U.S. Army Materiel Command
NDIA
2003 Tactical Wheeled Vehicles Conference
General Paul Kern
ESSENTIAL IN PEACE, INDISPENSABLE IN WAR
HEMTT COST PER SYSTEM and FMC RATE

<table>
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<th>Fiscal Year</th>
<th>DOLLARS</th>
<th>PERCENT</th>
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<tr>
<td>1996</td>
<td>95.0</td>
<td>85.0</td>
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<td>1997</td>
<td>94.0</td>
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<td>1998</td>
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<td>1999</td>
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<td>90.0</td>
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Linear (PART $ / SYS / YEAR)
Linear (FMC RATE)
HMMWV COST PER SYSTEM and FMC RATE

FY 2001 DOLLARS

PER CENT

FISCAL YEAR

PART $ / SYS / YEAR
FMC RATE
Linear (FMC RATE)
Linear (PART $ / SYS / YEAR)
Tech Insertion
Master Lighting Switch

- $1.86M to $63K
- 20 X Reliability
- HTI Product
- Operational Safety

- Prototype installed in FMTV Tech Demo Vehicle
Trucks Provide the Logistical Backbone to the Army

Fuel to a force can cost as much as $40-50/gal overland.

Fuel constitutes 70% of bulk tonnage needed to sustain a military force on the battlefield. This equates to about 600,000 gallons per day.

- Fuel Efficient AAN Task Force

The US Army has a fleet of over 246,000 tactical wheeled vehicles and drives 823 million miles annually.

Army After 2010 goal:
“...75% Reduction in Fuel Requirements for a Deployed Force…”
Hybrid Electric Projects

- Improved fuel efficiency
- On-board and off-board power

HMMWV

M-113

COMBATT

Class 8

HEMTT LHS

ESSENTIAL IN PEACE, INDISPENSABLE IN WAR
Hybrid-Electric Effects on Stryker Brigade Combat Team (BCT)

- Increase the range by 180 miles on a single tank of fuel (1.75x increase)
- Use 4,000 less gallons of fuel over 100 miles
- Increase an average of 37 miles per day over a 5 day deployment without resupply
- Increase the efficiency of the Support Battalion by 47,000 ton-miles per day
- In the SBCT (assuming all vehicles are hybrids):
  - Could replace some / all of the 123 generators that weigh 70 STONS and consume 19K cubic feet of space on deployment
Power Requirements Over Time

- **Jeep**
  - 25 amp alternator

- **M35**
  - 60 amp alternator

- **HMMWV**
  - 100 amp alternator

- **FMTV**
  - 100 amp alternator

- **SmarTruck II**
  - 150 amp alternator

**ESSENTIAL IN PEACE, INDISPENSABLE IN WAR**
SmarTruck Capabilities

- Bullet Proof Glass
- On-Board Diagnostics
- Lightweight Armor
- Wireless Communication
- Non-Lethal Weaponry
- Night Vision
- Remote Control Weapons Station
- Touch Screen Display
- Bomb Detection
- Global Positioning System

ESSENTIAL IN PEACE, INDISPENSABLE IN WAR
Blending of Technologies, Time and Space

ACCELERATION OF TECHNOLOGIES & COMPLEXITY

NETWORKED FIRES
OBJECTIVE FORCE WARRIOR

INDEPENDENT ORGANIZATIONS

ESSENTIAL IN PEACE, INDISPENSABLE IN WAR

INTERDEPENDENT ORGANIZATIONS

Systems of Systems Integration

= ?

TIME

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= ?

TIME
RDE Command Functions

Support Acquisition & Sustainment
- PEOs & PMs
- AMC MSCs

Transition Technology
- Provide advice to Decision Makers

Experiment & Analyze
- Mature the Design
- Rcmd a Decision

Assess the Value
- Within the System of Systems Architecture
- Prioritize Applications

Innovate Technology
- In partnership with all concerned
- Retain and Transfer knowledge

Evaluate the Process
- Continually
- Change as appropriate

Create and/or Acquire
New Scientific Knowledge

Interpret
Knowledge in light of Missions & Needs

Research, Development & Engineering
Future Tactical Truck System (ACTD)
Facing the Future... Together

ESSENTIAL IN PEACE, INDISPENSABLE IN WAR
Back Up charts
Fuel is the Second Largest Demand on the Battlefield

Next to Water, Fuel has the Most Tonnage on the Battlefield: 39% of the Demand
Fuel Cell Technology

WestStart-Calstart with Delphi Automotive and AeroVironment

Design next generation truck APU, demonstrate diesel reformer and planar solid oxide fuel cell

Decreased overall system volume and mass by 75% from proof of Concept APU to Gen 2 APU

Development of planar reformer design and demonstrated it on low sulfur diesel fuel

Detailed design for Generation 2 APU features excellent integration and component optimization

This system design, SOFC with catalytic partial oxidation reformation (CPOX), is very strong for use with logistic fuels
Liquid Fueled Fuel Cell APU

Ballard with Freightliner and the University of Alabama

Develop and road test a liquid fueled APU for a Class 8 application.

Program contracted under the Army’s Dual Use Science and Technology program. Commercial product largely tied to heavy truck industry for anti-idling considerations.

Road worthy methanol fueled PEM APU system to be installed on Freightliner tractor and extensively test for durability and performance.

Bench-top hydrocarbon reformer will be designed featuring improved thermal integration, reactor optimization and formulation of novel catalysts.

Prior art - hydrogen fueled APU

Detail of installed fuel cell subsystems
Regenerative Fuel Cell APU

Hydrogenics

Develop a flexible, modular, transportable fuel cell APU for military use

No external fuel supply, only system connection is to the vehicle electric system via NATO standard connectors

System generates hydrogen on-board for storage in low-pressure metal hydride cylinders

Good silent watch power source, up to 30x energy storage density vs. batteries

HEMTT WARTIME MISSION RELIABILITY

1000's OF MILES PER YEAR
NMC DAYS PER 100 MILES
Linear (1000's OF MILES PER YEAR)
Linear (NMC DAYS PER 100 MILES)
**Hybrid Hydraulic FMTV**

- **Hydraulic Assemblies:**
  - Piston type accumulators
  - Hydraulic fittings and hoses
  - Oil cooler
  - Oil reservoir
  - Low pressure/High pressure

- **RDS System Advantages:**
  - Potential 30% Fuel Reduction
  - Extended Engine Life
  - Improved Acceleration
  - Reduced Emissions
  - System Weight Lighter than Comparable Series or Parallel Electric Hybrid
  - Up to 80% Savings in Brake Wear
  - Up to 30% Reduction in Drive Line Wear