Hydrogen Powered Forklift Test-bed Brief

Leo Grassilli
on behalf of John Christensen, R&D Director
January 2007
## The DLA Enterprise

<table>
<thead>
<tr>
<th>FY</th>
<th>Sales/Services</th>
<th>$</th>
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<tbody>
<tr>
<td>02</td>
<td>$21.5B</td>
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<tr>
<td>03</td>
<td>$25B</td>
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<td>04</td>
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<td>05</td>
<td>$31.8B</td>
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<td>06</td>
<td>$35.5B</td>
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<td>07</td>
<td>$34.4B</td>
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</table>

- **Land/Maritime:** $3.2B
- **Aviation:** $3.4B
- **Troop Support:** $11.6B
- **Energy:** $13.5B
- **Distribution:** $1.5B
- **Other:** $1.2B
- ~95% of Services’ repair parts
- 100% of Services’ subsistence, fuels, medical, clothing & textile, construction & barrier materiel

### Foreign Military Sales
- **Sales:** $1.02B
- **Shipments:** 520K
- **Supporting 126 Nations**

### Scope of Business
- 54,000 Requisitions/Day
- 8,200 Contracts/Day
- #58 Fortune 500 – Above Sprint Nextel
- #3 in Top 50 Distribution Warehouses
- 26 Distribution Depots
- 25M Annual Receipts and Issues
- 5.2 Million Items – eight supply chains
- 1411 Weapon Systems Supported
- 132.8M Barrels Fuel Sold
- $14.6B Annual Reutilizations/Disposals
- Land/Maritime: $3.2B
- Aviation: $3.4B
- Troop Support: $11.6B
- Energy: $13.5B
- Distribution: $1.5B
- Other: $1.2B

### People
- 20,805 Civilians
- 519 Active Duty Military
- 754 Reserve Military
- Located in 48 States/28 Countries

### FY Sales/Services
- **FY02** Sales/Services: $21.5B
- **FY03** Sales/Services: $25B
- **FY04** Sales/Services: $28B
- **FY05** Sales/Services: $31.8B
- **FY06** Sales/Services: $35.5B
- **FY07** Projected: $34.4B

### Foreign Military Sales
- **Sales:** $1.02B
- **Shipments:** 520K
- **Supporting 126 Nations**
The Advanced Energy Initiative is focused on three promising ways to reduce gasoline consumption. One is increasing the use of ethanol, another is improving hybrid vehicles, and finally, one is developing hydrogen technology. All three go hand-in-hand; all three are an important part of a strategy to help us diversify away from hydrocarbons.

Advanced Energy Initiative 2006 -- to push for breakthroughs in two vital areas. …how we power our homes and offices, …how we power our automobiles.

Cooperative with DOE, DOT, EPA, and DOC(NIST)
DOD’s Role in President’s Advanced Energy Initiative

- Basic and Applied Research
  - Department of Energy
  - Department of Transportation
  - Department of Commerce

- First Adopter – Department of Defense
  - Move H2 sub-systems Down the learning / cost Curve
    - H2 Storage
    - Fuel Cells
    - Distribution

- H2 Powered Material Handling Equipment Near Term Opportunity
  - Provides operational advantages – not just advancing technology

- DDSP and DDJC provide critical concentration of forklifts
  - DDSP first – conventional H2 Fueling
  - DDJC – Potentially renewable Energy Source H2
Initiative Purpose

• Background
  – Reducing Petroleum Dependence
  – Advancing Fuel Cell Manufacturing Maturity
• Proposed Test
  – Forklift truck background
  – Proposed Test
  – Schedule
• Discussion
• Site walkaround
• Wrap Up
Defense Distribution Depot Susquehanna

• Eastern DLA Strategic Distribution Platform
  – New Cumberland and Mechanicsburg facilities.
  – Provides military and commercial repair parts, clothing and textiles, medical supplies and industrial and electronic components to military customers throughout the United States and the world.

• DDC MISSION:
  – Provide full range of distribution services and information enabling a seamless, tailored, worldwide DoD distribution network that delivers effective, efficient and innovative support to combatant commands, military services, and other agencies during peace and war.
Defense Distribution Depot Susquehanna

*New Cumberland Location*

1.7 million ft² warehouse
Broad Agency Announcement (BAA)

Research and Development for Hydrogen-Fueled Material Handling Equipment and Hydrogen Vehicle Fueling Station Pilot Projects

Pre-Proposal Conference and Site Visit

21 November 2006
Hydrogen Logistics-ManTech Initiative Participants

12 All Day Meetings with Energy Group and Industry Leaders and Other Alternative Fuel Innovators
Hydrogen Logistics ManTech Initiative
Energy Supplier View Point

The U.S.:
- Won’t run out of petroleum in the near term
- Economy will be subjected to continuing “energy shocks”
- Industry must make an investment decision soon: petroleum vs. alternative energy sources
Hydrogen Logistics ManTech Initiative
Auto Industry’s View Point

GM’s Objective

- Design and validate an automotive-competitive fuel cell propulsion system by 2010
- By automotive competitive, we mean a system that has the performance, durability, and cost (at scale volumes) of today’s internal combustion engine systems

DaimlerChrysler Fuel Cell Strategy

- Major Auto Firms Committed
- Recognize critical Government role
- DOD as an early adopter will help Hydrogen (H2) vehicle transition
- Concurrent Infrastructure Critical
Hydrogen Logistics ManTech Initiative
Sub-tier Industry View Points

- Fuel Cell Volume is key to Sub-tier
- Exercise component manufacturers’ to reduce cost and increase reliability
- Forklift applications are ready for early adopters
- Greater military operational usage dependent on increased commercialization
Hydrogen Logistics ManTech Initiative

H2 Supplier View Point

- Fixed Installation and vehicle efforts can be complementary if properly coordinated
DOD’s Role: Technology Transition

Historical vs. H2 Potential

Historical DOD Technology Transition

DOD

Basic, Applied, and Developmental R&D + Initial Production Buys

Industry

Leverage DOD Investment Into significant Business Opportunities

Internet

GPS

Microcircuits

NC Tools

Potential H2 DOD Technical Transition Model

DOE

Basic and Applied R&D

Industry

Development

Industry

Commercial Industrial Base

Spin Offs

Broad Military Production Base

• ManTech for:
  – Infrastructure
  – Limited Prod Buys
Leveraging Civil / Military Power Requirements

Civil
- Electronics
- Residential
- Forklifts
- Heavy Vehicle
- Industrial
- Locomotive

Military
- Soldier Power
- Sensors, Unmanned Vehicles
- Vehicles, Mobile Generators
- Ship Service
- Ship Propulsion
- Future Force Warrior

Watts
- $10^1$
- $10^2$
- $10^3$
- $10^4$
- $10^5$
- $10^6$
- $10^7$
- $10^8$
Hydrogen Logistics Initiative
Fuel Cell Benefit to DOD

Direct benefit to military applications
- Increased Fuel Efficiency
- Quiet, low-heat, zero-emissions
- Energy density
- Fuel diversity

Soldier Power
COMBATT APU
UAV
UUV
DDX
Micro-grids
Portable Gen-sets
Hydrogen Sourcing Options

- Central Production
- On-site Production

Distribution

Hydrogen

Onsite

Natural Gas, Propane, Methanol, Feedstocks

Air Products and Chemicals, Inc.
Confidential

Courtesy of Air Products
H2 Powered Forklift Pilot
High Level Schedule

<table>
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<th>Task Plan</th>
<th>Task Progress</th>
<th>Milestone</th>
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<tr>
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<td>H2 Storage Site Design &amp; Prep</td>
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FY 07 | FY 08

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Summary

• H2 Fuel Cell Forklifts have potential to improve DLA Distribution Operations
• Testing in DDC will provide real data that will allow an informed decision regarding costs and benefits for all DOD/others
• If successful, additional warehouses/sites could be outfitted with H2 Powered Forklifts