



# DoD's Energy Security Strategy

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# Report Documentation Page

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# Strategic Drivers



“This is our chance to step up and serve. The war against international terrorism has pitted us against a new kind of enemy that wages terror in new and unconventional ways. At home, fighting that enemy won't require us to build the massive war machine that Franklin Roosevelt called for so many years ago, but **it will require us to harness our own renewable forms of energy so that oil can never be used as a weapon against America.**

*Speech - Energy Security is National Security, February 2006*

“...The **well-being of the global economy is contingent on ready access to energy resources.** Notwithstanding national efforts to reduce dependence on oil, **current trends indicate an increasing reliance on petroleum products from areas of instability** in the coming years, not reduced reliance. The [US] will continue to foster access to and flow of energy resources vital to the world economy. Further, the Department is examining its own energy demands and is taking action to reduce fuel demand where it will not negatively affect operational capability. **Such efforts will reduce DoD fuel costs and assist wider U.S. Government energy security and environmental objectives.**”

*National Defense Strategy June 2008*



U.S. Marine Corps Maj. Gen. Richard Zilmer, Al-Anbar Commander, submitted an **urgent request for renewable energy systems**, due to the vulnerability of American supply lines to insurgent attack by ambush or roadside bombs. The request said **“reducing the military's dependence on fuel for power generation could reduce the number of road-bound convoys.”** ...’Without this solution [renewable energy systems], personnel loss rates are likely to continue at their current rate. Continued casualty accumulation exhibits potential to jeopardize mission success...”

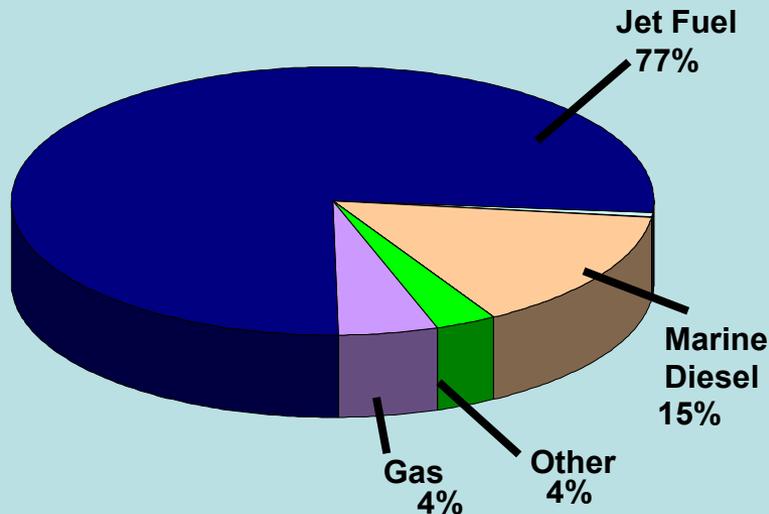
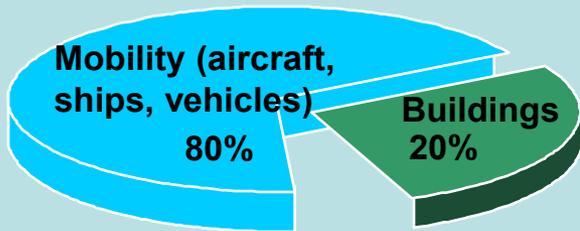
*Defense News, August 2006*





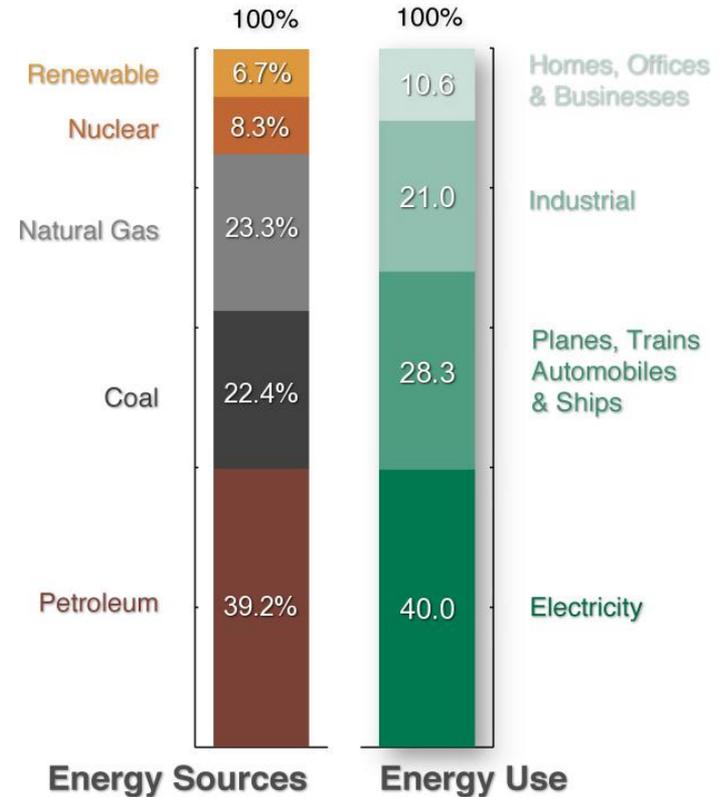
# DoD Energy Use

## DoD FY08 Consumption (by BTUs)



DoD Energy Use Statistics

## What We Use & How We Use It



IER © 2008 INSTITUTE FOR ENERGY RESEARCH

Source: USDOE, EIA Annual Energy Report, 2007

US Energy Use Statistics



# DoD Energy Cost Drivers



- DoD spent over \$20B on energy in FY08
- \$1.23T spent on energy nationwide in FY08
- Army Wartime OPTEMPO impacts:
  - Generator fuel usage increase x14
  - 26MGal in peacetime to 357MGal
  - Generators - largest Army user of fuel
    - > Combat vehicles
    - > Combat aircraft
    - > Tactical vehicles



**COST PAYOFF:** Reduced energy use for mobility, fixed and tactical installations

**OPERATIONAL PAYOFF:** Fewer refuelings; increased platform availability

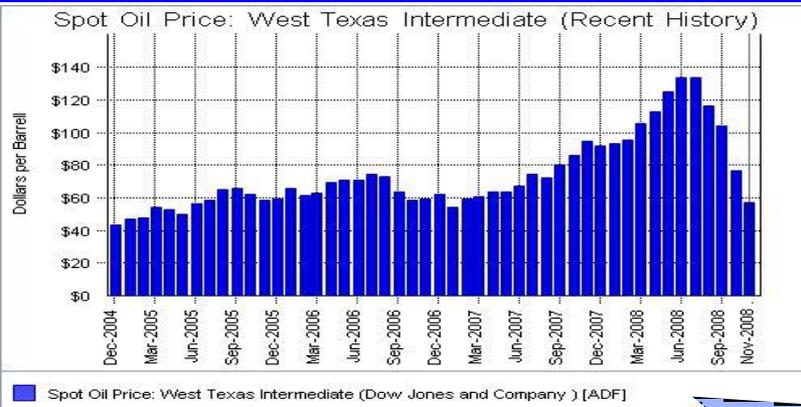
*Both support enhanced energy focus and free up resources to apply elsewhere*



# DoD Energy Security Drivers

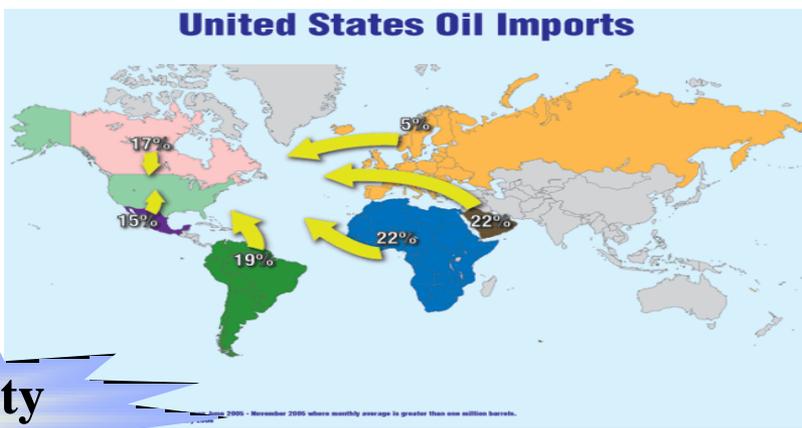


## Price Volatility Impacts Other Programs



## US Oil Sources May Not Be Stable

Source: EIA, Period Aug 07- JaN 08



# Energy Security Drivers

## Logistics of Moving Fuel Can Limit Combat OPS



## Modern Military Systems Use of Energy Increasing

OF – AFGHANISTAN (72 Hour Mission)

AN/PVS 14 (Night Vision) (6) AA .3 lbs/.05 watts*	Head Set (2) AA .1 lbs/.03 watts*
Mark VII (1) 3.9 V Lithium .12 lbs	PEQ-2A (2) AA .1 lbs/.01 Watts
MBITR (9) BB 521 7.92 lbs/5.8 watts*	HTWS (Night) (66) AA 6.6 lbs/1.1 watts*
Sure Fire Light (144) CR-123A 8.64 lbs/28 watts*	M68 CCO (Day) (1) AA .1 lbs/.000054 watts*
Mag Lite (2) AA .1 lbs/.01 watts*	LMR (8) 3600 mAh NIMH 1 lbs/4 watts*
DAGR (24) AA & (6) ½ AA 1.32 lbs/.97 watts*	P-Beacon (1) 9V .1 lbs/.03 watts*

Total: 7 types of batteries, 264 batteries  
\*Average Watts per 72 hours



# DoD Energy Security Drivers --Wild Cards--



## Influence from Global Suppliers

### Price of oil bounces off four-year lows

OPEC president suggests large production cut on the way

Ap Associated Press December 8, 2008 @ 1700

Oil prices rebounded from four-year lows and shot above \$43 a barrel Monday as OPEC floated the possibility of a "severe" production cut and several countries announced new measures to boost their economies...

## Humanitarian Relief



## Future Systems



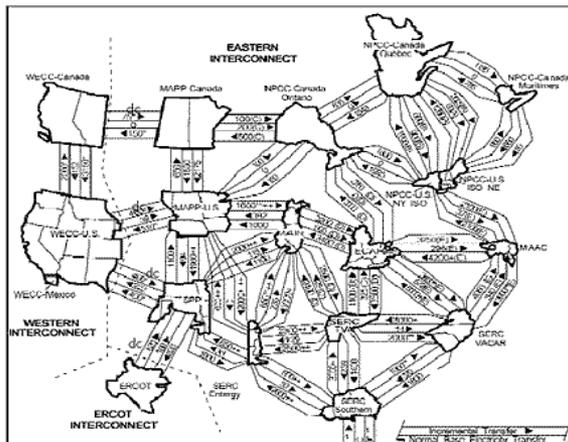
## Russia wields the energy weapon

BBC News, Moscow, February 14, 2006

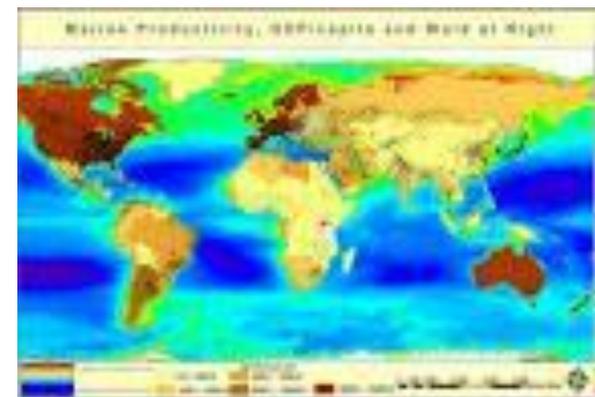
When Russia turned off the gas to Ukraine, it sent shivers across Europe where customers are increasingly dependent on Russia to keep warm.



## Energy as a Strategic "Weapon"



## Grid Vulnerability



## Climate Change????

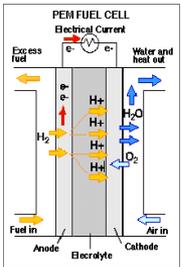


# Energy Security Challenge



## Supply Security

## Demand Reduction



### Supply

- Conventional fossil fuels
- Synthetic fuels (e.g. coal, natural gas derived fuels)
- Other alternative fuels (e.g. renewable jet and diesel, biomass, alcohols, hydrogen, etc.)
- Renewables (e.g. solar, geothermal, wind, wave/ocean)
- Novel supply (e.g. fuel cells)
- Nuclear
- Exotics (e.g. isomers)
- Local electrical grid

### Demand

- Conservation Initiatives
- Fixed base
- Tactical base
- Platforms
- Efficiency
- Life-Cycle Cost



- Direct oil / fossil fuel costs
- Policy, processes and risk assessment
- Refining capacity
- Energy availability
- Doctrine

### Assured Distribution

### Convergence for Energy Security





# DoD Focuses on Energy

- DoD is proactively responding to the energy challenge
  - Established DoD and Service Task Forces
    - Services designated energy leads
    - DoD and each Service developed strategic plans
  - Increased investment in energy initiatives
    - From \$440M in FY06 to ~\$1.2B in FY09
  - DoD has directed us of fuel efficiency in acquisition decisions
  - DoD has maintained Energy Security Task Force



# DoD Progress to Date

- Finalized strategic plan, providing a framework for considering and valuing energy across DoD
- Consistent with the strategy, DoD has a number of ongoing initiatives
  - Since 2005, DoD total energy demands down 6%
  - Since 2003, DoD installation energy demand down 10%
  - DoD gets almost 12% of its electricity from renewables
  - Revising requirements and acquisition processes
    - Energy as a selective key performance parameter
    - Inclusion of fully burdened cost of fuel in acquisition programs

***DoD is making progress in energy security***



# DoD Energy Security Strategic Plan



- Four overarching goals:
  - Maintain or enhance operational effectiveness by reducing total force energy demands
  - Increase energy strategic resilience by developing alternative/assured fuels and energy
  - Enhance operational and business effectiveness by institutionalizing energy considerations and solutions in DoD planning & business processes
  - Establish and monitor Department-wide energy metrics





# Ongoing Activity, Goals 1 and 2

## - Installations -



- Each Service has active programs or pilots to reduce installation energy and increase resilience
- Example programs

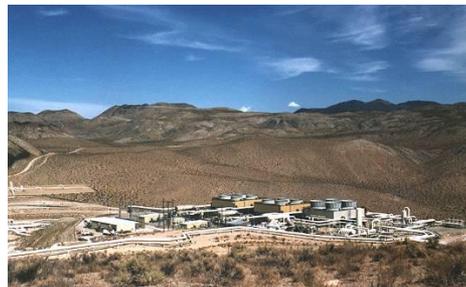
### Army

- **Net zero pilot, Ft. Irwin**
  - \$25M upfront cost
  - \$105M savings in 5 years
- **Tent foam, Iraq**
  - \$95M upfront cost
  - Estimated reduction \$300K+/day
- **Energy efficient housing demo, Ft. Belvoir**



### Navy

- **Existing geothermal plant, China Lake, CA**
  - 270 MW (supports ~180,000 households)
- **Building geothermal plant at NAS Fallon**
  - Working with Hawthorne Army Depot



### Air Force

- **Infrastructure Energy Plan**
  - Facility energy intensity -13% since FY03
- **New solar farm, Nellis AFB, NV**
  - Powers 25% of base
- **Testing waste-to-energy systems**





# Eskimo Spray Foam Insulation

- *Already Accomplished in Theater* -



## **DESCRIPTION**

- US Army Rapid Equipping Force funded approx \$10M to spray foam over half million sqft
- MNF-I awarded \$95M contract to foam additional 9 million sqft; similar contract being awarded in Afghanistan
- Spray Foam insulation addresses the demand side – 75% reduction is typical
- Unless connected to a commercial utility or large Prime Power Grid, action must be taken to address the supply side to realize savings (turn off spot generators, install FOB Prime Power Grid, etc).

## **BENEFITS/METRICS**

- Reduces Coalition risk on lines of communication by reducing external fuel requirements
- Metric 1: Gallons of Conventional Fuel required to power an Enduring Forward Operating Base/Facility
- Metric 2: \$/kWh of electricity at Enduring Forward Operating Base/Facility



Gym, Iraq



Gym, Djibouti



FOB, Afghanistan



Tent, Kuwait

## **FUNDING REQUIREMENTS**

n/a -- Demo Projects Completed  
MNF-I has "Ownership" of Way Ahead



# Ongoing Activity, Goals 1 and 2

## - Platforms -



- Each Service has active programs or pilots to reduce platform energy and increase resilience
- Example programs

### Army

### Navy

### Air Force

- **Fuel Efficient Ground Vehicle Demonstrator**

- 30-40% increased efficiency

- **Thermal Management**

- **Rotorcraft Advanced Turbine Engine**

- 25% decrease in fuel consumption with increased horsepower



- **Solid oxide fuel cells**

- **Reduced friction coatings for propellers**

- 5+% increased efficiency

- **UAVs/UUVs**



- **Advanced Turbine Research**

- 25% increased efficiency

- **Efficient engines for UAVs and generators**

- 20% increased efficiency

- **Synfuel certification ongoing**

- Goal: Fleet certification by 2011



UAV Transports ISR



# Increase Alternatives – Jet Fuel

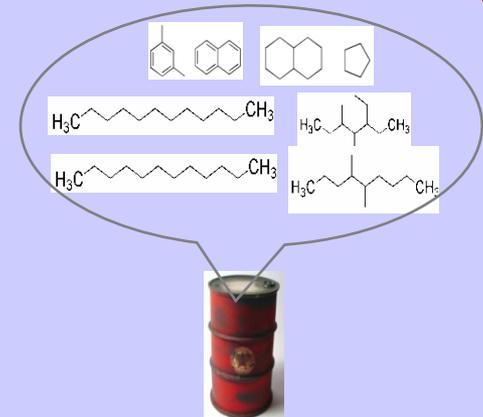


## - Biofuels -

- BioFuels: Alternate Feedstocks
  - **Objective:** An alternative and affordable feedstock
  - **Currently,** large scale production provides algal oil for > \$20/gal
  - **Key technical challenges:**
    - Integrating advances in growth systems
    - Nutrition management
    - Cropstock selection
    - Waste stream management
    - Intermediate product extraction
- Program Metrics
  - **Phase I**
    - < \$2/gal triglyceride oil from algae
    - Projected cost of production of JP-8 < \$3/gal at 50 Mgal/yr
  - **Phase II**
    - < \$1/gal triglyceride oil from algae
    - Projected cost of production of JP-8 < \$3/gal at 50 Mgal/yr



“Build-down” process:  
Crack/re-arrange C12-C16





# Goal 3: Include Energy in Planning and Business Processes



## EXAMPLES

### Planning and Analysis

- DoD strategic plan in work
- Component-designated energy leads/organizational structures
- Component-developed strategic plans
- Revising Analytic Agenda products (Defense Planning Scenarios, Multi-Service Force Deployments, and Analytic Baselines) to include fuel considerations
- JS simulator study – initial results show potential for large savings

### Acquisition

- Energy as KPP
- Fully Burdened Cost of Fuel pilot for life cycle energy costing
- Decisions based on return on investment (monetary and capability)
- Lifecycle/Total ownership costs
- Long-term contracts for alternative fuels







# DoD Energy and the American Reinvestment and Recovery Act



- DoD received \$300M in Stimulus Bill for energy research
- Multiple projects – fuel cells, ground vehicles, hybrid motors, etc.
- List and competition rules may be found at <http://www.defenselink.mil/recovery/>

The screenshot shows the U.S. Department of Defense website from May 4, 2009. The main headline is "Department of Defense Moves Swiftly to Implement Recovery Act". Below the headline, there is a sub-headline "Release of DoD Recovery Act Projects" and a paragraph of text. To the right of the text is a small graphic with the text "Defense is Moving Swiftly on Recovery Act" and a pie chart showing the distribution of funds. Below the text is a list of five numbered items detailing the projects. The website also features a sidebar with "DefenseLINK" and "H1N1 Flu Outbreak" information, and a "LATEST FEATURES" section with a "LIFE IN IRAQ" graphic.

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SEARCH May 4, 2009 Threat Advisory ELEVATED

## Department of Defense Moves Swiftly to Implement Recovery Act

### Release of DoD Recovery Act Projects

The American Recovery and Reinvestment Act of 2009 (ARRA) provides \$7.4 billion to the Department largely for projects that are located at Defense installations spread across all fifty states, District of Columbia and two U.S. territories.

On March 20, 2009, the Department of Defense (DoD) released its first report of projects to be funded by the ARRA. This plan contains \$2.3 billion in construction projects, including two major hospital construction projects: Camp Pendleton, California, Fort Hood, Texas, and a hospital alteration project at the Naval Air Station, Jacksonville, Florida. The plan also contains \$2.4 billion for nearly 3,000 facility repair and improvement projects that will immediately generate additional employment in communities around Defense installations. Furthermore, the plan details how \$300 million for non-term energy technology research will be allocated.

On April 20, 2009, the DoD announced details of more than 100 additional facility improvement projects funded by the ARRA. The \$835 million budget for these new projects represents the remaining funds of the first ARRA infrastructure investment list announced on March 20, 2009. These projects will be conducted at Army and Army National Guard facilities in 37 states and the District of Columbia. More than half of the \$835 million will be spent in ten states: Texas (\$155 million), Kentucky (\$103 million), North Carolina (\$103 million), Oklahoma (\$103 million) and Hawaii (\$103 million). In addition to making much-needed improvements to military installations, an additional \$348 million will be spent on energy-related projects, enabling the DoD to lead the way in the national effort to achieve greater energy independence.

- Department of Defense Expenditure Plans – March 20, 2009 Report (PDF)
- Department of Defense Expenditure Plans – April 20, 2009 Report (PDF)

### Background on the Recovery Act

The American Recovery and Reinvestment Act of 2009 includes approximately \$7.4 billion in Defense-related appropriations, which account for less than 1 percent of the total \$787 billion stimulus package signed on February 17 by President Obama. The Department intends to spend this funding with full transparency and accountability.

As stated on [recovery.gov](http://recovery.gov), the purpose of the Recovery Act is to create and save jobs, jumpstart our economy, and build the foundation for long-term economic growth. In order to fulfill these objectives, the Department intends to execute Defense-related funds as quickly as possible:

1. \$3.0 billion for facility infrastructure investments to upgrade DoD facilities, including energy-related improvements
2. \$2.1 billion for military construction, including \$1.3 billion for hospitals
3. \$0.4 billion to repair and modernize military medical facilities, including energy-related improvements
4. \$0.1 billion for additional construction projects, including housing for troops and their families
5. \$0.6 billion for a temporary expansion of the Homeowner's Assistance Program (HAP) benefits for private home sale losses of both DoD military and

**Defense is Moving Swiftly on Recovery Act**

Support of Defense

Click to enlarge

Department of Defense Recovery Act

Local Intranet



# Next Steps

- Determine how new Director of Operational Energy Plans and Programs will interact with ongoing groups
  - Per Section 902 of the FY09 National Defense Authorization Act
- Establish platform goals
- Develop cost estimates to achieve specific levels of energy security/assured fuels
- Investigate/develop self-sustaining energy conservation fund
  - Pilot to develop methodologies and processes in work
  - Using 6 ongoing projects as test cases
- Implement fully burdened cost of fuel in acquisition processes and associated directives and decisions
- Develop business case for alternative fuels, including environmental impacts



# Summary

- There is more work to be done, but DoD is making progress in energy security
- DoD's energy strategy balances demand reduction and assured alternative sources
- Our energy efforts will
  - Increase operational capability for the warfighters
  - Reduce costs
  - Help the nation reduce its dependence on oil



**BACKUP**

# Ground Combat Vehicle Evolution



## M47 Patton

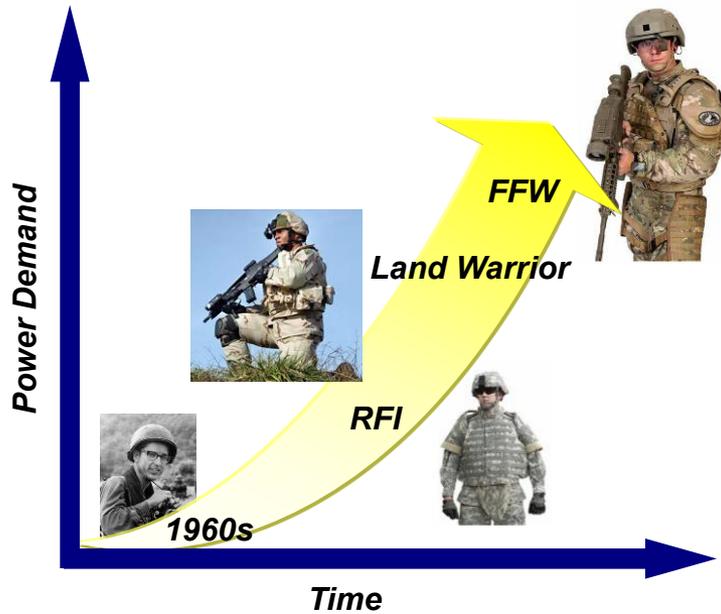
- FM Radio
- Direct View Optics
- Engine Gauges
- Ballistic Periscopes



## M1A2 Abrams

- Secure data/voice radio
- Thermal Viewer
- FBCB2 Digital Battle Command
- Digital Fire Control
- 1 Color/3 Monochromatic Displays

# Soldier as System Evolution



## Late 1960s Soldier

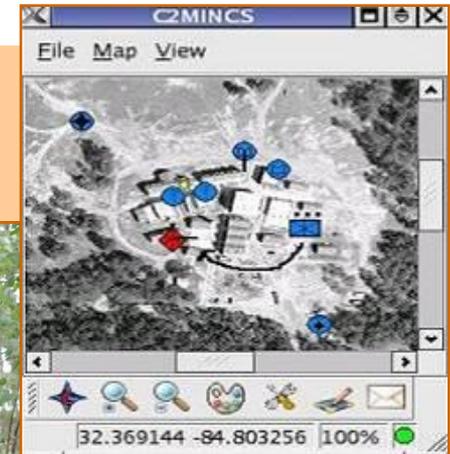
- FM radio
- Early I<sup>2</sup> devices
- Binoculars
- M-16 with daylight scope

## Future Force Warrior (FFW)

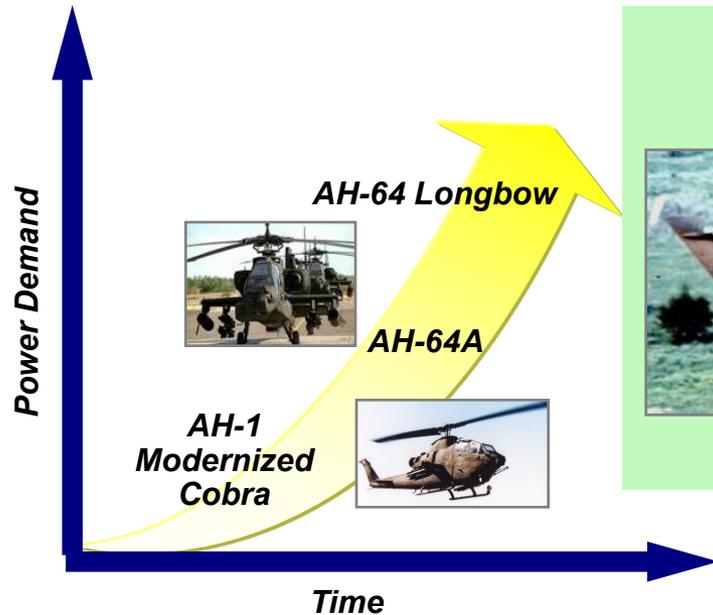
- Integrated body armor & equipment carriage suite
- Helmet mounted thermal imaging
- Radio digitally linked to unit communications network displaying individual locations
- Laser aided weapon precision fire control
- Embedded training



Handheld Soldier Display



# Helicopter Evolution



## AH-1 G Cobra



- FM Radio
- Direct View Optics
- 2.75 inch rockets and 7.62mm machine gun

## AH-64 Apache Longbow

- Secure data/voice radio
- Integrated pilot night vision system
- Digital fire control linking gunners view & weapons systems
- Longbow MMW radar
- Hellfire missiles and 30mm cannon
- Survivable rotors—up to 23mm AA





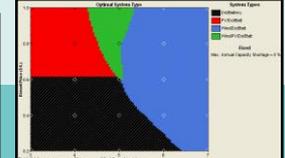
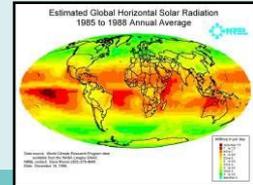
# Reduce Consumption/Increase Alternatives

## - Net Zero Plus JCTD -



### DESCRIPTION

- Reduce fuel requirements of Forward Operating Bases (FOB) through reduced energy demand, efficient power distribution & increased alternative supply
- Emphasis on energy efficient structures & technology; Smart power generation that measures, analyzes, and connects power flow; Integration of renewable and conventional energy generation to provide assured power using less fuel



### BENEFITS/METRICS

- Already Completed: \$1.5M Power Surety Task Force/Army REF Net Zero Structure (NZS) at National Training Center (NTC); initial data analysis on Dome power.
- In-Progress: Data recording; Spray foam of tents.
- Future Efforts: Alternative energy efficient structures; Smart power generation; Prime Hybrid Power; Waste to Energy; Efficient Lighting; Transition to Theater & PMs

### Timeline

Annual Spinout through FY11



# Reduce Consumption - Ground Vehicles

## - *Fuel Efficient Ground Vehicle Demonstrator* -

### ***DESCRIPTION***

- Identify opportunities in fuel efficient technologies, lightweight components and armor, reduced weight structure/ frame, efficient propulsion/driveline and others
- Build a virtual vehicle to predict performance, set objectives and establish test criteria
- Demonstrate decreased fuel consumption, without decreasing performance or capability, in a tactical vehicle using innovative design, advanced lightweight materials and fuel efficient components



### ***BENEFITS***

- Leverages on-going S&T investments and efforts supporting HMMWV replacement
- Baseline is Heavy HMMWV  
Capabilities - Fuel savings estimated 30-40%



# Reduce Consumption

## - Fuel Efficient Propeller Coatings -

### **DESCRIPTION**

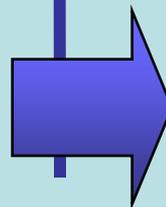
- Evaluate propeller coatings for cavitation erosion resistance and antifouling properties. Candidate materials could include metal borides and nanomaterials-based metal oxide.
- Test fuel savings in lab for candidates and evaluate performance of optimum coating in at-sea tests.
- Production cost: ~\$200K/ship



### **BENEFITS/METRICS**

- Anticipate 4-5% fuel efficiency
- Additional benefits: reduced cavitation erosion and antifouling benefits, resulting in reduced maintenance costs

- 
- ROI: 5% savings on \$2.8B annual fuel bill (\$14.17M for 200 ships) ≈ \$142M/yr



### **Payback**

Applying this technology to 200 ships @ \$200K/ship:  
Payback ~ < 1yr



# Air Force Alternative Aviation Fuels Certification

- **Synthetic alternative aviation fuel blend certification**
  - On track to meet 2011 goal: on schedule and under budget
- **Biomass-derived alternative aviation fuel blend certification**
  - Supports 2016 goal: new effort recently approved



***Alternative Fuels Enhance Long-term National Security***

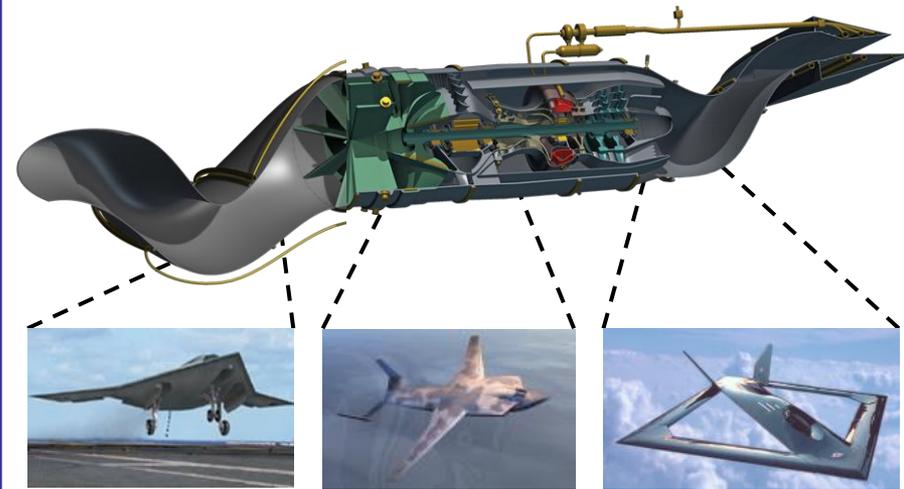


# Reduce Consumption - Air Platforms - *Highly Efficient Embedded Turbine Engine* -



## **DESCRIPTION**

- Accelerate development of fuel efficient, high-bypass subsonic propulsion in an embedded configuration
- Supports future ISR, mobility, and UCAV extreme endurance and range requirements
- High power extraction for multi-sensor suites is an integral part of program
- Addresses more than 80% of the aircraft fleet (mobility, fighters, etc.)



UAV's

Transports

ISR

## **BENEFITS**

- Theoretical performance enhancements of the concepts are:
  - 25% reduction in fuel consumption
  - 100-400 kW power extraction capability



# Goal 3: Include Energy in Planning and Business Processes



## EXAMPLES

### Planning and Analysis

- DoD strategic plan in work
- Component-designated energy leads/organizational structures
- Component-developed strategic plans
- Revising Analytic Agenda products (Defense Planning Scenarios, Multi-Service Force Deployments, and Analytic Baselines) to include fuel considerations
- JS simulator study – initial results show potential for large savings

### Acquisition

- Energy as KPP
- Fully Burdened Cost of Fuel pilot for life cycle energy costing
- Decisions based on return on investment (monetary and capability)
- Lifecycle/Total ownership costs
- Long-term contracts for alternative fuels

Air Force Energy Strategy



Army Energy Strategy





# RDT&E Recovery Act Projects

## - Selection Process -



- ~\$550+M initial inputs based on
  - \$87.5M per Service + additional \$200M DW
  - 138 proposals submitted
- Binned projects into broad categories used by the Energy Security Task Force
- Convened Senior and Action Officer level working groups with Service energy leads to de-conflict / leverage projects
- Final list: \$75M per Component for RDT&E energy projects - \$300M total
- Project prioritization
  - Projects must be able to be executed quickly
  - Projects must be consistent with Energy Security Strategic Plan
  - Projects were not allowed to “fix” existing acquisition programs
  - Projects could not create outyear tails
- Final submittal / approval from Service Principals
  - 51 Total: (8 Army; 11 Navy; 17 AF; 15 DW)



# Energy Categories



- Fuel Optimization for Mobility Platforms
  - Propulsion/Electric Drive/Engine Efficiency
  - Aircraft Fuel Efficiency
  - Ship Fuel Efficiency
  - Logistics
- Operational Efficiencies/ Commercial Practices
  - Operational Changes (e.g. mission routing/planning, distributed operations training)
- Facility Energy Initiatives
  - Facility Energy Initiatives
- Domestic Energy Supply/ Distribution
  - Alternative Fuels
  - Renewable Power Systems R&D
  - Nuclear Power
- Tactical Power Systems/ Generators
  - Fuel Cells
  - Generators
  - Tactical Micro-grids



# DoD Energy Program



## - RDT&E Recovery Act Projects Summary -

( \$ M)

Fuel Optimization for Mobility Platforms	\$ 134.9	Propulsion / Energy Efficiency; Aircraft Fuel Efficiency; Ship Fuel Efficiency; Logistics
Operational Efficiencies / Commercial Practices	\$ 3.0	Operational Changes (e.g. mission routing/planning, distributed operations training)
Facility Energy Initiatives	\$ 22.5	Facility Energy Initiatives
Domestic Energy Supply / Distribution	\$ 105.1	Alternative Fuels; Renewable Power Systems R & D; Nuclear Power
Tactical Power Systems / Generators	\$ 34.5	Fuel Cells; Generators; Tactical Micro-Grids
<b>TOTAL FUNDING</b>	<b>\$ 300.0</b>	