

DOE Workshop

**Portable Power  
R&D Needs**

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Input from  
Angstrom, Johnson Matthey, Trulite, and Ultracell

# Wide Range of Systems and Fuels Fit Into Portable Power Portfolio

Some examples from USFCC Portable Power Working Group



250 W, IdaTech



150-250 W, Trulite



100 W, Jadoo



30 W, Protonex



25 W, Ultracell



1 W, MTI Micro

# DOE Portable Power Background

- DOE Multi-Year Research, Development and Demonstration Plan currently identifies targets for portable power technology and consumer electronics applications
- 
- Develop novel fabrication methods for membranes and other cell components
  - Develop portable power technologies
    - Develop membranes that will reduce crossover
    - Design, build and test portable power system under real-world conditions

**Table 3.4.7 Technical Targets: Consumer Electronics (sub-Watt to 50-Watt)**

Characteristic	Units	2005 Status <sup>a, b</sup>	2006	2010
Specific power	W / kg	20	30	100
Power density	W / L	20	30	100
Energy density	Wh / L	300	500	1,000
Cost	\$ / W	40 <sup>c</sup>	5	3
Lifetime	hours	>500	1,000	5,000

# Big Picture

- Portable power leads the way into early market entry
- Very large market in consumer electronics
- 5-10x size and cost reduction are needed to capture a significant share of this market
- Solving challenges for this market will produce a large demand for fuel cells
- Solutions here help
  - Hydrogen infrastructure for all groups
  - Fuel cell technology and component supplier capability
  - Public understanding and adoption of fuel cells

# Portable Power has Early Entry into Consumer Electronics Markets

- Market size examples:
  - Laptops (2006, 100M), (2012, 300M)
  - PDA's (2006, 10M)
  - Cell phones (2006, 1B), (2012, 2B)
- Ever increasing demand for function
- Batteries presently limited in capability
- Fuel cells with compact fuel sources offer great potential



# Power Levels



Sub 1 - 10 W



10 - 50 W



50 - 250 W

# Power Range: 50 – 250 W

## Markets

- Military battery charging
- First responders
- Remote, portable power

## Barriers

- Catalyst and membrane cost
- Raw Materials Cost

## R&D Needs

- Improved MEA power density (end of life)
- Cathode Pt thrifiting i.e. increased mass activity (H<sub>2</sub> and DMFC)
- Anode Pt thrifiting i.e. increased mass activity (DMFC)
- Lower cost membrane for H<sub>2</sub> PEM applications
- Support for fuels development



# Power Range: 10 – 50 W

## Markets

- On body military power
- Laptops: directly power and recharge
- Remote stationary power
- Emergency and backup power

## Barriers

- Heat rejection
- Size

## R&D Needs

- Small components and better integration
- Increase efficiency
- Reduce methanol membrane crossover and increase conductivity
- Lower DMFC catalysis temperature





# Power Range sub 1 – 10 W

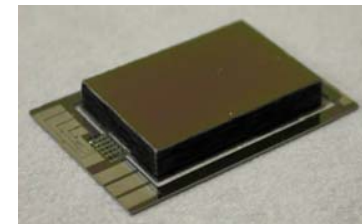
## Markets

- Handheld consumer electronics
- Remote and urban sensors
- Wireless networks
- Fuel cartridge business



## Barriers

- Heat rejection
- BOP size and integration
- Performance stability
- Advanced DMFC MEA
- Hydrogen infrastructure for refueling



# R&D Needs

- Manufacturing process development (low cost/high volume)
- Miniaturization and integration of FC and BOP components
  - Nano-scale materials and advanced micro-manufacturing processes
  - Solid-state micropump and microactuator technologies for all fluid types
  - Miniaturization and seamless integration of the thermal management
- Target plug and play 1-W, 3-W, 10-W FC modules/chips
  - Reduced loading
  - Compression free systems
  - ORR kinetics improvements of greater than 40%
  - Low cost/high volume (manufacturing readiness)



**FC Chip**



**FC Power Pack**



**Integrated FC**

# Conclusions

- Consumer electronics continue to push for mobility and functionality – demanding more energy
- Small fuel cells have significant potential to meet the energy density demand
- This large market can build important fuel cell infrastructure and technology elements
  - It also increases public awareness of FC advantages
- DOE R&D support is instrumental in providing resources and creating the teams to address key barriers