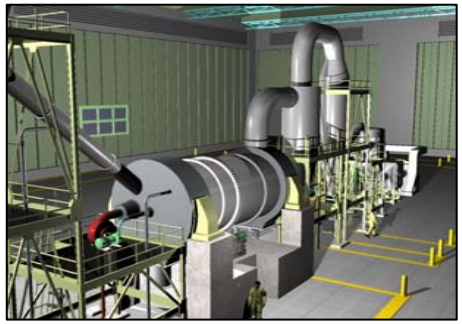
U.S. Army Requirements-Driven Remote Power and Microgrid Opportunities

Distributed Generation

H_2 Generation & Storage

Waste to Energy



Remote Power

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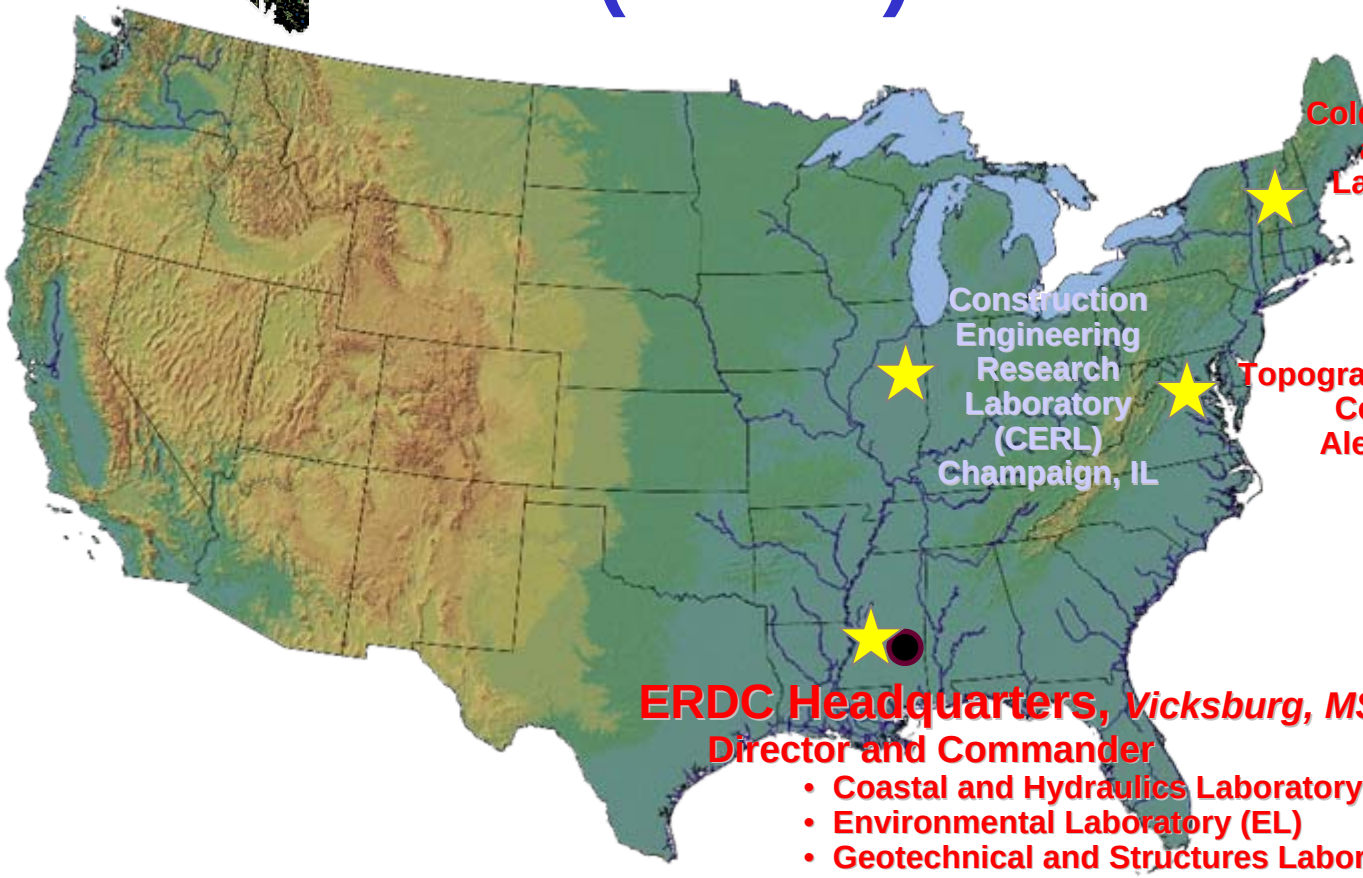
Presentation Outline

- Introduction
- Background
- Goals and Requirements
  - Installation
  - Warfighter
- Army Funded Activities
- Acknowledgements

Engineer Research and Development Center (ERDC)

European Research Office



Cold Regions Research and Engineering Laboratory (CRREL) Hanover, NH

Construction Engineering Research Laboratory (CERL) Champaign, IL

Topographic Engineering Center (TEC) Alexandria, VA

ERDC Headquarters, ***Vicksburg, MS***

Director and Commander

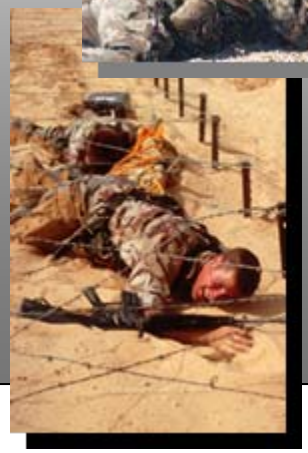
- Coastal and Hydraulics Laboratory (CHL)
- Environmental Laboratory (EL)
- Geotechnical and Structures Laboratory (GSL)
- Information Technology Laboratory (ITL)

Soldiers, Families, and Civilians

Home to the Force

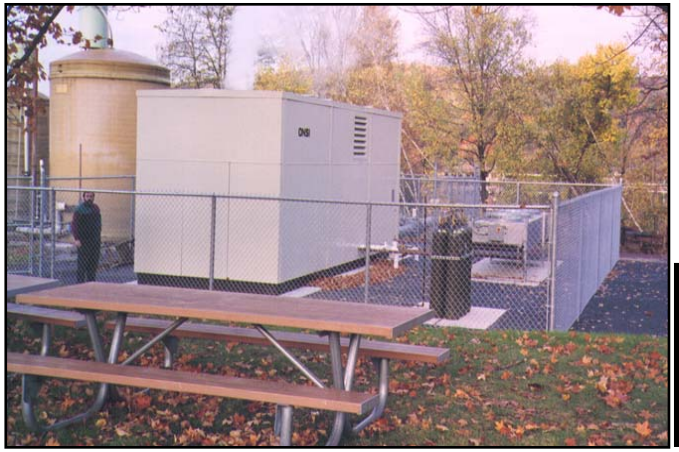
Power Projection

Work & Training



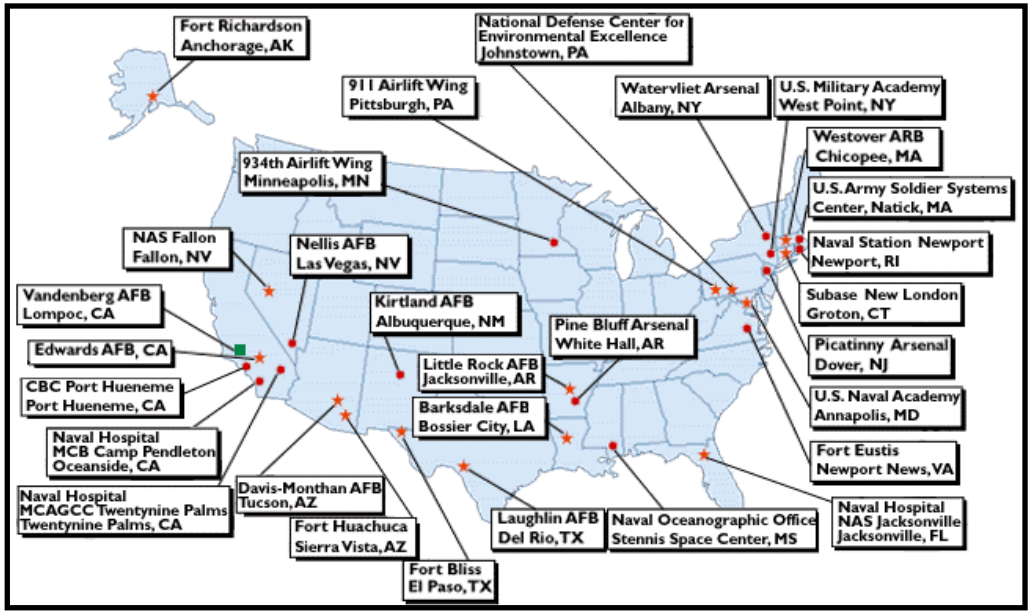
… are our Customers!

Fuel Cell Demonstrations at Military Sites

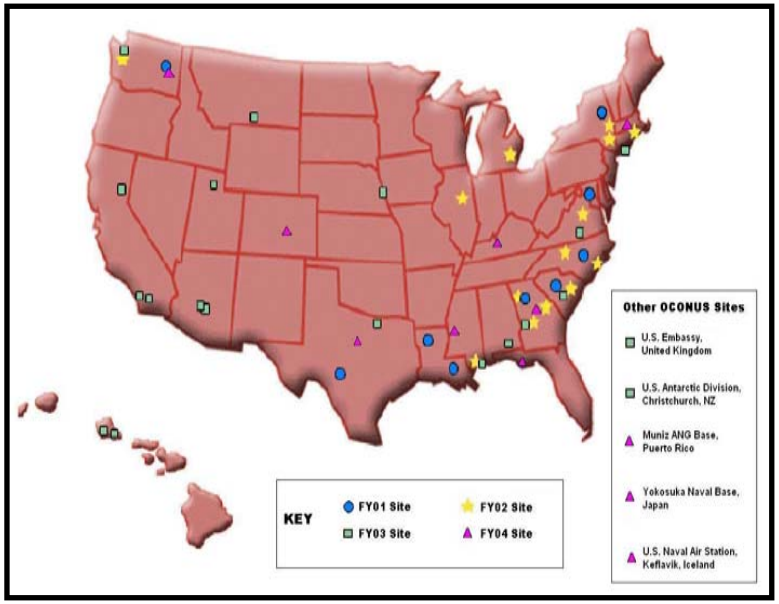


30 Fuel Cells
30 Sites
1 Manufacturer

91 Fuel Cells
56 Sites
5 Manufacturers

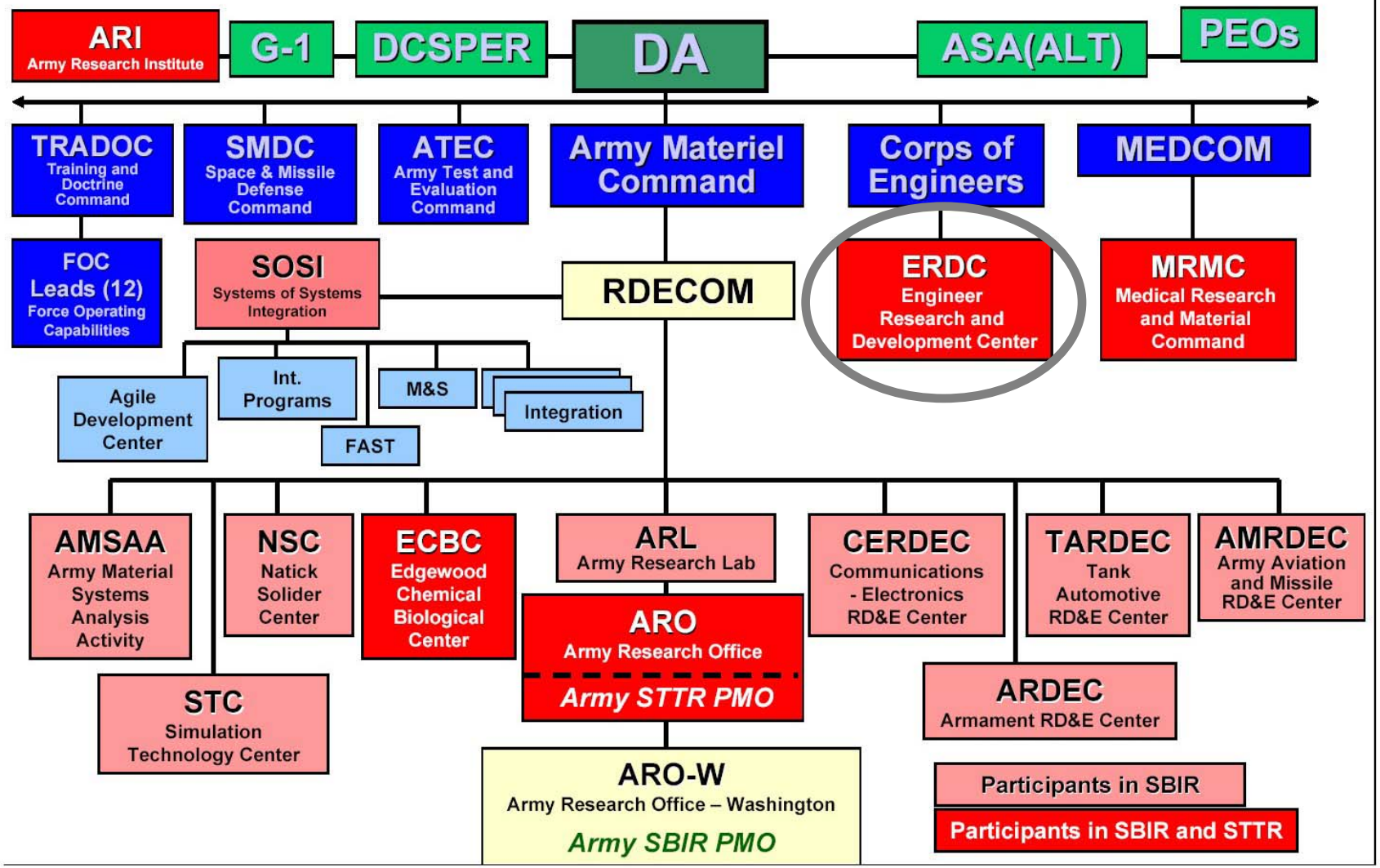


FY93-FY94 Phosphoric Acid Fuel Cell (PAFC) Project Sites



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

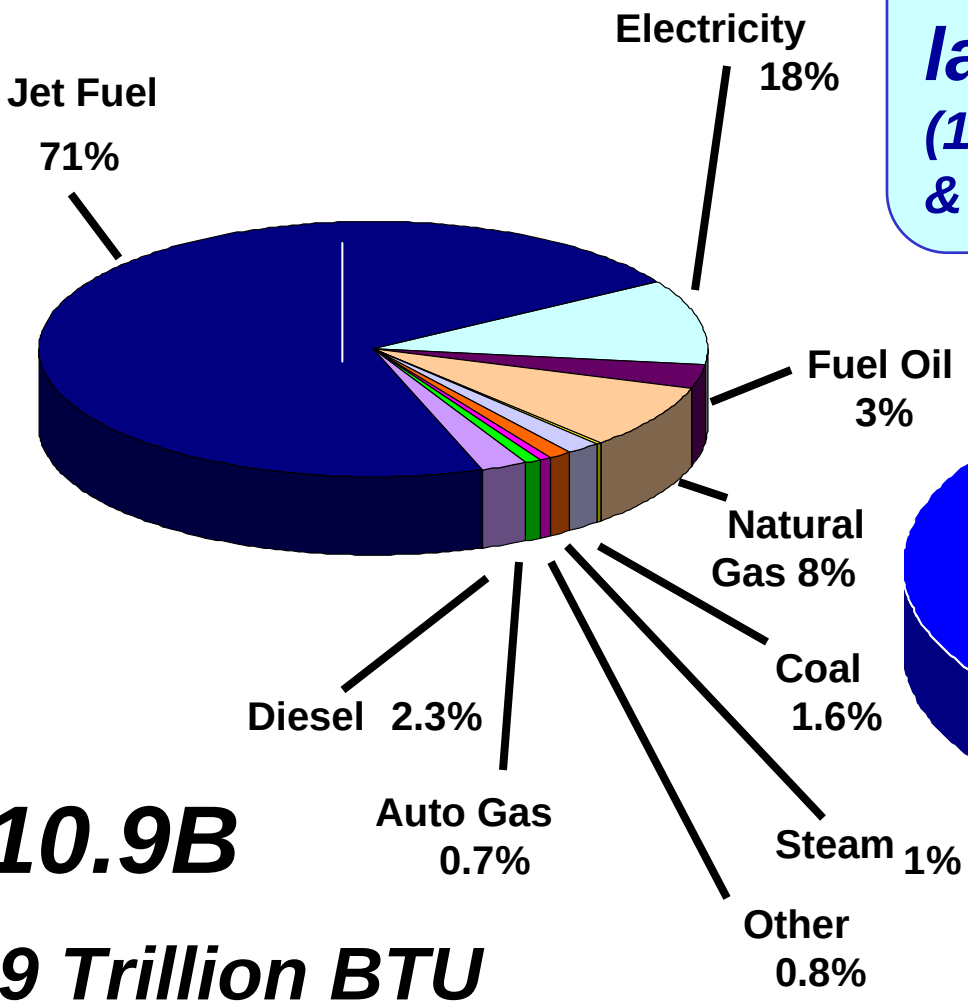
ARMY R&D Organizations



FY05 DoD Energy Use

Total Site-delivered Energy (BTU)

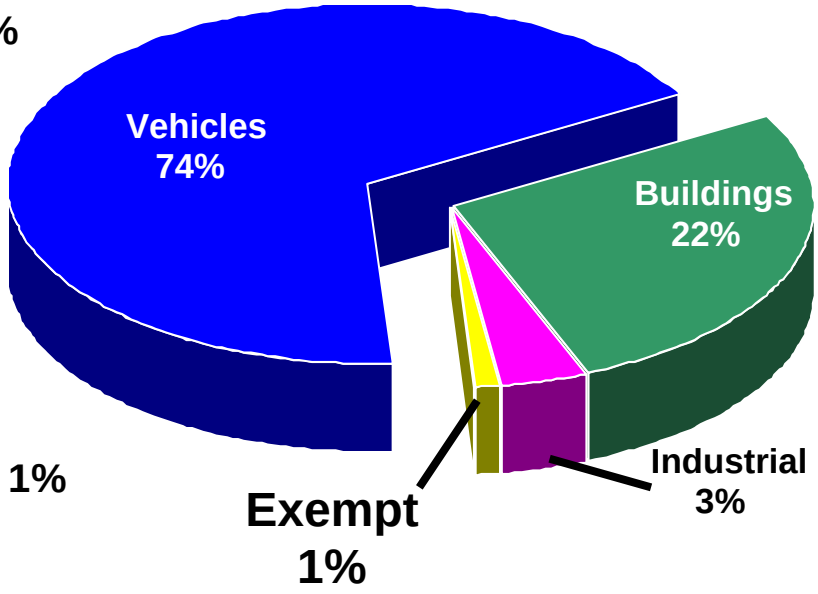
Commodity



Nation's single largest energy user

(1% of total U.S. energy use & 78% of Federal energy use)

Application

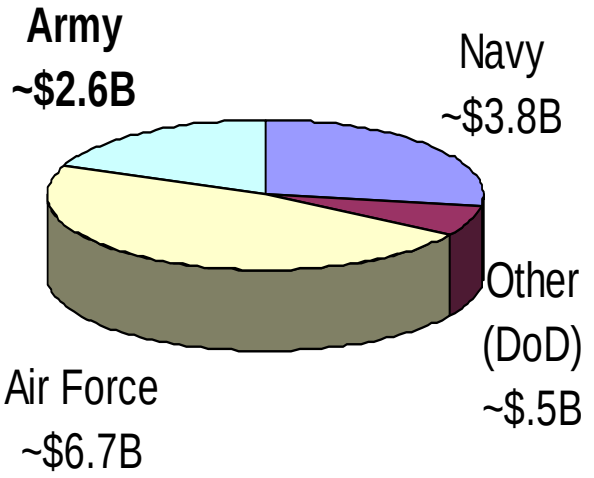


$10.9B

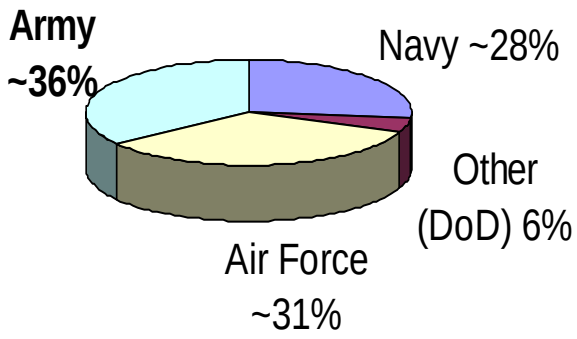
919 Trillion BTU

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***

Army Universe

Scope for Power and Energy Considerations (FY06)

Installations

IMCOM	84
Reserves	4
National Guard	56
AMC	27
Other	5

Platforms

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

Forward Area Bases

- Support facility outside of CONUS
- Manned by U.S. military or host-nation nationals
- Capability determined by the forces and by the risks and costs of positioning specific capabilities at its location.

Land Acreage

United States	15,174,634
Europe	162,174
Asia	51,291
Other Overseas	15,213

Environmental Clean-up

(Installation Restoration Program & Military Munitions Response Program)

Active Sites	1,763
BRAC Sites	213
Formerly Used Defense Sites	2,153

Buildings

(million square feet)

United States	770
Europe	153
Asia	46
Other	7

Utilities

Electric, gas, water and sewer - 47,803 miles

People

Active	482,400
USAR	205,000
ARNG	350,000
Civilians	229,000

FY06 Army fuel and utility consumption:

- 412 M gallons of jet and multi-purpose mobility fuel at cost of $940 M
- 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

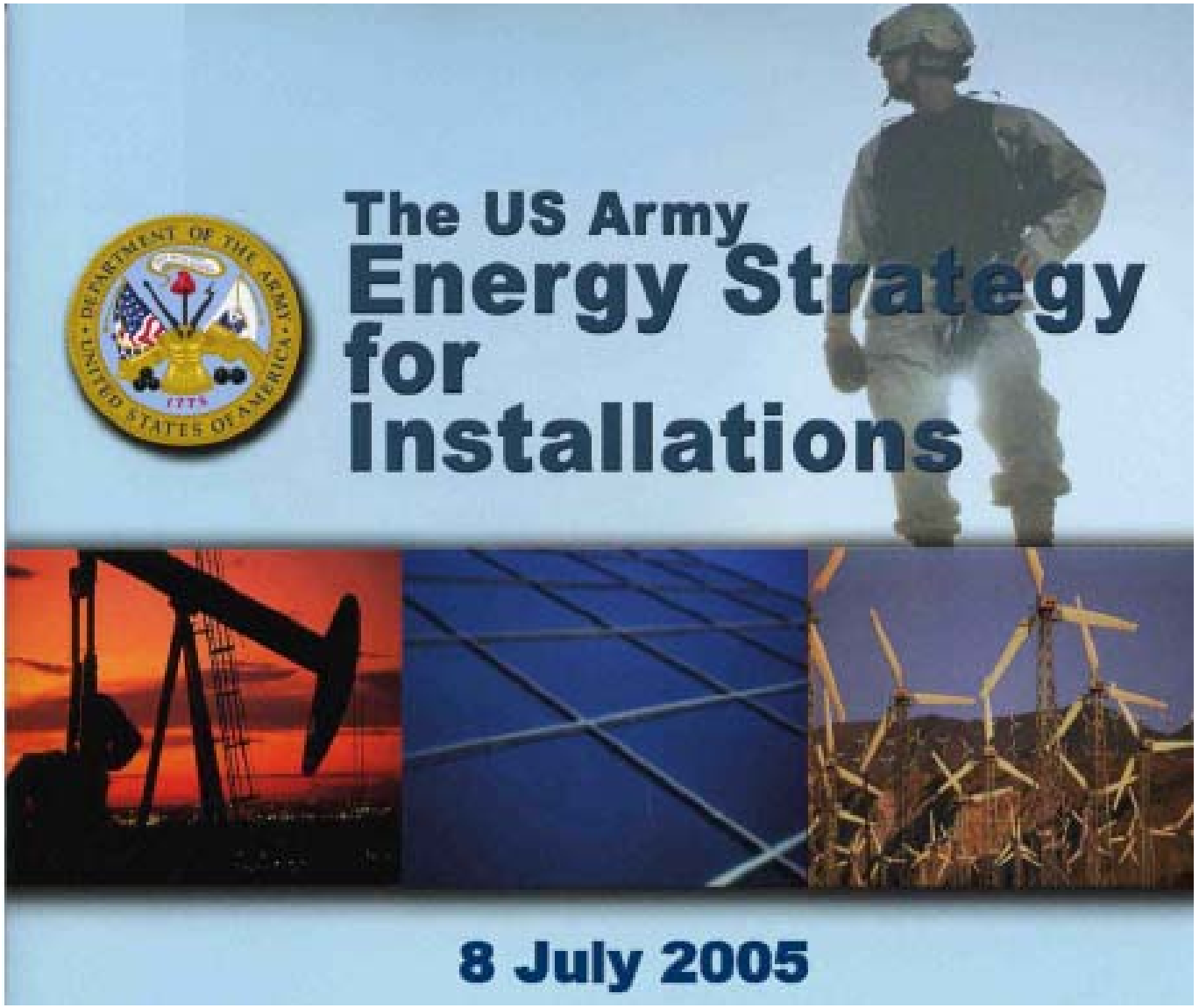
Ten largest U.S. Army installations ranked by the total number of on-base personnel (DOD 2005).

Rank	Facility	Military Personnel	Total Installation Personnel	Total Acres
1	Fort Bragg, NC	43,890	52,367	152,922
2	Fort Hood, TX	42,391	50,215	214,778
3	Fort Campbell, KY	28,753	33,395	35,985
4	Fort Benning, GA	27,627	32,600	171,873
5	Fort Lewis, WA	21,893	27,932	86,041
6	Fort Leonard Wood, MO	21,873	26,247	62,911
7	Fort Jackson, SC	22,351	26,076	52,301
8	Fort Sill, OK	18,735	22,796	93,831
9	Fort Knox, KY	15,359	20,135	109,054
10	Fort Stewart, GA	13,628	19,317	279,271

Rank	Facility	Average Annual Demand	Summer Peak Electricity Demand	Minimum Demand	Peak kW/ Base person	Annual Average/ Summer Peak
1	Fort Bragg, NC		100-110 MW peak going to 150 MW		2.01	
2	Fort Hood, TX		99 MW		1.98	
3	Fort Campbell, KY	~30 MW	48-56 MW (32-38 MW winter peak)		1.56	0.58
4	Fort Benning, GA					
5	Fort Lewis, WA	27 MW	36 MW		1.29	0.75
6	Fort Leonard Wood, MO					
7	Fort Jackson, SC	~ 20 MW	31 MW summer peak, 23 MW winter peak		1.18	0.64
8	Fort Sill, OK	19.4 MW	36 MW	8-10 MW winter night	1.58	0.54
9	Fort Knox, KY		22.36 MW		1.09	
10	Fort Stewart, GA					
Averages					*1.53*	*0.60*

Goals and Requirements

- ✓ 2005 Army Energy and Water Campaign Plan
- ✓ 2005 Energy Policy Act
- 2006 TRADOC Pamphlet 525-66,
  - FOC-09-03: Power & Energy
  - FOC-08-04: Installations as our Flagships
- 2007 Executive Order 13423
- ✓ 2007 SERDP SON for Scalable Power Grids
- ✓ 2006/2007 Defense Science Board Key Facility Energy Strategy Recommendations



http://army-energy.hdqa.pentagon.mil

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***

What is Energy Security?
Utility Reliability?

- **Energy security is the capacity to avoid adverse impact of energy disruptions caused either by natural, accidental or intentional events affecting energy and utility supply and distribution systems.**

Energy Policy Act of 2005

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

2007 Strategic Environmental Research and Development Program (SERDP) Statement of Need (SON) for Scalable Power Grids

- **The Objective of this SON is to Provide DoD Installations with the Capability to Network Distributed Generation (DG) Technologies, Including Renewables, Especially at Mission Critical Facilities.**

- **Requirements**
  - **Robust Network Topology Dynamics**
  - **Dynamic Response of Distributed Control Strategies**
  - **Mission-Based Load Shedding and Algorithms**
  - **Conduct Simulation-Based Microgrid Experiments**

2006/2007 Defense Science Board Key Facility Energy Strategy Recommendations

- **Released February 2008**

- **Recommendation #2: Reduce the Risk to Critical Missions at Fixed Installations from Loss of Commercial Power and Other Critical National Infrastructure.**
  - **Develop a plan to "Island Critical Missions from the Grid by December 2008**
  - **Require that all DoD Installations Meet a "Net Zero" Energy Standard by 2025**

$ / Gallon of
Delivered Fuel to Battlefield

$ 10 – Truck Convoy Driven from Kuwait

$ 40 – Cargo Ship from Overseas

$ 400 – Flown in Via Aircraft

$$ What Cost in Lives ??

How Do We Get There?

To be successful, the Army Campaign Objectives need a Full-Spectrum Power Architecture … microgrid concept