

# U.S. Army Energy and Environmental Requirements and Goals: Opportunities for Fuel Cells and Hydrogen

## Facility Locations and Hydrogen Storage/Delivery Logistics

Distributed Generation



H<sub>2</sub> Generation & Storage



Material Handling



H<sub>2</sub> Vehicles



**Nicholas M. Josefik**

217-373-4436

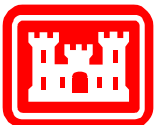
N-josefik@cecer.army.mil

www.dodfuelcell.com

**Franklin H. Holcomb**

Project Leader, Fuel Cell Team

27 OCT 08

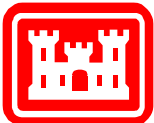


US Army Corps  
of Engineers®

Engineer Research and Development Center

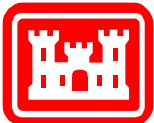
# Presentation Outline

- **DoD Energy Use**
- **Federal Facilities Goals and Requirements**
- **Federal Vehicles and Fuel Goals**
- **Opportunities & Conclusions**



# Where Does the Energy Go?

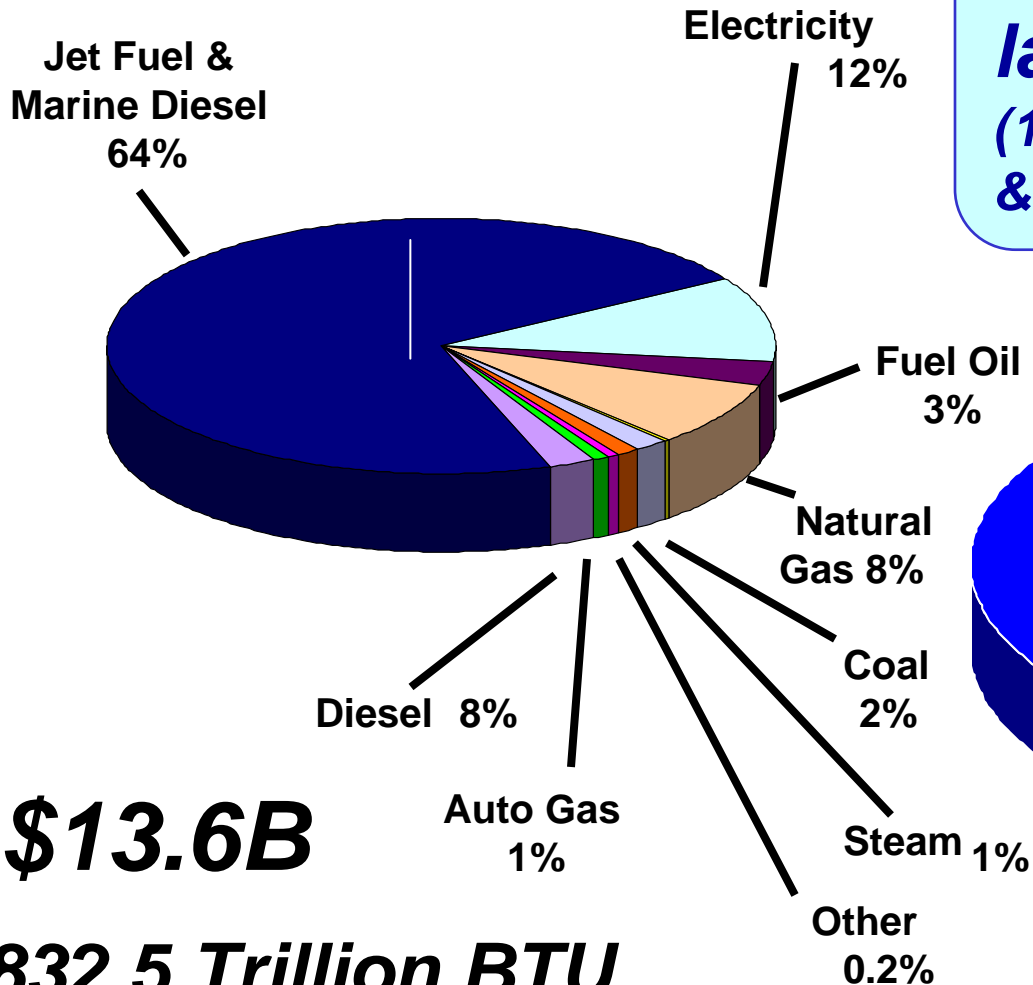
- **Tactical and Combat Vehicles (Jets, Ships, Tanks, Humvees...)**
- **Tactical Facilities (Forward Operating Bases, etc. Powered by Generators)**
- **Fixed Installation Utilities (Electricity, Natural Gas, Water...)**
- **Non Tactical Vehicles**



# FY06 DoD Energy Use

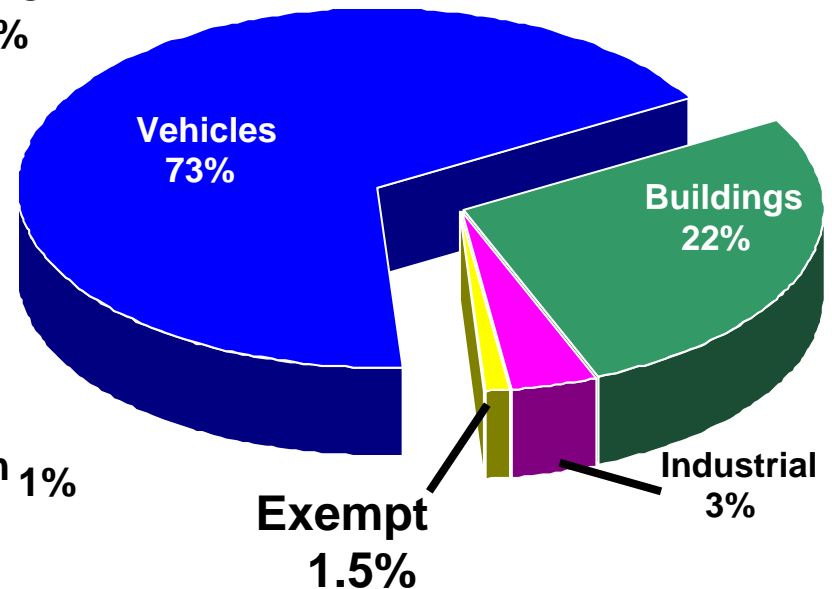
Total Site-delivered Energy (BTU)

## Commodity



***Nation's single  
largest energy user  
(1% of total U.S. energy use  
& 78% of Federal energy use)***

## Application

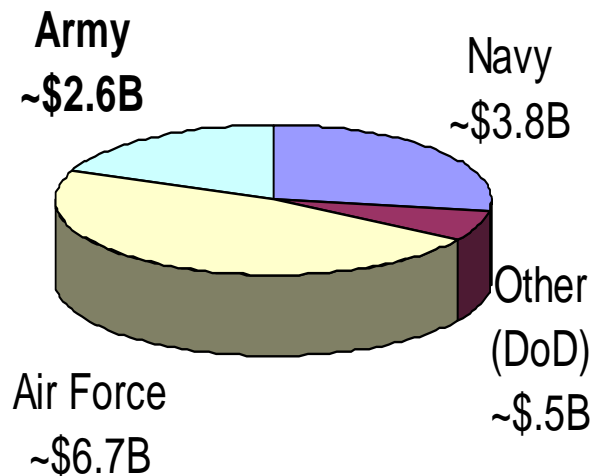


***\$13.6B***

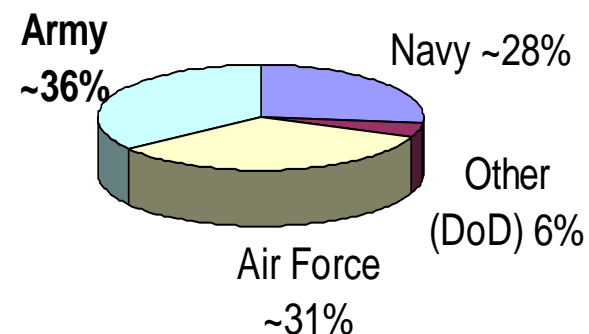
***832.5 Trillion BTU***

# FY06 DoD Energy Consumption

**DoD TOTAL ENERGY**  
**\$13.6B for 832.5 trillion BTUs**



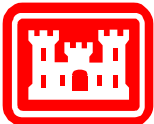
**DoD INSTALLATION UTILITIES**  
**~\$3.3B**



***The Army represents approximately:***

- 19% of DoD Energy consumption***
- 14% of DoD Fuel consumption***
- 36% of DoD Utility consumption***

# **Federal Facilities and Installations Goals and Requirements**

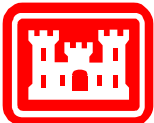


**US Army Corps  
of Engineers®**

**Engineer Research and Development Center**

# Energy Policy Act of 2005

- **Effective on August 8, 2005**
- **Federal Facilities Provisions**
  - **Energy Reduction Goals - 20% by FY 2015 (rel. to 2003)**
  - **Energy Efficient Buildings - 30% better than ASHRAE standards**
  - **Renewable Energy – Purchase 7.5% or more in 2013 and beyond**  
**(DoD Internal Guidance is 25% by 2025)**
  - **Energy Efficient Products – Install Energy Star or FEMP designated products**



# Army Energy Strategy for Installations

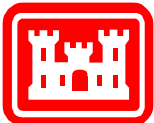
- The 2005 Strategy sets the general direction for the Army in five major initiatives:
  - Eliminate energy waste in existing facilities
  - Increase energy efficiency in new construction and renovations
  - Reduce dependence on fossil fuels
  - Conserve water resources
  - Improve energy security





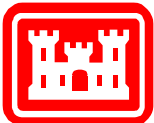
# 2006/2007 Defense Science Board Key Facility Energy Strategy Recommendations

- By December 2008, Develop a Plan to “**Island**” Critical Missions From the Grid.
- By 2025, Require that all DoD Installations Meet A “**Net Zero Energy**” Standard, i.e., they will Produce as Much or More Energy as they Consume.



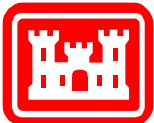
# Energy Independence & Security Act

- Effective on December 19, 2007
- Federal Facilities Provisions
  - Energy Reduction Goals - **30%** by FY 2015 (rel. to 2005)
  - Increased use of Energy Savings Performance Contracts (ESPCs – Third Party Financing)
  - **Fossil Fuel Generated Energy Reduction (rel. to 2003 levels)**
    - 55% by 2010
    - 65% by 2015
    - 80% by 2020
    - 90% by 2025
    - **100% by 2030**

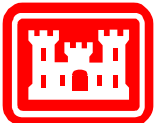


# Key Takeaways

- **Renewable, Renewable, Renewable**
- **Net Zero Energy**
  - Energy Efficiency (Conservation)
  - Energy Production (Ostensively Renewable)
    - Waste to Energy
  - Energy Storage
- **Energy Security**
  - Distributed Generation
  - No Single Points of Vulnerability
- **Do All of the Above but Don't Increase Carbon Footprint**
- **BTW, We're Broke, You Have to Finance...**



# Federal Vehicles and Fuels Goals and Requirements



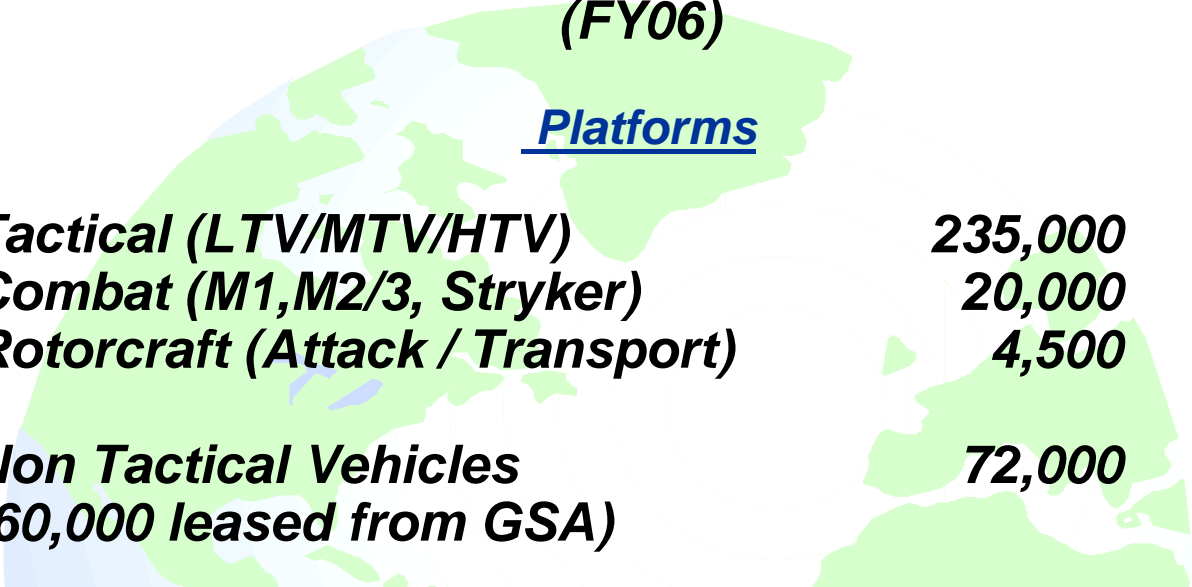
US Army Corps  
of Engineers®

Engineer Research and Development Center

# ***Army Universe***

## ***Scope for Power and Energy Considerations (FY06)***

### **Platforms**



<b><i>Tactical (LTV/MTV/HTV)</i></b>	<b><i>235,000</i></b>
<b><i>Combat (M1,M2/3, Stryker)</i></b>	<b><i>20,000</i></b>
<b><i>Rotorcraft (Attack / Transport)</i></b>	<b><i>4,500</i></b>
<b><i>Non Tactical Vehicles (60,000 leased from GSA)</i></b>	<b><i>72,000</i></b>

### **FY06 Army Fuel and Utility Consumption:**

- 412 M gallons of jet and multi-purpose mobility fuel at cost of \$940M***
- 59 M gallons of diesel at cost of \$123 M***
- 20 M gallons of gasoline at cost of \$45 M***
- 330,000 gallons of biodiesel fuel at cost of \$775 K***
- \$1.211 B annual utility cost for 77.3 BBtu***

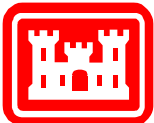
*as of 30 Sep 05*

# Energy Policy Act of 1992

- Effective October 24, 1992
- Federal vehicle fleet energy management goals
  - Defined alternative fuels (AF) and alternative fuel vehicles (AFV)
  - Procure AFVs - 75% by FY 1999 and thereafter
  - Arrange for commercial refueling of AFVs to the maximum extent practicable

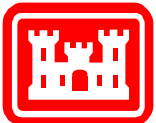
# Energy Policy Act of 2005

- Effective on August 8, 2005
- Federal Vehicle Provision – Sec 701
  - Operate dual fuel vehicles on alternative fuels unless DOE Secretary waiver pursued



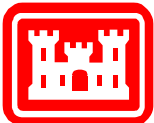
# Executive Order 13149

- **Effective on April 21, 2000**
- **Reinforces EPC Act 1992**
- **Federal vehicle fleet energy management goals**
  - Reduce petroleum consumption - 20% by FY 2005
  - Use alternative fuels – to meet “a majority” of alternative fuel vehicle fuel requirements
  - Increase miles per gallon (mpg) fleet fuel efficiency – 3% by 2005
- **Military tactical vehicles are exempted**



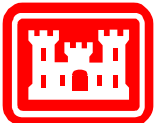
# Executive Order 13423

- **Effective on January 26, 2007**
- **Federal vehicle fleet energy management goals**
  - **Reduce petroleum consumption in fleet vehicles by 2% annually through 2015**
  - **Increase alternative fuel consumption at least 10% annually**
  - **Increase purchase of alternative fuel, hybrid, and plug-in hybrid vehicles when commercially available**





# Fuel Cell and Hydrogen Projects



US Army Corps  
of Engineers®

Engineer Research and Development Center

# Army's First Fuel Cell Truck

April 2005



# Material Handling Equipment

- Delivered in May of 06
- Now Being Tested at Grand Forks Army National Guard Base
- Powered by General Hydrogen Fuel Cell Pack



General Hydrogen's Fuel Cell Pack





# DLA MHE Demonstration

## Defense Depot Susquehanna, PA



*Slide Courtesy of Defense Logistics Agency*

### Objectives:

- Explore fuel cell infrastructure and functionality with forklifts
- Develop a business case for fuel cells
- Collect and analyze operational data

### Approach:

- Retrofit 40 forklifts with fuel cells
- Conduct Fly-Off between 2 fuel cell producers
- Set up storage & dispensing systems for delivered H<sub>2</sub>

### DOD Impacts:

- Develop knowledge of fuel cell powered fork lift capabilities, costs, limitations and benefits
- Improve MRLs and costs

### Customers:

- Defense Depot located at New Cumberland, PA (DDSP)

### Performers:

**Air Products**, Plug Power (formerly General Hydrogen)  
**East Penn Manufacturing**, Nuvera

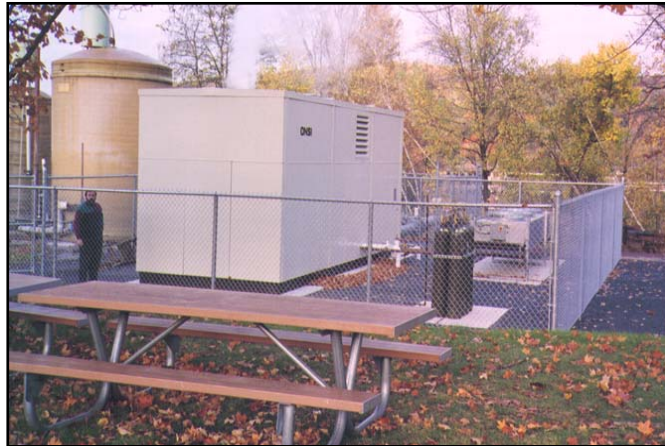
**Budget:** \$5M

### Milestones:

- Contract awarded – August 2007
- First Articles – Q2 2008



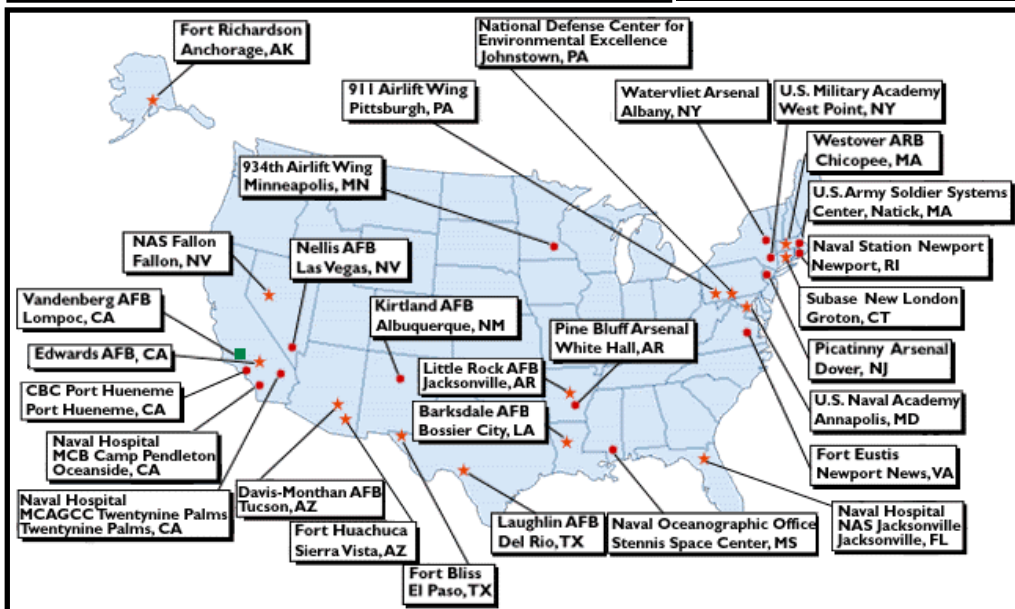
# Fuel Cell Demonstrations at Military Sites



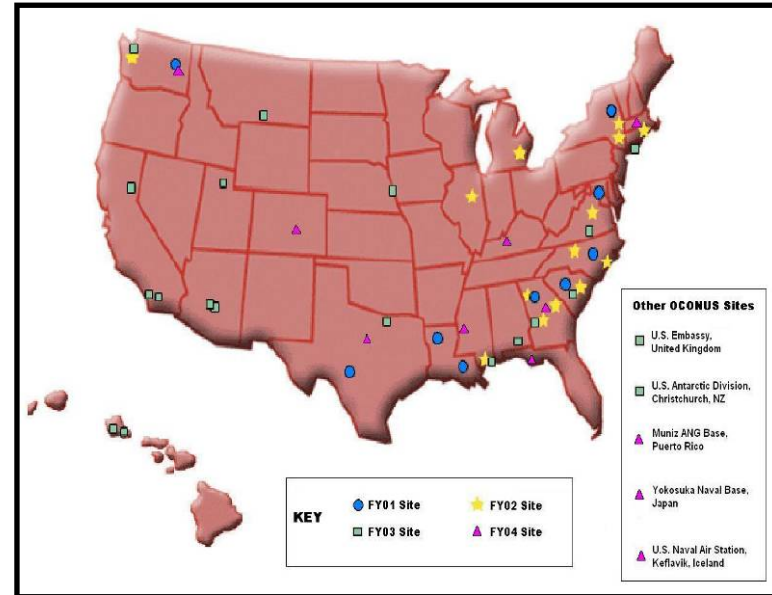
**30 Fuel Cells  
30 Sites  
1 Manufacturer**



**91 Fuel Cells  
56 Sites  
5 Manufacturers**



**FY93-FY94 Phosphoric Acid Fuel Cell (PAFC) Project Sites**

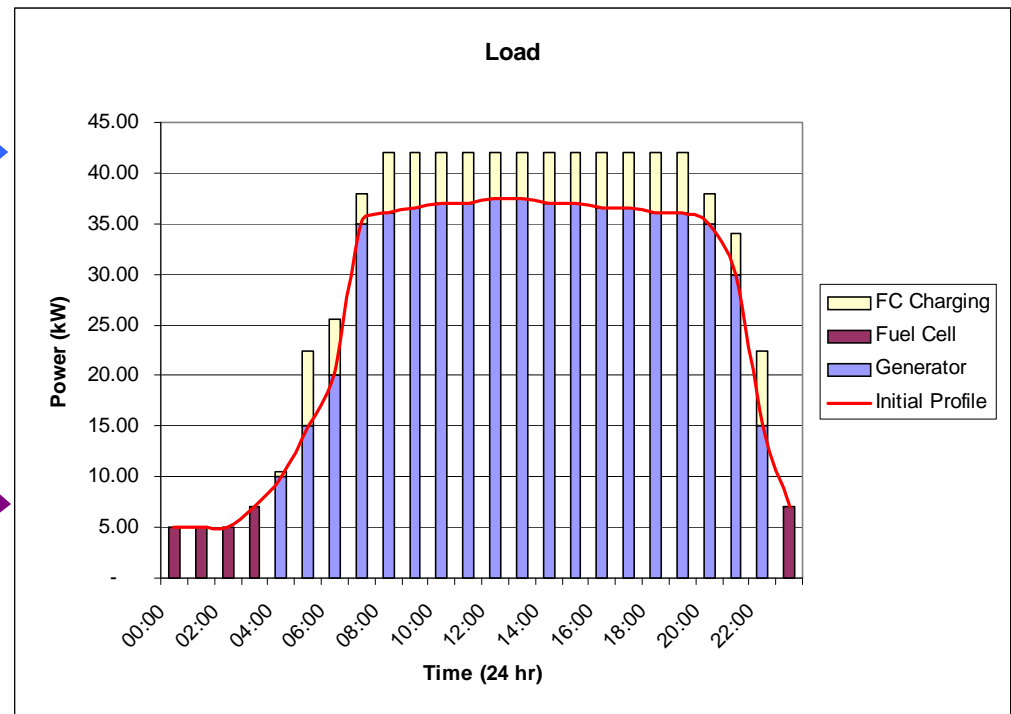
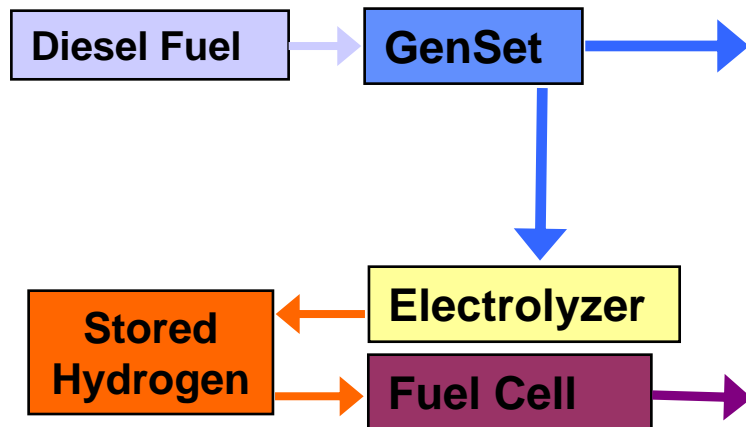


**FY01-FY04 Residential Proton Exchange Membrane Fuel Cell (PEMFC) Project Sites**

# Advanced Energy Concepts for Base Camps

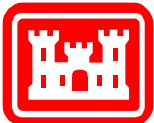
## Silent Camp™

- Diesel Generators Lightly Loaded, Inefficient, Noisy
- Increase GenSet Output to Electrolyze Water
- Store H<sub>2</sub> Produced from Electrolyzer
- Use Stored H<sub>2</sub> and Fuel Cell to Power Loads at Night
- Shut GenSet Off During Fuel Cell Operation
- Can Maximize Silent Camp Operation or Fuel Savings



# Conclusions

- **Some DoD Requirements & Goals Supportive of H2 and Fuel Cell Technology**
- **DoD is Good Testbed for New Technology, Focus on Dual Use (Military / Commercial)**
- **Perfect Storm of Energy Prices / Goals & Requirements**
- **Some Unfunded Mandates**



# <http://dodfuelcell.cecer.army.mil>

