Managing Operational Energy

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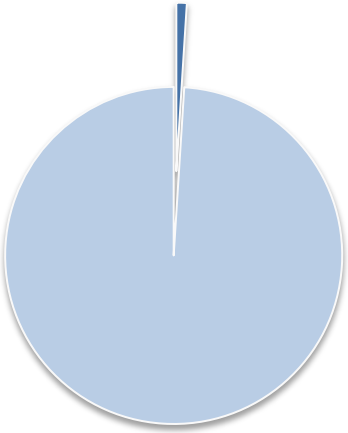
DoD Energy Use: $13.7B in FY10

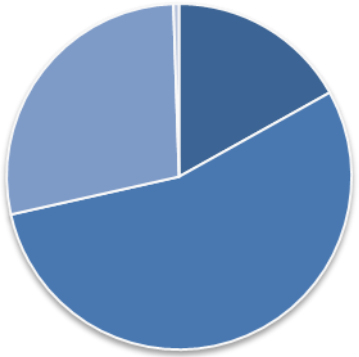
Total U.S. Energy Use[1]



Federal Energy Use[2]

DOD Energy Use[3]

Service Operational Use[4]



Federal Energy Use 1%
Rest of United States 99%

DOD Energy Use 80%
Other Federal 20%

Operational Use 75%
Installations Use 25%

Army 16.9%
Navy/MC 28.0%
Air Force 54.6%
Other DOD .5%

[1] EIA Annual Energy Report 2009 ,Figures by consumption
[2] FY 09 EIA U.S. Government Energy Consumption by Agency, figures by consumption
[3] FY 09 DOD Annual Energy Management Report, figures by site delivered BTUs
[4] FY10 DLA Energy Net Fuel Sales, figures by sales

Why Manage Energy at DoD?

- **Operational Energy is the energy required for training, moving, and sustaining military forces and weapons platforms for military operations. The term includes energy used by tactical power systems and generators and weapons platforms"**

- **Increased energy <u>efficiency</u> of military operations**
- **Increasing energy consumption means:**
  - **Increasing costs**
  - **Increasing risks -- tactical, operational, strategic**

Improves Efficiency, Effectiveness, Cost

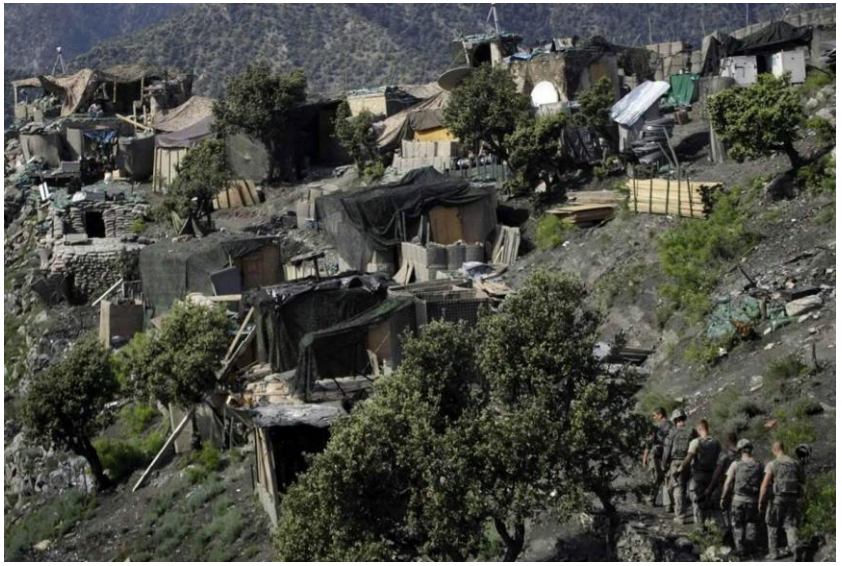
The Highest Price

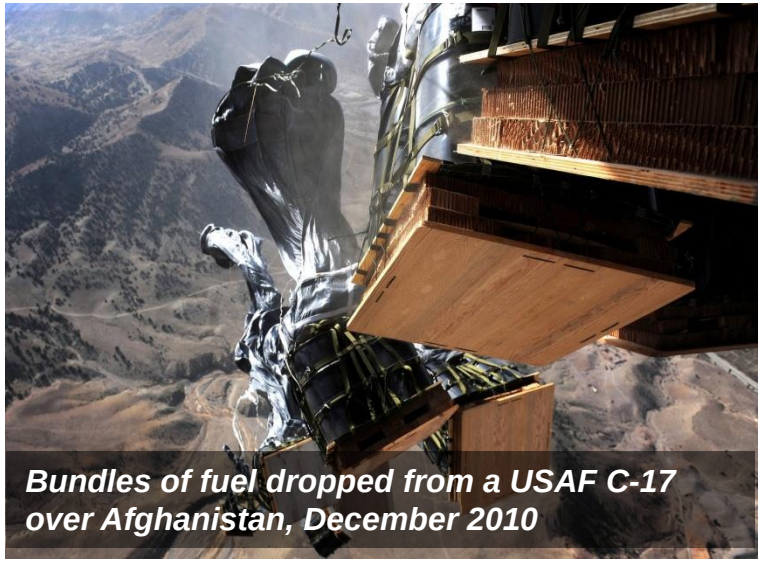
- Iraq & Afghanistan – 3,000 Army personnel or contractors killed or wounded between FY03-07 in attacks on water and fuel convoys

- Afghanistan – One Marine wounded for every 50 convoys in 2010

Getting Fuel to the Fight: A Tactical Challenge

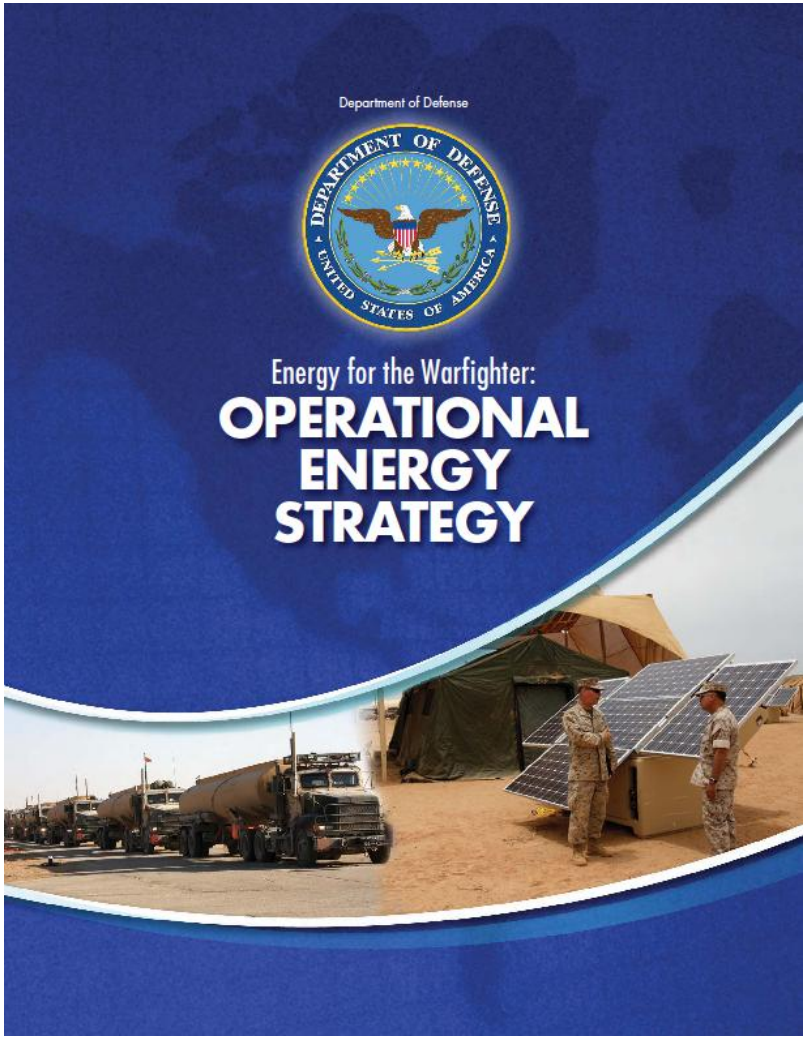
Supply Convoys Backed Up at Pakistan's Torkham Gate





Bundles of fuel dropped from a USAF C-17 over Afghanistan, December 2010

OASD (OEPP) Policy Documents



Operational Energy Strategy:

Implementation Plan

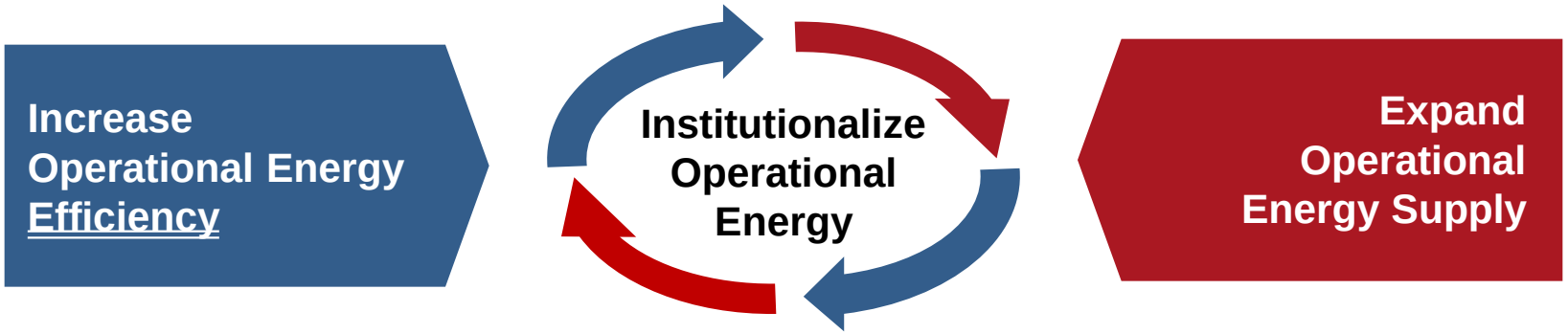
Department of Defense

March 2012

Preparation of this report/study cost the Department of Defense a total of approximately $240,000 in Fiscal Years 2011 - 2012.
Cost estimate generated on
October 21, 2011
0816 RefID: 3-9BCEC11

Operational Energy Strategy

Vision: Energy will be a strategic advantage for U.S. military forces

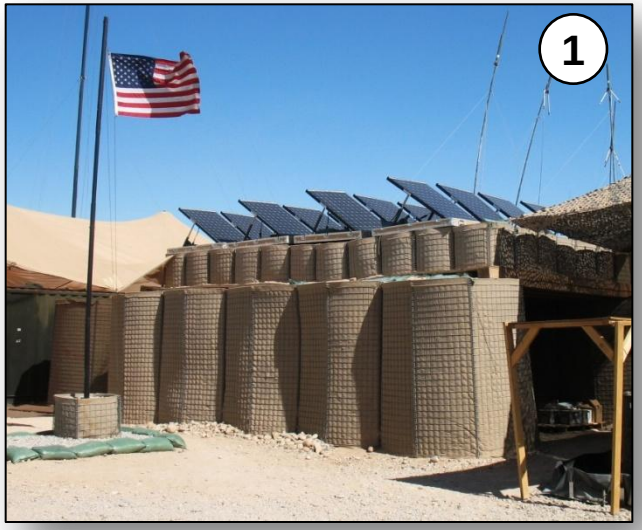


Defense.energy.mil

Observations on Afghanistan Camps

- 16 sites studied in Aug 2011:
  - Electric power generation consumes >40% of fuel
  - HVAC units consume power inefficiently because many units are improperly sized & poorly controlled
  - Spot electrical generation is used sub-optimally
  - Centralized power plants have been very reliable & improved fuel use efficiency
  - Renewable energy is minimally employed for power grids & lighting (< 1%)

Energy Projects in Afghanistan



1. US Marines @ Patrol Base Boldak reduced fuel demand 20%
2. 28kW solar array supplanted diesel generators at four company-sized camps
3. Centralized power plants @ 5 bases; will replace 620 spot generators and reduce fuel demand 15-25%

Energy Projects in Afghanistan

4. 300W Zero Base Regenerator mobile solar system

5. 1MW microgrid...reduced fuel demand 17% and generator run time 85%

6. tactical solar power or fuel cell systems

Army P & E Challenges & Goals
Ground Vehicles

GOALS

FY 03 04 05 06 07 08 09 10 11

Prime Power

1 kW/kg 0.3

Engine

Weight-Efficient Prime Power 3X

1

Energy Storage

200 W-hr/kg 50

Li-Ion Batteries

4X Balanced Solutions for Platform Energy Storage needs

200

Motors

12 kW/l 3

Motor Torque

Traction

Power In-Hub

3X Volume Efficient Motors

12

Power Conditioning

5 kW/l 0.75

Si Converters

Si-C Converters

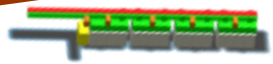
6X Solid State/High Temp solutions

5

Pulse Power

2.0 J/cc 0.7

Capacitors

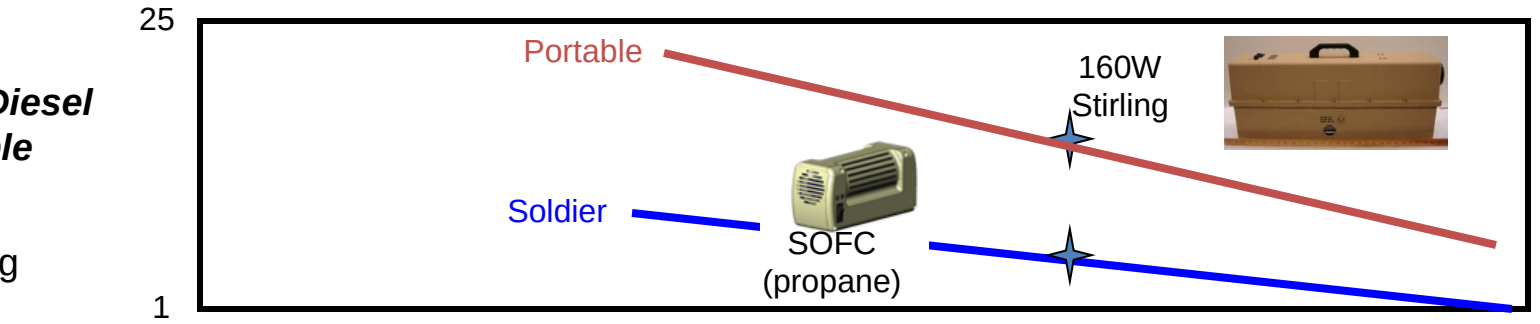


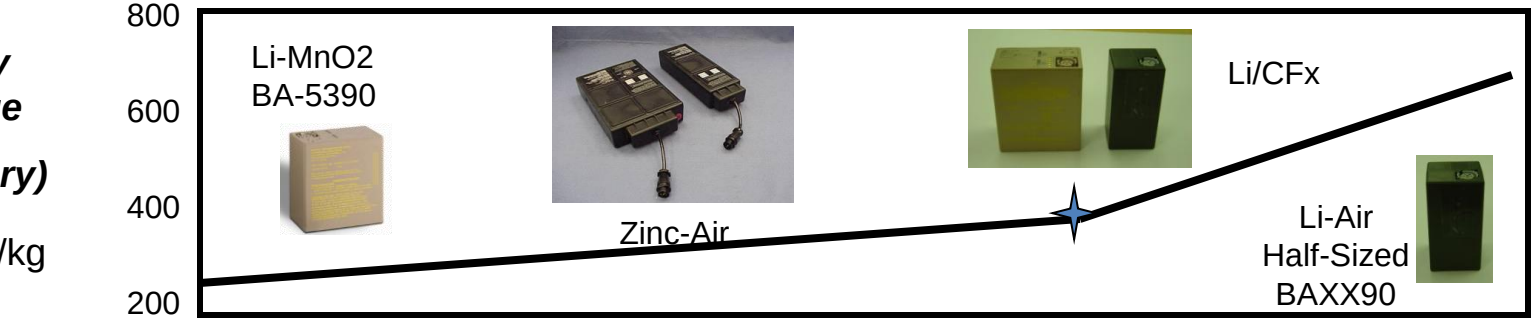
2X Solid State/Thin Film solutions

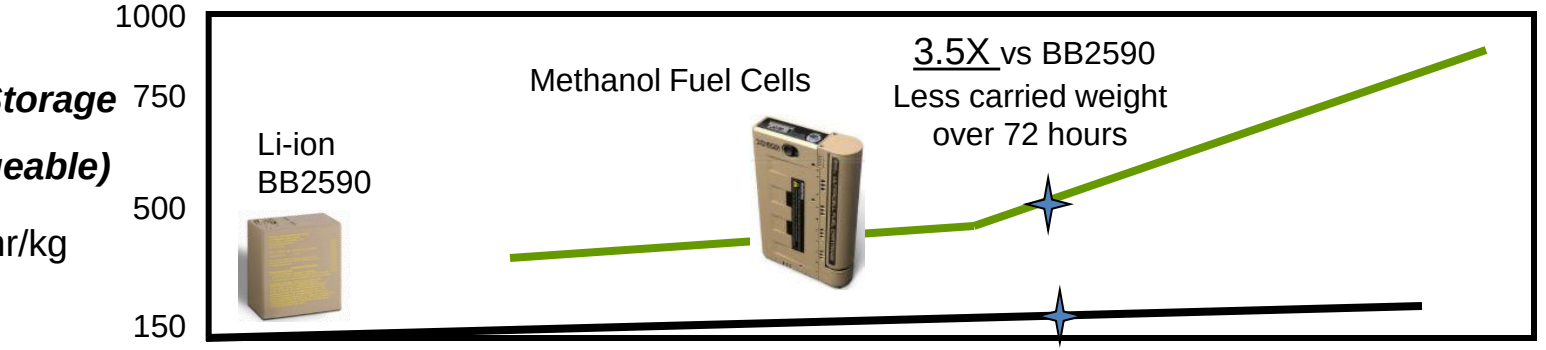
2.0

Army P & E Challenges & Goals
Soldier Power

GOALS	FY 03	04	05	06	07	08	09	10	11







Army TARDEC RDT&E

Ground Vehicle Power and Energy Technology

Prime & Non-Primary Power


Diesel Engines


Transmissions

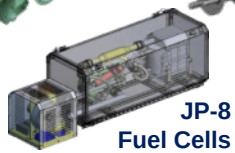

Traction Motors


Integrated Starter Generator


Alternators


Track Systems


Rotary Engines

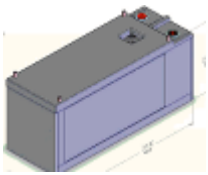

JP-8 Fuel Cells


Turbine Engines

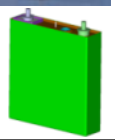

Drivelines


Suspension

Energy Storage


Li-Ion / Ultracap Hybrid Energy Storage


Capacitors

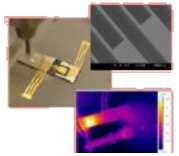



Advanced Batteries

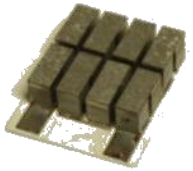

Fuels

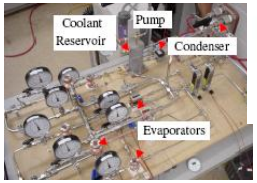
Thermal Management


Radiators

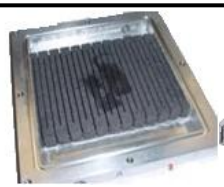


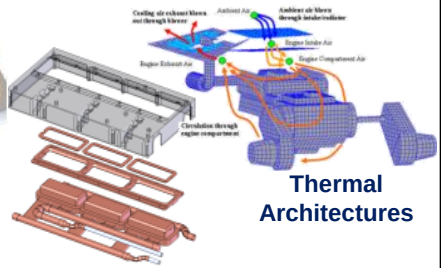

Thermal Interface Materials


Heat Recovery



Phase Change Cooling


Advanced Electronics Cooling


Thermal Architectures

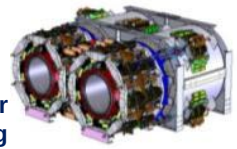
Power Management


Power Controllers for Power Management

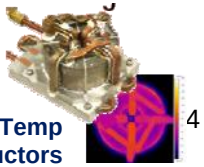

Power Converters/Inverters


Wide Band Gap Materials (SiC)


High Temperature SiC Modules


Pulse Power Switching


High Temperature Capacitors


High Temp Inductors

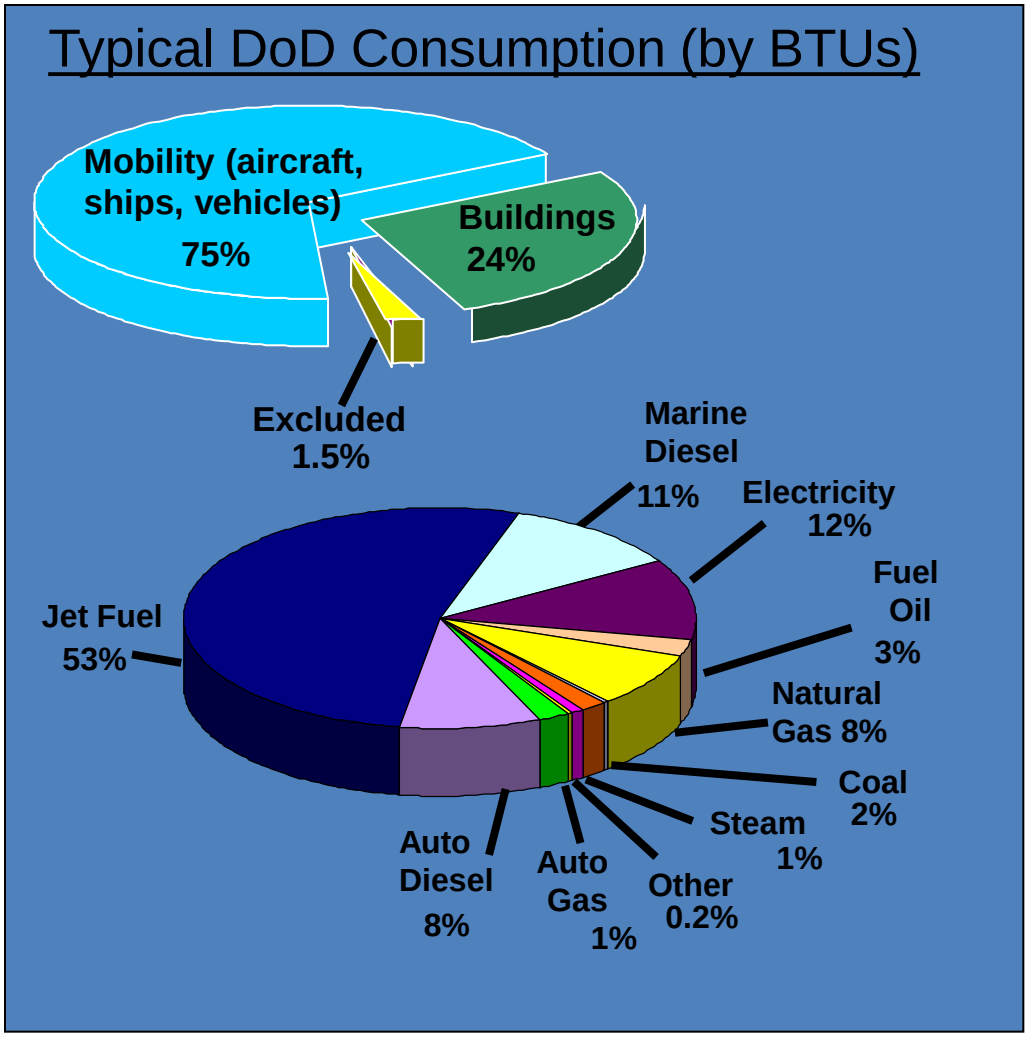
Reducing Energy Consumption of Expeditionary Shelter Systems

1

2

1. **Spray Foam Insulation significantly reduced energy loads for environmental control, but…**
   - **Users rarely resized environmental and power equipment, thus did not realize true savings potential**
   - **Disposal continues to be a challenge; the land fill and shipping options are both proving to be costly**
2. **Tent liners and LED tent lights continue to flow into theater to be added into existing tentage**

DoD Energy Use



What Does Success Look Like?

- Improves endurance and range of forces
- Frees combat forces from protecting supply lines to perform operational missions
- Fewer casualties and battle-damage from moving & protecting fuel
- Strengthening DOD's resilience to energy price and supply volatility and disruption.
- Posturing the future force for success by better aligning resources to tactical, operational, and strategic goals.

By improving how we use energy…
the warfighter can be more effective…

More Fight, Less Fuel

- **The Department must:**
  - Reduce overall demand for operational energy
  - Improve the efficiency of military energy used to enhance combat effectiveness
- **This can be done by:**
  - Accelerating and adopting technological and management innovations reducing demand and improving efficiency