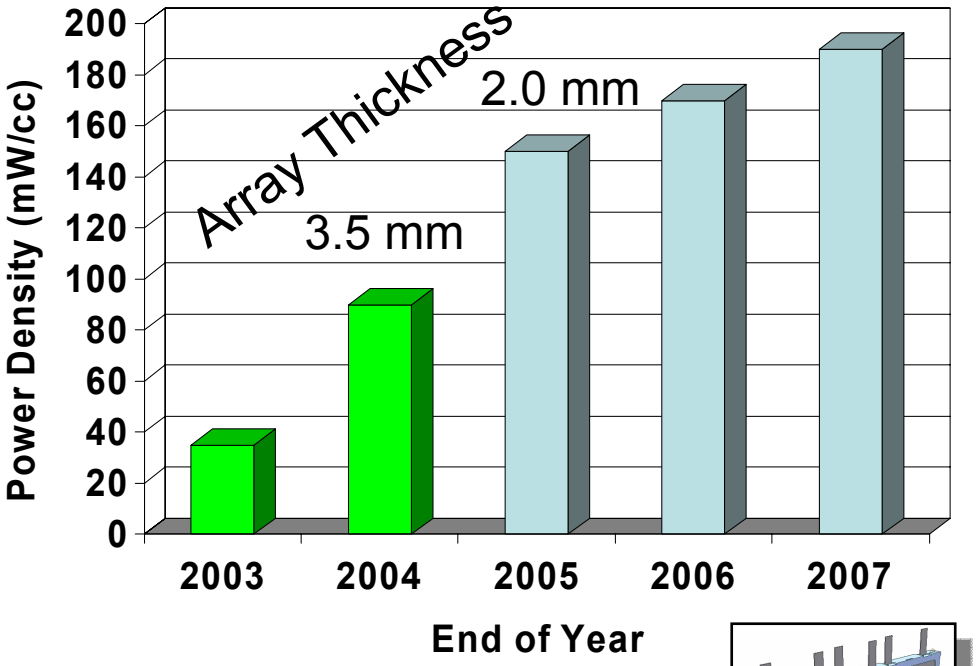
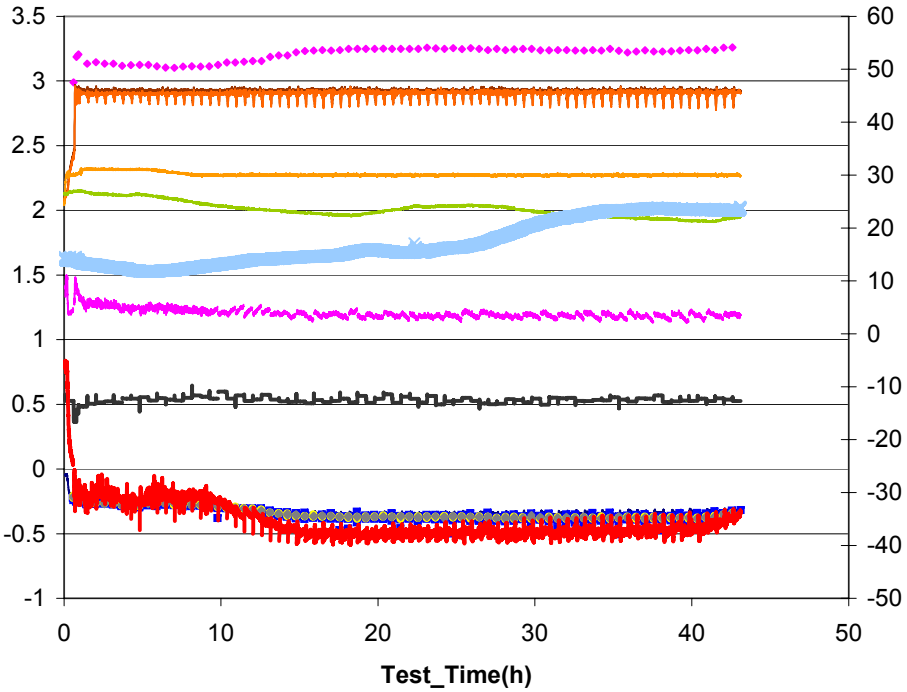
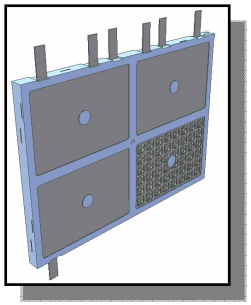
Array Power Density

- Array area specific power - 40 mW/cm^2
- Current production arrays at 90 mW/cc
- New prototypes in fabrication trials that reduce array thickness







- Clear path to program objective of 100 – 200 mW/cc

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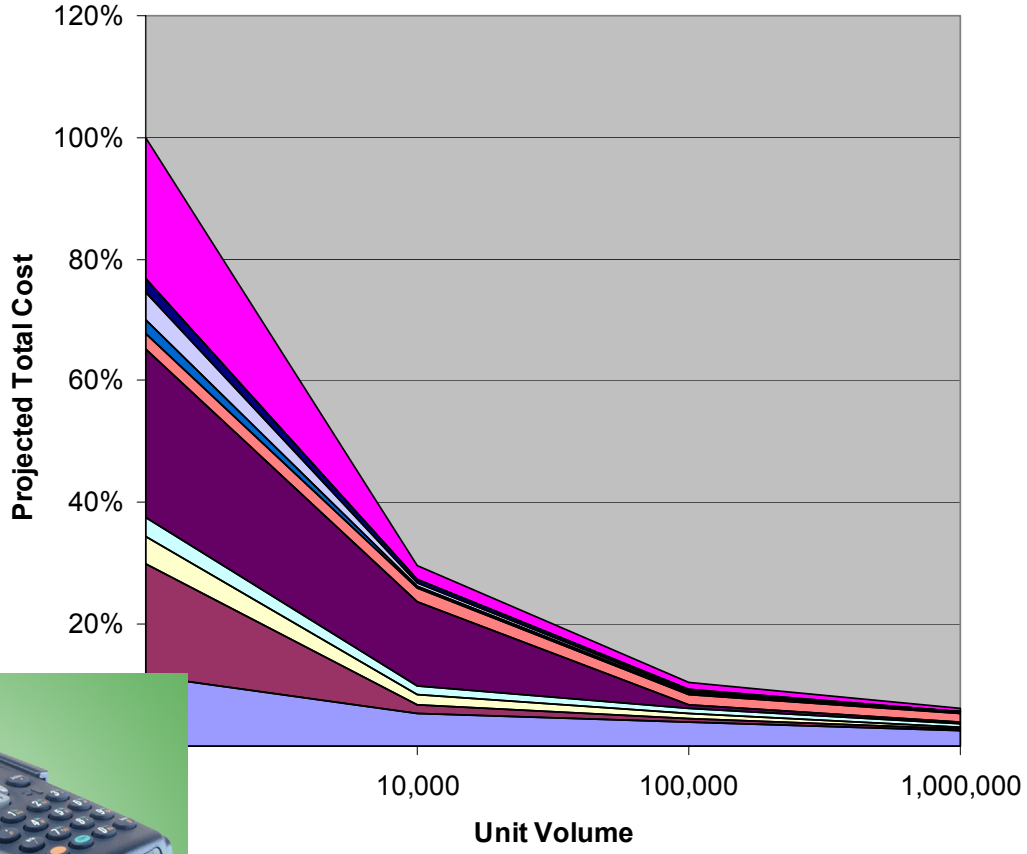
Manufacturing Studies Support Technology Path to Low Cost

- Mobion™ technology provides product simplification
  - Reduces part count
  - Minimizes active subsystems
- High volume manufacturing processes are projected to meet market price points
- Current product introduction provides a benchmark for cost model

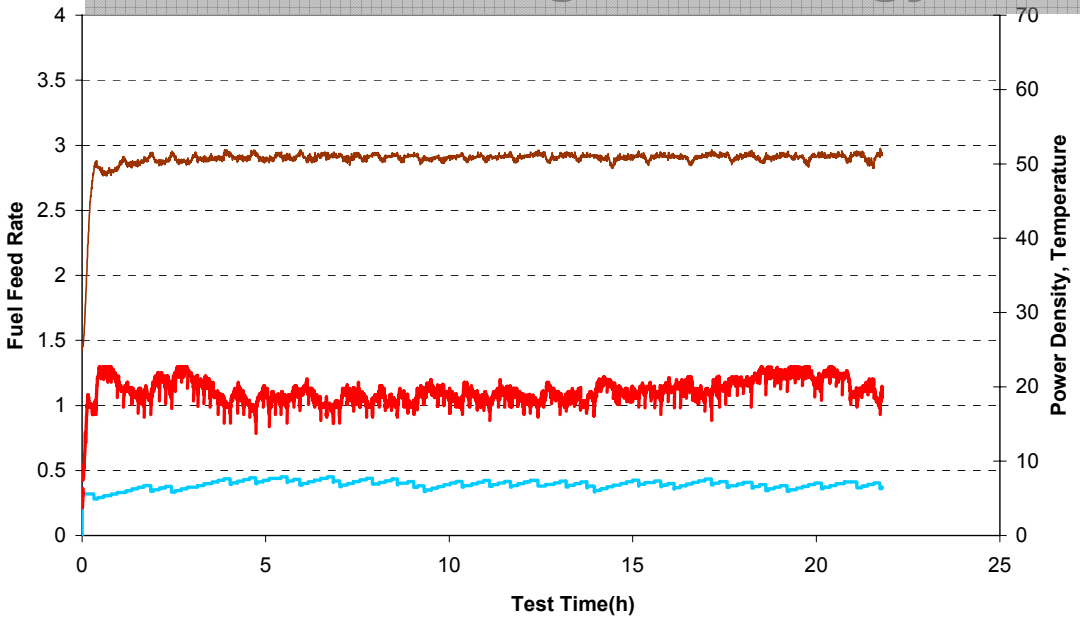


Dec '04 - MTI introduced first fuel cell powered handheld for Intermec, with Flextronics manufacturing support

Prototype Development

- Fabricated and tested breadboard units
  - Using array designed for high volume
  - Includes all system elements and fuel cartridge
  - Uses 100% methanol
- Developed fuel cartridge prototype with leading battery supplier
- Produced in-phone working models

Demonstrating technology for handheld FC system



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Codes and Standards

- MTI and Methanol Foundation sit on several critical committees
- MTI fuel cartridge passes CSA and UL certification process
- UN established new Shipping & Packaging ID #3473 for “Fuel Cell Cartridges with Flammable Liquid”-December ‘04
- IEC and UL/CSA working groups drafting safety standard with MTI playing key role
- IEC TC 105 Safety Draft to be micro fuel cell certification document for ICAO
- MTI Micro is taking leading DMFC position with Domestic and International Transport Regulatory Organizations
- MTI and Methanol Foundation have been key presenters at modal agency meetings

Clear regulatory pathway to fuel cartridges available in every store and accepted in every airline passenger cabin

Codes and Standard

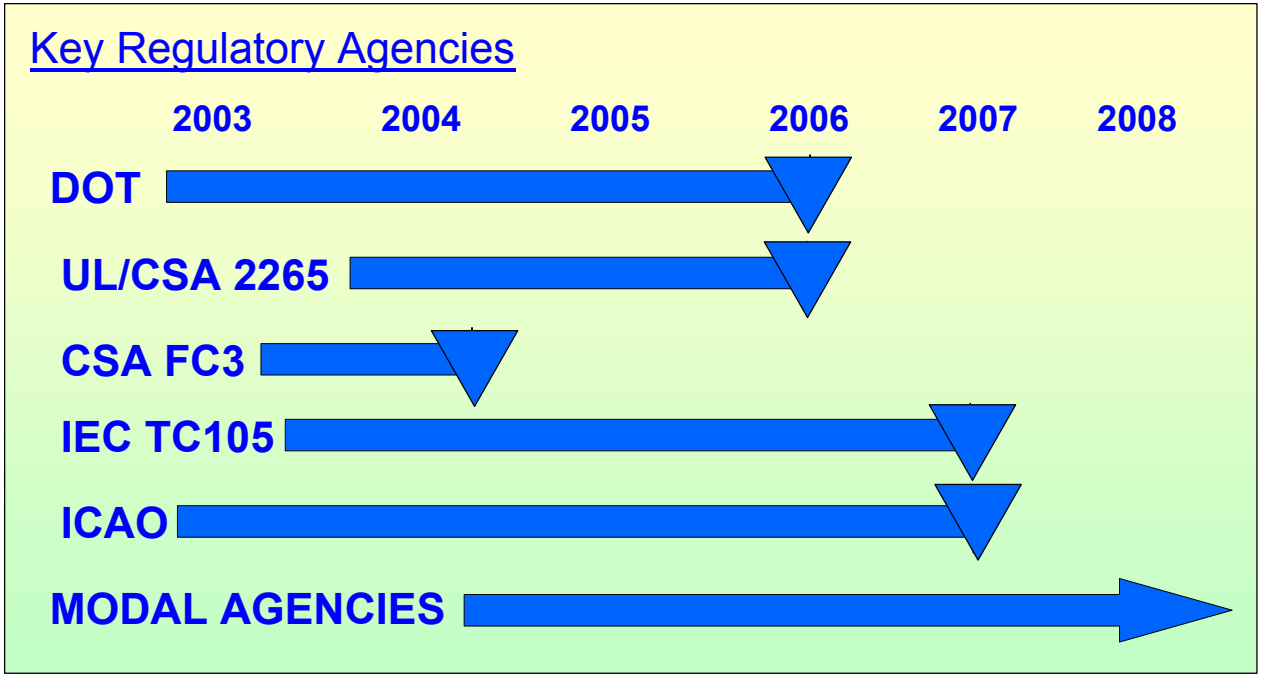
- Continued work with IEC and UL/CSA to establish Safety Standard
- Close liaison with ICAO and DOT to maintain close partnership in attaining on-board use of micro fuel cell devices and their cartridges
- Maintain close ties with all international fuel cell industry members to facilitate cohesion and standardized, workable safety guidelines

Milestones – Remainder of Year

- Update and finalize roadmap
- UL/CSA 2265 draft
- US DOT passenger exclusion petition
- ICAO cabin exemption proposal
- Methanol CD library

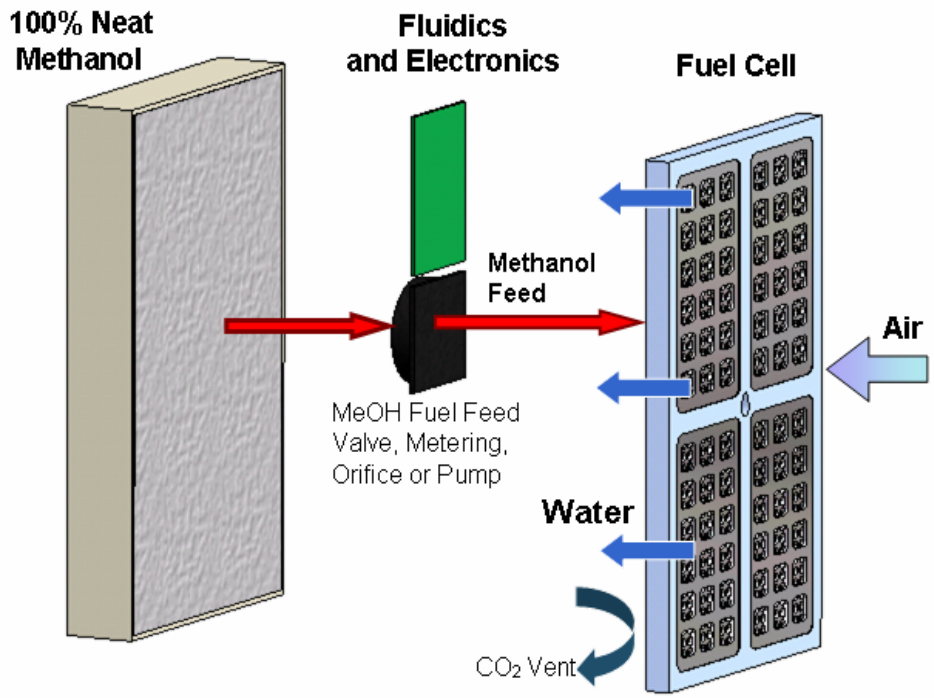
Milestones – Next Year

- Complete IEC TC 105 and UL/CSA 2265 standards
- Adoption of passenger exclusion



Technology Roadmap

- Current collector and MEA fabrication methods for high mold feed rates
- Microfluidic design and manufacturing that produces low cost, integrated fluid management and transport
- Passive thermal management and heat spreading
- BOP component integration
- Power management and control
- Benchmark performance stability



Technology roadmap is a first year deliverable

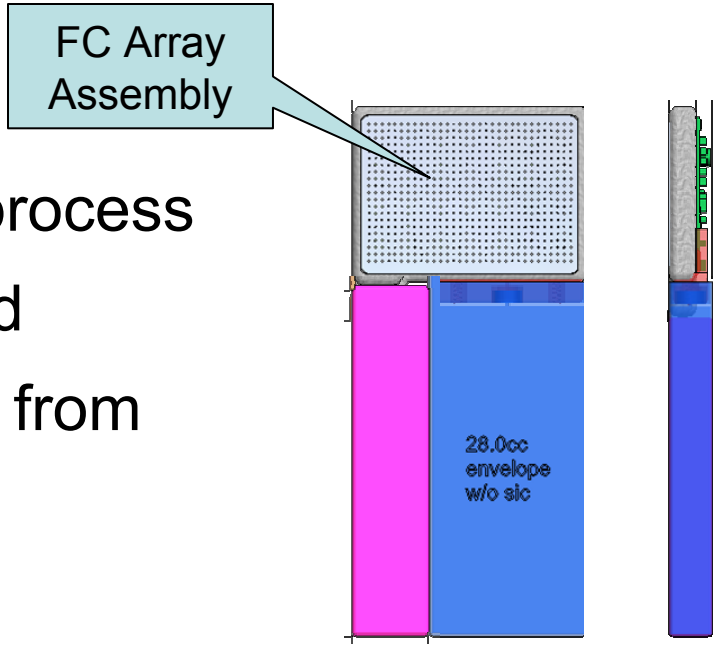
Prototype Demonstration

Prototypes will provide benchmark on performance targets

Year	Approximate Number of Units	Date to Complete Testing	System Performance	
			Power (mW)	Energy (Wh)
1	5	8/31/5	250	20
2	10	8/31/6	350	30
3	40	7/31/7	450	36

First Year Prototype

- Array from current manufacturing process
- Systems will be hand manufactured
- Multiple units tested independently from design team



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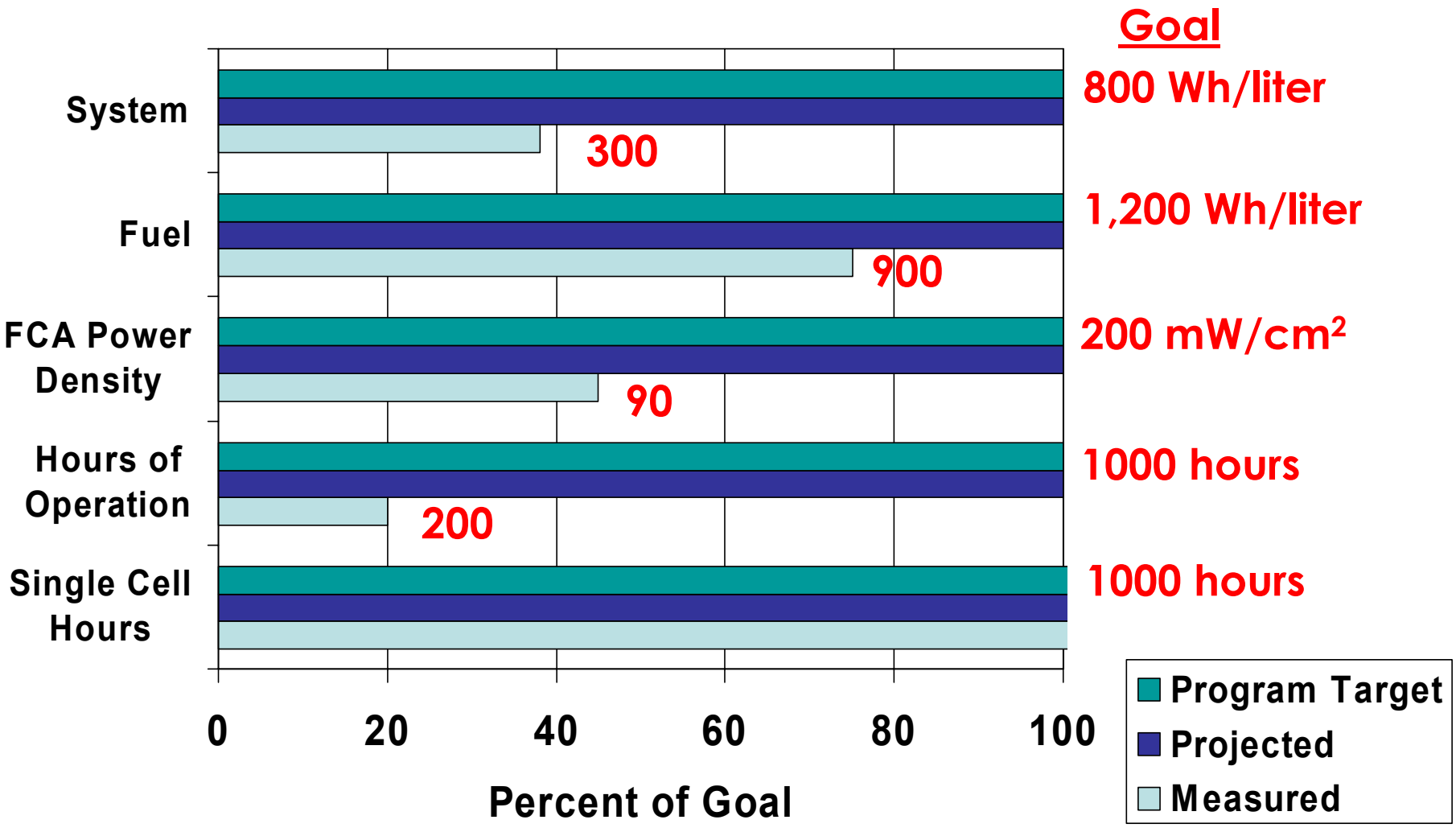
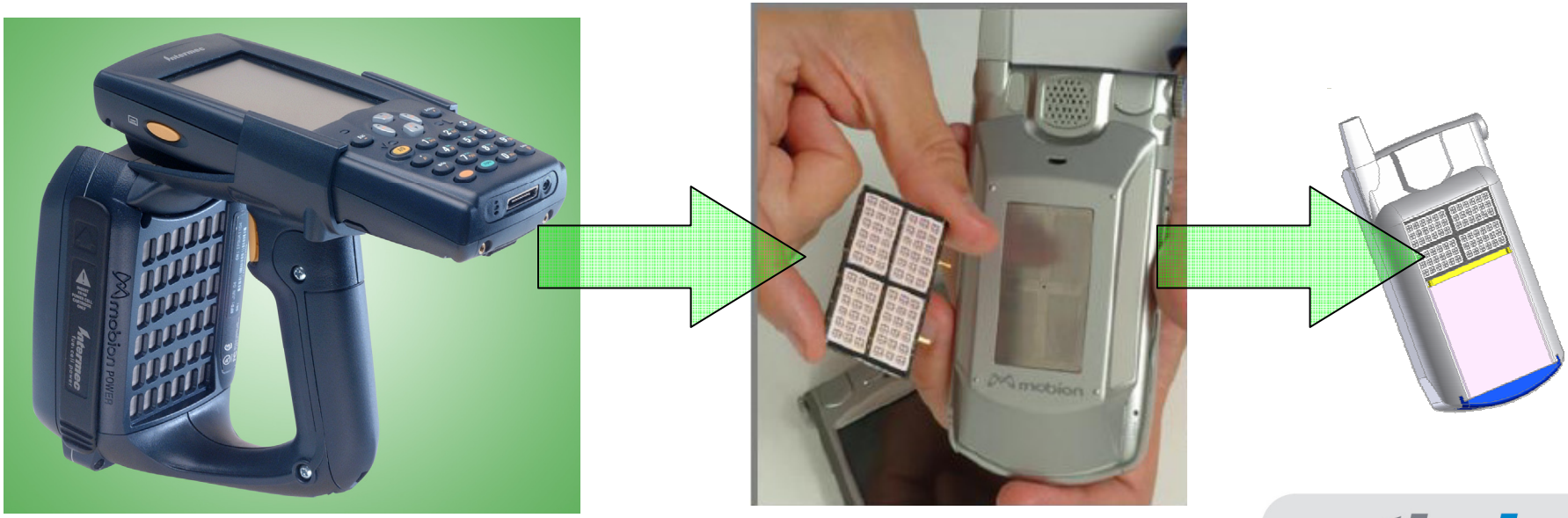
Status Against Objectives



Summary

- Program has had a great start
- Roadmaps still need to be completed this summer
- Manufacturing is still gearing up in some areas
  - This will be the key to meeting cost targets
- Prototypes will benchmark performance progress
  - Breadboards will provide early assessment
  - First prototype late this summer
- Excellent progress on codes and standard
  - Active roles on many fronts



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