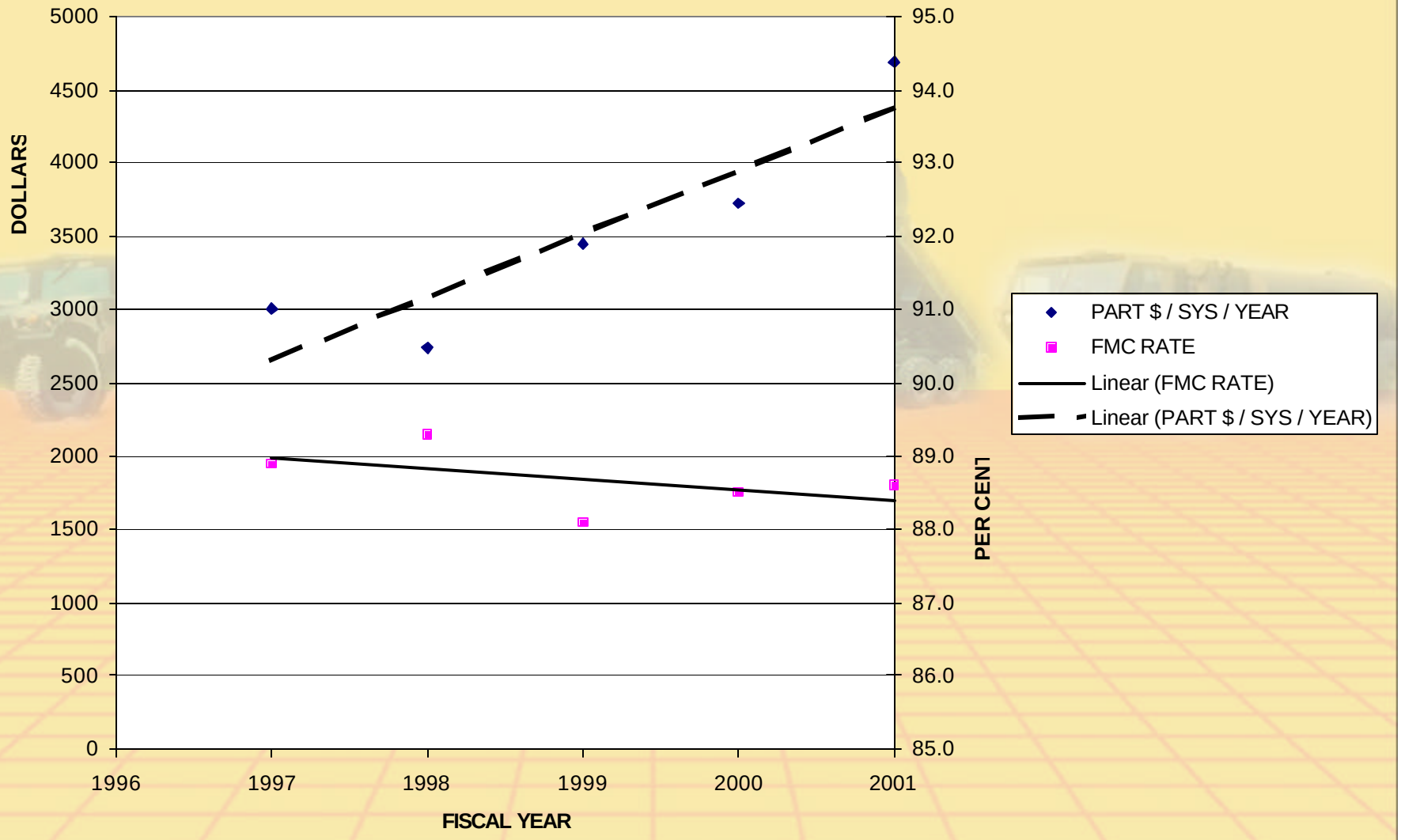
U.S. ARMY MATERIEL COMMAND

NDIA
2003 Tactical Wheeled Vehicles Conference

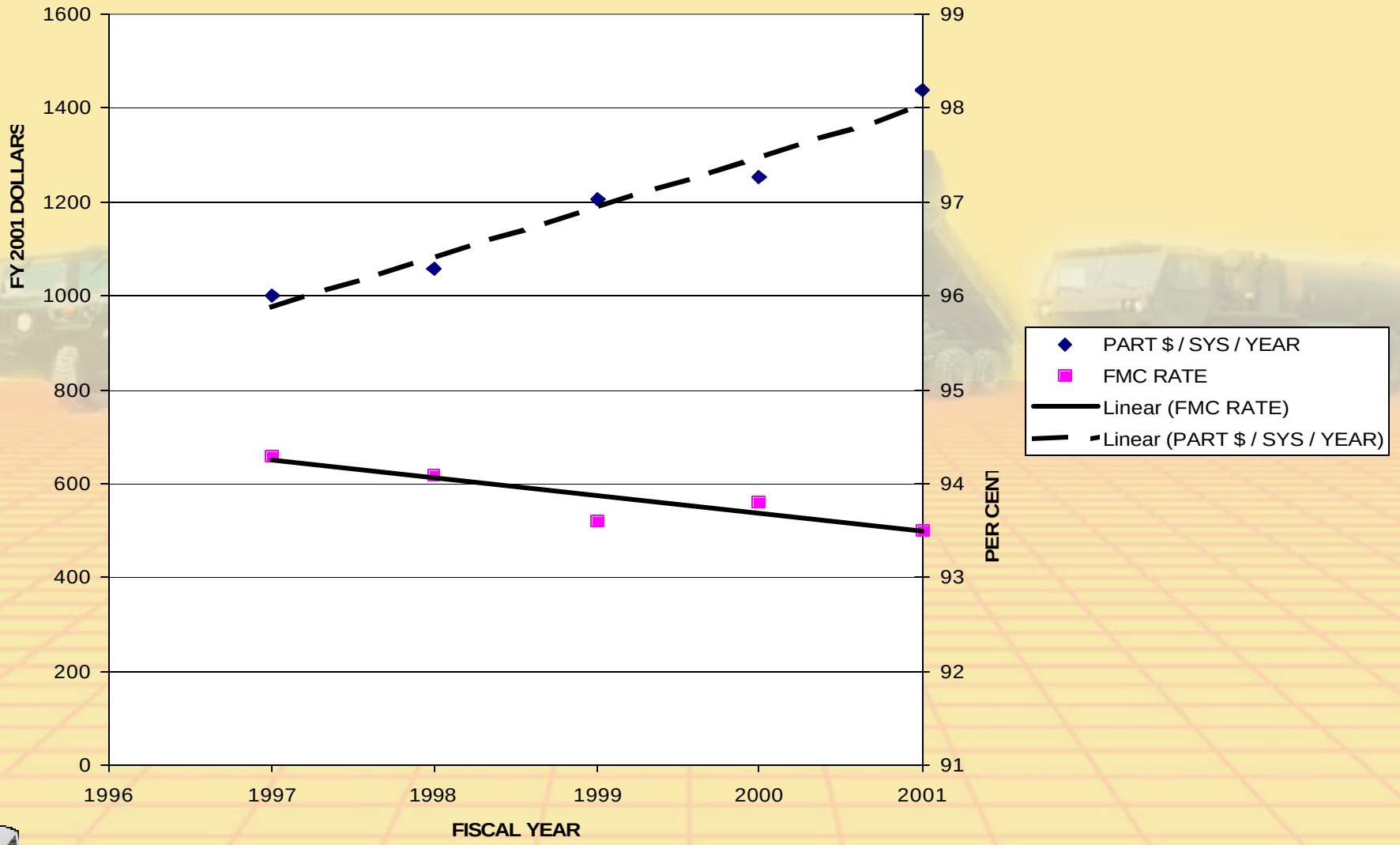
GENERAL PAUL KERN

ESSENTIAL IN PEACE, INDISPENSABLE IN WAR

HEMTT COST PER SYSTEM and FMC RATE



HMMWV COST PER SYSTEM and FMC RATE



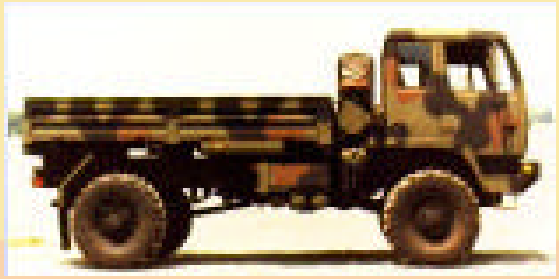
Tech Insertion
Master Lighting Switch

- **$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…"

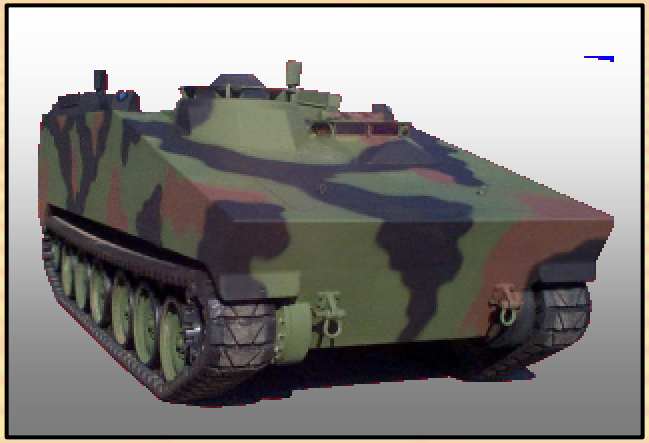
Hybrid Electric Projects

HMMWV

COMBATT

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

M-113



Class 8

HEMTT LHS

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

FMTV

100 amp alternator

HMMWV

100 amp alternator

M35

60 amp alternator

SmarTruckII

150 amp alternator

SmarTruck Capabilities

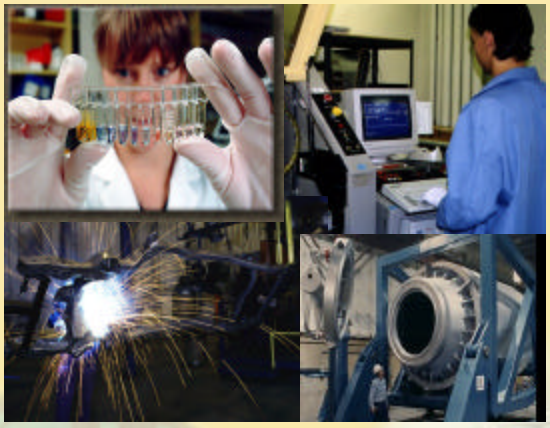
- Bullet Proof Glass
- On-Board Diagnostics
- Lightweight Armor
- Wireless Communication
- Non-Lethal Weaponry
- Night Vision
- Remote Control Weapons Station
- Touch Screen Display
- Bomb Detection
- Global Positioning System


RDE COMMAND
ESSENTIAL IN PEACE, INDISPENSABLE IN WAR

Blending of Technologies, Time and Space

ACCELERATION OF TECHNOLOGIES & COMPLEXITY

TIME



FCS
NETWORKED FIRES
OBJECTIVE FORCE WARRIOR

COMANCHE

APACHE (D)
M1A2SEP
JTRS

IAV

FBCB2
ABCS

APACHE (C)
HELLFIRE
JAVELIN
SINGARS

APACHE (A)
M1
MLRS

Systems of Systems Integration

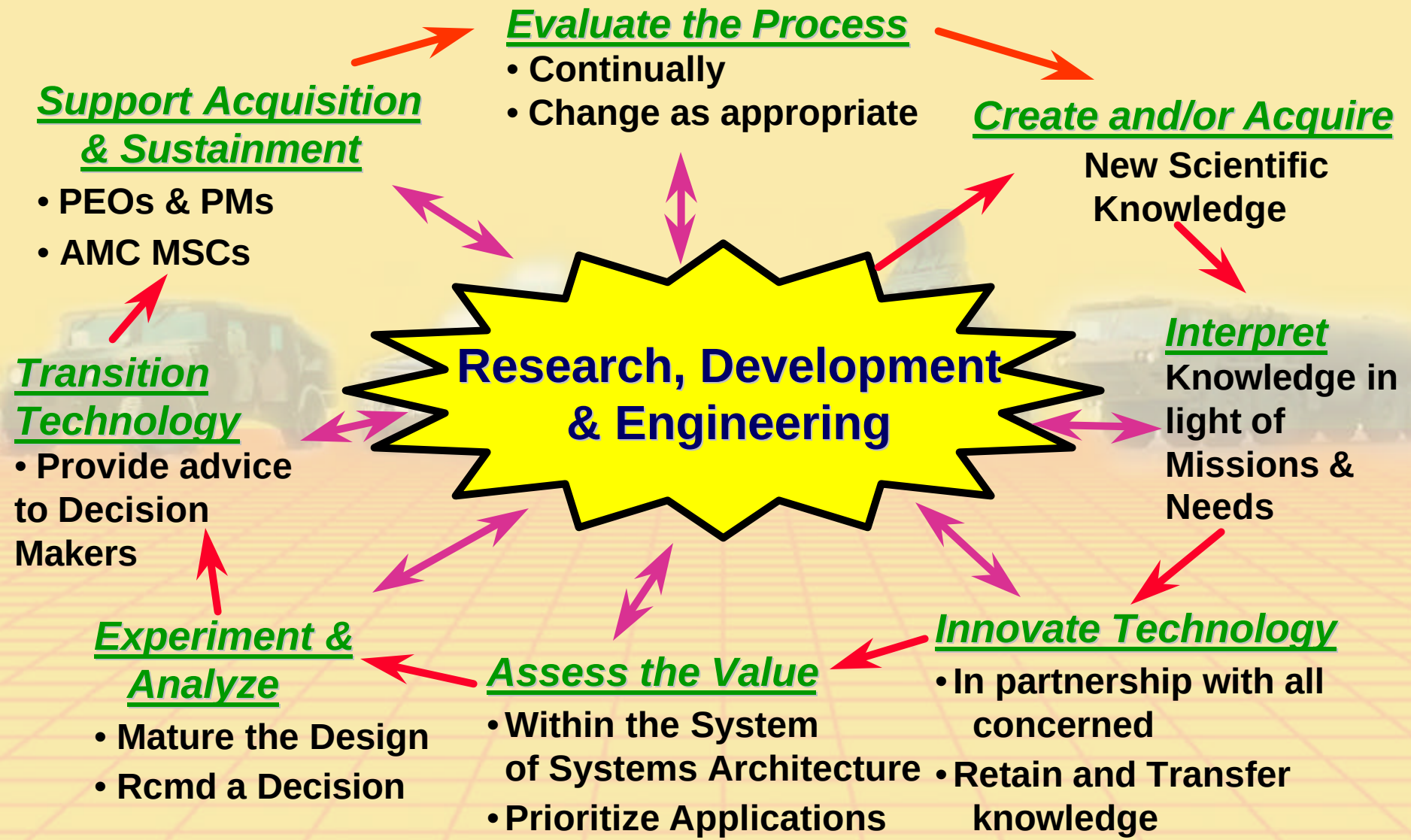
= ?

INDEPENDENT ORGANIZATIONS

INTERDEPENDENT ORGANIZATIONS

ESSENTIAL IN PEACE, INDISPENSABLE IN WAR

RDE Command Functions

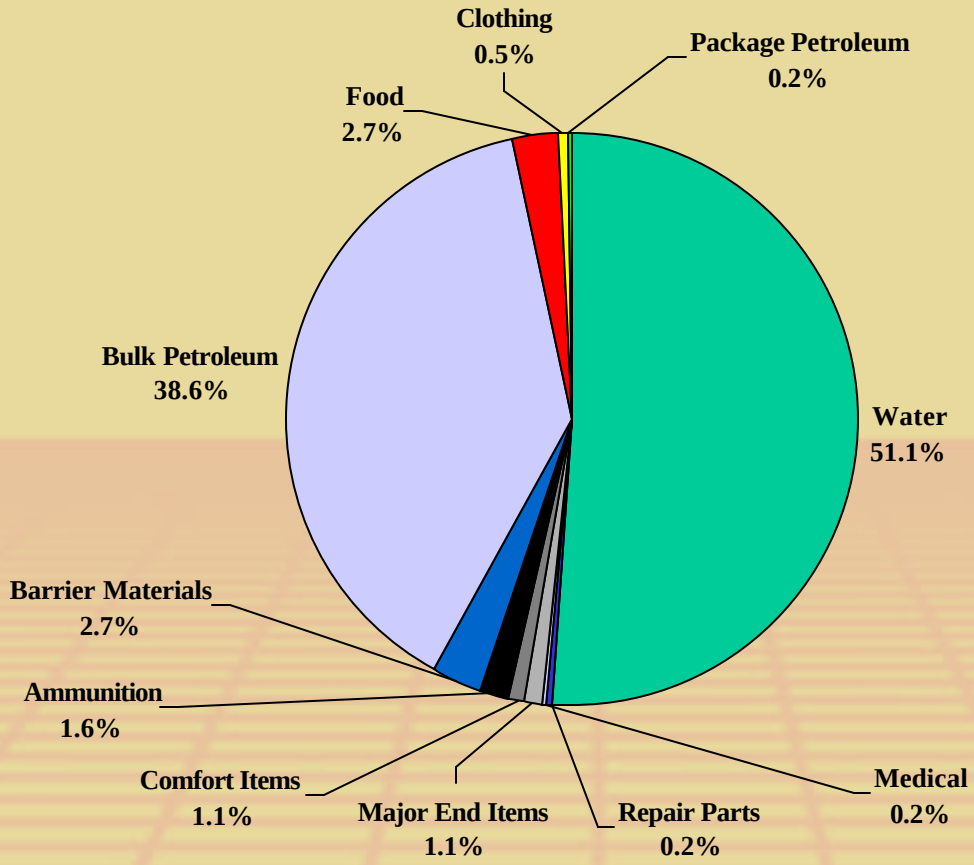


Future Tactical Truck System (ACTD)


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

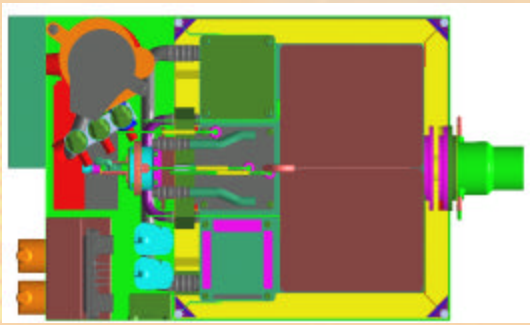
Fuel Cell Technology

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

Engineering model of fuel cell APU



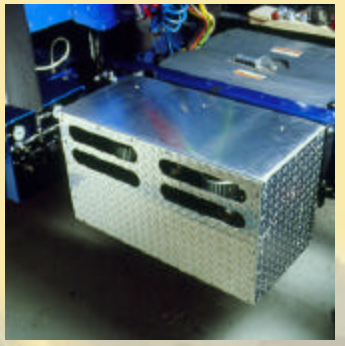
Generation 2 APU component layout

Liquid Fueled Fuel Cell APU

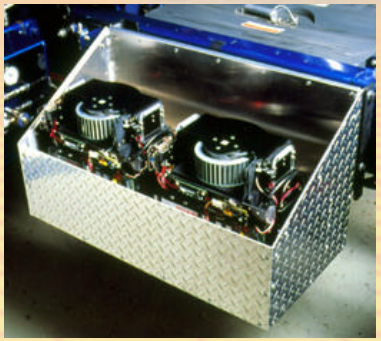
Ballard with Freightliner and the University of Alabama

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

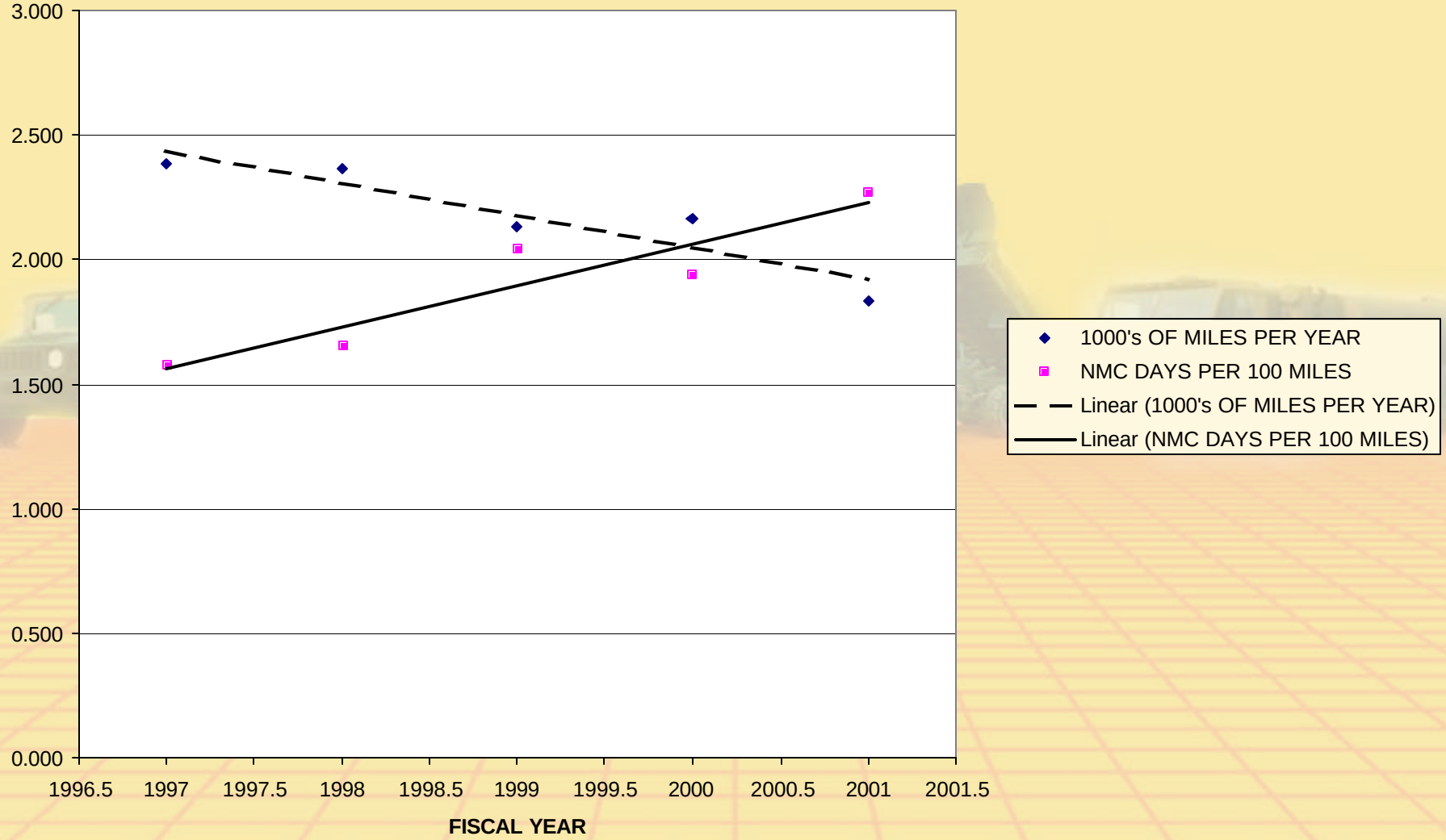
Develop a flexible, modular, transportable fuel cell APU for military use

- 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
- System was delivered to General Motors Dec. 2002 for integration into a hybrid electric COMBATT. Vehicle displayed at North American International Auto Show in Jan. 2003. Ship to TACOM for evaluation Feb. 2003.

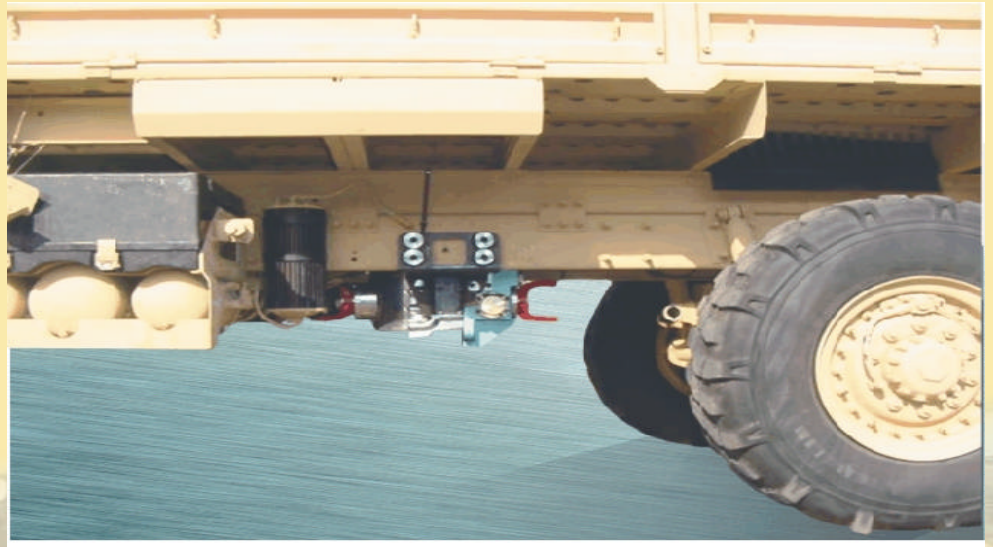
Proof of concept regenerative APU

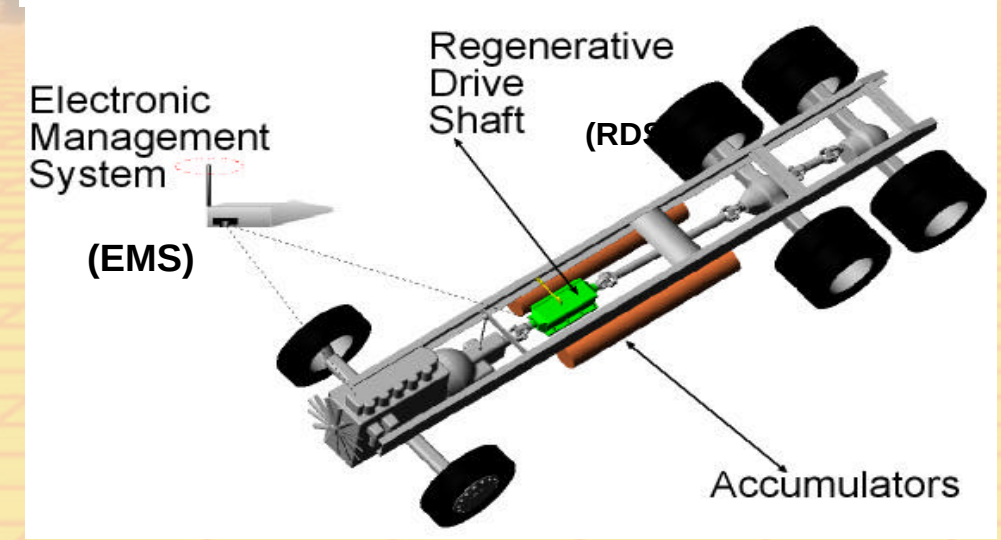
GM hybrid electric COMBATT

HEMTT WARTIME MISSION RELIABILITY



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**

Research, Development and Engineering Command (Provisional)