Fuel Cells and Hydrogen Energy

Power Expo

Ruth Cox
Fuel Cell and Hydrogen Energy Association
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BRINGING THE ELEMENTS TOGETHER

View in Washington

- **DOE Fuel cell and hydrogen programs are one of the most successful research, development and deployment plans ever.**
- **Misperception that fuel cells are not commercially ready – when in fact, several sectors are already in the market and growing.**

FCHEA's Focus:

- Get the Administration to embrace fuel cells of all kinds and hydrogen energy as integral components of the clean energy portfolio.
- Have that reflected in rhetoric, policies and purchasing behavior.
- New approach is gaining momentum and catching the attention of people in the right places.
- Gain the support in Congress, DoD and DOT in deployment of fuel cell and H2 energy systems

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Fuel Cells and Hydrogen ARE Integral Components of the Clean Energy Portfolio

- **FC&HE enhance the performance of renewables**
  - Solar and wind are intermittent; FC&HE can accelerate the return on solar and wind investments with transformation and storage
  - Biomass – it's a dirty business and we can clean it up
  - Biofuels – increased efficiency; lower pollution
- **FC&HE enhance performance and lower the negative environmental impacts of fossil fuels**
  - Efficient use of finite domestic energy sources
  - CO2 separation and virtually ZERO criteria pollutants
  - Can even work with coal and jet fuel!!
- **Distributed generation is the most efficient and reliable way to deliver power**
- **FCEV's crucial to reaching energy goals**
  - FCEVS are technologically ready
  - Best option for medium-large size vehicles
  - H2 infrastructure required for commercial rollout

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Commercially Deployed TODAY!

- **Refrigeration, prime power, back-up power**
  - Price Chopper/Whole Foods/Central Grocers
  - AT&T, Sprint, Verizon, US Military
- **Large corporations**
  - Google/eBay/Staples/Coca-Cola/FedEx/Walmart
- **Renewable solutions**
  - Sierra Nevada/Fosters/Sapporo/Kirin/Gills Onions
  - Wastewater treatment plants/landfills
- **Hotels across the country**
  - Sheraton/Hilton/Hyatt/Westin Hotels
- **Research and Data Banks**
  - University Campuses in Connecticut and throughout California

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DOE

U.S. DEPARTMENT OF ENERGY

- Recovery Act funding ($43 million) will deploy up to 1,000 fuel cells for early market applications
  - Materials Handling and Telecom Back-up Power deployments
- Waste to Energy Programs
- Technology validation projects - data collection and operation of backup power systems and specialty vehicles
- Collaboration with DOT on the Fuel Cell Bus Program will continue; and CHHP demonstration (with CaFCP and SCAQMD)
- Funding opportunities for residential stationary fuel cells, CHHP fuel cell systems and APUs for aircraft and heavy duty trucks

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Demonstrations Underway

- CHHP in Fountain Valley, CA
- Portable and auxiliary power in the military, aviation and trucking industry
- Propulsion for unmanned vehicles
- Fuel cell buses and vehicles in CA and HI
  - Partnership in HI noteworthy for involving the natural gas utilities
- Grid applications

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DoD Hydrogen and Fuel Cell R&D

- **Hydrogen Research**
  - **$18M in FY10 (primarily congressionally funded efforts)**
    - Biocatalysts for H2 production
    - Reformation of logistics fuels
- **Fuel Cell Research & Demonstration**
  - **~$35M in FY10**
    - Basic and applied research in catalysts and materials (~1/3 congressionally funded)
    - Unmanned systems, deployable field units and man portable applications

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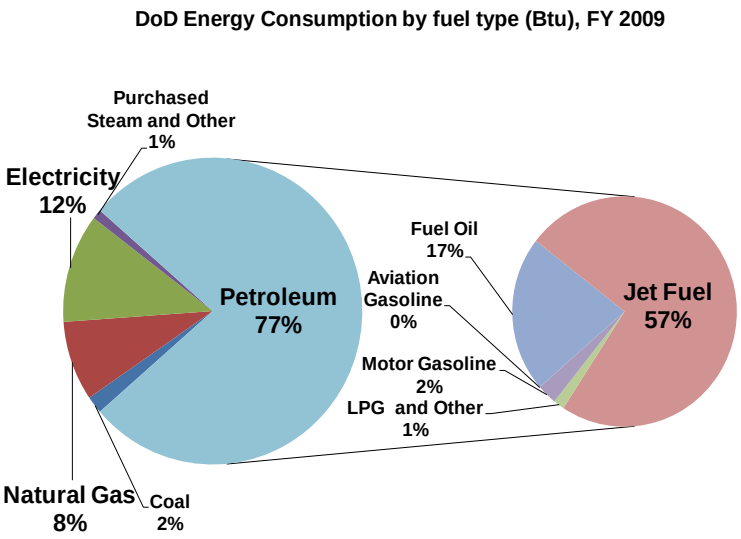
DoD-Energy

- **DoD is the nation's largest energy consumer**



Source: http://www.eia.gov/aer/pdf/pages/sec1_29.pdf

- Facilities energy cost $4 billion in FY 2009
- Many directives, mandates, goals and targets

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DoD Commercial Roll-out Program

FC AND H2 applications with near-term commercial potential

- Distributed Stationary Power
- Back-up Power
- Non-tactical Material Handling and Ground Support Equipment (MHE/GSE)
- Portable Power for Tactical Operations
- Unmanned Air, Ground and Underwater Vehicles (UXVs)

Other applications of interest to DoD

- Soldier Wearable and Portable Power
- Remote Sensors and Surveillance
- Auxiliary Power Units for Ground Vehicles, Ships and Aircraft
- Non-tactical Light Duty Vehicles
- Mobile Electric Power (MEP)
- Power for Ships
- Non-tactical Personnel Transport (Buses)

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Distributed Stationary

DoD Market Characteristics

- Over 500,000 buildings at 5,000 sites
- Facilities account for 30% of DoD's energy costs
- Prime Opportunities for Combined Heat and Power (CHP)
- Mission-critical needs for uninterruptible power
- Little knowledge of fuel cells and potential benefits.

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Distributed Stationary Power

- **<u>Fuel Cells at DoD Installations</u>**
  - Camp Pendleton, CA
  - MCAGCC, 29 Palms, CA
  - Camp Parks, CA
  - Naval Sub Base, Groton, CT
  - PMRF, Kauai, HI

- **<u>A Growing Private Sector Market</u>**
  - UTC Power PAFCs
  - FuelCell Energy MCFCs
  - BloomEnergy SOFCs

- Market supported by government subsidies

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Distributed Stationary Power

Value Proposition

- **Benefits**
  - Reliable, grid-independent power for critical needs
  - Higher efficiency = Lower energy costs
  - Scalability
  - Reduced pollutants and GHG
  - Compliance with legislation and EOs
  - Quiet

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Backup Power

DoD Market Characteristics

- 1,000's of DoD facilities with mission-critical needs for continuous power.
- Missions with critical power needs have increased.
- DSB concluded military installations too dependent on vulnerable grid; back-up power is inadequate.
- Little knowledge of fuel cells and potential benefits.

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Backup Power

- **Fuel Cells at DoD Installations**
  - Fort Jackson, SC (Zero outages/102 hours saved)
  - Los Alamitos Joint Training Base, CA
  - Marine Corps Logistics Base, Barstow, CA
  - Air National Guard Sites, HI
  - Army CERL Projects

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Backup Power

A Growing Private Sector Market

- Sprint Nextel
- AT&T
- PG&E
- Metro PCS, FL

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Backup Power

Value Proposition

- **Benefits**
  - Longer system life than alternatives
  - Lower maintenance requirements
  - Reduced emissions, including GHG
  - Reduced noise

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Materials Handling/Ground Support

DoD Market Characteristics

- Tens of thousands of units in DoD inventory
- Currently use batteries, propane, diesel fuel and gasoline
- Validation Programs advancing commercial readiness of fuel cells and hydrogen

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Materials Handling/Ground Support

- **Fuel Cells at DoD Installations**
  - DLA Distribution Center, Susquehanna, PA
  - DLA Distribution Depot, Warner Robins, GA
  - DLA Distribution San Joaquin, CA
  - Hickam Air Force Base, HI

- **A Growing Private Sector Market**
  - Sysco Distribution Center, TX
  - FedEx Service Center, MO
  - GENCO Distribution Centers
  - Central Grocers' Distribution, IL
  - Whole Food
  - Price Chopper

Forkliftfueling - a Plug Power forklift

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Materials Handling/Ground Support

Value Proposition

- **Benefits**
  - Improved productivity
  - Lower O&M costs
  - Reduced emissions and noise
  - Lower costs
  - Smaller footprint
  - Environmental

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Soldier Power

Issue

- **Sharp rise in Soldier worn capability has resulted in a dramatic increase in the numbers and variety of batteries carried by the war fighter—added weight.**
- **This trend is unsustainable from a Soldier load and logistical perspective.**
- **Load injuries sharply on the rise**

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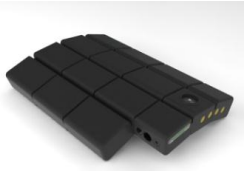
Nett Warrior Power Excursions

Worn Power

Conformal Batteries

Increase Energy Density

Ergonomic



Portable Charging

Fuel Cells

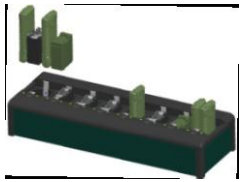
Renewable Energy

Portable Charging

Unit Charging

Universal Chargers

Soldier Load



Mobile Power

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Soldier Power

Message to Industry

- Safely increase energy density of current and emerging tech.
- Reduce size and weight of soldier-worn power
- Integrate capabilities to reduce load and complexity
- Improve system efficiency and reduce the logistical burden to the war-fighter

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UAV

Objective: To provide advanced electrochemical devices, including fuel cells, to enhance the capability of the warfighter.

- Persistent Wearable Power: Micro Air Vehicles (< 1 lb)
  - 10's to 100's of Watts

- Squad/Fire-Team Support: Hand-Launched/Air-Dropped (Target: < 20 lbs)
  - 10's to 100's of Watts

- Persistence UAS/Strike Capable : Ground-Launched/Air-Dropped (Target 50 – 150 lbs)
  - 1000's of Watts

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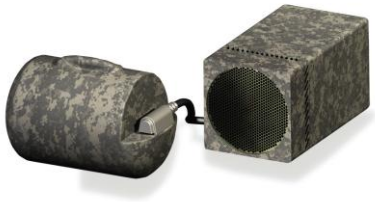
UAV

Objective: To provide advanced electrochemical devices, including fuel cells, to enhance the capability of the warfighter.

- DLA/Naval Surface Warfare Center, Crane Division
  - Protonix
- TARDEC
  - Adaptive Materials
- Naval Air Weapons Station, China Lake
  - Adaptive Materials



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Recommendations for DoD

- FC systems should be considered for providing power, heat and cooling for new and current installations
- Monitor and evaluate new FC systems development
- Develop power purchase agreement models that enhance ability to efficiently acquire FC systems
- Improve ability to realize benefits of third party financing
- Expand field testing of soldier and UMV power
- Support development and demonstration projects with R&D funds.

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Thank You

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